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: 10/26/2020

STRUCTURAL ENGINEERING

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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

PROJ. #

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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Lawler Remodel
Seismic Criteria

DATE 5/7/2020
PROJ. #
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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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

WIND CONTROLS

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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

WIND CONTROLS

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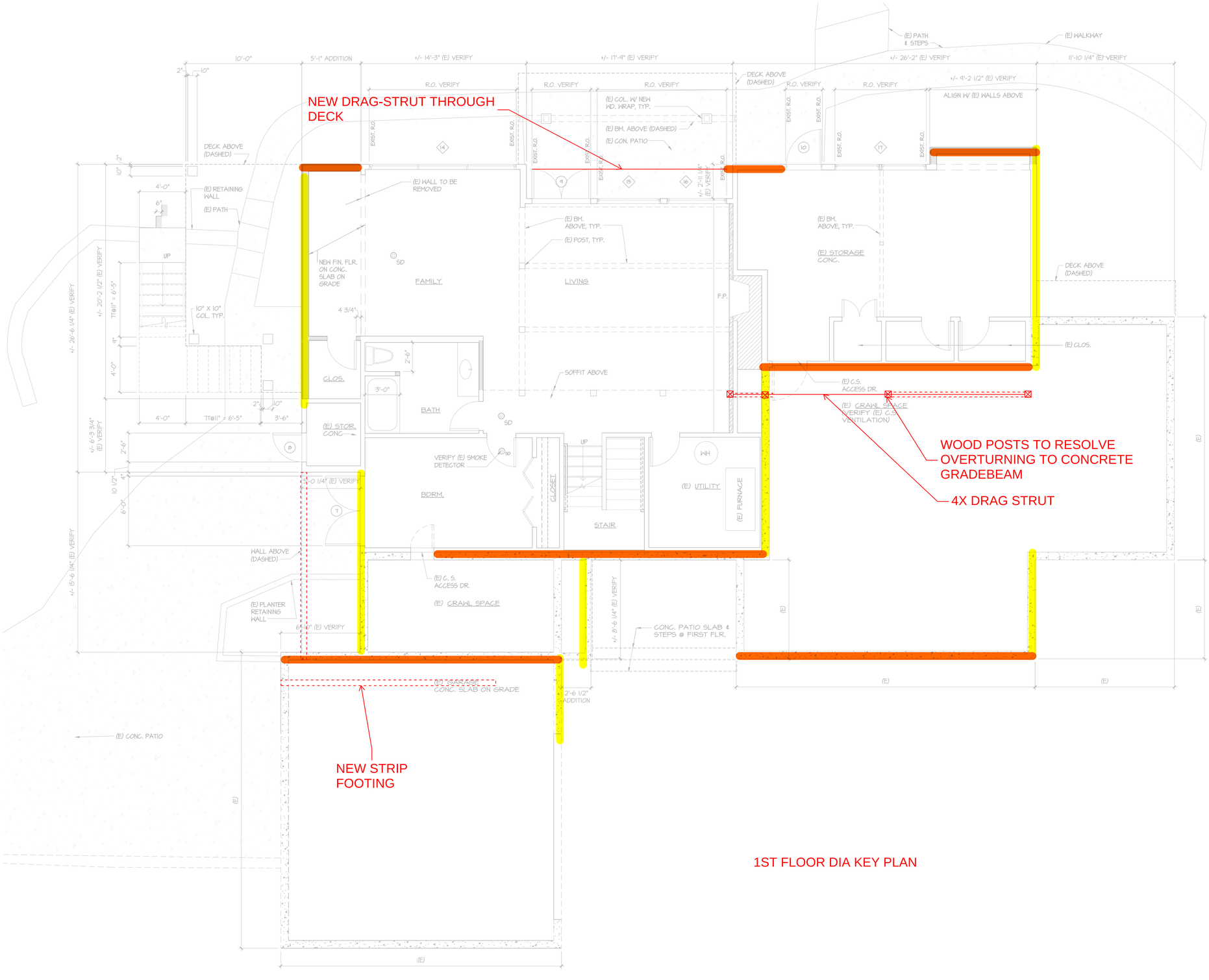
Project Title:	Date	SSF project no.
LAWLER	05/07/2020	---
	Design: AGL	
Sheet Title: WIND ANALYSIS	Drawn: AGL	Sheet



1ST FLOOR DIA KEY PLAN

WALL TYPE LEGEND

	NEW TYP. EXT. 2 X 6 WALL CONST., U.N.O. • BOARD AND BATTEN SIDING • WEATHER BARRIER • 1/2" PLY. WD. SHEATHING • 2X6 STUDS @ 16" O.C. MAX W/ R-21 BATT. INSUL. • 1/2" GYP. BD. W/ PVA PAINT
	NEW TYP. INT. 2 X 6 WALL CONST., U.N.O. • 1/2" GYP. BD. • 2X6 STUDS @ 16" O.C. MAX W/ R-21 BATT. INSUL. • 1/2" GYP. BD.
	NEW TYP. INT. 2 X 4 WALL CONST., U.N.O. • 1/2" GYP. BD. • 2X4 STUDS @ 16" O.C. • 1/2" GYP. BD.
	(E) EXT. 2 X 4 WALL CONST., U.N.O. • (E) BOARD AND BATTEN SIDING, TO REMAIN • (E) WEATHER BARRIER TO REMAIN. • (E)1/2" PLY. WD. SHEATHING • (E) 2X4 STUDS @ 16" O.C. ADD R-21 BATT INSULATION IN EXPOSED CAVITIES. • (E) GYP. BD.
	(E) INT. 2 X 4 WALL CONST., U.N.O. • (E) GYP. BD. • (E) 2X4 STUDS @ 16" O.C. • (E) GYP. BD.
	(E) FOUNDATION WALL • (E) FOUNDATION WALL, TO REMAIN
	(E) INT. BRICK WALL CONST., U.N.O. • (E) 4"(VERIFY) BRICK. • (E) MORTAR • (E) CEMENT BD. • (E) 2X4 STUDS @ 16" O.C. • (E) GYP. BD.

PLAN NORTH

MAGNETIC NORTH

1 BSMT. PLAN

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

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7116 REGISTERED ARCHITECT
Stephen Reed Rising 5/11/2020
STEPHEN REED RISING
STATE OF WASHINGTON

PERMIT SET

Revisions: Date:

Project Title:

Modifications to
LAWLER RESIDENCE
8456 N MERCER WAY,
MERCER ISLAND, WA. 98040

Sheet Title:
BSMT. FLOOR PLAN

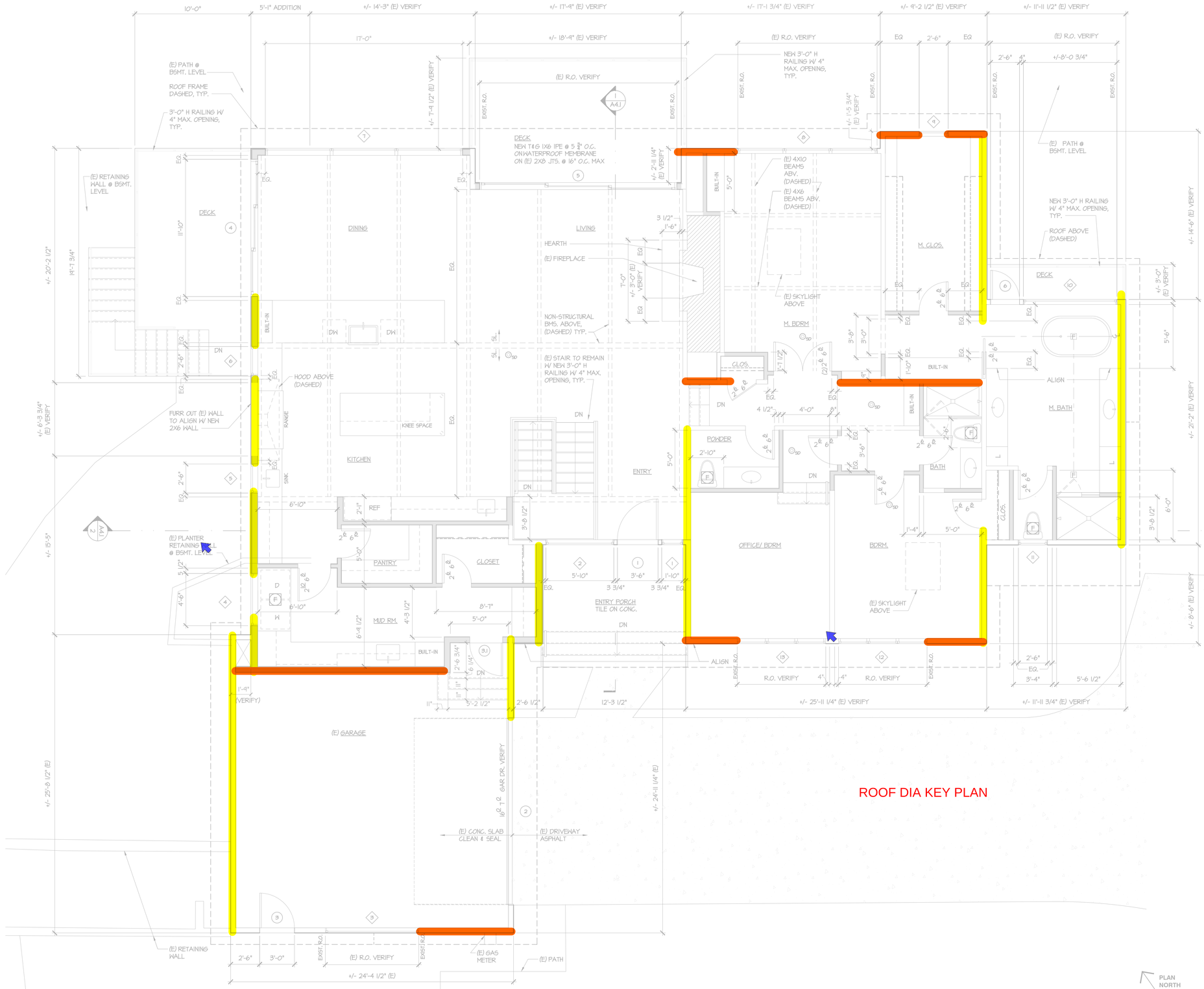
Scale: 1/4" = 1'-0"

20-05

Date: 06/30/2020

Sheet Number:

A2.1



1 FIRST FLR. PLAN

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

WALL TYPE LEGEND

	NEW TYP. EXT. 2 X 6 WALL CONST. U.N.O. • BOARD AND BATTEN SIDING • WEATHER BARRIER • 1/2" PLY. WD. SHEATHING • 2X6 STUDS @ 16" O.C. MAX W/ R-21 BATT. INSUL. • 1/2" GYP. BD. W/ PVA PAINT
	NEW TYP. INT. 2 X 6 WALL CONST. U.N.O. • 1/2" GYP. BD. • 2X6 STUDS @ 16" O.C. MAX W/ R-21 BATT. INSUL. • 1/2" GYP. BD.
	NEW TYP. INT. 2 X 4 WALL CONST. U.N.O. • 1/2" GYP. BD. • 2X4 STUDS @ 16" O.C. • 1/2" GYP. BD.
	(E) EXT. 2 X 4 WALL CONST. U.N.O. • (E) BOARD AND BATTEN SIDING, TO REMAIN • (E) WEATHER BARRIER TO REMAIN. • (E)1/2" PLY. WD. SHEATHING • (E) 2X4 STUDS @ 16" O.C. ADD R-21 BATT INSULATION IN EXPOSED CAVITIES. • (E) GYP. BD.
	(E) INT. 2 X 4 WALL CONST. U.N.O. • (E) GYP. BD. • (E) 2X4 STUDS @ 16" O.C. • (E) GYP. BD.
	(E) FOUNDATION WALL • (E) FOUNDATION WALL, TO REMAIN
	(E) INT. BRICK WALL CONST. U.N.O. • (E) 4"(VERIFY) BRICK. • (E) MORTAR • (E) CEMENT BD. • (E) 2X4 STUDS @ 16" O.C. • (E) GYP. BD.

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STEPHEN REED RISING
STATE OF WASHINGTON
5/11/2020

PERMIT SET

Revisions: Date:

Project Title:

Modifications to
LAWLER RESIDENCE
8456 N MERCER WAY,
MERCER ISLAND, WA. 98040

Sheet Title:
FIRST FLR. PLAN

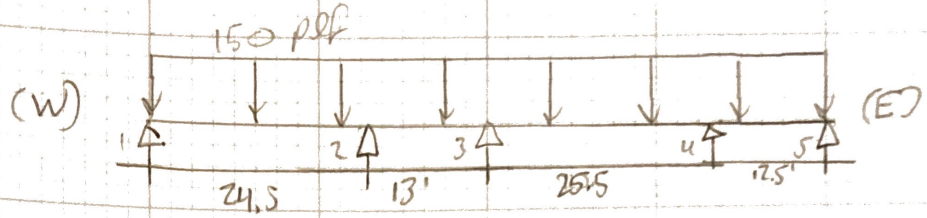
Scale: 1/4" = 1'-0"
20-05
Date: 06/30/2020

Sheet Number:
A2.2

LATERAL DESIGN

WIND CONTROLLED

N/S DIR: ROOF DIA



	1	2	3	4	5	
F	1838	2213	2890	2850	940	1138
l_{SW}	45	14	18	23	21	ft
USW	45	201	161	124	45	plf
SW	W6	W6	W6	W6	W6	
OT	410	1910	1530	1180	430	lbs
OD	300	680	840	900	700	lbs
HD	CS16	HDU2	HDU2 or CS16	HDU2	—	

NO CHANGE TO SHEAR AREA OR FRAMING. (E) STRUCTURE SUFFICIENT PER CODE

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PROJECT LAWLER RESIDENCE
PERMIT CORRECTIONS

DATE 10/21/20

PROJ. # 1GL

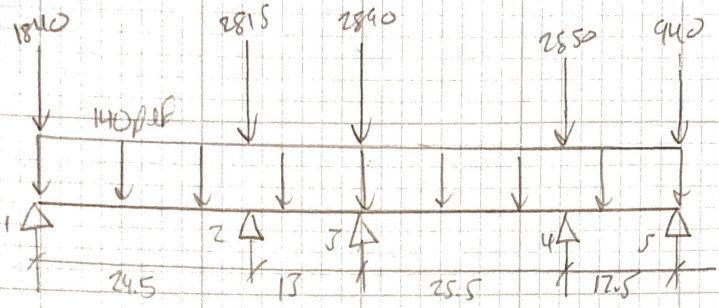
DESIGN

SHEET

LATERAL DESIGN

WIND CONTROLS

N/S DIR. ROOF DIA



	1	2	3	4	5	
F	3554	5438	5587	6510	1817	lbs
h_w	21	14	25	26	21	ft
v_{sw}	170	388	225	212	87	plf
SW	W6	CONC	W6	W6	CONC	
OT	1445		900	1802		lbs
EOTS	1555		1600	2582		lbs
O.G.D	735		828	1760		lbs
HD	HDU2		HDU2	HDU2		

(E) CONC FDN

(E) CONC FDN

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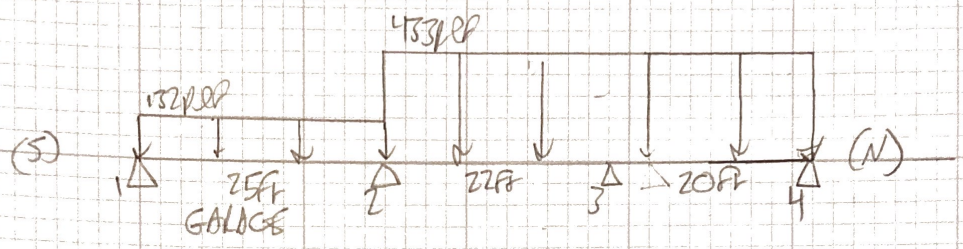
LATERAL DESIGN

WIND CONTROLLED

E/W DIR: ROOF DIA



	1	2	3	4	
F	1650	6413	9093	4330	k/ft
l_{sw}	8	28	15	11	ft
V_{sw}	206	229	606	394	#/ft
SW	W6	W6	W12	W14	
OT	1957	2176	5857	5743	lbs
0.6D	1450	4150	330	880	lbs
HD	HDU2	HDU2	CMST14 (2) @ 16" o.c.		

→ PER ASCE 7-16 2.4 LOAD COMBINATIONS

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SSF STRUCTURAL ENGINEERING

PROJECT LANIER RESIDENCE
PERMIT CORRECTIONS

DATE 10/20/20

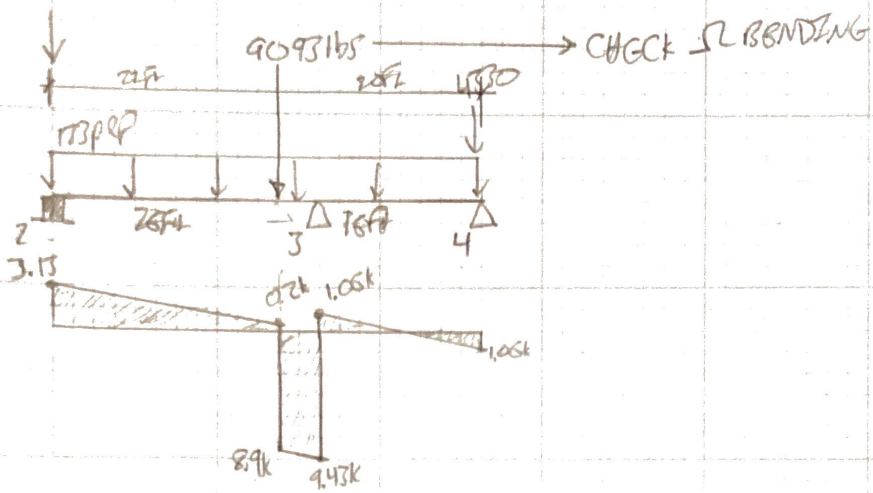
PROJ. DESIGN AGL

SHEET

LATERAL DESIGN

WIND CONTROLLED

E/W DIR: MAIN FLOOR DIA



	2	3	4	DIA	
F	6.43	10.5	5.400	9.43	kip
lsw	CONC	28	19	22	ft
Usw		375	284	430	plf
Sw		W4	W4	4" OC	
OT		3000	2272		lbs
EOT		—	5135		lbs
OSD		200	1150		lbs
HD		HDU4	HDU4		

USE (2) HDU2 FOR POST INSTALL
l_n = 5100#

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SSF STRUCTURAL ENGINEERING

PROJECT: LAMEN RESIDENCE PERMIT CORRECTIONS

DATE: 10/7/20

PROJ/DESIGN: JC-L

SHEET:

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

1.Project information

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

Project description: HDU2 Post Install
Permit Correction
Worst case HDU2
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: B 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

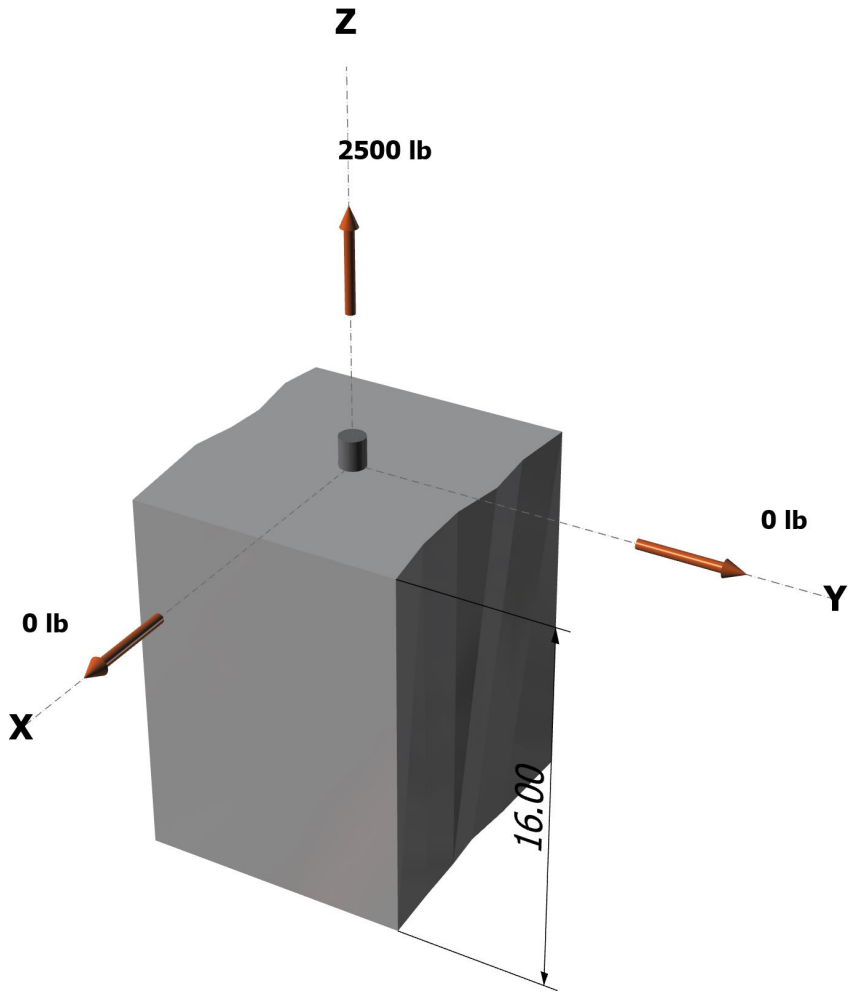
Recommended Anchor
Anchor Name: AT-XP® - AT-XP w/ 5/8"Ø F1554 Gr. 36
Code Report: IAPMO UES ER-263

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
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: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

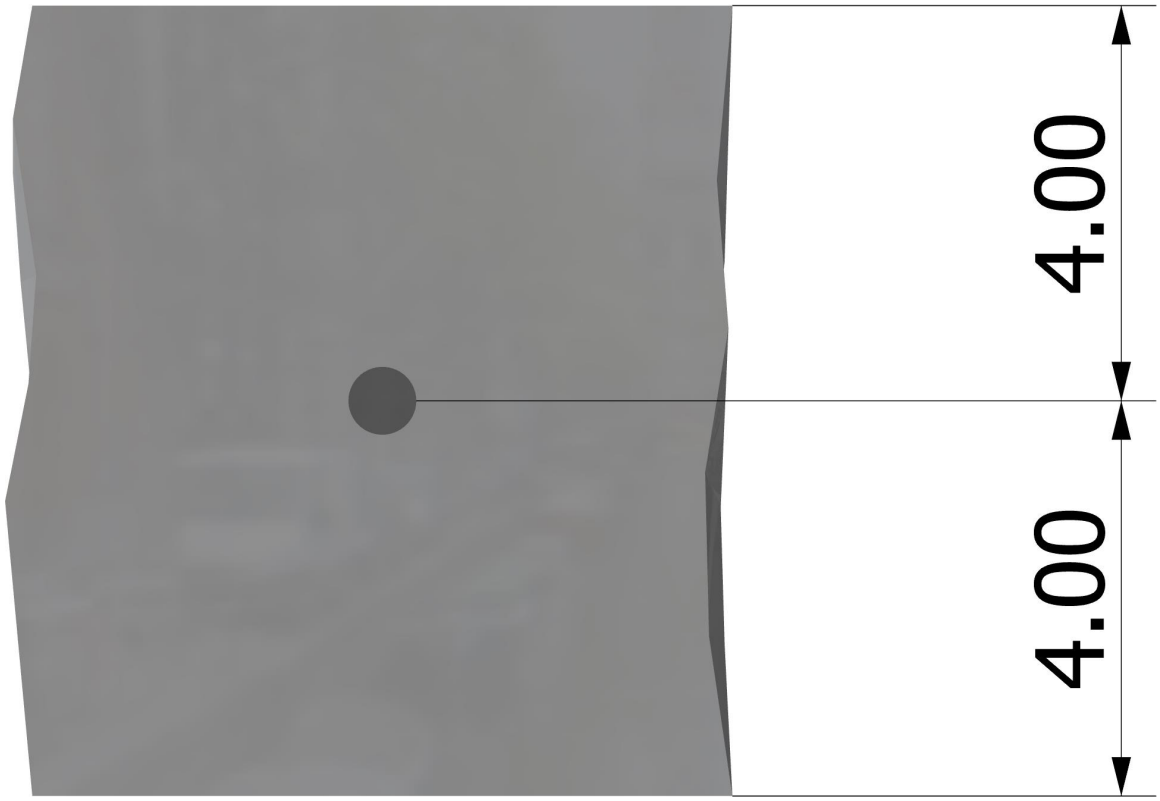
Strength level loads:

N_{ua} [lb]: 2500
V_{uax} [lb]: 0
V_{uay} [lb]: 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	2500.0	0.0	0.0	0.0
Sum	2500.0	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 2500
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	0.65	3215

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	2500	9833	0.25	Pass
Concrete breakout	**2500**	**3215**	**0.78**	**Pass (Governs)**
Adhesive	2500	4187	0.60	Pass

AT-XP w/ 5/8"Ø F1554 Gr. 36 with hef = 12.000 inch meets 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	2500	15732	15.9%	

Concrete	Factored Load, N_{ua} (lb)	Nominal Strength, N_n (lb)	Ratio	
Concrete breakout	**2500**	**6594**	**37.9%**	**Governs**
Adhesive	2500	8589	29.1%	

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

12. Warnings

- Brittle failure governs for tension. Governing anchor failure mode is brittle failure. Attachment shall be designed to satisfy the requirements of ACI 318-14 Section 17.2.3.4.3 for structures assigned to Seismic Design Category C, D, E, or F when the component of the strength level earthquake force applied to anchors exceeds 20 percent of the total factored anchor force associated with the same load combination. In case when ACI 318-14 Sections 17.2.3.4.3 (a)(iii) to (vi), (b), (c) or (d) is satisfied for tension loading, select appropriate checkbox from Inputs tab to disable this message. Alternatively, Ω0 factor can be entered to satisfy ACI 318-14 Section 17.2.3.4.3(d) to increase the earthquake portion of the loads as required.

- 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:	Lawler		
Address:			
Phone:			
E-mail:			

1.Project information

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

Project description: (2)HDU 2 Post Install
Permit corrections
alternative to hdu 4 pi
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): 7.500
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.88
c_{ac} (inch): 14.47
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: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: Yes
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 6.00 x 12.00 x 0.50

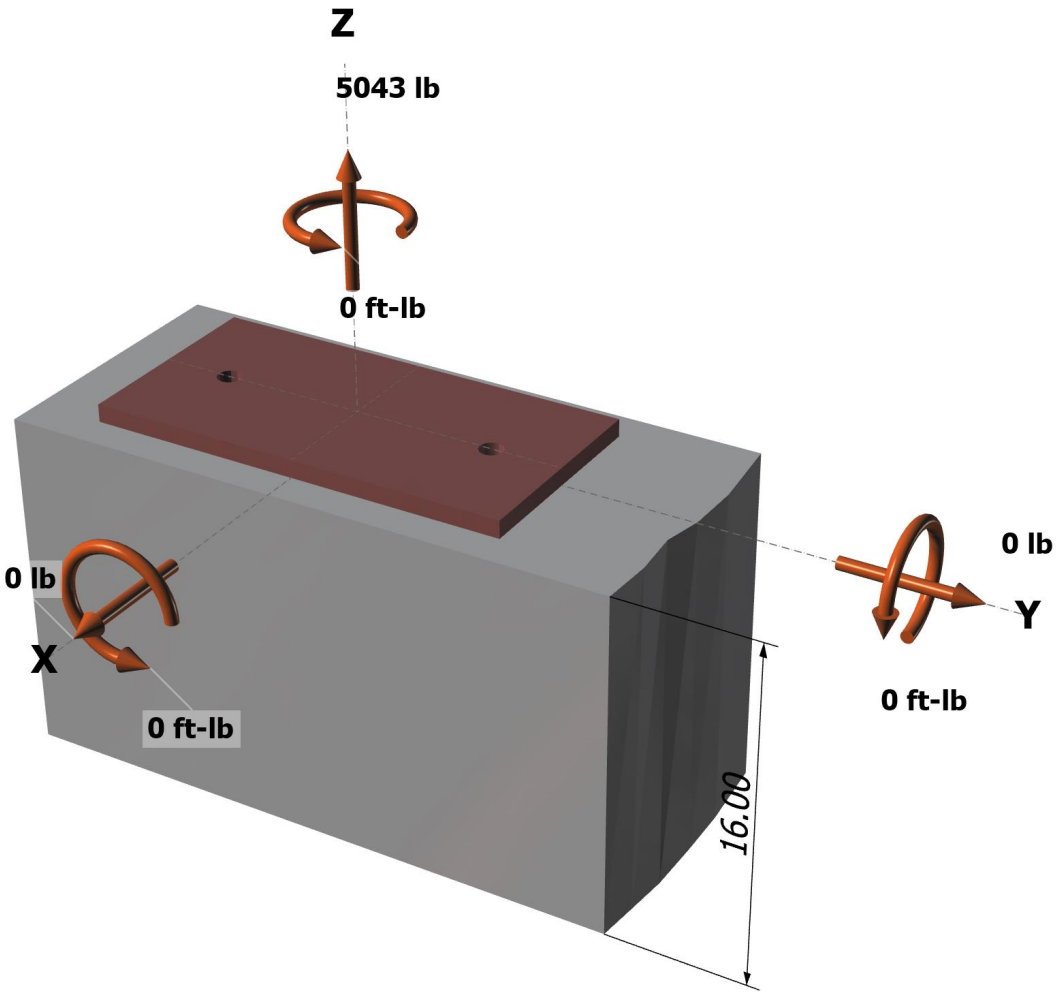
Recommended Anchor
Anchor Name: SET-3G - SET-3G w/ 5/8"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-4057

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: U = 0.9D + 1.0W
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

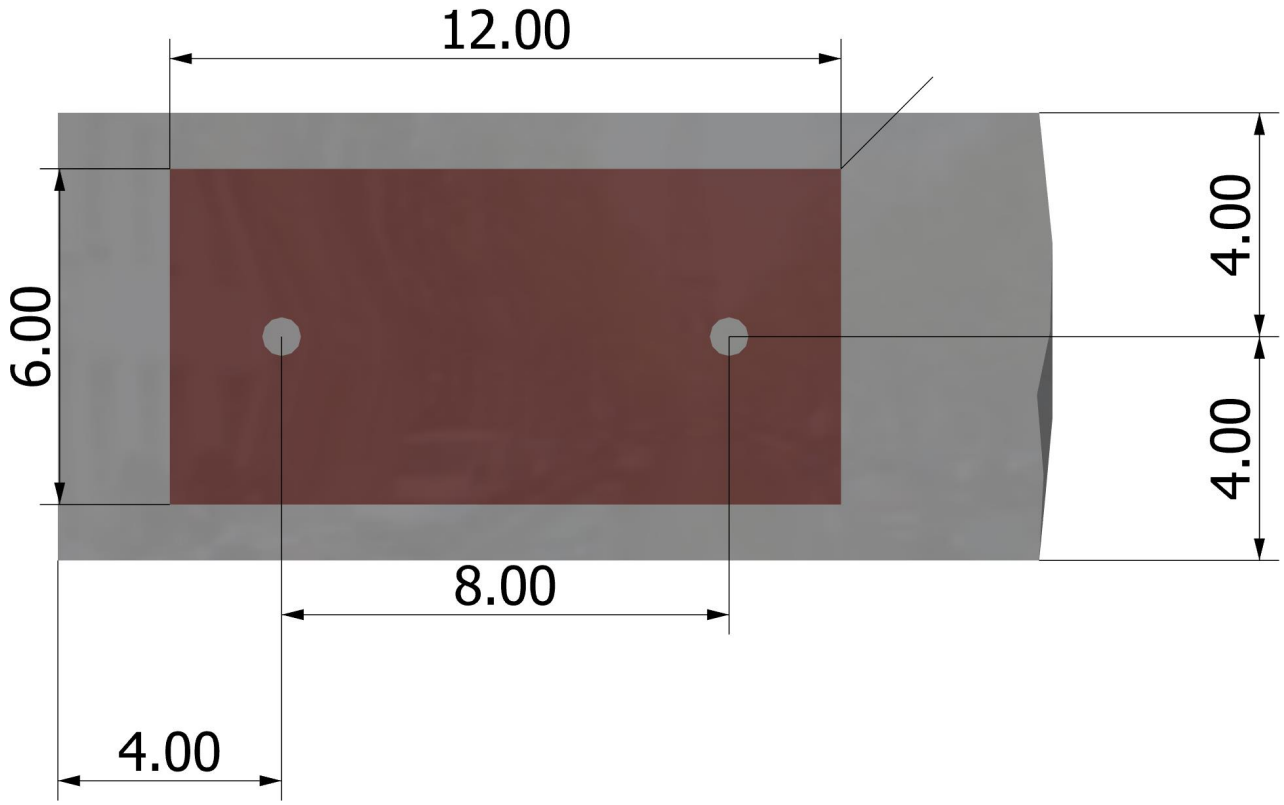
Service level loads:

	D	W	*Strength level loads*
N_a [lb]:	-1080	6015	*5043*
V_{ax} [lb]:	0	0	*0*
V_{ay} [lb]:	0	0	*0*
M_x [ft-lb]:	0	0	*0*
M_y [ft-lb]:	0	0	*0*
M_z [ft-lb]:	0	0	*0*

<Figure 1>



<Figure 2>

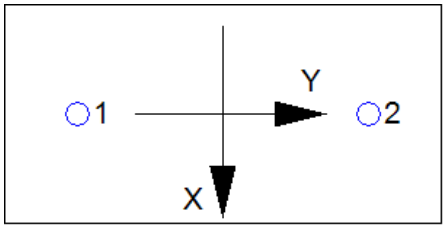


3. Resulting Anchor Forces

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	2521.5	0.0	0.0	0.0
2	2521.5	0.0	0.0	0.0
Sum	5043.0	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 5043
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

<Figure 3>



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	2.667	4055

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

A_{Nc} (in²)	A_{Nco} (in²)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
128.00	64.00	4.00	1.000	1.000	1.00	1.000	4055	0.65	5271

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

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} (f'_c / 2{,}500)^n$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	f'_c (psi)	n	$\tau_{k,cr}$ (psi)
1356	1.00	1.00	3000	0.24	1417

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

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	1417	0.63	7.500	20862

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

A_{Na} (in²)	A_{Na0} (in²)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
166.10	307.10	8.76	4.00	1.000	0.837	1.000	20862	0.65	6138

11. Results

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

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	2522	9833	0.26	Pass
Concrete breakout	**5043**	**5271**	**0.96**	**Pass (Governs)**
Adhesive	5043	6138	0.82	Pass

SET-3G w/ 5/8"Ø F1554 Gr. 36 with hef = 7.500 inch meets the selected design criteria.

12. Warnings

- Concrete breakout strength in shear has not been evaluated against applied shear load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

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

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