Supplemental Structural Calculations For:

Lawler Residence

Mercer Island, WA

Prepared for: TCA Architecture and Planning
6211 Roosevelt Way NE
Seattle, WA 98115

Job #: 00461-2020-01

Date: 7/1/2020

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TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 O 253.284.9470

Criteria Sheet

Codes:

Structural:	IBC 2015
Loading:	ASCE 7-10
Wood:	NDS 2015
Steel:	AISC 360-10
Concrete:	ACI 318-14
Masonry:	TMS 402/602-13

Project Location:

Street & Number:	8456 N Mercer Way		
City:	Mercer Island	State:	WA
ZIP:	98040		
Latitude:	47.5854 N		
Longitude:	-122.2240 W		

Occupancy Category

Risk Category: II ASCE 7 Table 1.5-1

Seismic Load Summary:

Analysis Procedure:	Equivalent Lateral Force Procedure		
Lateral System:	Light-frame (wood) Walls Sheathed with Wood Structural Panels Rated for Shear Resistance		
R:	6.50	C_d=	4
Base Shear V =	13 kips	Ω_o=	3
S_S=	1.375	S_1=	0.529
S_{DS}=	0.92	S_{D1}=	0.53
C_s=	0.141	I_E=	1.0

Wind Load Summary:

V=	110	K_{ZT}=	1.00
Exposure =	C		

Dead Loads:

Roof				
Roofing	2.5	psf		
1/2" Sheathing	1.8	psf		
Joists @ 24" oc	2.5	psf		
Misc./Mech.	1.5	psf		
Ceiling Finish	2.8	psf		
Solar Panels	4	psf		
	15.1	psf		
Use	15	psf		
Floor				
Finish Floor	1	psf		
3/4" Sheathing	2.7	psf		
Joists @ 16" oc	2.5	psf		
Misc./Mech.	2	psf		
Ceiling Finish	2.8	psf		
	11	psf		
Use	12	psf		
Use				

Live Loads:

Snow	25	psf
Floor	40	

Soils:

Allowable Bearing	1500	psf

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Lawler Remodel

Criteria

DATE 5/7/2020

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DESIGN AGL

SHEET 1

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Seismic Design

ASCE 7-10 Seismic Analysis Equivalent Lateral Force Procedure

Seismic Force Resisting System: Per Table 12.2-1		
	System:	Bearing Wall Systems
	Type:	Light-frame (wood) Walls Sheathed with Wood Structural Panels Rated for Shear Resistance

Seismic Design Cat.	D	
Risk Category	II	I, II, or III, or IV per Table 1.5-1
Site Class	D	per soils report (D assumed, without soils report)
Diaphragm Flexibility	Semi-Rigid/Rigid	

Ω_o	3	
S_S	1.375 g	2% in 50 yr, Latitude & Longitude lookup
S_1	0.529 g	2% in 50 yr, Latitude & Longitude lookup
h_n	21.0 ft	
R	6.50	
I_e	1.0	Table 1.5-2
C_d	4	
Ct	0.02	Table 12.8-2
x	0.75	Table 12.8-2
T	0.20 sec	Eq. 12.8-7 s
T_0	0.12 sec	
T_S	0.58 sec	
k	1.000	
Fa	1.00	Table 11.4-1
Fv	1.50	Table 11.4-2
S_{MS}	1.38 g	Eq. 11.4-1
S_{M1}	0.79 g	Eq. 11.4-2
S_{DS}	0.917 g	Eq. 11.4-3
S_{D1}	0.529 g	Eq. 11.4-4
Cs	***0.141 Controls***	Eq. 12.8-2
	0.415	Eq. 12.8-3 need not exceed, $I < I_L$
	0.010	Eq. 12.8-5 or 12.8-6 minimum
Cs, design	0.141	
Bldg. Weight	93.0 k	
$V = C_S W$	13.1 k	Eq. 12.8-1, Strength Level Base Shear
$V = C_{Sasd} W$	9.2 k	Eq. 12.8-1 ASD Base Shear

$T_a = C_t h_n^x$ Eq. 12.8.7

$S_{MS} = F_a S_S$ Eq. 11.4-1
$S_{M1} = F_v S_1$ Eq. 11.4-2
$S_{DS} = {}^2/_3 S_{MS}$ Eq. 11.4-3
$S_{D1} = {}^2/_3 S_{M1}$ Eq. 11.4-4

$C_S = \frac{S_{DS}}{(R/I_e)}$ Eq. 12.8-2
$C_S = \frac{S_{D1}}{T(R/I_e)}$ Eq. 12.8-3
$C_S = \frac{S_{D1} T_L}{T^2(R/I_e)}$ Eq. 12.8-4
$C_S \geq 0.044 S_{DS} I_e$ Eq. 12.8-5
$C_S \geq 0.01$ Eq. 12.8-5

$C_{VX} = w_x h_x^k / \sum_{i=1}^{n} w_x h_i^k$ Eq. 12.8-12

$F_{px} = {}^{\sum_{i=x}^{n} F_i}/_{\sum_{i=x}^{n} w_i} w_{px}$ Eq. 12.10-1
$F_{px} \geq 0.2 S_{DS} I_e w_{px}$ Eq. 12.10-2
$F_{px} \leq 0.4 S_{DS} I_e w_{px}$ Eq. 12.10-3

Vertical Distribution ASD ρ= 1.3

Level	h_x (ft)	W_x (k)	h_x^k (ft)	$W_x h_x^k$	Story Shear ASD			Diaphragm Force (ρ not included)				
					C_{vx} (%)	F_x (k)	SV (k)	$F_{px,calc}$	$F_{px,min}$	$F_{px,max}$	$F_{px,design}$	$\gamma = F_{px}/F_x$
Roof	21.0	61.5	21.0	1292	0.828	9.9	**9.9**	7.6	7.9	15.8	**7.9**	0.80
Main	8.5	32	8.5	268	0.172	2.0	**11.9**	3.1	4.0	8.1	**4.0**	1.97
Σ		93.0		1559		**11.9**						

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Seismic Criteria

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DESIGN AGL
SHEET 2

Wind Design - MWFRS

ASCE 7-10 Chapter 27 - Directional Procedure

Design Method	ASD

Wind Coefficients

Exposure	C	
V=	110	mph
K_d=	0.85	Table 26.6-1
K_h=	0.94	Table 27.3-1
G=	0.85	26.9.4

Location and Building Dimensions

Calculate Kzt?	Yes	
Kzt	1.00	
Roof Type	Gable	
Roof Angle - Transverse Dir	23	degrees
Roof Angle - Long Dir	23	degrees
Ground to top of roof	27.5	ft
Bot of roof to top of roof	6.5	ft
Mean Roof Height, h	24.25	ft
Short Plan Dimension	71.5	ft
Long Plan Dimension	77.5	ft
Parapet ?	No	
Ground to top of parapet		ft
Average Parapet Height		ft
Ht of 2nd Level Above Grade	8.5	ft

Velocity Pressure at Mean Roof Height, q_h =	24.7	psf

Transverse Wind Pressures

L/B = 0.92 h/L = 0.34

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.50
Windward Roof	-0.28 / 0.21
Leeward Roof	-0.60

Wall Pressures (Unfactored): ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lwwalls}$	**P_{walls} (psf)**
0-15	0.85	22.38	15.22	10.51	**15.44**
15-20	0.9	23.70	16.11	10.51	**15.97**
20-25	0.94	24.75	16.83	10.51	**16.40**
25-30	0.98	25.80	17.55	10.51	**16.83**
30-40	1.04	27.38	18.62	10.51	**17.48**
41-50	1.09	28.70	19.52	10.51	**18.02**
51-60	1.13	29.75	20.23	10.51	**18.44**
61-70	1.17	30.81	20.95	10.51	**18.87**
71-80	1.21	31.86	21.66	10.51	**19.30**
81-90	1.24	32.65	22.20	10.51	**19.63**
91-100	1.26	33.18	22.56	10.51	**19.84**

Roof Pressures (Unfactored) ASD

Windward		Leeward	**Horiz Proj (psf)**
Max	Min		
4.4	-5.8	-12.6	**4.80**

Longitudinal Wind Pressures

L/B = 1.08 h/L = 0.31

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.48
Windward Roof	-0.27 / 0.22
Leeward Roof	-0.60

Wall Pressures (Unfactored): ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lwwalls}$	**P_{walls} (psf)**
0-15	0.85	22.38	15.22	10.16	**15.23**
15-20	0.9	23.70	16.11	10.16	**15.76**
20-25	0.94	24.75	16.83	10.16	**16.19**
25-30	0.98	25.80	17.55	10.16	**16.62**
30-40	1.04	27.38	18.62	10.16	**17.27**
41-50	1.09	28.70	19.52	10.16	**17.80**
51-60	1.13	29.75	20.23	10.16	**18.23**
61-70	1.17	30.81	20.95	10.16	**18.66**
71-80	1.21	31.86	21.66	10.16	**19.09**
81-90	1.24	32.65	22.20	10.16	**19.41**
91-100	1.26	33.18	22.56	10.16	**19.63**

Roof Pressures (Unfactored) ASD

Windward		Leeward	**Horiz Proj (psf)**
Max	Min		
4.7	-5.6	-12.6	**4.80**

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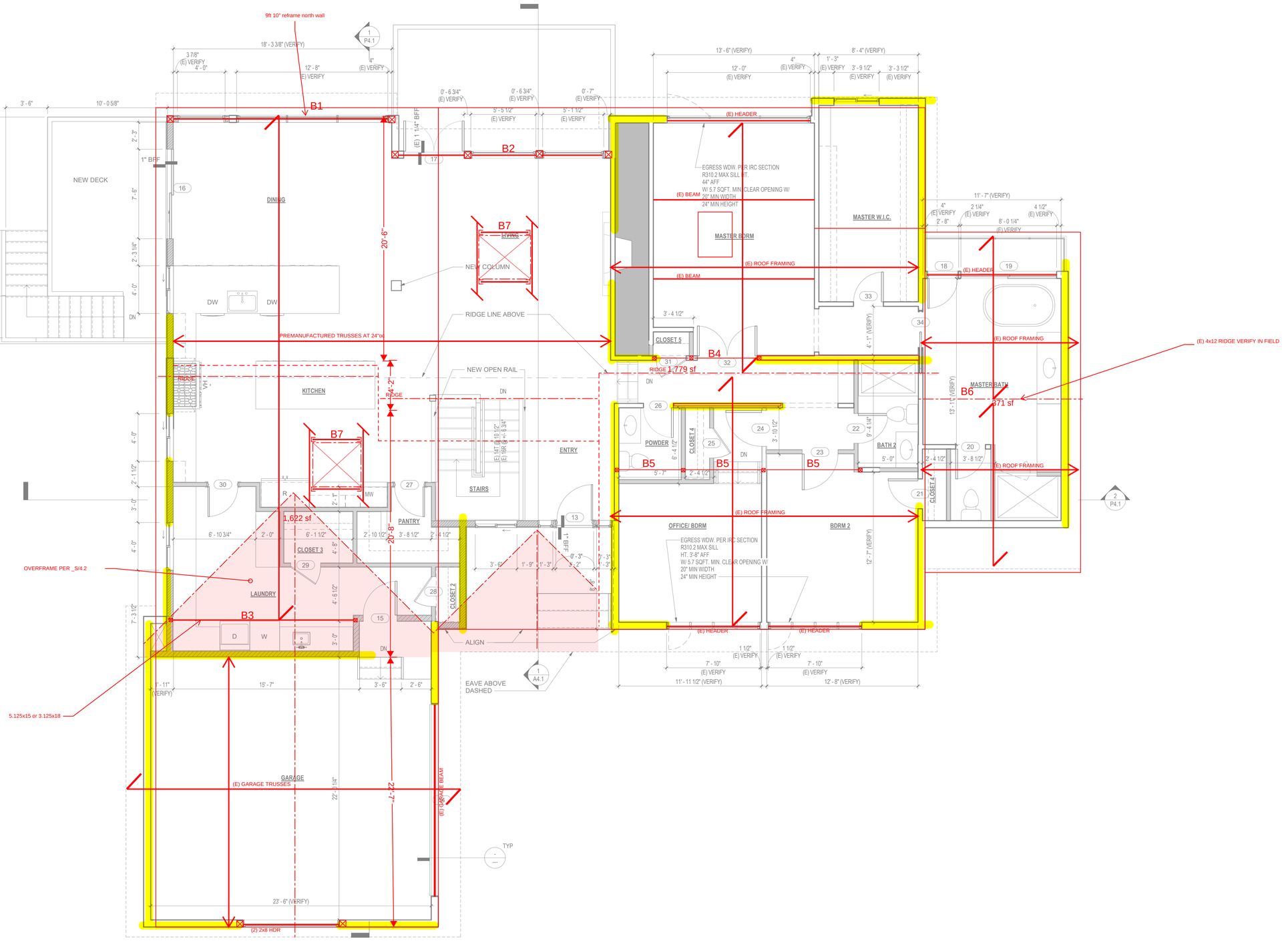

1 PROPOSED FLOOR PLAN - MAIN FLOOR PLAN

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

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DATE:

PROJECT NO:

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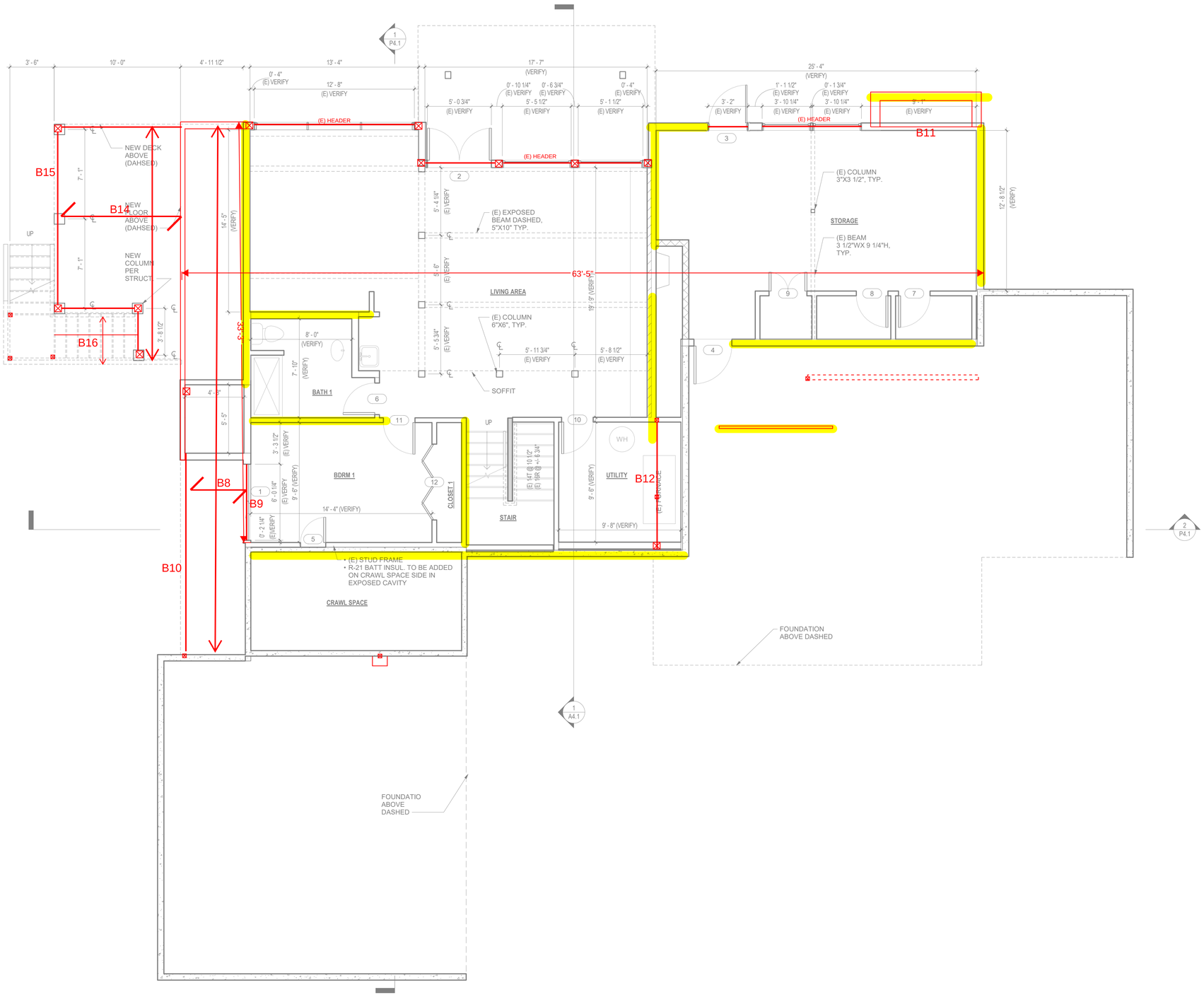
NO: OF SHEETS:



1 FLOOR PLAN -proposed BASEMENT PLAN

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

0 1

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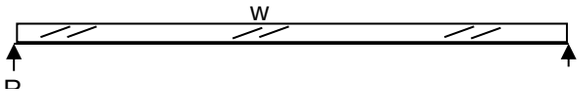
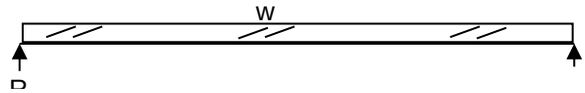
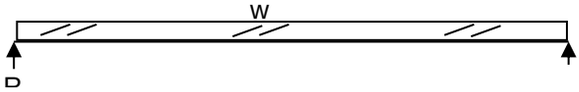
Truss 2 24"		Truss		DF-L	2	x 6
w=	80	plf		R=	1,680	lbs
L=	42	ft		M=	17,640	ft-lbs
b=	1.50	in		Fb=	27,991	psi
d=	5.50	in		Fv=	299	psi
E=	1700	ksi		Δ=	158.42	in
Cv=	1.00	≤1.0		l /	3	



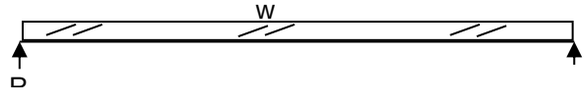
Beam		B4		HF	4	x 8
w=	400	plf		R=	1,100	lbs
L=	5.5	ft		M=	1,513	ft-lbs
b=	3.50	in		Fb=	592	psi
d=	7.25	in		Fv=	51	psi
E=	1300	ksi		Δ=	0.06	in
Cv=	1.00	≤1.0		l /	1158	



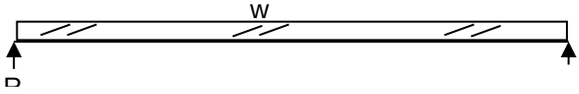
Beam		B1		GL	5 1/8	x 18
w=	840	plf		R=	7,770	lbs
L=	18.5	ft		M=	35,936	ft-lbs
b=	5.13	in		Fb=	1,558	psi
d=	18.00	in		Fv=	106	psi
E=	1800	ksi		Δ=	0.49	in
Cv=	0.97	≤1.0		l /	450	



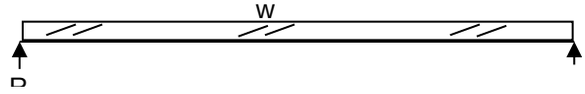
Beam		B5		DF-L	4	x 10
w=	440	plf		R=	1,760	lbs
L=	8	ft		M=	3,520	ft-lbs
b=	3.50	in		Fb=	846	psi
d=	9.25	in		Fv=	66	psi
E=	1700	ksi		Δ=	0.10	in
Cv=	1.00	≤1.0		l /	929	



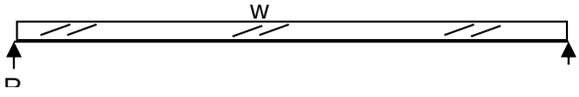
Beam		B2		DF-L	4	x 8
w=	840	plf		R=	2,310	lbs
L=	5.5	ft		M=	3,176	ft-lbs
b=	3.50	in		Fb=	1,243	psi
d=	7.25	in		Fv=	107	psi
E=	1700	ksi		Δ=	0.09	in
Cv=	1.00	≤1.0		l /	721	



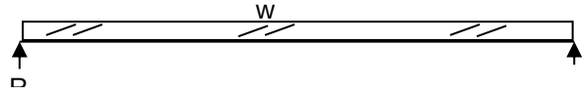
E RIDGE		B6		PSL	3 1/2	x 11 1/4
w=	420	plf		R=	2,520	lbs
L=	12	ft		M=	7,560	ft-lbs
b=	3.50	in		Fb=	1,229	psi
d=	11.25	in		Fv=	81	psi
E=	17	ksi		Δ=	27.76	in
Cv=	1.00	≤1.0		l /	5	



Beam		B3		GL	3 1/8	x 18
w=	840	plf		R=	6,510	lbs
L=	15.5	ft		M=	25,226	ft-lbs
b=	3.13	in		Fb=	1,794	psi
d=	18.00	in		Fv=	140	psi
E=	1800	ksi		Δ=	0.40	in
Cv=	1.00	≤1.0		l /	466	



Beam		B7		DF-L	4	x 8
w=	240	plf		R=	600	lbs
L=	5	ft		M=	750	ft-lbs
b=	3.50	in		Fb=	294	psi
d=	7.25	in		Fv=	27	psi
E=	1700	ksi		Δ=	0.02	in
Cv=	1.00	≤1.0		l /	3359	



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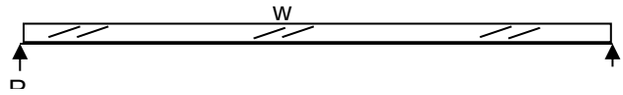
Date: 06/11/20

Project #:

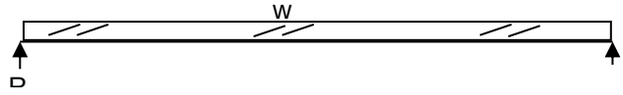
Design: AGL

Sheet:

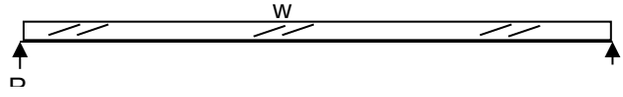
West Exp Joists 16"	B8		HF	2	x 8	
w=	75	plf		R=	188	lbs
L=	5	ft		M=	234	ft-lbs
b=	1.50	in		Fb=	214	psi
d=	7.25	in		Fv=	20	psi
E=	1300	ksi		Δ=	0.02	in
Cv=	1.00	≤1.0		l /	3523	



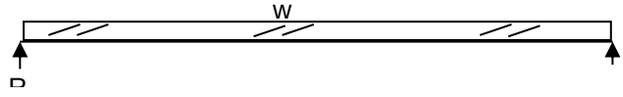
Beam	B9		HF	3	x 8	
w=	150	plf		R=	450	lbs
L=	6	ft		M=	675	ft-lbs
b=	3.00	in		Fb=	308	psi
d=	7.25	in		Fv=	25	psi
E=	1300	ksi		Δ=	0.04	in
Cv=	1.00	≤1.0		l /	2039	



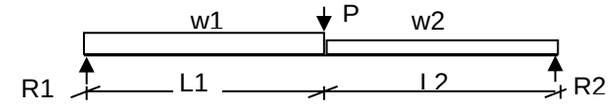
Beam	B10		GL	3 1/2	x 12	
w=	260	plf		R=	2,080	lbs
L=	16	ft		M=	8,320	ft-lbs
b=	3.50	in		Fb=	1,189	psi
d=	12.00	in		Fv=	65	psi
E=	1800	ksi		Δ=	0.42	in
Cv=	1.00	≤1.0		l /	454	



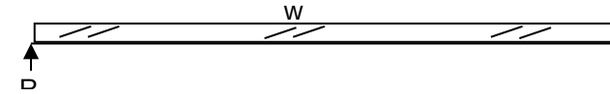
Beam	B11		DF-L	4	x 10	
w=	500	plf		R=	2,250	lbs
L=	9	ft		M=	5,063	ft-lbs
b=	3.50	in		Fb=	1,217	psi
d=	9.25	in		Fv=	86	psi
E=	1700	ksi		Δ=	0.19	in
Cv=	1.00	≤1.0		l /	574	



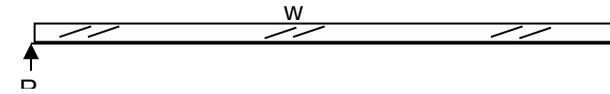
Beam	B12		GL	3 1/8	x 12	
w1=	350	plf		R1 =	2,830	lbs
w2=	350	plf		R2 =	2,470	lbs
L1=	4	ft		M =	8,520	lb-ft
L2=	6	ft		Fb =	1,363	psi
X=	4.0	ft		Fv =	99	psi
P=	1,800	lbs		Δ=	0.17	in
b=	3.13	in		l /	722	
d=	12.00	in		Cv=	1.00	
E=	1,800	ksi				



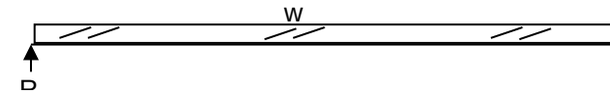
Beam	B13		DF-L	4	x 8	
w=	950	plf		R=	2,375	lbs
L=	5	ft		M=	2,969	ft-lbs
b=	3.50	in		Fb=	1,162	psi
d=	7.25	in		Fv=	106	psi
E=	1700	ksi		Δ=	0.07	in
Cv=	1.00	≤1.0		l /	849	



Deck joists at 24"	B14		HF	2	x 10	
w=	150	plf		R=	750	lbs
L=	10	ft		M=	1,875	ft-lbs
b=	1.50	in		Fb=	1,052	psi
d=	9.25	in		Fv=	69	psi
E=	1300	ksi		Δ=	0.26	in
Cv=	1.00	≤1.0		l /	457	



Beam	B15		DF-L	6	x 12	
w=	375	plf		R=	2,813	lbs
L=	15	ft		M=	10,547	ft-lbs
b=	5.50	in		Fb=	1,091	psi
d=	11.25	in		Fv=	60	psi
E=	1700	ksi		Δ=	0.39	in
Cv=	1.00	≤1.0		l /	468	



SSF STRUCTURAL ENGINEERING

2124 Third Avenue . Suite 100 . Seattle . WA 98121
www.swensonsayfaget.com
Office: 206.443.6212
Fax: 206.443.4870

Project: Lawler Residence

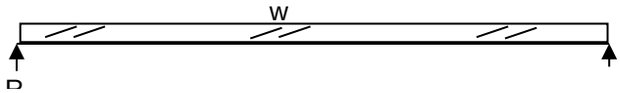
Date: 06/11/20

Project #:

Design: AGL

Sheet:

Deck stair stringer		B16		HF	2	x 8
w=	150	plf		R=	525	lbs
L=	7	ft		M=	919	ft-lbs
b=	1.50	in		Fb=	839	psi
d=	7.25	in		Fv=	60	psi
E=	1300	ksi		Δ=	0.13	in
Cv=	1.00	≤1.0		l /	642	



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Fax: 206.443.4870

Project: Lawler Residence

Date: 06/11/20

Project #:

Design: AGL

Sheet:

Wind Direction		North			
Levels Exposed			1		
Wind Areas	Pressure (psf)	Width	Height	Proj. Area (ft^2)	Vtrib (lbs)
Main Roof	4.8	77.5	10	775	3720
Main Walls	15.5	77.5	9.5	485.925	7532
				Vbase	**11252 lbs**
				Wavg	145 plf

Wind Direction		South			
Levels Exposed			2		
Wind Areas	Pressure (psf)	Width	Height	Proj. Area (ft^2)	Vtrib (lbs)
Main Roof	4.8	77.5	10	775	3720
Main Walls	15.5	77.5	9.5	485.925	7532
Basement	15.5	77.5	8	678.125	10511
				Vmain	**11252 lbs**
				Wavg	145 plf
				Vbase	**21763 lbs**
				Wavg	281 plf

STRUCTURAL ENGINEERING
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Project Title: LAWLER
Date: 05/07/2020
SSF project no.: ---
Design: AGL
Sheet Title: WIND ANALYSIS
Drawn: AGL
Sheet:

Wind Direction	West				
Levels Exposed	1				

Wind Areas	Pressure (psf)	Width	Height	Proj. Area (ft^2)	Vtrib (lbs)	
Main Walls	15.5	44	20	580.8	9002	
Garage Roof	4.8	30	7	138.6	665	
Garage Walls	15.5	30	7.5	148.5	2302	
				Vmain	**9002**	**lbs**
				Wavg	204.6	plf
				Vgarage	**2967**	**lbs**
				Wavg	99	plf

Wind Direction	East				
Levels Exposed	2.5				

Wind Areas	Pressure (psf)	Width	Height	Proj. Area (ft^2)	Vtrib (lbs)	
Main Gable e	16	44	44	968	15488	
Main Walls	15.5	44	8	176	2728	
Basement	15.5	44	8.5	363	5627	
Garage Roof	4.8	30	7	210	1008	
Garage walls	15.5	30	7.5	148.5	2302	
				Vmain	**18216**	**lbs**
				Wavg	414	plf
				Vbase	**23843**	**lbs**
				Wavg	542	plf
				Vgarage	**3310**	**lbs**
				Wavg	110	plf

STRUCTURAL ENGINEERING
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Project Title: LAWLER
Date: 05/07/2020
SSF project no.: ---
Design: AGL
Sheet Title: WIND ANALYSIS
Drawn: AGL
Sheet:

LATERAL ANALYSIS

SEISMIC: $V_{BASE} = 10k$ip $V_{GARAGE} = 2.3k$ip

WIND: $V_{UPPER} = 15k$ip

DIR	V_{BASE}	V_{UPPER}	V_{garage}
N	11—p	11.25kip	—
S	21.81kip	11.25kip	—
E	—	9kip	3kip
W	23.8kip	18.25kip	3.3kip

SEISMIC CONTROLS UPPER STORY
LOWER STORY EXTERIOR WALLS TO RESIST
WIND V_{BASE} LOADS

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STRUCTURAL ENGINEERING

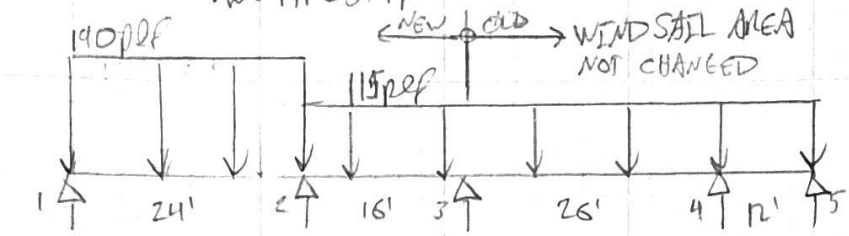
PROJECT: LAWLER RESIDENCE
DATE: 04/29/20
PROJ #:
DESIGN: LGL
SHEET:

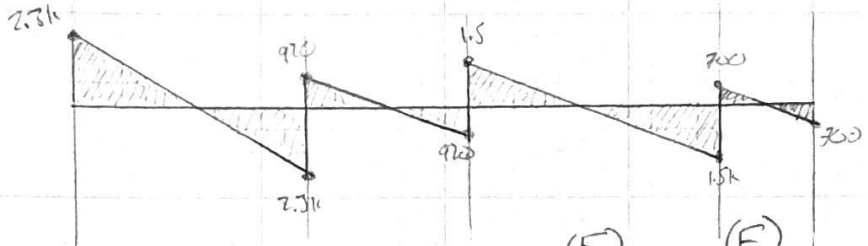
LATERAL DESIGN

N/S DIR

ROOF DIA: V_{EQ} = 10.5k/p – SEISMIC CONTROLS

V_W = 11.25k/p





	1	2	3	(E) 4	(E) 5	
F	2.3	3.3	2.5	2.3	0.7	k
ℓ_{SW}	38	15	50	31	21	FT
V_{SW}	61	220	50	75	33	PLF
SW	W6 or (E)	W6	W6 or (E)	(E) or W6	(E) or W6	
OT	610	2200	500	750	330	lbs
0.6DL	800	1250	680	800	1200	lbs
HD	—	HDU2	—	—	—	

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SSF STRUCTURAL ENGINEERING

LAWLER RESIDENCE — PROJECT

4/29/20 — DATE

PROJ. # AGL

DESIGN

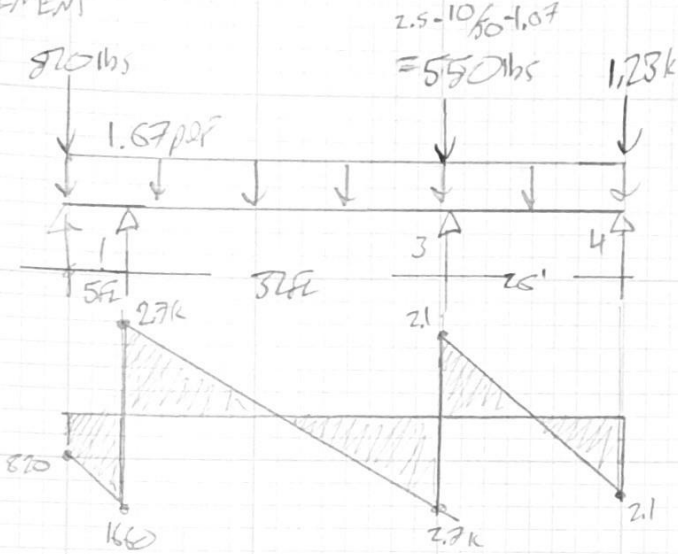
SHEET

LATERAL DESIGN

N/S DIR

MAIN FLOOR DIA: $V_u = 10.5$ kip

BASEMENT



← REDUCED LOADS BY FRACTION OF WALL ON UPPER FDN

	1	3	(E) 4	
F	4.4	4.9	3.3	kip
l_{SW}	20	23	18	ft
Σl_{SW}	220	215	185	plf
SW	W6	W6	W6 OR (E)	
DL	1760	1720	1465	lbs
0.6D	1800	1980	1500	lbs
HD	—	—	—	

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STRUCTURAL ENGINEERING

LAMER RESIDENCE — PROJECT

04/29/20 — DATE

PROJ. # AGL

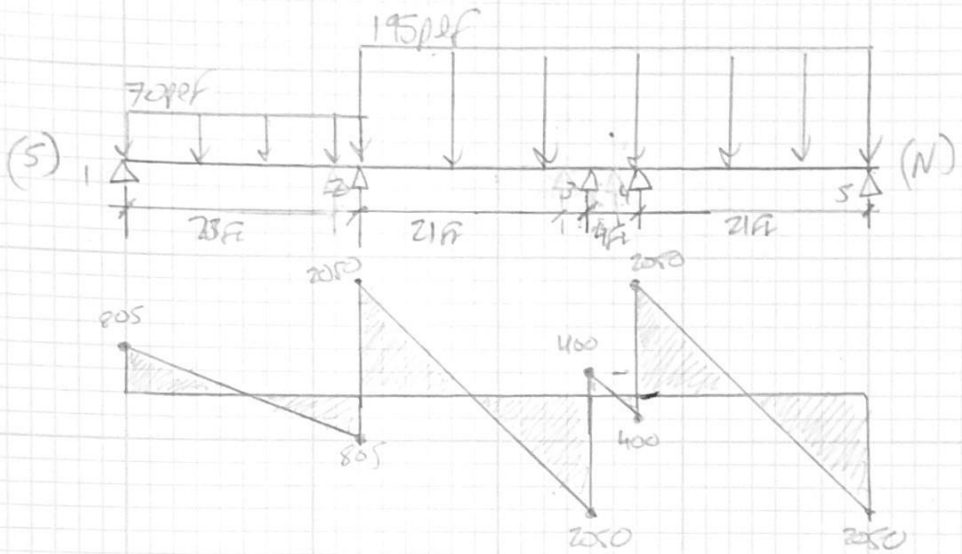
DESIGN

SHEET

LATERAL DESIGN

E/W DIR

ROOF DIA: V_{EQ} = 10.4 K



	1	2	3	4	5	
F	0.805	2.9	2.5	2.5	2.1	kip
l_{SW}	16	26	9	17	11	ft
Σ_{SW}	50	112	278	147	191	plf
SW	W8 or (E)	W6	W4	W6	W6	
OT	400	1120	2225	750	1910	lbs
0.6DL	600	1200	800	800	500	lbs
HD	—	—	HDQZ	HDQZ	CS16	

LAWLER RESIDENCE — PROJECT

04/30/20 — DATE

PROJ. # AGL

DESIGN

SHEET

SSF STRUCTURAL ENGINEERING

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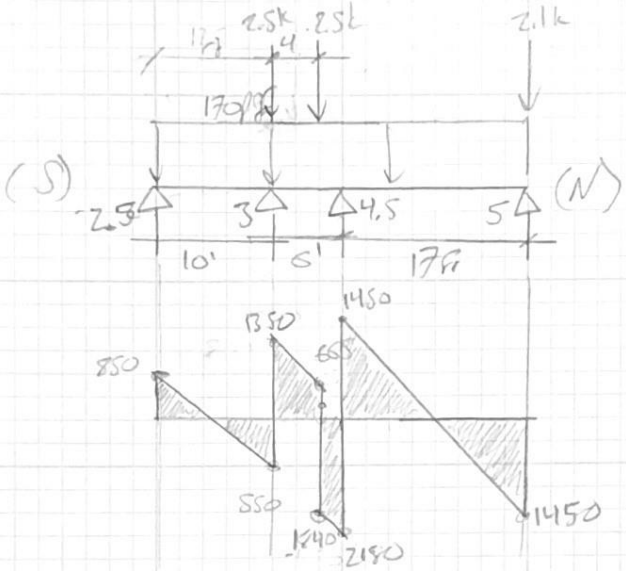
LATERAL DESIGN

E/W DIR

BASEMENT DIA: $V_{wind} = 5.6$kip



	2.5	3	4.5	5
F	550	2200	3630	2550
l_{SW}	35	25	30	11
V_{SW}	25	88	121	232
SW	CONC BMT	W6	W6	W6
OT	—	700	968	1850
O.SDL	—	800	1300	800
HD	—	—	—	HDQ2

SSF STRUCTURAL ENGINEERING

LAWLER RESIDENCE — PROJECT

04/30/20 — DATE

PROJ. # 1GL

DESIGN

SHEET

Company:		Date:	5/7/2020
Engineer:		Page:	1/5
Project:			
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description: HDU 4 Post Install
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: IAPMO UES ER-263
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 7.25
c_{ac} (inch): 14.93
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 8.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

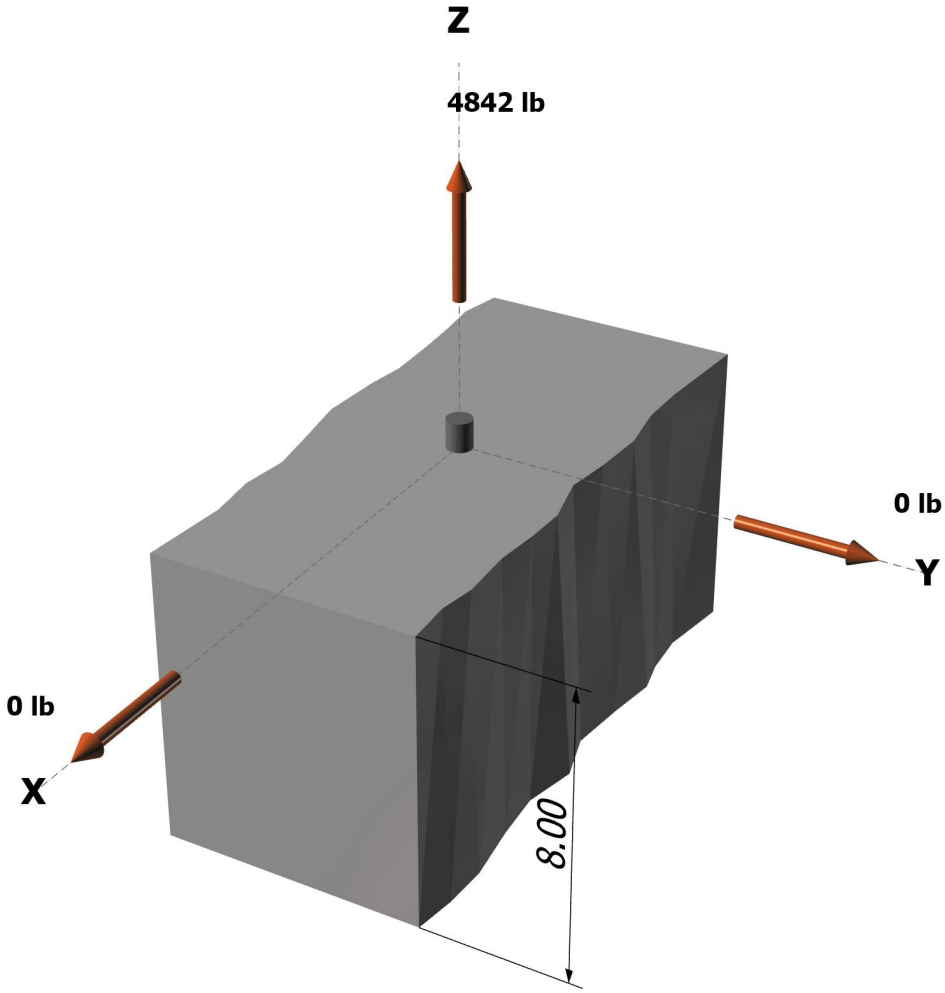
Recommended Anchor
Anchor Name: AT-XP® - AT-XP w/ 5/8"Ø F1554 Gr. 36
Code Report: IAPMO UES ER-263

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: U = 0.9D + 1.0E
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (a) (iii)-(vi) is satisfied
Ductility section for shear: 17.2.3.5.3 (a) is satisfied
Ω_0 factor: 2.5
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

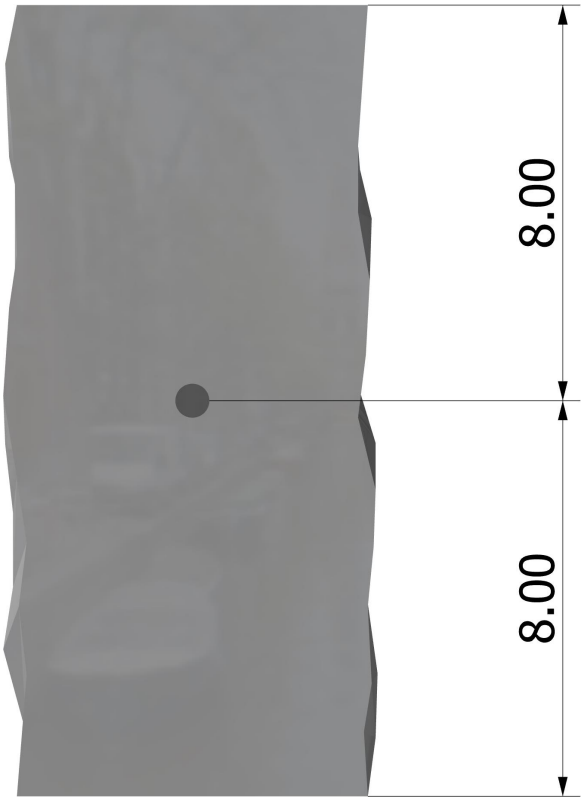
Service level loads:

	D	E	*Strength level loads*
N_a [lb]:	-800	2225	*4842*
V_{ax} [lb]:	0	0	*0*
V_{ay} [lb]:	0	0	*0*

<Figure 1>



<Figure 2>



3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	4842.0	0.0	0.0	0.0
Sum	4842.0	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 4842
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
13110	0.75	9833

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	3000	6.000	13685

$0.75\phi N_{cb} = 0.75\phi \, (A_{Nc} / A_{Nco}) \, \Psi_{ed,N} \, \Psi_{c,N} \, \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1a)

A_{Nc} (in^2)	A_{Nco} (in^2	$c_{a,min}$ (in)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cb}$ (lb)
288.00	324.00	8.00	0.967	1.00	1.000	13685	0.65	5732

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} \alpha_{N,seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N,seis}$	$\tau_{k,cr}$ (psi)
980	1.00	1.00	0.85	833

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	833	0.63	6.000	9814

$0.75\phi N_a = 0.75\phi \, (A_{Na} / A_{Na0}) \, \Psi_{ed,Na} \, \Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1a)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ed,Na}$	$\Psi_{p,Na}$	N_{a0} (lb)	ϕ	$0.75\phi N_a$ (lb)
243.61	243.61	7.80	8.00	1.000	1.000	9814	0.65	4784

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	4842	9833	0.49	Pass
Concrete breakout	4842	5732	0.84	Pass
Adhesive	**4842**	**4784**	**1.01**	**Fail (Governs)**

FAIL! Selected anchor type and embedment do not meet the selected design criteria.

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) Calculations for Ductility requirement for tension load

Steel	Factored Load, N_{ua} (lb)	1.2 x Nominal Strength, N_n (lb)	Ratio	
Steel	4842	15732	30.8%	
Concrete	Factored Load, N_{ua} (lb)	Nominal Strength, N_n (lb)	Ratio	
Concrete breakout	4842	11759	41.2%	
Adhesive	**4842**	**9814**	**49.3%**	**Governs**

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) is not satisfied since steel ratio does not govern.

12. Warnings

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

Company:		Date:	5/7/2020
Engineer:		Page:	1/5
Project:			
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description: HDU2 Post Install
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 12.000
Code report: IAPMO UES ER-263
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 13.25
c_{ac} (inch): 30.40
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 16.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, A shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

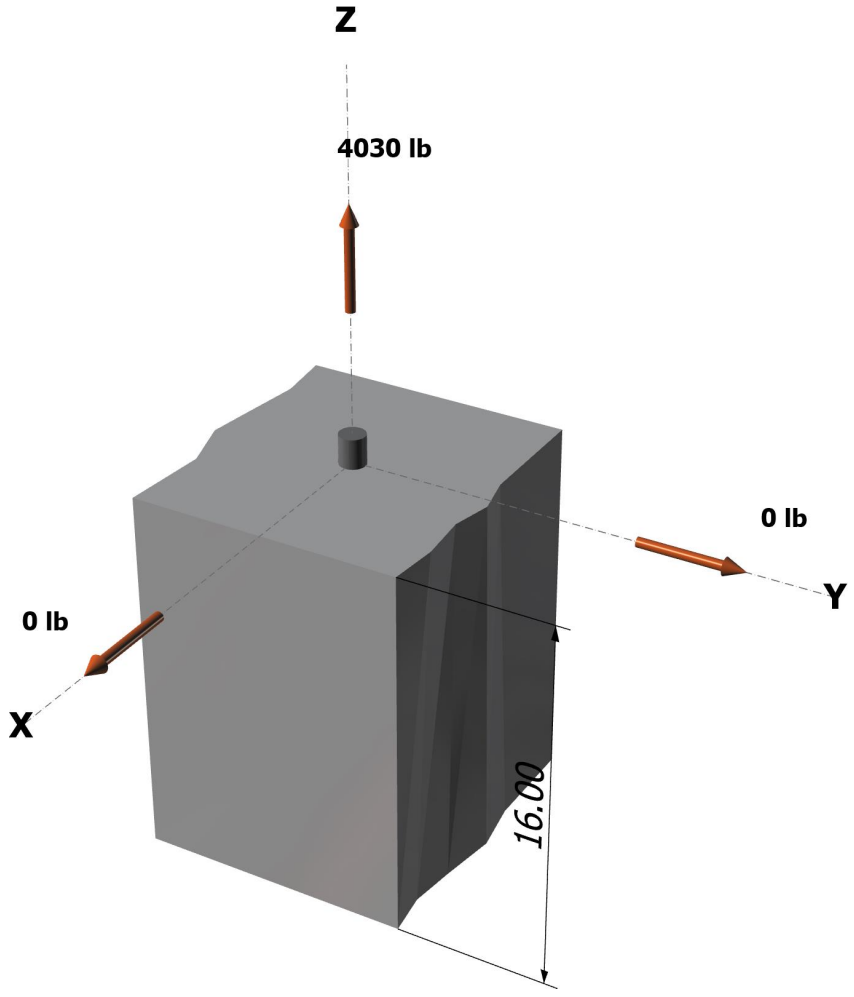
Recommended Anchor
Anchor Name: AT-XP® - AT-XP w/ 5/8"Ø F1554 Gr. 36
Code Report: IAPMO UES ER-263

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: U = 0.9D + 1.0E
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (a) (iii)-(vi) is satisfied
Ductility section for shear: 17.2.3.5.3 (a) is satisfied
Ω_0 factor: 2.5
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

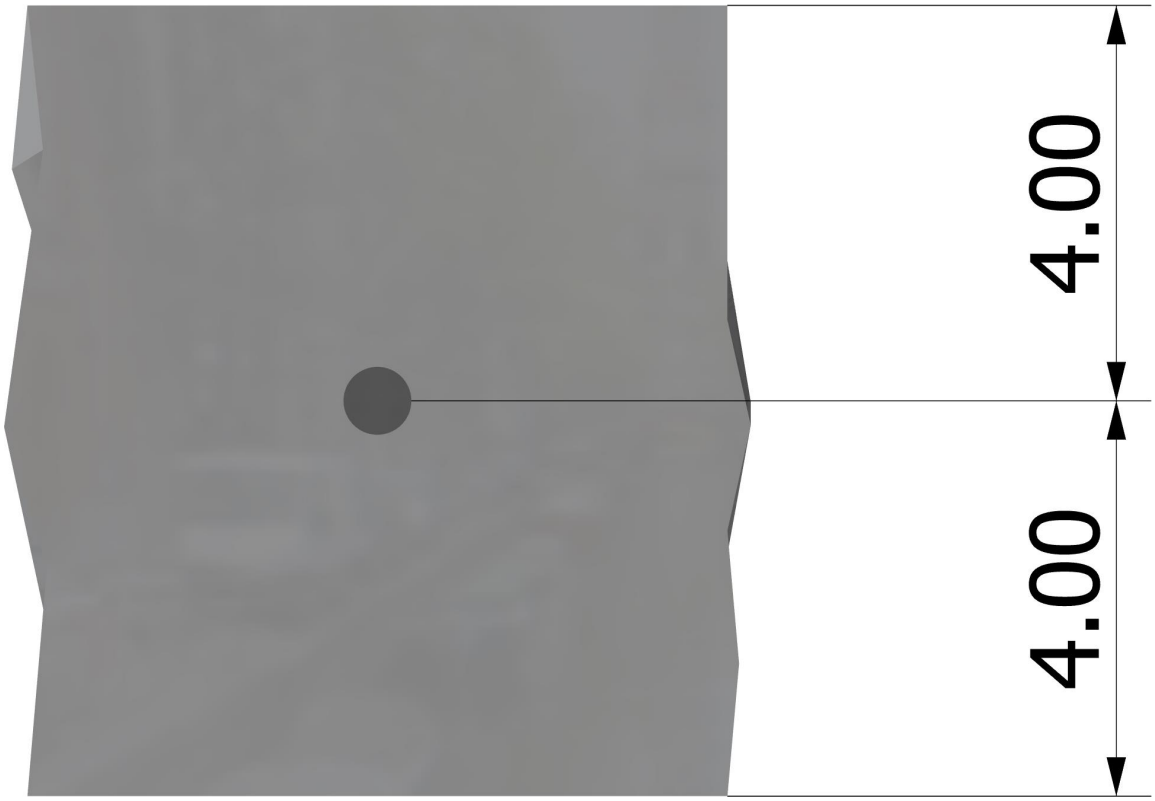
Service level loads:

	D	E	*Strength level loads*
N_a [lb]:	-800	1900	*4030*
V_{ax} [lb]:	0	0	*0*
V_{ay} [lb]:	0	0	*0*

<Figure 1>



<Figure 2>



3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	4030.0	0.0	0.0	0.0
Sum	4030.0	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 4030
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
13110	0.75	9833

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	3000	12.000	38706

$0.75\phi N_{cb} = 0.75\phi \, (A_{Nc} / A_{Nco}) \, \Psi_{ed,N} \, \Psi_{c,N} \, \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1a)

A_{Nc} (in^2)	A_{Nco} (in^2	$c_{a,min}$ (in)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cb}$ (lb)
288.00	1296.00	4.00	0.767	1.00	1.000	38706	0.75	3709

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} \alpha_{N,seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N,seis}$	$\tau_{k,cr}$ (psi)
980	1.00	1.00	0.85	833

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	833	0.63	12.000	19627

$0.75\phi N_a = 0.75\phi \, (A_{Na} / A_{Na0}) \, \Psi_{ed,Na} \, \Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1a)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ed,Na}$	$\Psi_{p,Na}$	N_{a0} (lb)	ϕ	$0.75\phi N_a$ (lb)
124.86	243.61	7.80	4.00	0.854	1.000	19627	0.65	4187

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	4030	9833	0.41	Pass
Concrete breakout	**4030**	**3709**	**1.09**	**Fail (Governs)**
Adhesive	4030	4187	0.96	Pass

FAIL! Selected anchor type and embedment do not meet the selected design criteria.

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) Calculations for Ductility requirement for tension load

Steel	Factored Load, N_{ua} (lb)	1.2 x Nominal Strength, N_n (lb)	Ratio	
Steel	4030	15732	25.6%	
Concrete	Factored Load, N_{ua} (lb)	Nominal Strength, N_n (lb)	Ratio	
Concrete breakout	**4030**	**6594**	**61.1%**	**Governs**
Adhesive	4030	8589	46.9%	

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) is not satisfied since steel ratio does not govern.

12. Warnings

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.