August 23, 2019

QUANTUM
CONSULTING ENGINEERS

SUPPLEMENTAL STRUCTURAL CALCULATIONS
(Permit Corrections #2)

LEE-BOYLE RESIDENCE
4150 Boulevard Place
Mercer Island, WA 98040

Quantum Job Number: 19052.01

Prepared for:
STUART SILK ARCHITECTS
2400 N. 45th Street
Seattle, WA 98103

Prepared by:
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QUANTUM | CONSULTING ENGINEERS

LEE-BOYLE RESIDENCE
4150 78TH. AVE SE
MERCER ISLAND, WA

QUANTUM JOB NUMBER: 19052.01

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QUANTUM | CONSULTING ENGINEERS

STRUCTURAL DESIGN CRITERIA

LEE-BOYLE RESIDENCE
4150 78TH. AVE SE
MERCER ISLAND, WA

QUANTUM JOB NUMBER: 19052.01

CODE CRITERIA:

BUILDING CODE.....2015 INTERNATIONAL BUILDING CODE
BUILDING DEPARTMENT.....CITY OF MERCER ISLAND
WIND CRITERIA .....110 MPH; EXPOSURE "C"
.....RISK CATEGORY = II
.....K_{ZT}= 1.00

SEISMIC ZONE..... SDC = D
..... SITE CLASS = D
..... R = 6.5
..... I_E = 1.0
.....S_S = 1.411, S_1 = 0.543
.....S_{DS} = 0.941, S_{D1} = 0.543
SNOW LOAD .....25 PSF
DECK LIVE LOAD.....60 PSF
LIVE LOAD .....40 PSF
PHOTOVOLTAIC SOLAR PANEL DEAD LOAD.....5 PSF

SOILS CRITERIA:

ALLOWABLE BEARING PRESSURE .....2,500 PSF
MINIMUM FOOTING WIDTH ..... CONTINUOUS: 18" MIN., ISOLATED: 24" MIN.
FROST DEPTH .....18" MIN.
LATERAL EARTH PRESSURE (RESTRAINED/UNRESTRAINED).....55 PCF /35 PCF
SEISMIC SURCHARGE PRESSURE ..... 6H PSF
TRAFFIC SURCHARGE PRESSURE (PASSENGER VEHICLE) .....70 PSF
PASSIVE SOIL PRESSURE.....300 PCF
COEFFICIENT OF FRICTION.....0.40 PCF

MATERIALS CRITERIA:

CONCRETE (28 DAY STRENGTH):

FOUNDATION/S.O.G.....F'C=2,500 PSI

REINFORCING STEEL:

GRADE 60 (#5 BAR OR LARGER)..... .....FY=60,000 PSI
GRADE 40 (#4 BAR)..... .....FY=40,000 PSI

WOOD FRAMING:

2X, 3X, & 4X FRAMING MBRS.....HF#2 OR DF#2
6X FRAMING MBRS.....DF#1
LVL MEMBERS – BEAMS & HEADERS.....2.0 E LVL
LSL MEMBERS – BEAMS & HEADERS.....1.55E LSL
WOOD SHTG..... APA RATED

STRUCTURAL STEEL:

WIDE-FLANGE SECTIONS: A-992	Fy=50,000 PSI
MISCELLANEOUS SECTIONS: A-36	Fy=36,000 PSI
TUBE SECTIONS: A-500	Fy=46,000 PSI
PIPE SECTIONS: A-53	Fy=35,000 PSI
WELDING	Fy=70,000 PSI

STRUCTURAL DESIGN CRITERIA

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ASSEMBLY WEIGHTS

ROOF LOADS		GRAVITY	SEISMIC	**COMMENTS**
STANDARD MEMBRANE ROOFING		3.0 PSF	3.0 PSF	
15/32" PLYWOOD SHEATHING		1.7 PSF	1.7 PSF	
14 "TJI ROOF JOIST @ 16" O.C.		3.0 PSF	3.0 PSF	
INSULATION		1.5 PSF	1.5 PSF	
LIGHTS & DUCTS		1.0 PSF	1.0 PSF	
5/8" GWB		2.8 PSF	2.8 PSF	
MISCELLANEOUS		1.0 PSF	0.0 PSF	
PV SOLAR PANELS		5.0 PSF	5.0 PSF	
	ROOF DL	19.0 PSF	18.0 PSF	SL = 25 PSF

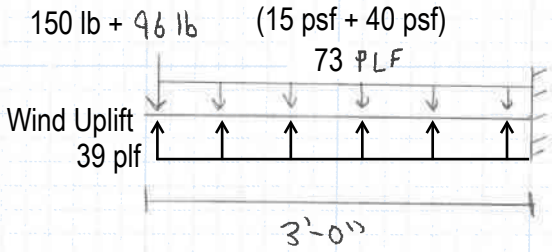
FLOOR LOAD				
HARDWOOD FLOORING		4.0 PSF	4.0 PSF	
23/32" PLYWOOD SHEATHING		2.3 PSF	2.3 PSF	
FLOOR JOISTS @ 16" O.C.		3.4 PSF	3.4 PSF	
5/8" GWB		2.8 PSF	2.8 PSF	
LIGHTS, DUCTS		1.0 PSF	1.0 PSF	
MISCELLANEOUS		1.0 PSF	0.0 PSF	
INSULATION		0.5 PSF	0.5 PSF	
	FLOOR DL	15.0 PSF	14.0 PSF	LL = 40 PSF

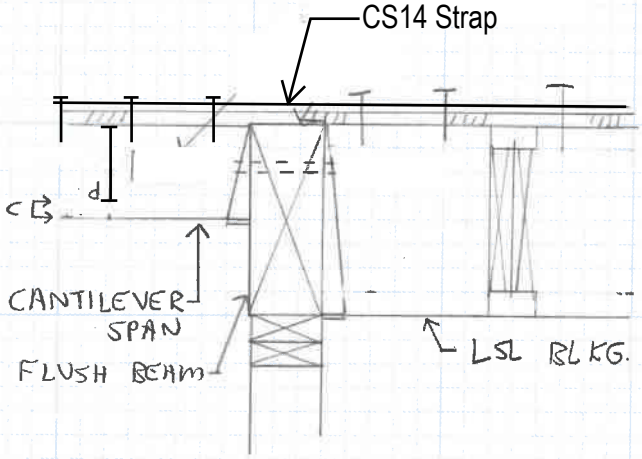
EXTERIOR WALL LOAD			
SIDING		3.0 PSF	3.0 PSF
15/32"PLYWOOD SHEATHING		1.7 PSF	1.5 PSF
2X6 STUDS @ 16"O.C.		1.7 PSF	1.7 PSF
INSULATION		1.8 PSF	1.8 PSF
5/8" GWB		2.8 PSF	2.8 PSF
MISCELLANEOUS		1.0 PSF	0.0 PSF
	WALL DL	12.0 PSF	11.0 PSF

INTERIOR PARTITIONS	8.0 PSF	
EXTERIOR GLAZING	8.0 PSF	

CANTILEVER FLOOR

- CANTILEVER SPAN = 3'-0"
- FLOOR Load + GLAZING + 1/2 of 300 lb concentrated load. (Rim Board distributes)
- 16" o.c. SPACING





V = 73 PLF (3'-0") + 96 lb + 150 lb
V = 465 lb USE LUS HGR.

M = 246 lb (3') + 73 PLF (3')^2 / 2
M = 1067 lb-ft = 12,798 lb-in

USE CS14 Strap

T_{ALL} = (2490 lb) / 1.6
T_{ALL} = 1556 lb

$F_{c\perp}$ LSL

a = 1556 lb (2) / (1.5" (900 PSI)) 1.25
a = 1.9"

C_b

$d_{req'd}$ = (12,798 lb-in / 1556 lb) + 1.9"
$d_{req'd}$ = 10.12"

Compression block not included in calculating internal moment arm. Method conservative per engineering judgment.

- LOCATE DTT22 CTR'D 2" DOWN FROM SHEATHING
JOIST DEPTH REQ'D = 10.12" USE 2 x 12 MIN.

Ignore conservative placement of strap at top of joist.

V_{UPLIFT} = 0.6 (39 plf - 19 plf) (3'-0")
V_{UPLIFT} = 36 lb LUS HGR. OK for uplift

M_{UPLIFT} = 0.6 (39 plf - 19 plf) (3'-0")^2 / 2 - 0.6(96 lb (3'-0"))
M_{UPLIFT} = -119 lb-ft Dead load is sufficient to resist wind uplift, no additional attachment required.

Blocking Design

Use (2) bays of blocking attached to adjacent joists with A35 clips. Blocking will transfer overturning forces to joists.

V = 12,798 lb-in / (3 (12.5"))
V = 341 lb = 256 plf Use A35 clip @ blocking to joist connection.

Apply 256 plf load to joists in this area, see calcs. Use 1 3/4" x 14" LVL joists.

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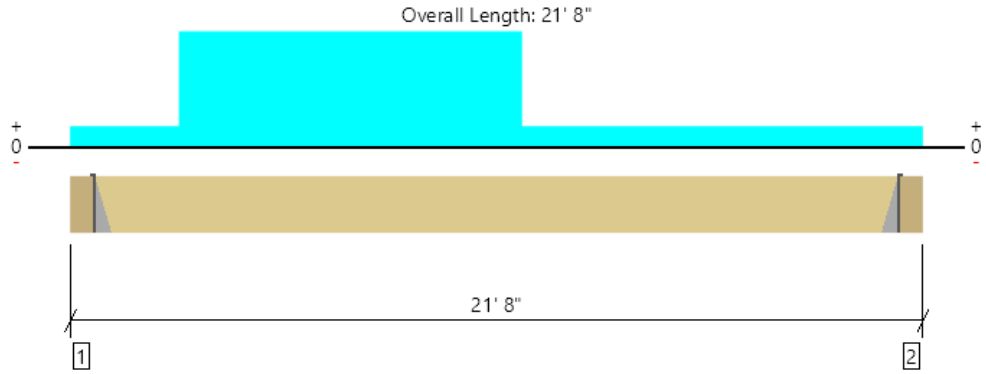
LEE-BOYLE RESIDENCE (project)	2/26/19 (date)	19052.01 (project no.)
	TVM (designer)	(sheet)
STUART SILK ARCH (client)	(checked by)	

Upper Level, UJ2: Master Bed

Current Solution: 1 piece(s) 1 3/4" x 14" 2.0E Microllam® LVL @ 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)	2300 @ 5 1/2"	2300 (1.75")	Passed (100%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2215 @ 1' 7 1/2"	4655	Passed (48%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	11842 @ 9' 1 15/16"	12614	Passed (94%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.268 @ 10' 10"	0.519	Passed (L/928)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	1.049 @ 10' 4 5/8"	1.038	Passed (L/237)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	48	45	Passed	--	--

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

All Product Solutions					
Depth	Series	Plies	Spacing	**TJ-Pro™ Rating**	Wood Volume
14"	1 3/4" 2.0E Microllam® LVL	1	16"	48	3.06

The purpose of this report is for product comparison only. Load and support information necessary for professional design review is not displayed here. Please print an individual Member Report for submittal purposes.

ForteWEB Software Operator	Job Notes
Travis Michaud QCE (603) 953-3921 tmichaud@quantumce.com	

SANDRO KODAMA
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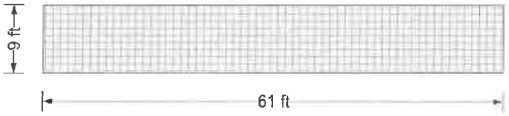
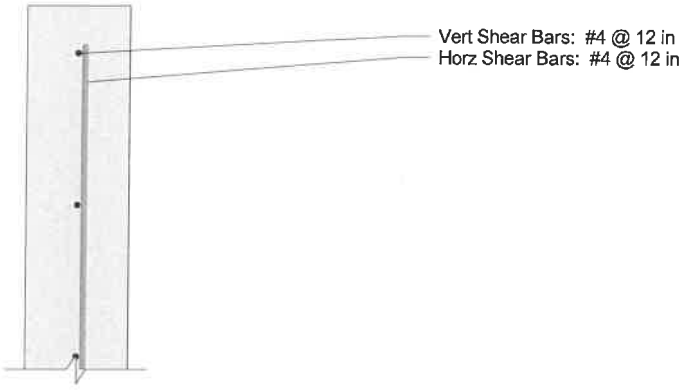
Single Curtain Wall 1
Grid line E -8" concrete Basement wall

Job # Lee Boyle R...

Design Detail





Criteria

Use basic criteria from common project settings	No
Building Code	IBC 2015
Load Combination	IBC 2015 (Strength)
Apply Sds Factor to Seismic Combinations for Ev	Yes
Sds (from ASCE 7)	0.94
Use Seismic Provisions	Yes
Apply Ch 11 Shear Checks	Yes
Design Displacement	1 in
f'c	3000 psi
fy	40000 psi
Wall Unit Weight	145 lb/ft³
Apply Wall Weight	Yes
Shear Is At Wall Top	Yes
Use phi = 0.6 for Shear	Yes

Check Summary

Ratio	Check	Provided	Required	Combination
---- Reinforcement Details -----				
✓ 0.250	Cover (wall)	3 in	0.75 in	N/A
----- Wall Reinforcement Limits -----				
✓ 0.960	Horz Bar Rho	0.00208	0.00200	N/A
✓ 0.667	Horz Bar Spacing	12 in	18 in	N/A
✓ 0.576	Vert Bar Rho	0.00208	0.00120	N/A
✓ 0.667	Vert Bar Spacing	12 in	18 in	N/A
✓ 1.000	Vert vs. Horz Rho	0.00208	0.00208	N/A
✓ 1.000	Number of Layers	1.0	1.0	N/A
✓ 1.000	Number of Curtains	1.0	1.0	N/A
----- Special Boundary Elements -----				
✓ 0.000	SBEs Not Required	1.00000	0.00000	N/A
----- Ordinary Boundary Elements -----				
✓ 0.000	OBE Confinement ...	1.00000	0.00000	N/A
✓ 0.000	OBE Horz Bar Anch...	0.00000	0.00000	N/A
----- Strength -----				
✓ 0.017	Shear	750.8 k	13.1 k	(0.9 - 0.2Sds)D + 1.0E
✓ 0.024	Axial Compression	8248 k	200.9 k	1.2D + 1.6L + 0.5S
✓ 0.007	Moment (in-plane)	15939 ft·k	117.9 ft·k	(0.9 - 0.2Sds)D + 1.0E

Loads Summary

Load Set	Axial	Shear	Moment
Earthquake	0 k	13.1 k	0 ft·k
Wind	0 k	12.2 k	0 ft·k
Dead	46.5 k	0 k	0 ft·k
Snow	22.3 k	0 k	0 ft·k
Live	43.9 k	0 k	0 ft·k

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Single Curtain Wall 1
Grid line E -8" concrete Basement wall

Job # Lee Boyle R...

Results Summary

Load Combination	Factored Axial (k)	Factored Moment (ft·k)	Factored Shear (k)	Mu (ft·k)	phiMn (ft·k)	Vu (k)
1.4D	65.1	0	0	0	18593	0
1.2D + 1.6L + 0.5S	137.2	0	0	0	20975	0
1.2D + 1.6L	126	0	0	0	20543	0
1.2D + 0.5L + 1.6S	113.4	0	0	0	20055	0
1.2D + 1.6S + 0.5W	91.48	0	6.1	54.9	19204	6.1
1.2D + 1.6S	91.48	0	0	0	19204	0
1.2D + 0.5W	55.8	0	6.1	54.9	17822	6.1
1.2D + 0.5L + 0.5S + 1.0W	88.9	0	12.2	109.8	19104	12.2
1.2D + 0.5L + 0.5S	88.9	0	0	0	19104	0
1.2D + 0.5L + 1.0W	77.75	0	12.2	109.8	18672	12.2
1.2D + 0.5S + 1.0W	66.95	0	12.2	109.8	18254	12.2
1.2D + 0.5S	66.95	0	0	0	18254	0
1.2D + 1.0W	55.8	0	12.2	109.8	17822	12.2
(1.2 - 0.2Sds)D + 0.5L + 0.2S + 1.0E	73.47	0	13.1	117.9	18120	13.1
(1.2 + 0.2Sds)D + 0.5L + 0.2S + 1.0E	90.95	0	13.1	117.9	19570	13.1
1.2D + 0.5L + 0.2S	82.21	0	0	0	18845	0
(1.2 - 0.2Sds)D + 0.5L + 1.0E	69.01	0	13.1	117.9	17947	13.1
(1.2 + 0.2Sds)D + 0.5L + 1.0E	86.49	0	13.1	117.9	19398	13.1
1.2D + 0.5L	77.75	0	0	0	18672	0
(1.2 - 0.2Sds)D + 0.2S + 1.0E	51.52	0	13.1	117.9	17269	13.1
(1.2 + 0.2Sds)D + 0.2S + 1.0E	69	0	13.1	117.9	18720	13.1
1.2D + 0.2S	60.26	0	0	0	17995	0
(1.2 - 0.2Sds)D + 1.0E	47.06	0	13.1	117.9	17096	13.1
(1.2 + 0.2Sds)D + 1.0E	64.54	0	13.1	117.9	18547	13.1
1.2D	55.8	0	0	0	17822	0
0.9D + 1.0W	41.85	0	12.2	109.8	16664	12.2
(0.9 - 0.2Sds)D + 1.0E	33.11	0	13.1	117.9	15939	13.1
(0.9 + 0.2Sds)D + 1.0E	50.59	0	13.1	117.9	17390	13.1
0.9D	41.85	0	0	0	16664	0

Load Combination	phiVn (k)	phiVc (k)	Vs (k)	Pu (k)	phiPn (k)
1.4D	759	524.8	390.4	139.4	8248
1.2D + 1.6L + 0.5S	766.4	532.2	390.4	200.9	8248
1.2D + 1.6L	765.1	530.8	390.4	189.7	8248
1.2D + 0.5L + 1.6S	763.6	529.3	390.4	177.1	8248
1.2D + 1.6S + 0.5W	760.9	526.7	390.4	155.2	8248
1.2D + 1.6S	760.9	526.7	390.4	155.2	8248
1.2D + 0.5W	756.6	522.4	390.4	119.5	8248
1.2D + 0.5L + 0.5S + 1.0W	760.6	526.4	390.4	152.6	8248
1.2D + 0.5L + 0.5S	760.6	526.4	390.4	152.6	8248
1.2D + 0.5L + 1.0W	759.3	525	390.4	141.4	8248
1.2D + 0.5S + 1.0W	758	523.7	390.4	130.6	8248
1.2D + 0.5S	758	523.7	390.4	130.6	8248
1.2D + 1.0W	756.6	522.4	390.4	119.5	8248
(1.2 - 0.2Sds)D + 0.5L + 0.2S + 1.0E	757.6	523.3	390.4	127.2	8248
(1.2 + 0.2Sds)D + 0.5L + 0.2S + 1.0E	762.1	527.8	390.4	164.6	8248
1.2D + 0.5L + 0.2S	759.8	525.6	390.4	145.9	8248
(1.2 - 0.2Sds)D + 0.5L + 1.0E	757	522.8	390.4	122.7	8248
(1.2 + 0.2Sds)D + 0.5L + 1.0E	761.5	527.3	390.4	160.2	8248
1.2D + 0.5L	759.3	525	390.4	141.4	8248
(1.2 - 0.2Sds)D + 0.2S + 1.0E	754.9	520.7	390.4	105.2	8248
(1.2 + 0.2Sds)D + 0.2S + 1.0E	759.4	525.2	390.4	142.7	8248
1.2D + 0.2S	757.2	522.9	390.4	123.9	8248
(1.2 - 0.2Sds)D + 1.0E	754.4	520.2	390.4	100.8	8248
(1.2 + 0.2Sds)D + 1.0E	758.9	524.6	390.4	138.2	8248
1.2D	756.6	522.4	390.4	119.5	8248
0.9D + 1.0W	753.1	518.8	390.4	89.61	8248
(0.9 - 0.2Sds)D + 1.0E	750.8	516.6	390.4	70.89	8248
(0.9 + 0.2Sds)D + 1.0E	755.3	521.1	390.4	108.3	8248
0.9D	753.1	518.8	390.4	89.61	8248

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Single Curtain Wall 1
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Job # Lee Boyle R...

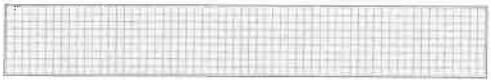
Reinforcement Details

Wall Cover (ACI 318-14 11.7.1.1», 20.6.1.3.1)

$cover_{min}$ = 0.75 in (#11 or smaller bar, interior exposure)

cover = 3 in ≥ $cover_{min}$ = 0.75 in ✓

Reinforcement Limits



Vertical bars: #4 @ 12 in, total area = 24.8 in²

Horizontal bars: #4 @ 12 in, total area = 4 in²

Minimum Steel (ACI 318-14 11.6, 11.7.2.3, 18.10.2.1, 18.10.2.2)

$\rho_t = \frac{A_{v\_horz}}{s_2\, t_{wall}} = \frac{(0.2\ in^2)}{(12\ in)(8\ in)} = 0.0021$

$\rho_l = \frac{A_{v\_vert}}{s_1\, t_{wall}} = \frac{(0.2\ in^2)}{(12\ in)(8\ in)} = 0.0021$

V_u = 13.1 k (most extreme seismic case)

V_u = 13.1 k ≤ $A_{cv}\,\lambda\sqrt{F'_c}$ = (40.67 ft²)(1.0)$\sqrt{3000\ psi}$ = 320.7 k

∴ limits of 11.6 apply, per 18.10.2.1

0.5 ϕ V_c = 0.5 (0.60) (860.9 k) = 258.3 k

∴ ρ_l and ρ_t are determined by 11.6.1

ρ_t = 0.0021 ≥ ρ_{t_min} = 0.0020 ✓

ρ_l = 0.0021 ≥ ρ_{l_min} = 0.0012 ✓

h_w / l_w = (9 ft) / (61 ft) = 0.1475 ≤ 2.0

∴ ρ_l must not be less than ρ_t per 18.10.4.3

ρ_l = 0.0021 ≥ ρ_t = 0.0021 ✓

Wall thickness not greater than 10 inches; 1 layer required per 11.7.2.3. ✓

V_u = 13.1 k <= 2 $A_{cv}\,\lambda\sqrt{F'_c}$ = 2 (40.67 ft²)(1.0)$\sqrt{3000\ psi}$ = 641.5 k

$\frac{h_w}{l_w} = \frac{(9\ ft)}{(61\ ft)} = 0.1475 < 2.0$

∴ two curtains not required per 18.10.2.2 ✓

Bar Spacing (ACI 318-14 11.7.2.1, 11.7.3.1)

Vertical Bars:

3 h = 3 (8 in) = 24 in

18 inch limit governs

s_{vert} = 12 in ≤ s_{vert_max} = 18 in ✓

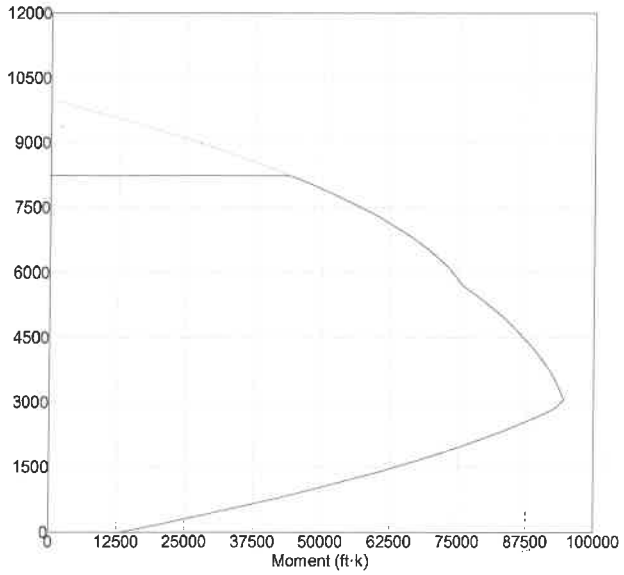
Horizontal Bars:

3 h = 3 (8 in) = 24 in

18 inch limit governs

s_{horz} = 12 in ≤ s_{horz_max} = 18 in ✓

Interaction Diagram



Special Boundary Element Checks

Check for Need (ACI 318-14 18.10.6.1, 18.10.6.2)

$\frac{h_w}{l_w} = \frac{(9\ ft)}{(61\ ft)} = 0.1475 \quad < \quad 2.0$

∴ Special boundary elements are not required ✓

Transverse Reinforcement General Requirements (ACI 318-14 18.10.6.4e, 18.7.5.2a-e)

Transverse reinforcement is detailed as rectilinear hoops with crossties. ✓

Bends of rectilinear hoops and crossties are detailed to engage peripheral longitudinal bars. ✓

Consecutive crossties are detailed to alternate end to end. ✓

Ties are No. 4 or larger ✓

Corner and alternate longitudinal bars are laterally supported by tie corners. ✓

No unsupported bar is further than 6 in. from a laterally supported bar. ✓

Per 18.10.6.4e, h_x is also limited to two thirds of the boundary element thickness.

$\frac{2}{3} t_{BE} = \frac{2}{3}(0\ in) = 0\ in$

$h_{x\_max} = 0\ in$

$h_x = -0.14\ in \quad \leq \quad h_{x\_max} = 0\ in$ ✓

Special Boundary Element Checks (continued)

Ordinary Boundary Element Checks

Ordinary Boundary Elements ('Where SBEs are not required')

The regions of special detailing discussed in 18.10.6.5 "where special boundary elements are not required" are not given a name by the ACI code, but following a convention from NEHRP documents this software will generally refer to these areas as Ordinary Boundary Elements (OBEs).

Check Ordinary Boundary Element Requirements (ACI 318-14 18.10.6.5)

18.10.6.5 (a) :

$\rho_{wb} = \frac{n_{bars} A_b}{A_{wb}} = \frac{(1.0)(0.2\ in^2)}{(0.67\ ft^2)} = 0.0021$ (ρ at the wall boundary)

$\rho_{wb\_limit} = 400 / f_y = 400 / (40000\ psi) = 0.010$

$\rho_{wb} = 0.0021 \leq \rho_{wb\_limit} = 0.010$

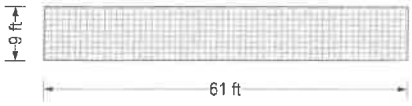
Therefore 18.7.5.2 (a) through (e) need not be satisfied

18.10.6.5 (b) :

$V_u = 13.1\ k$ (most extreme seismic case)

$V_u = 13.1\ k < A_{cv} \lambda \sqrt{F'_c} = (40.67\ ft^2)(1.0)\sqrt{3000\ psi} = 320.7\ k$

Horizontal reinforcement termination restrictions do not apply



SANDRO KODAMA
QUANTUM CONSULTING ENGINEERS

Single Curtain Wall 1
Grid line E -8" concrete Basement wall

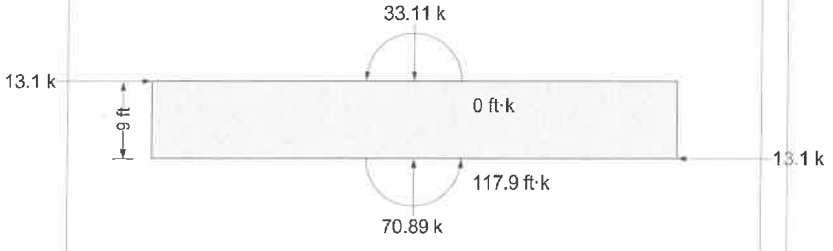
Job # Lee Boyle R...

Strength Checks [Load Combination: (0.9 - 0.2Sds)D + 1.0E]

Design Forces

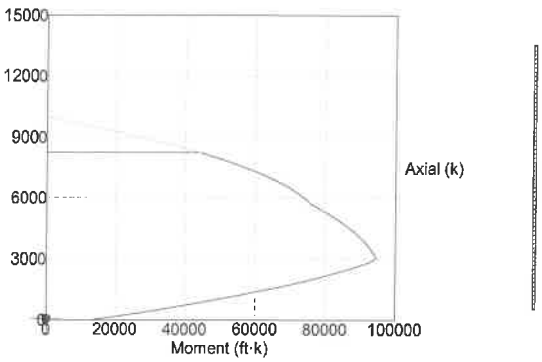
Factored Loads

Axial Force	33.11 k
Moment (in-plane)	0 ft·k
Shear Force	13.1 k
Wall Weight	37.79 k
Includes Seismic	Yes



P_u = 33.11 k + 37.79 k = 70.89 k
V_u = 13.1 k
Moment due to applied shear: (13.1 k) (9 ft) = 117.9 ft·k
M_u = 0 ft·k + 117.9 ft·k = 117.9 ft·k

Axial/Flexure Checks



Neutral axis depth at nominal moment capacity is 30.23 in

Axial Compression (ACI 318-14 22.4.2, 21.2)

$P_o = 0.85\ F'_c\ (A_g - A_{st}) + f_y\ A_{st}$
$= 0.85\ (3000\ psi)\ [(40.67\ ft^2) - (24.8\ in^2)] + (40000\ psi)\ (24.8\ in^2)$
$= 15862\ k$

$\phi P_{nmax} = 0.80\ \phi\ P_o = 0.80\ (0.650)\ (15862\ k) = 8248\ k$

$\phi P_{nmax} = 8248\ k \geq P_u = 70.89\ k$ ✓

Moment (ACI 318-14 11.4.2.1)

$\phi M_n = M_p = (15939\ ft{\cdot}k) = 15939\ ft{\cdot}k$ (M at given P; from interaction diagram)

$\phi M_n = 15939\ ft{\cdot}k \geq M_u = 117.9\ ft{\cdot}k$ ✓

Shear Check

Shear Capacity (ACI 318-14 11.5.4, 18.10.4, 21.2)

$\lambda = 1.0$ (normal weight concrete)

$d = 0.8\ l_w = 0.8\ (61\ ft) = 48.8\ ft$

(d) $V_c = 3.3\ \lambda\ \sqrt{F'_c}\ h\ d + \frac{N_u\ d}{4\ l_w} = 3.3\ (1.0)\ \sqrt{3000\ psi}\ (0.67\ ft)\ (48.8\ ft) + \frac{(70.89\ k)\ (48.8\ ft)}{4\ (61\ ft)} = 860.9\ k$

$\frac{M_u}{V_u} - \frac{l_w}{2} = \frac{(58.95\ ft{\cdot}k)}{(13.1\ k)} - \frac{(61\ ft)}{2} = -26\ ft$

...less than zero, so eqn (e) does not apply

Note: M_u in table 11.5.4.6 eqn (e) is at critical section per 11.5.4.7

$V_c = 860.9\ k$ → lesser of table 11.5.4.6 (d) and (e)

$V_s = \frac{A_v\ f_{yt}\ d}{s_2} = \frac{(0.2\ in^2)\ (40000\ psi)\ (48.8\ ft)}{(12\ in)} = 390.4\ k$

$V_n = V_c + V_s = (860.9\ k) + (390.4\ k) = 1251\ k$

$\rho_t = \frac{A_{s\_trans}}{A_{g\_trans}} = \frac{(4\ in^2)}{(40.67\ ft^2)} = 0.0007$

$V_{n\_max} = A_{cv} \left(\alpha_c\ \lambda\ \sqrt{F'_c} + \rho_t\ f_y\right) = (40.67\ ft^2) \left[(3.0)\ (1.0)\ \sqrt{3000\ psi} + (0.0007)\ (40000\ psi)\right] = 1122\ k$

$V_{n\_max} = 8\ A_{cv}\ \sqrt{F'_c} = 8\ (40.67\ ft^2)\ \sqrt{3000\ psi} = 2566\ k$

$\phi V_n = \phi\ V_n = (0.60)\ (1251\ k) = 750.8\ k$

$\phi V_c = \phi\ V_c = (0.60)\ (860.9\ k) = 516.6\ k$

$\phi V_{n\_max} = \phi\ 10\ \sqrt{F'_c}\ h\ d = (0.60)\ 10\ \sqrt{3000\ psi}\ (0.67\ ft)\ (48.8\ ft) = 1540\ k$

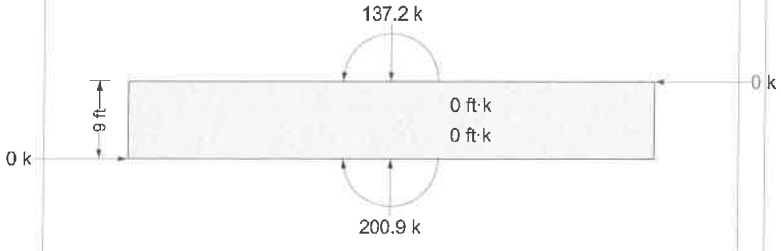
$\phi V_n = 750.8\ k \geq V_u = 13.1\ k$ ✓

Strength Checks [Load Combination: 1.2D + 1.6L + 0.5S]

Design Forces

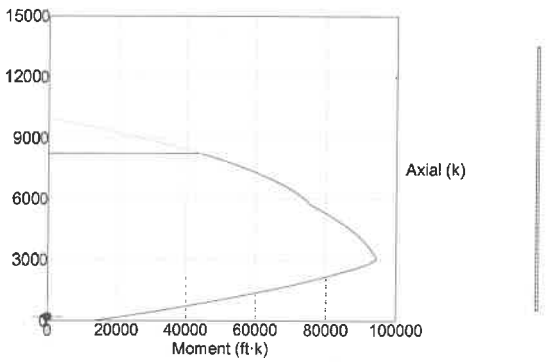
Factored Loads

Axial Force	137.2 k
Moment (in-plane)	0 ft·k
Shear Force	0 k
Wall Weight	63.68 k
Includes Seismic	No



P_u = 137.2 k + 63.68 k = 200.9 k
V_u = 0 k
Moment due to applied shear: (0 k) (9 ft) = 0 ft·k
M_u = 0 ft·k + 0 ft·k = 0 ft·k

Axial/Flexure Checks



Neutral axis depth at nominal moment capacity is 37.22 in

Axial Compression (ACI 318-14 22.4.2, 21.2)

$P_o = 0.85\ F'_c\ (A_g - A_{st}) + f_y\ A_{st}$
$= 0.85\ (3000\ psi)\ [(40.67\ ft^2) - (24.8\ in^2)] + (40000\ psi)\ (24.8\ in^2)$
$= 15862\ k$

$\phi P_{nmax} = 0.80\ \phi\ P_o = 0.80\ (0.650)\ (15862\ k) = 8248\ k$

$\phi P_{nmax} = 8248\ k \geq P_u = 200.9\ k$ ✓

Moment (ACI 318-14 11.4.2.1)

$\phi M_n = \phi M_p = (20975\ ft{\cdot}k) = 20975\ ft{\cdot}k$ (M at given P; from interaction diagram)

$\phi M_n = 20975\ ft{\cdot}k \geq M_u = 0\ ft{\cdot}k$ ✓

Shear Check

Shear Capacity (ACI 318-14 11.5.4, 18.10.4, 21.2)

$\lambda = 1.0$ (normal weight concrete)

$d = 0.8\ l_w = 0.8\ (61\ ft) = 48.8\ ft$

(d) $V_c = 3.3\ \lambda\ \sqrt{F'_c}\ h\ d + \frac{N_u\ d}{4\ l_w} = 3.3\ (1.0)\ \sqrt{3000\ psi}\ (0.67\ ft)\ (48.8\ ft) + \frac{(200.9\ k)\ (48.8\ ft)}{4\ (61\ ft)} = 886.9\ k$

$\frac{M_u}{V_u} - \frac{l_w}{2} = \frac{(0\ ft{\cdot}k)}{(0\ k)} - \frac{(61\ ft)}{2} = INF$

...less than zero, so eqn (e) does not apply

$V_c = 886.9\ k$ → lesser of table 11.5.4.6 (d) and (e)

$V_s = \frac{A_v\ f_{yt}\ d}{s_2} = \frac{(0.2\ in^2)\ (40000\ psi)\ (48.8\ ft)}{(12\ in)} = 390.4\ k$

$\phi V_n = \phi\ (V_c + V_s) = (0.60)\ [(886.9\ k) + (390.4\ k)] = 766.4\ k$

$\phi V_c = \phi\ V_c = (0.60)\ (886.9\ k) = 532.2\ k$

$\phi V_{n\_max} = \phi\ 10\ \sqrt{F'_c}\ h\ d = (0.60)\ 10\ \sqrt{3000\ psi}\ (0.67\ ft)\ (48.8\ ft) = 1540\ k$

$\phi V_n = 766.4\ k \geq V_u = 0\ k$ ✓

Splice/Development Calcs

Vertical Wall Bars

Straight Development Length (ACI 318-14 18.10.2.3», 25.4.2)

ψ_t = 1.0 (bars are not horizontal)

ψ_e = 1.0 (bar not epoxy coated)

ψ_s = 0.80 (bars are #6 or smaller)

λ = 1.0 (normal weight concrete)

s / 2 = (12 in) / 2 = 6 in

cover + d_b / 2 = (3.5 in) + (0.5 in) / 2 = 3.75 in

c_b = 3.75 in (lesser of half spacing, ctr to surface)

K_{tr} = 0.0 (no transverse reinforcement)

$$\frac{c_b + K_{tr}}{d_b} = \frac{(3.75\text{ in}) + (0.0)}{(0.5\text{ in})} = 7.50$$

$$l_d = \left(\frac{3.}{40} \frac{f_y}{\lambda \sqrt{F'_c}} \frac{\psi_t \psi_e \psi_s}{2.5} \right) d_b = \left[\frac{3.}{40} \frac{(40000\text{ psi})}{(1.0)\sqrt{3000\text{ psi}}} \frac{(1.0)(1.0)(0.80)}{2.5} \right] (0.5\text{ in}) = 8.76\text{ in}$$

12 inch minimum controls

Note: Multiply by 1.25 where yielding is likely to occur per ACI 18.10.2.3b

Splice Length, Class B (ACI 318-14 18.10.2.3», 25.5.2)

$l_{lap} = 1.3\, l_d = 1.3\,(12\text{ in}) = 15.6\text{ in}$

Note: Multiply by 1.25 where yielding is likely to occur per ACI 18.10.2.3b

Horizontal Wall Bars

Straight Development Length (ACI 318-14 18.10.2.3», 25.4.2)

ψ_t = 1.0 (cannot assume 12 inches of fresh concrete cast below)

ψ_e = 1.0 (bar not epoxy coated)

ψ_s = 0.80 (bars are #6 or smaller)

λ = 1.0 (normal weight concrete)

s / 2 = (12 in) / 2 = 6 in

cover + d_b / 2 = (3 in) + (0.5 in) / 2 = 3.25 in

c_b = 3.25 in (lesser of half spacing, ctr to surface)

K_{tr} = 0.0 (no transverse reinforcement)

$$\frac{c_b + K_{tr}}{d_b} = \frac{(3.25\text{ in}) + (0.0)}{(0.5\text{ in})} = 6.50$$

$$l_d = \left(\frac{3.}{40} \frac{f_y}{\lambda \sqrt{F'_c}} \frac{\psi_t \psi_e \psi_s}{2.5} \right) d_b = \left[\frac{3.}{40} \frac{(40000\text{ psi})}{(1.0)\sqrt{3000\text{ psi}}} \frac{(1.0)(1.0)(0.80)}{2.5} \right] (0.5\text{ in}) = 8.76\text{ in}$$

12 inch minimum controls

Note: Multiply by 1.25 where yielding is likely to occur per ACI 18.10.2.3b

Splice Length, Class B (ACI 318-14 18.10.2.3», 25.5.2)

$l_{lap} = 1.3\, l_d = 1.3\,(12\text{ in}) = 15.6\text{ in}$

Note: Multiply by 1.25 where yielding is likely to occur per ACI 18.10.2.3b

Splice/Development Calcs (continued)

Column Longitudinal Bars

No calcs to display - wall has no columns

This Wall in File: m:\stuart silk\19052.01_lee-boyle residence\calculations\lateral design\5.6 ft re

Cantilevered Retaining Wall

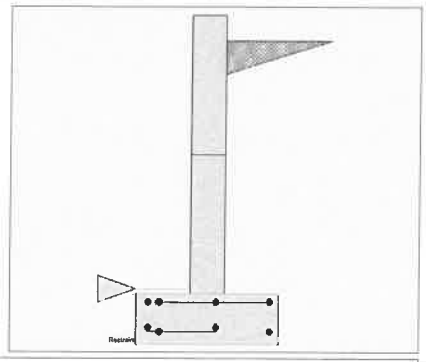
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.50 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	=	2,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 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 psf
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

Adjacent Footing Load

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

Axial Load Applied to Stem

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

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	6.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	36.000
Total Seismic Force	=	216.000

Design Summary

Wall Stability Ratios

Overturning	=	1.59 OK

Slab Resists All Sliding !

Total Bearing Load	=	1,588 lbs
...resultant ecc.	=	8.92 in
Soil Pressure @ Toe	=	1,674 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,500 psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	2,344 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	5.4 psi OK
Footing Shear @ Heel	=	7.6 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	781.2 lbs

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

Load Factors

Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	2.75	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	8.00	8.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	12.00	12.00
Rebar Placed at	=	6 in	6 in
Design Data			
fb/FB + fa/Fa	=	**0.056**	**0.459**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	222.8	880.0
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =	197.4	1,616.7
Moment.....Allowable	ft-# =	3,521.3	3,521.3
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =	3.1	12.2
Shear.....Allowable	psi =	82.2	82.2
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.00	6.00
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	100.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	3,000.0	3,000.0
Fy	psi =	40,000.0	40,000.0

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0116 in2/ft		
(4/3) * As :	0.0154 in2/ft	Min Stem T&S Reinf Area 0.528 in2	
200bd/fy : 200(12)(6)/40000 :	0.36 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 :	1.4631 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0949 in2/ft		
(4/3) * As :	0.1265 in2/ft	Min Stem T&S Reinf Area 0.528 in2	
200bd/fy : 200(12)(6)/40000 :	0.36 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 :	1.4631 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Dimensions & Strengths

Toe Width	=	1.04 ft
Heel Width	=	1.71
Total Footing Width	=	2.75
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 = 40,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,344	0 psf
Mu' : Upward	=	1,039	1 ft-#
Mu' : Downward	=	98	488 ft-#
Mu: Design	=	941	487 ft-#
Actual 1-Way Shear	=	5.44	7.63 psi
Allow 1-Way Shear	=	40.00	40.00 psi

Toe Reinforcing = # 4 @ 12.00 in
Heel Reinforcing = # 4 @ 12.00 in
Key Reinforcing = None Spec'd

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 0.71 in2
Min footing T&S reinf Area per foot 0.26 in2 /ft

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

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	630.0	2.00	1,260.0	Soil Over Heel	= 625.1	2.23	1,393.7
Surcharge over Heel	=				Sloped Soil Over Heel	=		
Surcharge Over Toe	=				Surcharge Over Heel	=		
Adjacent Footing Load	=				Adjacent Footing Load	=		
Added Lateral Load	=				Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=				* Axial Live Load on Stem	=		
Seismic Earth Load	=	151.2	3.00	453.6	Soil Over Toe	=		
	=				Surcharge Over Toe	=		
Total		781.2	**O.T.M.**	1,713.6	Stem Weight(s)	= 550.0	1.38	756.4
	=		=		Earth @ Stem Transitions	=		
Resisting/Overturning Ratio		= **1.59**			Footing Weight	= 412.6	1.38	567.4
Vertical Loads used for Soil Pressure		= 1,587.7 lbs			Key Weight	=		
					Vert. Component	=	2.75	
					Total =	1,587.7 lbs	**R.M.=**	2,717.4

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

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

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

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.

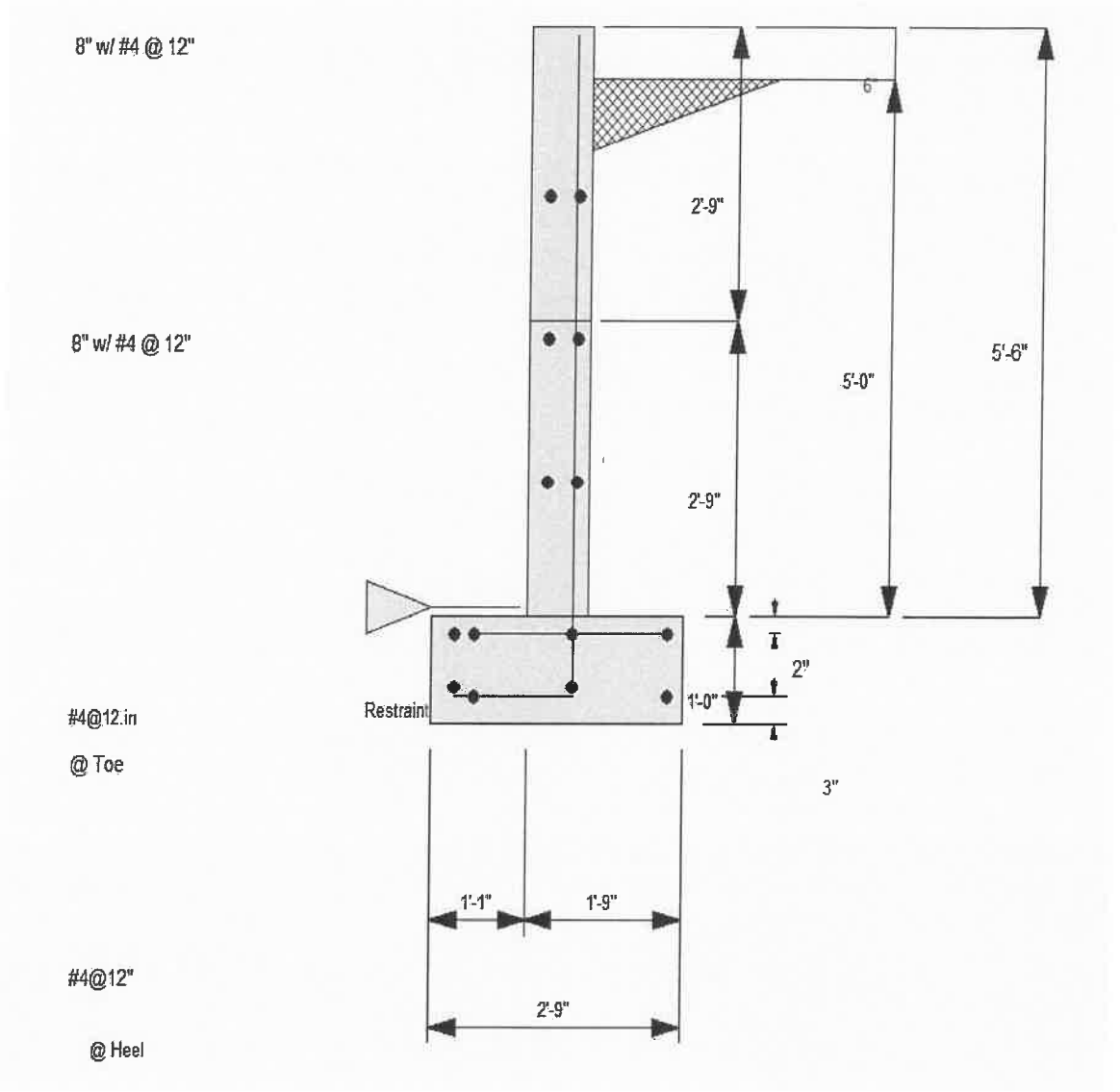
Tilt

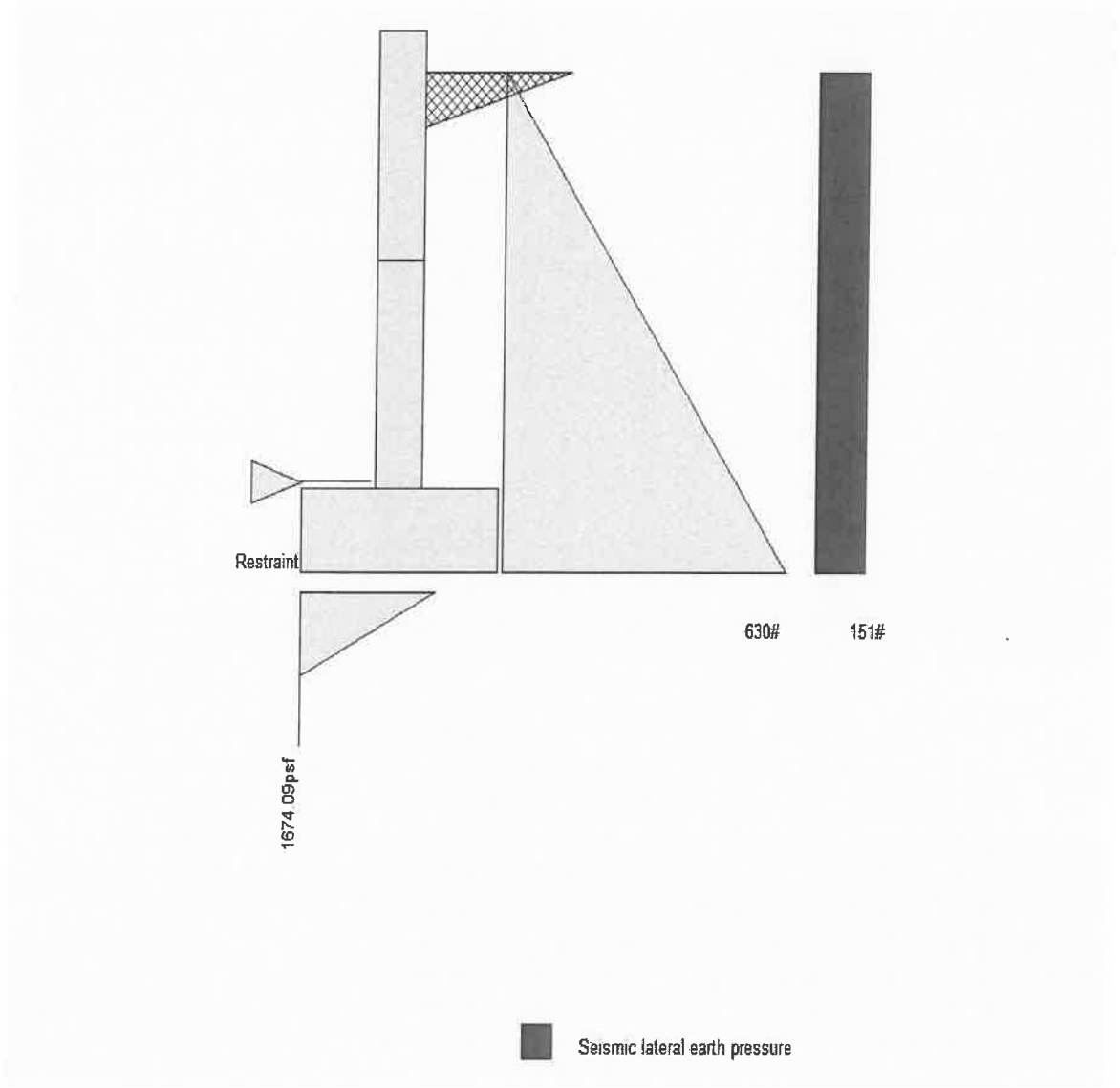
Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.093	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.


8" w/ #4 @ 12"
8" w/ #4 @ 12"
#4@12.in
@ Toe
#4@12"
@ Heel
Restraint
2'-9"
5'-0"
5'-6"
2'-9"
2"
1'-0"
3"
1'-1"
1'-9"
2'-9"


Restraint
630#
151#
1674.09psf
Seismic lateral earth pressure

SB Anchor Bolt

On This Page

Product Details

The SB anchor bolt offers an anchorage solution for our holdowns that call for a 5/8"-diameter, a 7/8"-diameter and a 1"-diameter anchor.

SB anchor bolts are code listed by ICC-ES under the 2012/2015/2018 IBC and IRC.

SIMPSON Strong-Tie

Key Features

- Identification on the bolt head showing embedment angle and model
- Sweep geometry to optimize position in form
- Rolled thread for higher tensile capacity
- Hex nuts and plate washer fixed in position
- Available in HDG for additional corrosion resistance

Material

- ASTM F-1554, Grade 36

Finish

- None. May be ordered HDG; contact Simpson Strong-Tie.

Installation

- SB is only for concrete applications poured monolithically except where noted.
- Top nuts and washers for holdown attachment are not supplied with the SB; install standard nuts, couplers and/or washers as required.
- On HDG SB anchors, chase the threads to use standard nuts or couplers or use overtapped products in accordance with ASTM A563, for example Simpson Strong-Tie NUT5/8-OST, NUT7/8-OST and NUT1-OST, CNW5/8-OST, CNW7/8-OST and CNW1-OST.
- Install SB before the concrete pour using AnchorMate® anchor bolt holders. Install the SB per the plan view detail.
- Minimum concrete compressive strength is 2,500 psi.
- When rebar is required it does not need to be tied to the SB.

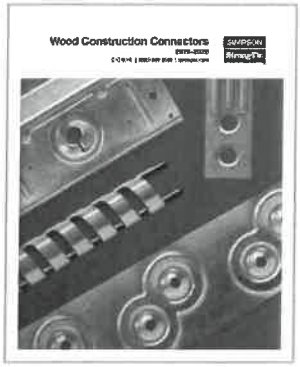
Related Links

- Wood Construction Connectors Technical and Installation Notes
- General Notes
- Corrosion Information
- Contact Simpson Strong-Tie

- 2015 and 2018 International Building Code® Resources Portal

Catalog Pages

- C-C-2019 (Wood Construction Connectors), pages 32–34



Wood Construction Connectors 2019-2020

C-C-2019 — *Catalog*

A catalog including new product information as well as any applicable specification and installation instructions for wood-to-wood and wood-to-concrete structural connectors.

SIMPSON Strong-Tie

Conectores para la construcción con madera 2019–2020

C-C-2019SP — *Catalog*

El catálogo incluye información sobre nuevos productos, así como especificaciones e instrucciones de instalación aplicables para conectores estructurales de madera a madera y de madera a concreto.

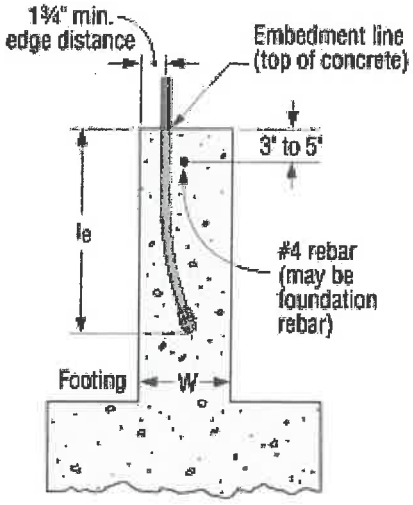
Load Tables

SB Bolts at Stemwall

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

Model No.	Dimensions (in.)				Allowable Tension Loads					
	Stemwall Width	Dia.	Length	Min. Embed. (l_e)	Wind and SDC A&B			SDC C–F		
					Midwall	Corner	End Wall	Midwall	Corner	End Wall
SB5/8X24	6	5/8	24	18	6,675	6,550	6,550	6,675	5,730	5,730
SB7/8X24	8	7/8	24	18	10,055	8,980	6,550	8,795	7,855	5,730
SB1X30	8	1	30	24	13,110	9,505	6,930	11,470	8,315	6,065

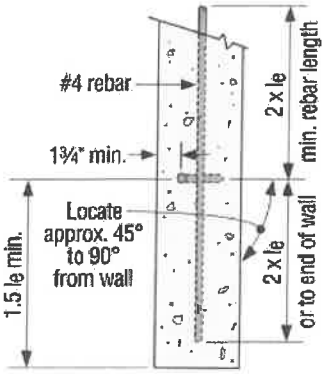
1. Rebar is required at the top of stem wall foundations, but is not required for slab-on-grade edge and garage curb, or stem wall garage front installations.
2. Minimum end distances for SB bolts are as shown in graphics.
3. To obtain LRFD values, multiply ASD seismic load values by 1.4 and wind load values by 1.67 (1.6 for 2012 IBC).
4. Per Section 1613 of the IBC, detached one- and two-story dwellings in SDC C may use "Wind and SDC A&B" allowable loads.



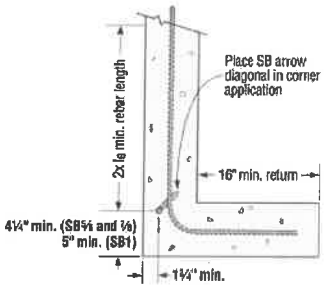
5. Midwall loads apply when anchor is 1.5 l_e or greater from the end. For bolts acting in tension simultaneously, the minimum bolt center-to-center spacing is 3 l_e.
6. Full catalog loads apply for two-pour installation for slab-on-grade: edge.

Typical SB Installation

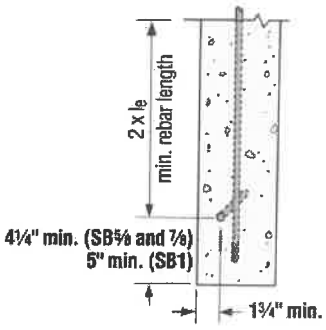
Stemwall Plan Views



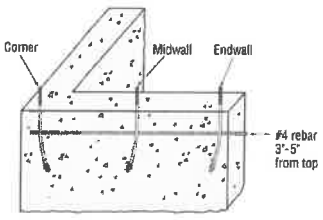
Midwall



Corner



End Wall



Perspect

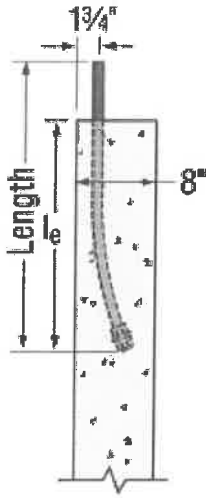
SIMPSON Strong-Tie

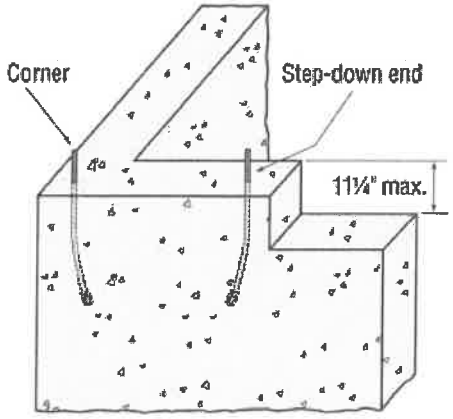
SB Bolts at Stemwall: Garage Front

These products are available with **additional corrosion protection**. Additional products on this page may also be available with this option, **check with Simpson Strong-Tie** for details.

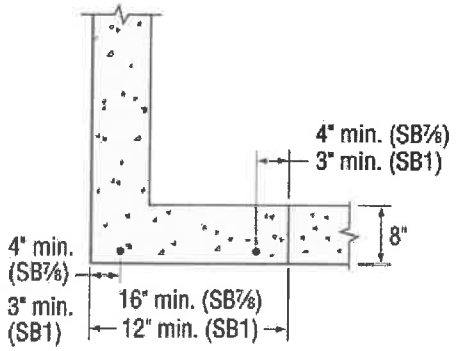
Model No.	Dimensions (in.)				Allowable Tension Loads			
	Stemwall Width	Diameter	Length	Min. Embed. (l_e)	Wind and SDC A&B		SDC C–F	
					Step-Down End	Corner	Step-Down End	Corner
SB7/8X24	8	⅞	24	18	6,935	7,355	6,070	6,435
SB1X30	8	1	30	24	10,850	9,400	9,495	8,030

1. Rebar is required at the top of stem wall foundations, but is not required for slab-on-grade edge and garage curb, or stem wall garage front installations.
2. Minimum end distances for SB bolts are as shown in graphics.
3. To obtain LRFD values, multiply ASD seismic load values by 1.4 and wind load values by 1.67 (1.6 for 2012 IBC).
4. Per Section 1613 of the IBC, detached one- and two-story dwellings in SDC C may use "Wind and SDC A&B" allowable loads.
5. Midwall loads apply when anchor is 1.5 l_e or greater from the end. For bolts acting in tension simultaneously, the minimum bolt center-to-center spacing is 3 l_e.





Perspective View



Plan View

January 1, 2019

Re: Concrete Stemwall Anchor Reinforcement for Simpson Strong-Tie® Strong-Wall® Shearwall Anchorage

To Whom It May Concern:

Typical anchorage solutions for Simpson Strong-Tie Strong-Wall shearwalls in concrete stemwall applications require the anchor bolt to be embedded in the footing beneath the stemwall. In certain cases, such as daylight/walkout basements or other tall stemwall applications, this requirement may result in installation challenges or additional expense. As an alternative, Simpson Strong-Tie has developed anchorage solutions for concrete stemwall applications using anchor reinforcement. This allows the Strong-Wall anchor bolt to terminate in the stemwall which eliminates the need for the anchor to extend into the footing.

When anchor reinforcement is included and developed on both sides of the breakout surface, evaluation of the concrete breakout strength is not required per ACI 318-14 Section 17.4.2.9. All other limit states defined in ACI 318-14 Table 17.3.1.1 are required and used to determine anchor strength. Additionally, all seismic design requirements defined in ACI 318-14 Section 17.2.3 have been satisfied.

Stemwall anchor reinforcement solutions for the Steel Strong-Wall (SSW) and Strong-Wall Wood Shearwall (WSW) are presented in Table 1 and Figures 1-5. Table 2 provides the required standard or high strength anchor model for each bolt diameter and corresponding Strong-Wall shearwall model. High strength anchor bolts are required for the SSW and WSW when the anchor tension force exceeds the allowable load for standard strength anchor bolts and for the SSW12 when the seismic shear multiplied by the shearwall height exceeds 61.6 k.-in.

Solutions provided herein have been developed for cases where the Strong-Wall shearwall is located at the edge of concrete or at the inside face of a 2x6 framed wall. Table 3 provides minimum required distances from edge of concrete to center of Strong-Wall anchor bolt for both cases. Two anchor reinforcement development configurations have also been considered. The first may apply for shorter concrete stemwalls with or without a cold joint between the stemwall and footing. In this case, a lap splice and standard hook are used to develop the anchor reinforcement below the breakout surface as shown in Figure 3. The second configuration applies for taller stemwalls and uses continuous anchor reinforcement below the breakout surface as shown in Figure 4. Note the Strong-Wall shearwall may be located either at the edge of concrete or at the inside face of a 2x6 framed wall for both anchor reinforcement development configurations. In all cases, a minimum 8-inch-thick concrete stemwall with a compressive strength of 2,500 psi is required. In some applications, depending upon the anchor bolt diameter and grade and Strong-Wall location, concrete compressive strengths above 2,500 psi and up to 4,500 psi are required. See following anchor reinforcement solutions for additional details.

The information in this letter is valid until **12/31/2019** when it will be re-evaluated by Simpson Strong-Tie. Please visit strongtie.com for additional pertinent information. If you have questions or need further assistance regarding this matter, please contact the Simpson Strong-Tie engineering department at 800.999.5099.

Sincerely,

SIMPSON STRONG-TIE COMPANY INC.

Simpson Strong-Tie Company Inc. 5956 W. Las Positas Boulevard Pleasanton, CA 94588 Phone: 925.560.9000 Fax: 925.847.1605 www.strongtie.com

Table 1: Strong-Wall Concrete Stemwall Anchorage Solutions with Anchor Reinforcement[1, 2]

Design Criteria	Anchor Diameter (in.)	Anchor Strength[5]	Strong-Wall Panel Location[10]						
			Edge of Concrete			Flush with Inside Face of 2x6 Wall			
			ASD Allowable Tension (lb.)	Minimum Concrete Strength, f'c (psi)[4]	Anchor Reinforcement Schedule[3]	ASD Allowable Tension (lb.)	Minimum Concrete Strength, f'c (psi)[4]	Anchor Reinforcement Schedule[3]	
Seismic[6]	3/4	Standard	9,600	2,500	(2) # 4	9,600	2,500	(2) # 4	
		High Strength	NS			19,900	2,500	(6) # 4	
	7/8	Standard	12,300	**3,500**	(4) # 4	13,100	2,500	(4) # 4	USED
		High Strength	NS			24,400	**3,000**	(6) # 4	
	1	Standard	NS			17,100	2,500	(4) # 4	USED
		High Strength	NS			32,500	**4,500**	(8) # 4	
Wind[7]	3/4	Standard	9,600	2,500	(2) # 4	9,600	2,500	(2) # 4	
		High Strength	10,800	2,500	(2) # 4	10,800	2,500	(2) # 4	
			13,800	**3,000**	(4) # 4	19,900	2,500	(4) # 4	
			16,900	**4,500**	(4) # 4	—			
	7/8	Standard	10,800	2,500	(2) # 4	10,800	2,500	(2) # 4	
			13,000	**3,000**	(4) # 4	13,100	2,500	(4) # 4	
		High Strength	15,900	**4,500**	(4) # 4	21,600	2,500	(4) # 4	
			NS			25,400	2,500	(6) # 4	
						27,100	**3,000**	(6) # 4	
	1	Standard	NS			10,800	2,500	(2) # 4	
						17,100	2,500	(4) # 4	
		High Strength	NS			21,600	2,500	(4) # 4	
						27,700	2,500	(6) # 4	
						32,400	**3,500**	(6) # 4	

1. Anchorage designs conform to ACI 318-14 with reinforcement used to develop the tension anchorage in cracked and uncracked concrete.
2. Anchor reinforcement has been designed in accordance with ACI 318-14 Section 17.4.2.9 and shall be developed on both sides of the breakout surface.
3. Anchor reinforcement schedule is per anchor bolt and shall be ASTM A615 Grade 60 No. 4.
4. Stemwall anchorage solutions based on minimum concrete strength, f'c, noted in table. Concrete strengths above 2,500 psi appear bold and underlined.
5. Anchor strength indicates required grade of SSWAB or WSW-AB anchor bolt. ASTM F1554 Gr. 36 for Standard and ASTM A449 for High Strength (HS).
6. Seismic indicates Seismic Design Category C through F. Seismic anchorage designs conform to ACI 318-14 Section 17.2.3.4.3.
7. Wind includes Seismic Design Category A and B and detached 1 and 2 family dwellings in SDC C.
8. Anchor reinforcement is for development of tension anchorage solutions only. Concrete stemwall and footing design (size and reinforcement) by Designer.
9. Anchor reinforcement development and lap splice requirements are in accordance with ACI 318-14 Sections 25.4 and 25.5.2 respectively.
10. Strong-Wall panel location, anchor reinforcement development length, lap splice length and installation details provided in Figures 1-5.
11. Concrete cover for anchor bolt and reinforcement shall be in accordance with ACI 318-14 Section 20.6 requirements.
12. NS = No solution.

Table 2: Strong-Wall shearwall and Anchor Bolt Models by Anchor Diameter

Anchor Diameter (in.)	Applicable Strong-Wall Models	Standard Strength Anchor Bolt Model	High Strength Anchor Bolt Model
3/4	SSW12	SSWAB¾ x 30	SSWAB¾ x 36HS
7/8	WSW12, WSW18	WSW-AB⅞ x 30	WSW-AB⅞ x 36HS
1	WSW24	WSW-AB1 x 30	WSW-AB1 x 36HS
1	SSW15, SSW18, SSW21, SSW24	SSWAB1 x 30	SSWAB1 x 36HS

1. Anchor bolt models provided ensure adequate anchor reinforcement development length. See C-L-SW17 for product, design and installation information.
2. Galvanized anchor bolts available, contact Simpson Strong-Tie for details.

Simpson Strong-Tie Company Inc. 5956 W. Las Positas Boulevard Pleasanton, CA 94588 Phone: 925.560.9000 Fax: 925.847.1605 www.strongtie.com

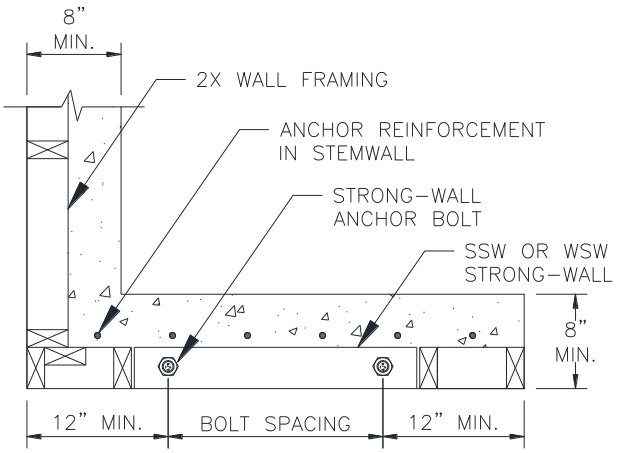


Figure 1: Strong-Wall at Edge of Concrete – Plan View

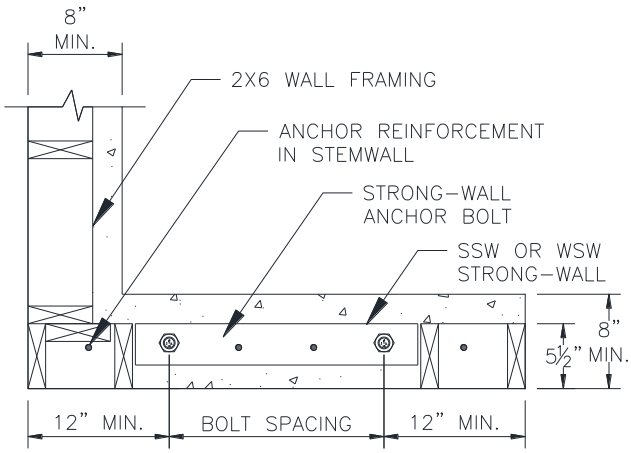


Figure 2: Strong-Wall Flush with Inside Face of 2x6 Wall – Plan View

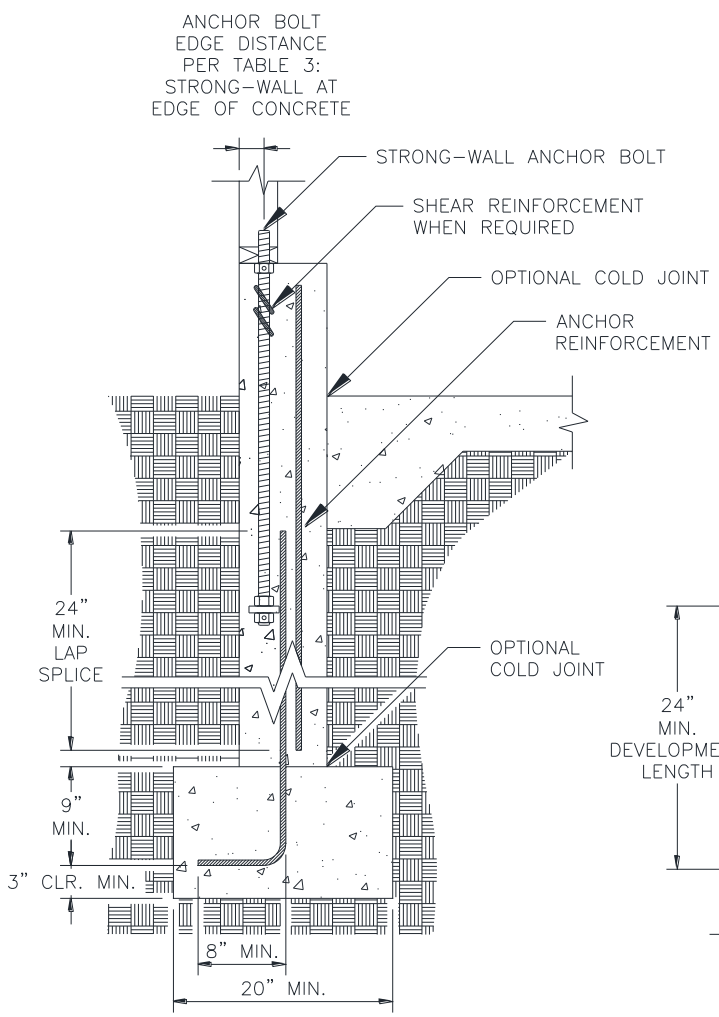


Figure 3: Strong-Wall at Edge of Concrete with Lap splice – Section
(Flush to Inside Face of 2x6 Wall Similar)

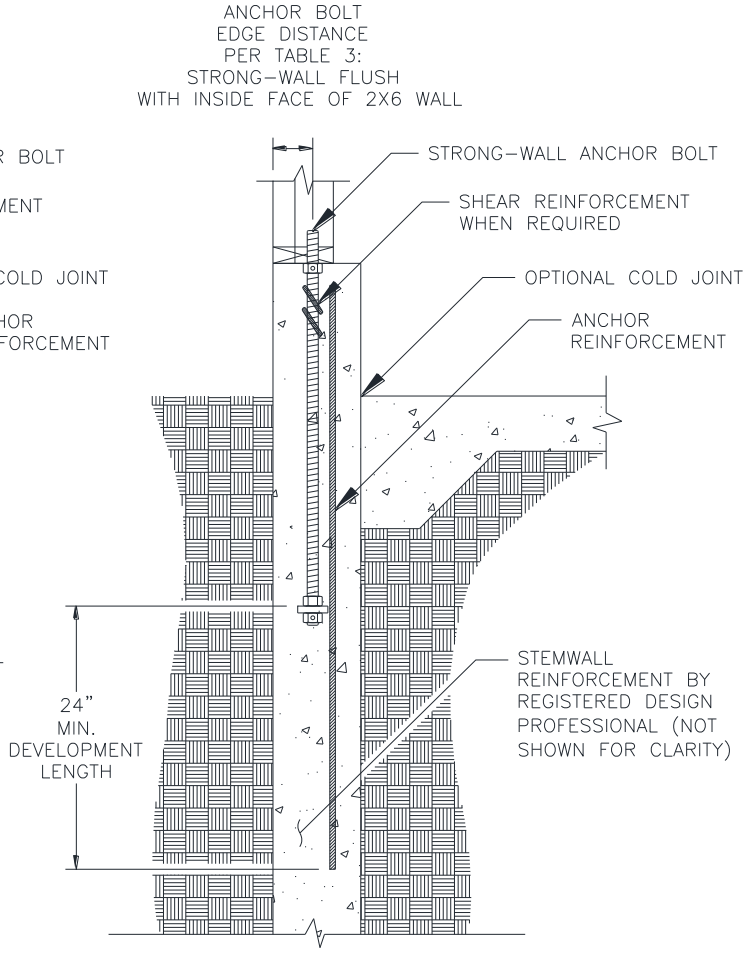


Figure 4: Strong-Wall Flush with Inside Face of 2x6 Wall – Section
(Strong-Wall at Edge of Concrete Similar)

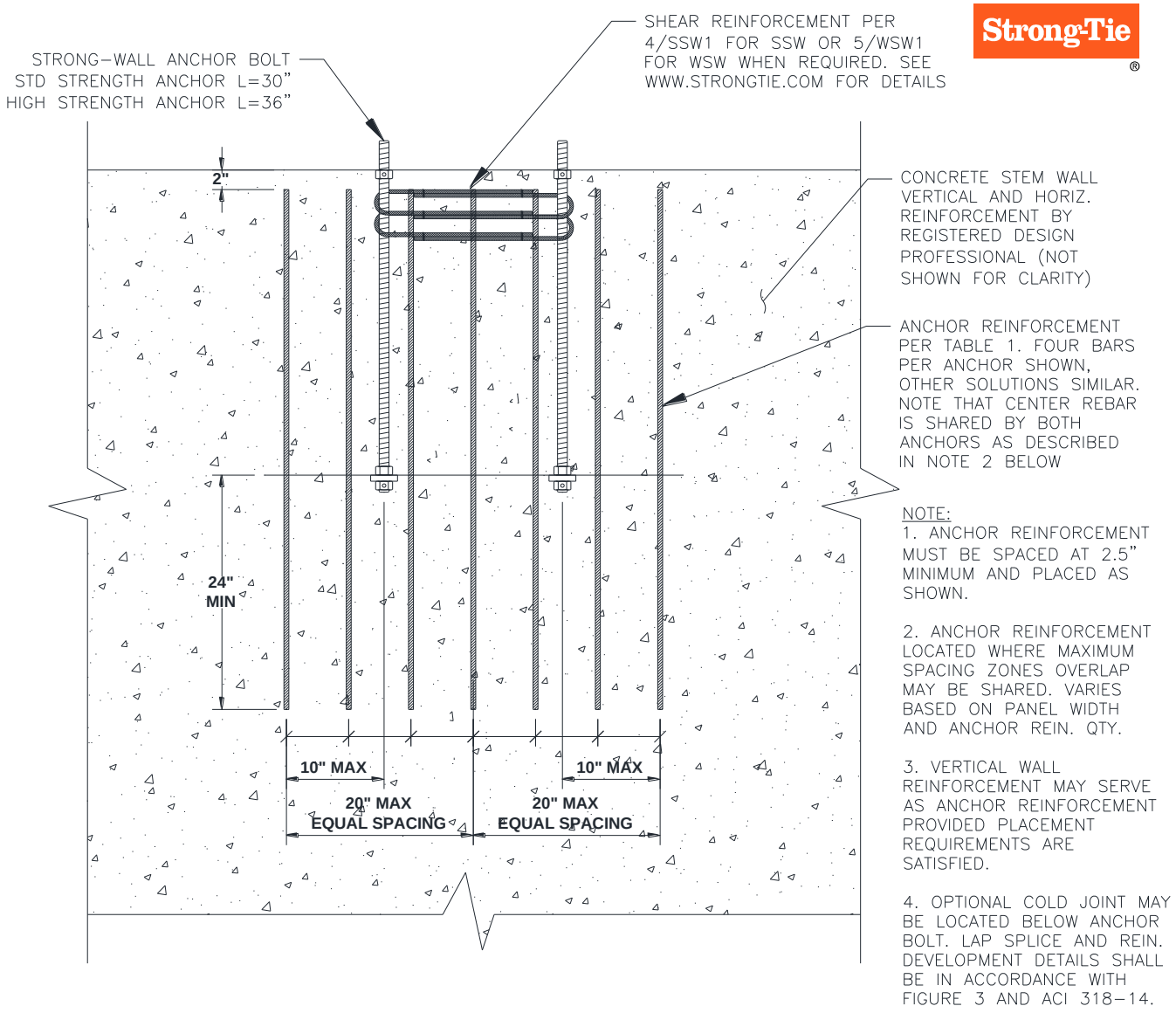


Figure 5: Concrete Stemwall Elevation with Strong-Wall Anchor Reinforcement and Placement Requirements

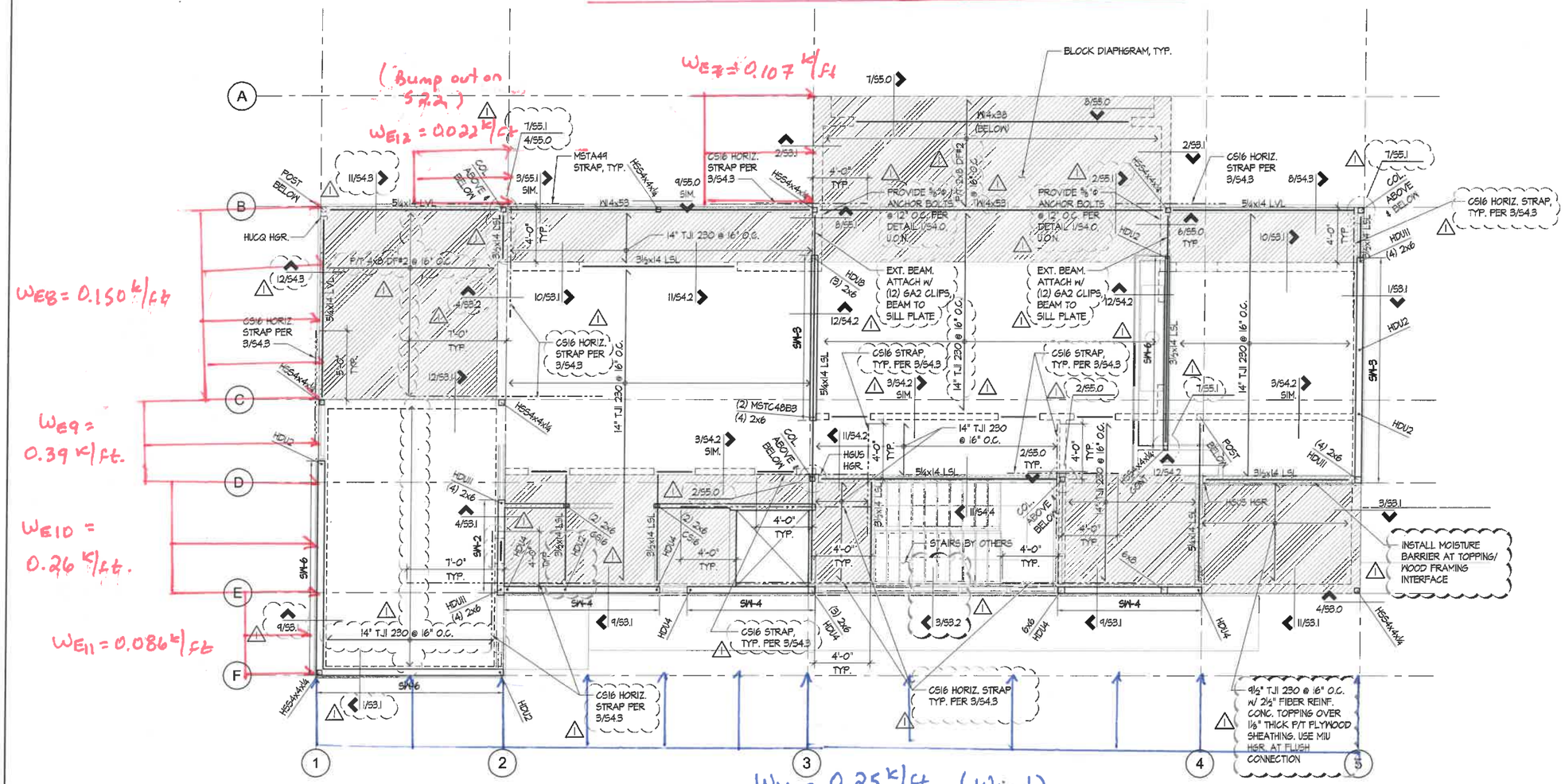
Table 3: Strong-Wall Anchor Bolt Edge Distance

Applicable Strong-Wall Models	Anchor Bolt Edge Distance Based on Strong-Wall Panel Location	
	Edge of Concrete	Flush with Inside Face of 2x6 Wall
SSW12	2"	3-5/8"
WSW12, WSW18	1-3/4"	3-3/4"
WSW24	1-3/4"	3-3/4"
SSW15, SSW18, SSW21, SSW24	1-7/8"	3-5/8"

1. Anchor bolt templates are recommended to properly locate bolts and are required in some jurisdictions.
2. See C-L-SW17 Strong-Wall Shearwalls catalog for product, design, and installation information.

Simpson Strong-Tie Company Inc. 5956 W. Las Positas Boulevard Pleasanton, CA 94588 Phone: 925.560.9000 Fax: 925.847.1605 www.strongtie.com

Shear Wall Tributary Diagrams & Loads



FLOOR FRAMING NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ON THE STRUCTURAL PLANS ARE FOR GENERAL INFORMATION ONLY AND SHALL BE VERIFIED BY THE CONTRACTOR WITH THE ARCHITECTURAL DRAWINGS BEFORE CONSTRUCTION BEGINS. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT AND ENGINEER IMMEDIATELY.
2. SEE SHEETS S1.0 THRU S1.2 FOR GENERAL STRUCTURAL NOTES AND ABBREVIATIONS. SEE SHEETS S4.0 THRU S4.4 FOR TYPICAL WOOD DETAILS. SEE SHEET S5.0 AND S5.1 FOR TYPICAL STEEL DETAILS.
3. TYPICAL FLOOR FRAMING CONSISTS OF 23/32" APA RATED T&G SHEATHING (INDEX 48/24), LAID FACE GRAIN PERPENDICULAR OVER 14" TJI JOISTS AT 16" O.C. HANG TJI JOISTS WITH ITS TOP FLANGE HANGERS TYPICAL AT FLUSH BEAMS, U.O.N.
4. NAIL FLOOR SHEATHING TO FRAMING WITH 8d NAILS (0.131"ø x 2.5" LONG) AT 6" O.C. AT ALL PANELS EDGES AND 8d NAILS AT 12" O.C. AT INTERMEDIATE FRAMING MEMBERS (BLOCKED). SEE DETAIL 6/S4.0.
5. ALL BEARING AND SHEAR WALLS SHALL BE 2x4 @ 16" O.C. INTERIOR AND 2x6 @ 16" O.C. EXTERIOR U.O.N.
6. POSTS INDICATED ARE AT THIS LEVEL. ALL POSTS NOT SPECIFIED SHALL BE (2) 2x U.O.N. SOLID SAWN MEMBERS OF EQUIVALENT SIZE MAY BE SUBSTITUTED FOR BUILT-UP MEMBERS (SUCH AS A 4x6 FOR (3) 2x4).
7. PROVIDE SOLID OR BUILT-UP WOOD POSTS BENEATH THE ENDS OF ALL FLOOR BEAMS AND ALL POSTS ABOVE FOR FULL BEARING. PROVIDE BLKG. AT JOISTS PER DETAIL 1/S4.1.
8. ALL HEADERS NOT SHOWN ON PLAN SHALL BE (2) 2x10 FOR EXTERIOR BEARING WALLS AND (2) 2x10 FOR INTERIOR BEARING WALLS. SEE 10/S4.1 FOR HEADER DETAIL.
9. FOR TOP PLATE SPLICE SEE DETAIL 6/S4.1.
10. ALIGN A JOIST OR JOIST BLOCKING OVER THE FULL LENGTH OF ALL BEARING/SHEAR WALLS. SEE 8/S4.0 FOR SPECIAL SHEAR WALL BLOCKING REQUIREMENTS.
11. SW-x INDICATES SHEAR WALL AT THIS LEVEL. SEE SHEAR WALL SCHEDULE 8/S4.0 FOR SHEATHING, BLOCKING, NAILING, AND ANCHOR BOLT REQUIREMENTS. ALL EXTERIOR WALLS SHALL BE SHEATHED PER SW-6 CRITERIA U.O.N.
12. HDUx INDICATES HOLDOWN TO CONCRETE FOUNDATION WALLS OR FOOTINGS. SEE 12/S4.0 FOR HOLDOWN DETAIL. USE MIN. (2) 2x POST U.O.N.
13. CMSTxx INDICATES HOLDOWN STRAP TO FRAMING BELOW WALL. SEE 10/S4.0 FOR STRAP HOLDOWN DETAIL AT FLOOR-TO-FLOOR AND BEAM SUPPORTING SHEAR WALL END. USE MIN. (2) 2x POST U.O.N.
14. ALL BEAMS ARE FLUSH FRAMED U.O.N.

LEGEND:

- INDICATES FRAMING DIRECTION
- INDICATES EXTENT OF FRAMING
- BLOCK DIAGPHRAGM PER 6/S4.0 & 2/S4.3
- SW-x INDICATES SHEAR WALL TYPE AT THIS LEVEL. SEE PLAN NOTE 11
- INDICATES WOOD BEARING OR SHEAR WALL AT THIS LEVEL. SEE PLAN NOTES 5 & 11
- INDICATES WOOD BEARING WALL OR SHEAR WALL BELOW. SEE PLAN NOTE 5
- INDICATES NON-BEARING/ NON-SHEAR WALL AT THIS LEVEL. SEE 1/S4.1 & 2/S4.1 FOR CONNECTION DETAILS
- INDICATES HEADER MEMBER BELOW. SEE PLAN NOTE 8
- (#)2x INDICATES MULTIPLE STUD POST AT THIS LEVEL. SEE PLAN NOTE 6
- HDx INDICATES HOLDOWN TYPE AT THIS LEVEL. SEE PLAN NOTES 12 & 13

PROJECT NORTH / TRUE NORTH

MAIN FLOOR FRAMING PLAN

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

Note: Loads shown at this level are transferred from the Diaphragm above to the shear walls shown at this Floor.

File: 052-2201.dwg Plotted: Thu, 07/25/2019 3:26 pm

QUANTUM
CONSULTING ENGINEERS
1511 THIRD AVENUE
SUITE 323
SEATTLE, WA 98101
TEL 206.957.3900
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SANDRO K. KODAMA
STATE OF WASHINGTON
36413
STRUCTURAL ENGINEER
PROFESSIONAL ENGINEER

DESIGN	FRU, TVM, MDA
DRAWN	SSN
CHECKED	SKK
SHEET ISSUE DATE - 3/11/19	

DRAWING SETS

DATE	DESCRIPTION
3/11/19	PERMIT SET

REVISIONS

1 7/26/19 SUB_2 (SUB_1 CORRECTIONS)

Stuart Silk Architects
2400 N. 45th St.
Seattle, WA 98103
WWW.STUARTSILK.COM

LEE-BOYLE

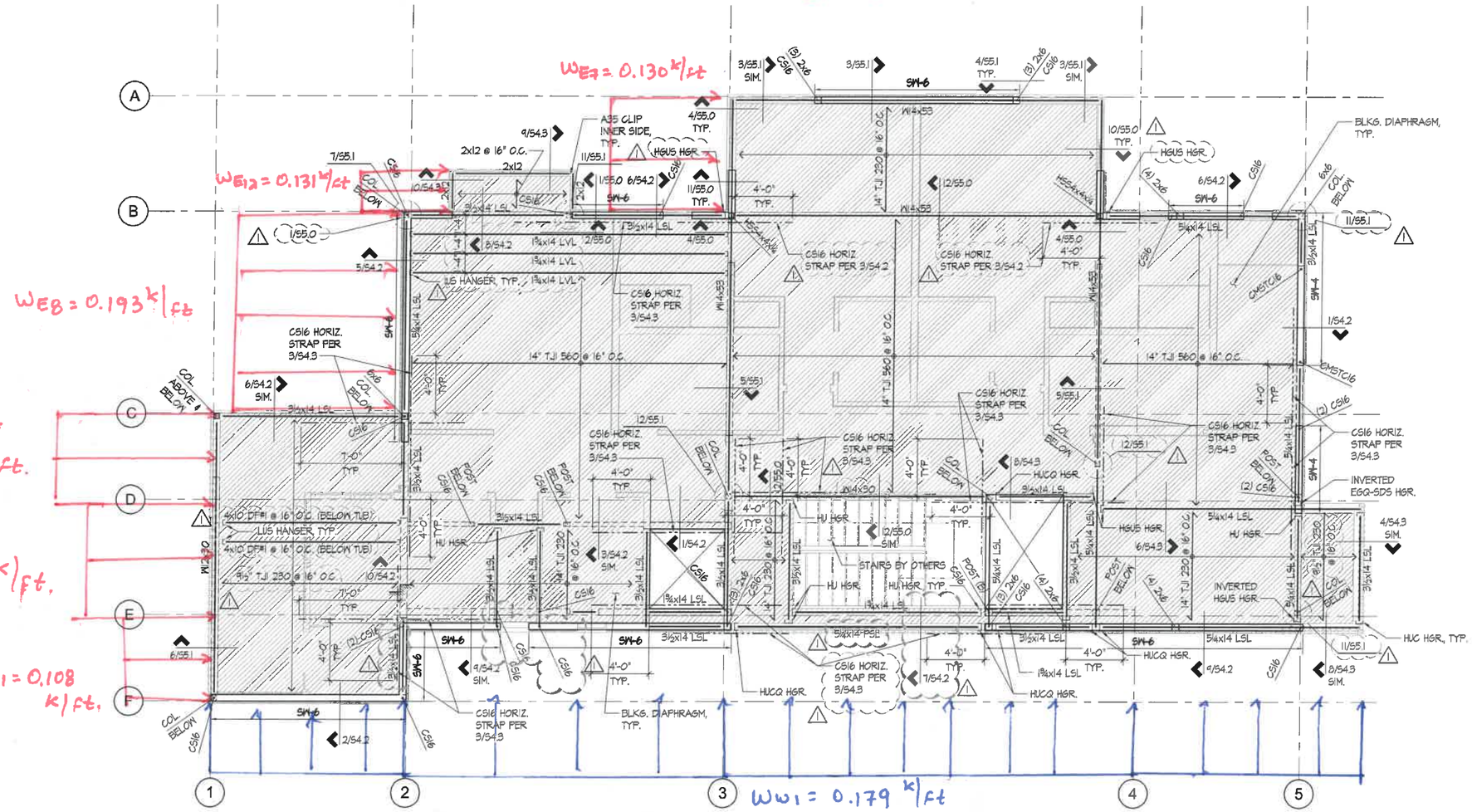
4150 BOULEVARD PLACE
MERCER ISLAND, WA 98040

PROJECT NO. 19052.01

MAIN FLOOR FRAMING PLAN

S2.1

Shear Wall Tributary Diagrams & Loads



FLOOR FRAMING NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ON THE STRUCTURAL PLANS ARE FOR GENERAL INFORMATION ONLY AND SHALL BE VERIFIED BY THE CONTRACTOR WITH THE ARCHITECTURAL DRAWINGS BEFORE CONSTRUCTION BEGINS. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT AND ENGINEER IMMEDIATELY.
2. SEE SHEETS S1.0 THRU S1.2 FOR GENERAL STRUCTURAL NOTES AND ABBREVIATIONS. SEE SHEETS S4.0 THRU S4.4 FOR TYPICAL WOOD DETAILS. SEE SHEETS S5.0 AND S8.1 FOR TYPICAL STEEL DETAILS.
3. TYPICAL FLOOR FRAMING CONSISTS OF 23/32" APA RATED T&G SHEATHING (INDEX 48/24), LAID FACE GRAIN PERPENDICULAR OVER 14" TJI JOISTS AT 16" O.C. HANG TJI JOISTS WITH ITS TOP FLANGE HANGERS TYPICAL AT FLUSH BEAMS, U.O.N.
4. NAIL FLOOR SHEATHING TO FRAMING WITH 8d NAILS (0.131"Φ x 2.5" LONG) AT 6" O.C. AT ALL PANELS EDGES AND 8d NAILS AT 12" O.C. AT INTERMEDIATE FRAMING MEMBERS (UNBLOCKED). SEE DETAIL 6/S4.0.
5. ALL BEARING AND SHEAR WALLS SHALL BE 2x4 @ 16" O.C. INTERIOR AND 2x6 @ 16" O.C. EXTERIOR U.O.N.
6. POSTS INDICATED ARE AT THIS LEVEL. ALL POSTS NOT SPECIFIED SHALL BE (2) 2x U.O.N. SOLID SAWN MEMBERS OF EQUIVALENT SIZE MAY BE SUBSTITUTED FOR BUILT-UP MEMBERS (SUCH AS A 4x6 FOR (3) 2x4).
7. PROVIDE SOLID OR BUILT-UP WOOD POSTS BENEATH THE ENDS OF ALL FLOOR BEAMS AND ALL POSTS ABOVE FOR FULL BEARING. PROVIDE BLKG. AT JOISTS PER DETAIL 7/S4.1.
8. ALL HEADERS NOT SHOWN ON PLAN SHALL BE (2) 2x10 FOR EXTERIOR BEARING WALLS AND (2) 2x10 FOR INTERIOR BEARING WALLS. SEE 10/S4.1 FOR HEADER DETAIL.
9. FOR TOP PLATE SPLICE SEE DETAIL 6/S4.1.
10. ALIGN A JOIST OR JOIST BLOCKING OVER THE FULL LENGTH OF ALL BEARING/SHEAR WALLS. SEE 8/S4.0 FOR SPECIAL SHEAR WALL BLOCKING REQUIREMENTS.
11. SW-x INDICATES SHEAR WALL AT THIS LEVEL. SEE SHEAR WALL SCHEDULE 8/S4.0 FOR SHEATHING, BLOCKING, NAILING, AND ANCHOR BOLT REQUIREMENTS. ALL EXTERIOR WALLS SHALL BE SHEATHED PER SW-6 CRITERIA U.O.N.
12. HDUx INDICATES HOLDOWN TO CONCRETE FOUNDATION WALLS OR FOOTINGS. SEE 12/S4.0 FOR HOLDOWN DETAIL. USE MIN. (2) 2x POST U.O.N.
13. CMSTC16 INDICATES HOLDOWN STRAP TO FRAMING BELOW WALL. SEE 10/S4.0 FOR STRAP HOLDOWN DETAIL AT FLOOR-TO-FLOOR AND BEAM SUPPORTING SHEAR WALL END. USE MIN. (2) 2x POST U.O.N.
14. ALL INVERTED HANGERS SHALL BE INSTALLED WITH SIMPSON SDI0212 SCREWS. FILL ALL HOLES.
15. ALL BEAMS ARE FLUSH FRAMED U.O.N.

LEGEND:

- INDICATES FRAMING DIRECTION
- INDICATES EXTENT OF FRAMING
- SW-x INDICATES SHEAR WALL TYPE AT THIS LEVEL. SEE PLAN NOTE 11
- INDICATES WOOD BEARING OR SHEAR WALL AT THIS LEVEL. SEE PLAN NOTES 5 & 11
- INDICATES WOOD BEARING WALL OR SHEAR WALL BELOW. SEE PLAN NOTE 5
- INDICATES NON-BEARING/ NON-SHEAR WALL AT THIS LEVEL. SEE 1/S4.1 & 2/S4.1 FOR CONNECTION DETAILS
- INDICATES HEADER MEMBER BELOW. SEE PLAN NOTE 8
- (3)2x INDICATES MULTIPLE STUD POST AT THIS LEVEL. SEE PLAN NOTE 6
- INDICATES HOLDOWN TYPE AT THIS LEVEL. SEE PLAN NOTES 12 & 13
- BLOCK DIAGPHRAGM PER 6/S4.0 & 2/S4.3

Note:
* Loads shown at this level are transferred from the Diaphragm above to shear walls shown at this Floor.

PROJECT NORTH / TRUE NORTH

UPPER FLOOR FRAMING PLAN

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

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QUANTUM CONSULTING ENGINEERS
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SANDRO K. KOD — STATE OF WASHINGTON — 36613 — REGISTERED PROFESSIONAL ENGINEER

DESIGN	FRU, TVM, MDA
DRAWN	SSN
CHECKED	SKK
SHEET ISSUE DATE - 3/11/19	

DRAWING SETS

DATE	DESCRIPTION
3/11/19	PERMIT SET

REVISIONS

1 7/26/19 SUB_2 (SUB_1 CORRECTIONS)

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PROJECT NO. 19052.01

UPPER FLOOR FRAMING PLAN

S2.2