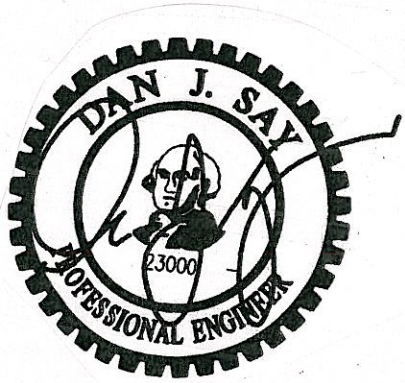
Structural Calculations For:

FUKANO RESIDENCE
6611 82nd Avenue SE
Mercer Island, WA. 98040

Suyama Peterson Deguchi
8601 8th Avenue S.
Seattle WA. 98108

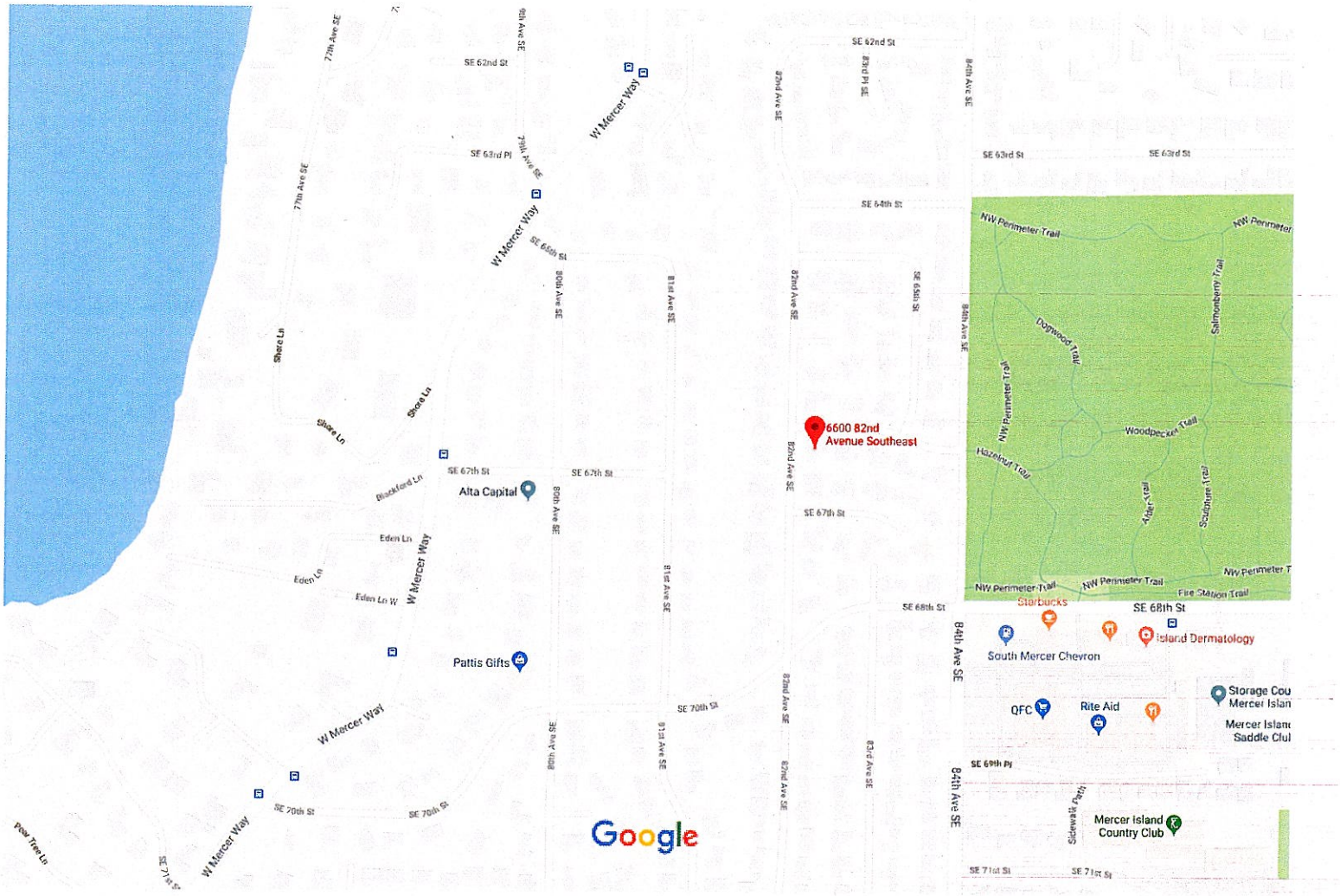


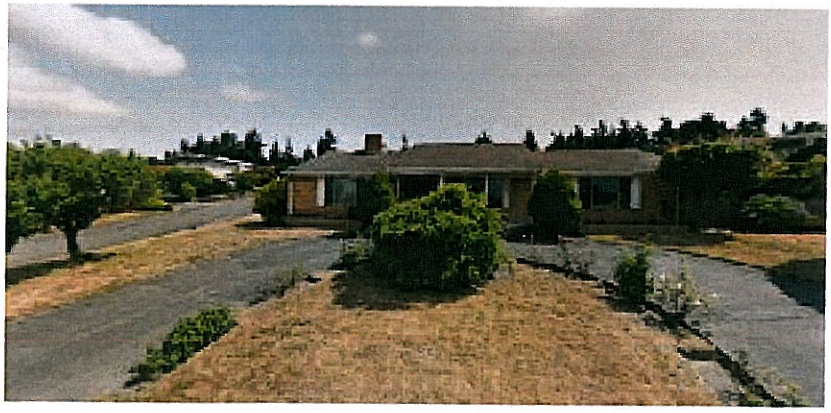
Project #00043-2018-09
Date: August 3, 2018
Revised 11/13/18

Google Maps

6600 82nd Ave SE

Fukano





6600 82nd Ave SE

Mercer Island, WA 98040

Climatic and Geographic Design Criteria

IRC TABLE R301.2 (1)
Climatic and Geographic Design Criteria

Roof Snow Load[a]	Wind Design[b]		Seismic Design Category[c]	Subject to Damage From:			Outside Design Temp–Heat/Cool	Ice Barrier Under-layment Required	Flood Hazards[e]	Air Freezing Index	Mean Annual Temp
	Speed	Topographic Effects		Weathering[d]	Frost Line Depth	Termite Decay					
25 psf	110 mph	See footnote[b]	D2	Moderate	12"	Slight to Moderate	24°F/83°F	No	NA	113	53°F

[a] When using this roof snow load it will be left to the engineer's judgment whether to consider drift or sliding snow. However, rain on snow surcharge of 5 psf must be considered for roof slopes less than 5 degrees.

[b] Wind exposure category and Topographic effects (Wind Speed-up Kzt factor) shall be determined on a site-specific basis by the Engineer of Record (components and cladding need not consider topographic effects unless otherwise determined by the engineer of record).

[c] From IRC Table 301.2(1).

[d] Weathering may require a higher strength concrete or grade of masonry than necessary to satisfy the structural requirements of this code. The grade of masonry units shall be determined from ASTM C 34, C 55, C 62, C 73, C 90, C 129, C 145, C 216 or C 652.

[e] The City of Mercer Island participates in the National Flood Insurance Program (NFIP); Regular Program (No Special Flood Hazard Area). Further NFIP participation information: CID 530083, Initial FHBM Identified 06/28/74, Initial FIRM Identified 05/16/95, Current Effective Map Date (NSFHA), Reg-Emer Date 06/30/97.

Criteria Sheet

Codes:

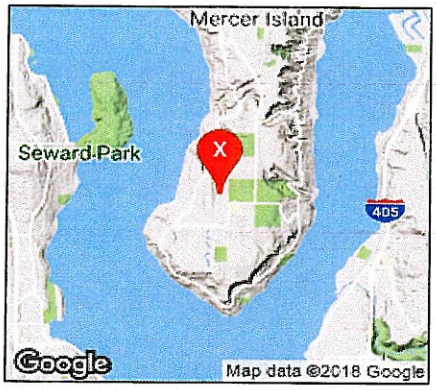
Structural:	IBC 2015
Loading:	ASCE 7-10
Wood:	NDS 2015
Steel:	AISC 360-10
Concrete:	ACI 318-14
Masonry:	TMS 402/602-13

Project Location:

Street & Number:	6600 82nd Ave. SE
City:	Mercer Islanc
State:	WA
ZIP:	98040
Latitude:	47.5434 N
Longitude:	-122.2290 W

Occupancy Category

Risk Category: II ASCE 7 Table 1.5-1



Seismic Load Summary:

Analysis Procedure:	Equivalent Lateral Force Procedure		
Lateral System:	Wood Structural Panels Rated for Shear Resistance		
R:	6.50	C_d=	4
Base Shear V =	8.4 kips	Ω_o=	2.5
S_S=	1.46	S_1=	0.559
S_{DS}=	0.97	S_{D1}=	0.37
C_s=	0.150	I_E=	1.0

Wind Load Summary:

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

Dead Loads:

Roof

Roofing	2.5	psf
1/2" Sheathing	1.8	psf
Trusses @ 24" oc	2.5	psf
Misc./Mech.	1.5	psf
Ceiling Finish	2.8	psf
Solar Panels	4	
	15.1	psf
Use	15	psf

Floor

Finish Floor	1	psf
3/4" Sheathing	2.7	psf
Joists @ 16" oc	2.2	psf
Misc./Mech.	2	psf
Ceiling Finish	2.8	
	10.7	psf
Use	12	psf

Live Loads:

Snow	25	psf
Floor	40	psf

Soils:

Allowable Bearing	2000	psf

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Project Fukano
Criteria

DATE 8/30/2018
PROJ. #
DESIGN Mac
SHEET 1

Revised Roof framing:

Ridge beams ~~C.5~~ D: grids changed

① $w = 40(26/2) = .52$
$L = 24.5$
$M = 39$
$\Delta = L/300 = .98"$
$EI = 2817$ 12 1565
$R = 6.5^k$

$6\frac{3}{4} \times 12$
$EI = 1750$
$\Delta = 2.4"$

$5\frac{1}{2} \times 15$ $EI = 2784$
$\Delta = 1.11"$ L/265

② $w = .52$
$L = 17.5$
$M = 20$
$\Delta = L/300 = .68"$
$EI = 1621$
$R = 4.6^k$

$6\frac{3}{4} \times 12$ or $5\frac{1}{2} \times 13.5$
$EI = 2264$

grid C.5 - 3
$P_{center} = 11.1^k$
$H = 9'$

3" ø STD. pipe OK

bms @ A

$w = 40(28)(14)/26 = .4$
$L = 12.5$
$M = 12$
$L/300 = .5$
$EI = 662$
$R = 3.8$
$5\frac{1}{2} \times 9\frac{1}{2}$

$W = .6$
$L = 7.5$
$M = 4.8$
$R = 2.4$
$A = 28$
$S = 46$
4×10

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PROJECT: Fukano
DATE: 9-18
PROJ. #:
DESIGN:
SHEET:

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Roof

bm. ② ~~D~~ E

W = 40 (26/2) = .52

L = 9

M = 5.26

S = 51

R = 2.84

A = 29

4x12

Mez2. LL = 40 psf DL = 10 psf

bm. ② (E)

W = 50 (17/2) = .43

L = 18'

M = 17.4

Δ = .72"

EI = 1409

R = 3.9

5½x 13.5 6¾x12

Joists L = 17.

11⅞ TJ: 360 @ 16" o.c

PR = 50 < 52

TL/Δ = L/647

Exist bm ② ~~D~~ E

① Roof + mez2

WR = .52 } .95
WM = .43 }

L = 9'

M = 9.62

R = 4.3

3½x 9½

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PROJECT Fufano

DATE 9-18

PROJ. #

DESIGN

SHEET

Ridge ⌀ East ⌀

$w = 40(20/2) = .4$
$L = 15'$
$m = 11.3$
$R = 3^k$
$5\frac{1}{2} \times 9\frac{1}{2}$ GLB

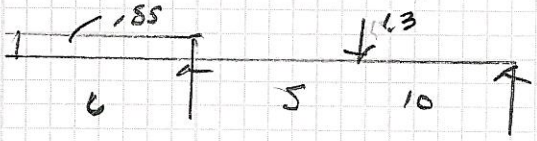
$w = 40(24/2) = .46$
$L = 15$
$m = 13$
$R = 3.5^k$
$5\frac{1}{2} \times 9\frac{1}{2}$ GLB

bm @ E

$w = 40(15)(7.5)/12.5 = .36$
$L = 13'$
$m = 7.6$
$R = 2.34$ $3\frac{1}{2} \times 9\frac{1}{2}$ GLB

Revised bm. along B & C

Worst case: Worst $R = 40(24/2) = .48$, Wattic $= 20(6.5/2) = .07$ } $.55$



$M = 10$
$S = 58$ $5\frac{1}{2} \times 10.5$ GLB $S = 94$ ok

Void

bm along 1

$w = 50(13/2) = .33$
$L = 12$
$M = 5.9$
$S = 29$ $3\frac{1}{2} \times 10.5$ $S = 64$ OK

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SSF STRUCTURAL ENGINEERING

PROJECT Fukano
DATE 5-18
PROJ. # MAC
DESIGN
SHEET

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

Risk Category	II	I, II, or III, or IV per Table 1.5-1
Site Class	B	per soils report (D assumed, without soils report)
Diaphragm Flexibility	Flexible	

Ω_o	2.5		
S_S	1.46	g	2% in 50 yr, Latitude & Longitude lookup
S_1	0.559	g	2% in 50 yr, Latitude & Longitude lookup
h_n	15	ft	
R	6.50		
I_e	1.0		Table 1.5-2
C_d	4		
Ct	0.02		Table 12.8-2
x	0.075		Table 12.8-2
T	0.02	sec	Eq. 12.8-7
T_0	0.08	sec	
T_S	0.38	sec	
k	1.000		
Fa	1.00		Table 11.4-1
Fv	1.00		Table 11.4-2
S_{MS}	1.46	g	Eq. 11.4-1
S_{M1}	0.56	g	Eq. 11.4-2
S_{DS}	0.973	g	Eq. 11.4-3
S_{D1}	0.373	g	Eq. 11.4-4
Cs	0.150		Eq. 12.8-2
	2.340		Eq. 12.8-3 need not exceed, $T < T_L$
	0.010		Eq. 12.8-5 or 12.8-6 minimum
Cs, design	0.150		
Bldg. Weight	55.8	k	
$V = C_S W$	8.4	k	Eq. 12.8-1, Strength Level Base Shear
$V = C_{Sasd} W$	6	k	Eq. 12.8-1 ASD Base Shear

$$T_a = C_t h_n^x \quad \text{Eq. 12.8.7}$$

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

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

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

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

Vertical Distribution

ASD ρ= 1.0

Level	hx (ft)	Wx	hx^k (ft)	Wxhx^k	Cvx (%)	Story Shear ASD Fx (k)	SV (k)	Diaphragm Force (ρ not included) Fpx_{calc}	Fpx_{min}	Fpx_{max}	Fpx_{design}	γ=Fpx/Fx
Roof	15.0	55.8	15.0	837.0	1.000	5.8	**5.8**	5.85	7.60	15.21	**7.60**	1.30
3	0.0	0	0.0	0.0	0.000	0.0	**5.8**	0.00	0.00	0.00	**0.00**	#DIV/0!
2	0.0	0	0.0	0.0	0.000	0.0	**5.8**	0.00	0.00	0.00	**0.00**	#DIV/0!
	S	55.8		837.0		5.8						

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Wind Design - MWFRS

ASCE 7-10 Chapter 27 - Directional Procedure

Design Method	ASD

Wind Coefficients

Exposure	B	
V=	110	mph
K_d=	0.85	Table 26.6-1
K_h=	0.7	Table 27.3-1
G=	0.85	26.9.4

Location and Building Dimensions

Calculate Kzt?	YES	
Kzt	See Criteria Sheet	
Roof Angle - Transverse Dir	30	degrees
Roof Angle - Long Dir	0	degrees
Ground to top of roof	32	ft
Bot of roof to top of roof	6	ft
Mean Roof Height, h	15	ft
Short Plan Dimension	45	ft
Long Plan Dimension	62	ft
Parapet ?	No	
Ground to top of parapet		ft

Velocity Pressure at Mean Roof Height, q_h =	18.4	psf

Transverse Wind Pressures

L/B = 0.7 h/L = 0.3

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.50
Windward Roof	-0.2 / 0.27
Leeward Roof	-0.60

Wall Pressures (Unfactored): ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lwwalls}$	**P_{walls} (psf)**
0-15	0.58	15.27	10.38	7.83	**10.93**
15-20	0.62	16.32	11.10	7.83	**11.36**
20-25	0.66	17.38	11.82	7.83	**11.79**
25-30	0.7	18.43	12.53	7.83	**12.22**
30-40	0.76	20.01	13.61	7.83	**12.86**
41-50	0.81	21.33	14.50	7.83	**13.40**
51-60	0.85	22.38	15.22	7.83	**13.83**
61-70	0.89	23.43	15.93	7.83	**14.26**
71-80	0.93	24.49	16.65	7.83	**14.69**
81-90	0.96	25.28	17.19	7.83	**15.01**
91-100	0.99	26.07	17.73	7.83	**15.33**

Roof Pressures (Unfactored) ASD

Windward		Leeward	**Horiz Proj (psf)**
Max	Min		
4.2	-3.1	-9.4	**4.07**

Parapet (Unf) ASD

Windward	Leeward	**Total (psf)**
-N/A-	-N/A-	**-N/A-**

Transverse Direction

Base Shear (kips)	**19.6**

Longitudinal Wind Pressures

L/B = 1.4 h/L = 0.2

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.42
Windward Roof	-0.9 / -0.18
Leeward Roof	-0.3

Wall Pressures (Unfactored): ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lwwalls}$	**P_{walls} (psf)**
0-15	0.58	15.27	10.38	6.65	**10.22**
15-20	0.62	16.32	11.10	6.65	**10.65**
20-25	0.66	17.38	11.82	6.65	**11.08**
25-30	0.7	18.43	12.53	6.65	**11.51**
30-40	0.76	20.01	13.61	6.65	**12.15**
41-50	0.81	21.33	14.50	6.65	**12.69**
51-60	0.85	22.38	15.22	6.65	**13.12**
61-70	0.89	23.43	15.93	6.65	**13.55**
71-80	0.93	24.49	16.65	6.65	**13.98**
81-90	0.96	25.28	17.19	6.65	**14.30**
91-100	0.99	26.07	17.73	6.65	**14.62**

Roof Pressures (Unfactored) ASD

Windward		Leeward	**Horiz Proj (psf)**
Max	Min		
-2.8	-14.1	-4.7	**0.00**

Parapet (Unf) ASD

Windward	Leeward	**Total (psf)**
-N/A-	-N/A-	**-N/A-**

Longitudinal Direction

Base Shear (kips)	**12.3**

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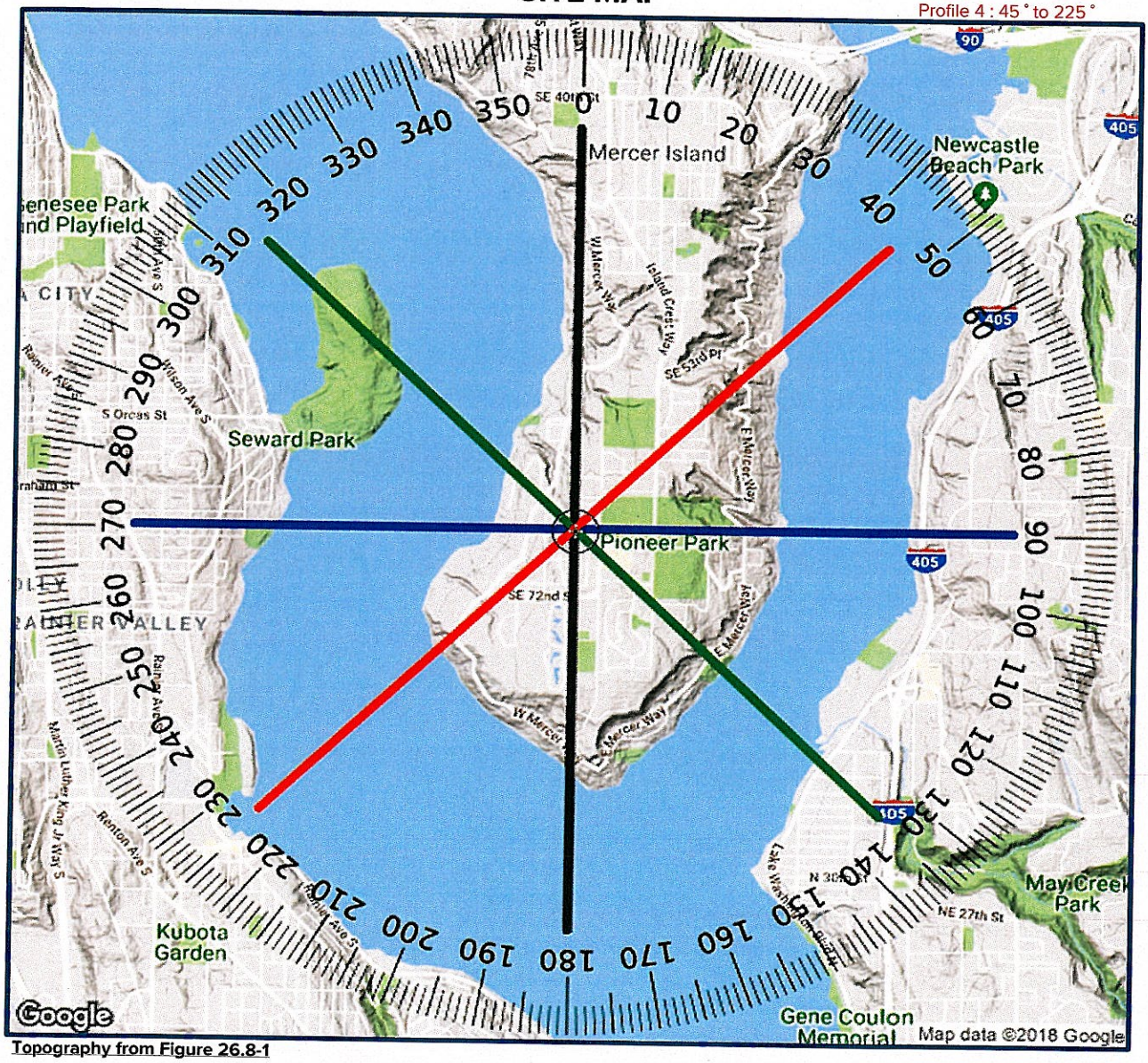
Site Address

Address	6611 82nd ave. SE		
City:	Mercer Islanc State:	WA.	
Lat Long	47.54339	-122.2297	

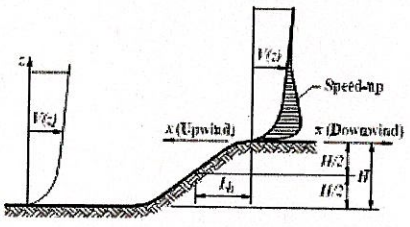
Wind Radius	2.00	Miles
Angle	0	°
Exposure	B	

Profile 1 : 0 ° to 180 °
Profile 2 : 270 ° to 90 °
Profile 3 : 315 ° to 135 °
Profile 4 : 45 ° to 225 °

SITE MAP



Topography from Figure 26.8-1



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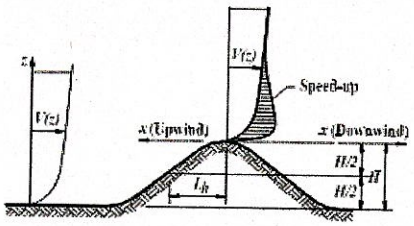

2-D RIDGE OR 3-D AXISYMMETRICAL HILL

$$K_{zt} = (1 + K_1 K_2 K_3)^2$$
$$K_1 = \text{Per Figure}$$
$$K_2 = (1 - |x|/\mu L_h)$$
$$K_3 = e^{-\gamma z / L_h}$$
$$K_{zt} = 1, \text{ If } H/Lh \le 0.2$$

PER FIGURE 26.8-1

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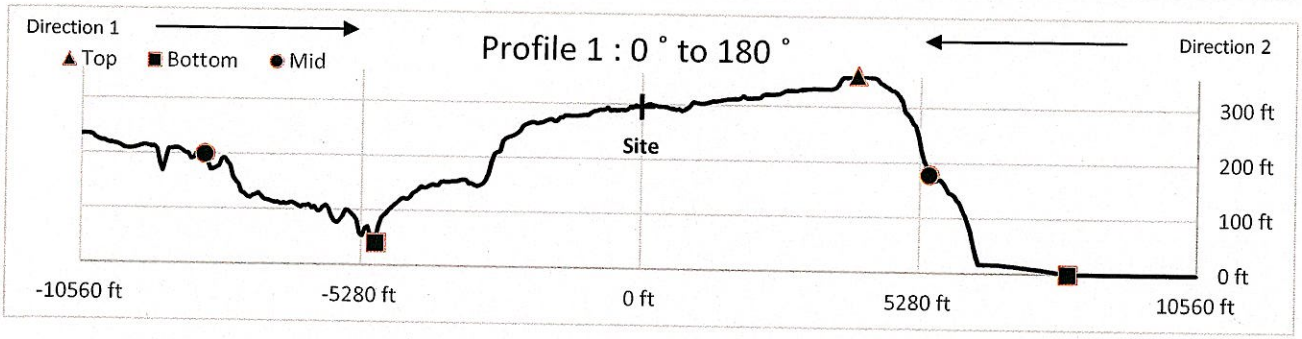
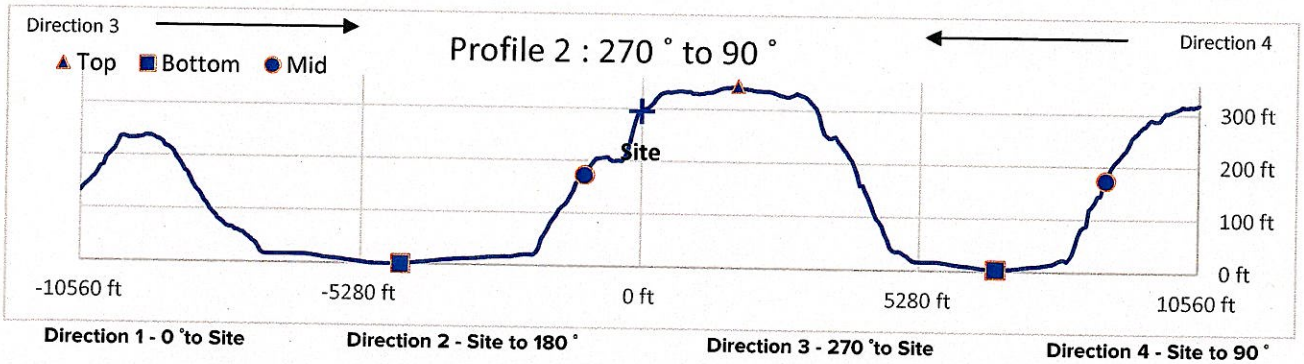
Project Fukano
Kzt Calculations

DATE 8/3/2018
PROJ. #
DESIGN ENG
SHEET 4





Direction 1 - 0 °to Site

Site Conditions (26.8.1)

1. Unubstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H≥ 60'	Yes

Kzt=1

Terrain Data

Terrain	Escrpmnt
Top of Hill Dist.	4086
Bott. of Hill Dist.	-4988
L @ H/2	-8225
Site	upwind
Top of Hill Elev.	357
Bott. of Hill Elev.	41
Site Elev.	295.3
Site Dist.	0
H/2	199

Kzt Calculations

H=	316
Lh=	12311
x=	4086
z=	20
μ=	1.5
γ=	2.5
K1 value =	0.75
K1=	0.02
K2=	0.78
k3=	1.00
H/Lh =	0.03
Kzt =	1.00

Direction 2 - Site to 180 °

Site Conditions (26.8.1)

1. Unubstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	Yes
5. H≥ 60'	Yes

Terrain Data

Terrain	Ridge
Top of Hill Dist.	4086
Bott. of Hill Dist.	8119
L @ H/2	5466
Site	downwnd
Top of Hill Elev.	357
Bott. of Hill Elev.	0
Site Elev.	295.3
Site Dist.	0
H/2	178

Kzt Calculations

H=	357
Lh=	1380
x=	4086
z=	20
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.34
K2=	0.00
k3=	0.96
H/Lh =	0.26
Kzt =	1.00

Direction 3 - 270 °to Site

Site Conditions (26.8.1)

1. Unubstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H≥ 60'	Yes

Kzt=1

Terrain Data

Terrain	Ridge
Top of Hill Dist.	1804
Bott. of Hill Dist.	-4511
L @ H/2	-1061
Site	upwind
Top of Hill Elev.	345
Bott. of Hill Elev.	0
Site Elev.	295.3
Site Dist.	0
H/2	172

Kzt Calculations

H=	345
Lh=	2865
x=	1804
z=	20
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.16
K2=	0.58
k3=	0.98
H/Lh =	0.12
Kzt =	1.00

Direction 4 - Site to 90 °

Site Conditions (26.8.1)

1. Unubstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H≥ 60'	Yes

Kzt=1

Terrain Data

Terrain	Ridge
Top of Hill Dist.	1804
Bott. of Hill Dist.	6739
L @ H/2	8809
Site	downwnd
Top of Hill Elev.	345
Bott. of Hill Elev.	3
Site Elev.	295.3
Site Dist.	0
H/2	174

Kzt Calculations

H=	342
Lh=	7005
x=	1804
z=	20
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.06
K2=	0.83
k3=	0.99
H/Lh =	0.05
Kzt =	1.00

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STRUCTURAL ENGINEERING

Project Fukano

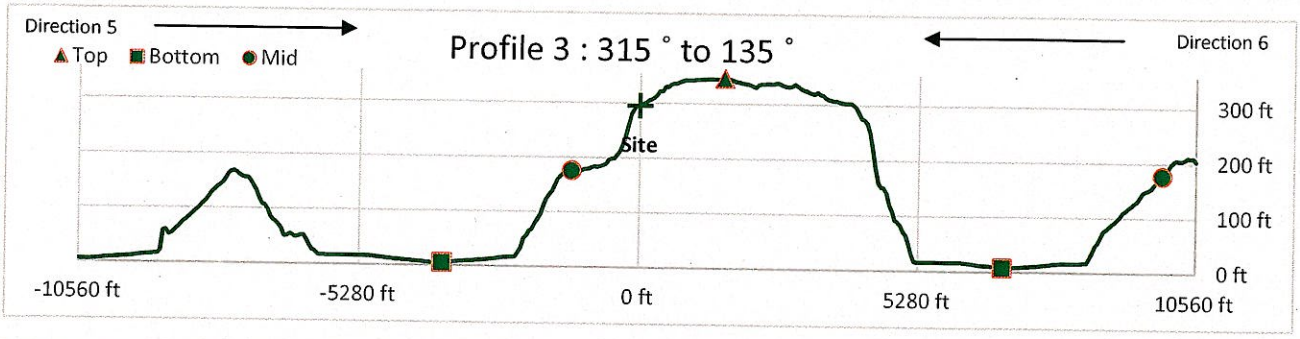
Kzt Calculations

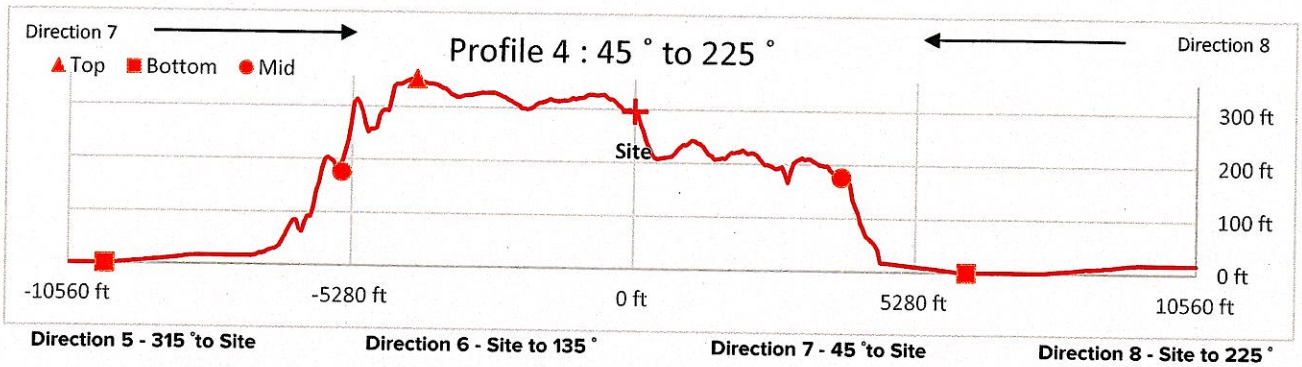
DATE 8/3/2018

PROJ. #

DESIGN ENG

SHEET 5





Direction 5 - 315 °to Site

Site Conditions (26.8.1)

1. Unubstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H≥ 60'	Yes

Kzt=1

Terrain Data

Terrain	Ridge
Top of Hill Dist.	1592
Bott. of Hill Dist.	-3715
L @ H/2	-1274
Site	upwind
Top of Hill Elev.	347
Bott. of Hill Elev.	5
Site Elev.	295.3
Site Dist.	0
H/2	176

Kzt Calculations

H=	342
Lh=	2866
x=	1592
z=	20
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.16
K2=	0.63
k3=	0.98
H/Lh =	0.12
Kzt =	1.00

Direction 6 - Site to 135 °

Site Conditions (26.8.1)

1. Unubstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H≥ 60'	Yes

Kzt=1

Terrain Data

Terrain	Ridge
Top of Hill Dist.	1592
Bott. of Hill Dist.	6898
L @ H/2	9923
Site	downwnd
Top of Hill Elev.	347
Bott. of Hill Elev.	7
Site Elev.	295.3
Site Dist.	0
H/2	177

Kzt Calculations

H=	339.517
Lh=	8331
x=	1592
z=	20
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.05
K2=	0.87
k3=	0.99
H/Lh =	0.04
Kzt =	1.00

Direction 7 - 45 °to Site

Site Conditions (26.8.1)

1. Unubstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	Yes
5. H≥ 60'	Yes

Terrain Data

Terrain	Ridge
Top of Hill Dist.	-4086
Bott. of Hill Dist.	-9870
L @ H/2	-5466
Site	downwnd
Top of Hill Elev.	352
Bott. of Hill Elev.	0
Site Elev.	295.3
Site Dist.	0
H/2	176

Kzt Calculations

H=	352
Lh=	1380
x=	4086
z=	20
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.33
K2=	0.00
k3=	0.96
H/Lh =	0.26
Kzt =	1.00

Direction 8 - Site to 225 °

Site Conditions (26.8.1)

1. Unubstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H≥ 60'	Yes

Kzt=1

Terrain Data

Terrain	Ridge
Top of Hill Dist.	-4086
Bott. of Hill Dist.	6262
L @ H/2	3874
Site	upwind
Top of Hill Elev.	352
Bott. of Hill Elev.	0
Site Elev.	295.3
Site Dist.	0
H/2	176

Kzt Calculations

H=	352.385
Lh=	7960
x=	4086
z=	20
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.06
K2=	0.66
k3=	0.99
H/Lh =	0.04
Kzt =	1.00

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Kzt Calculations

DATE 8/3/2018

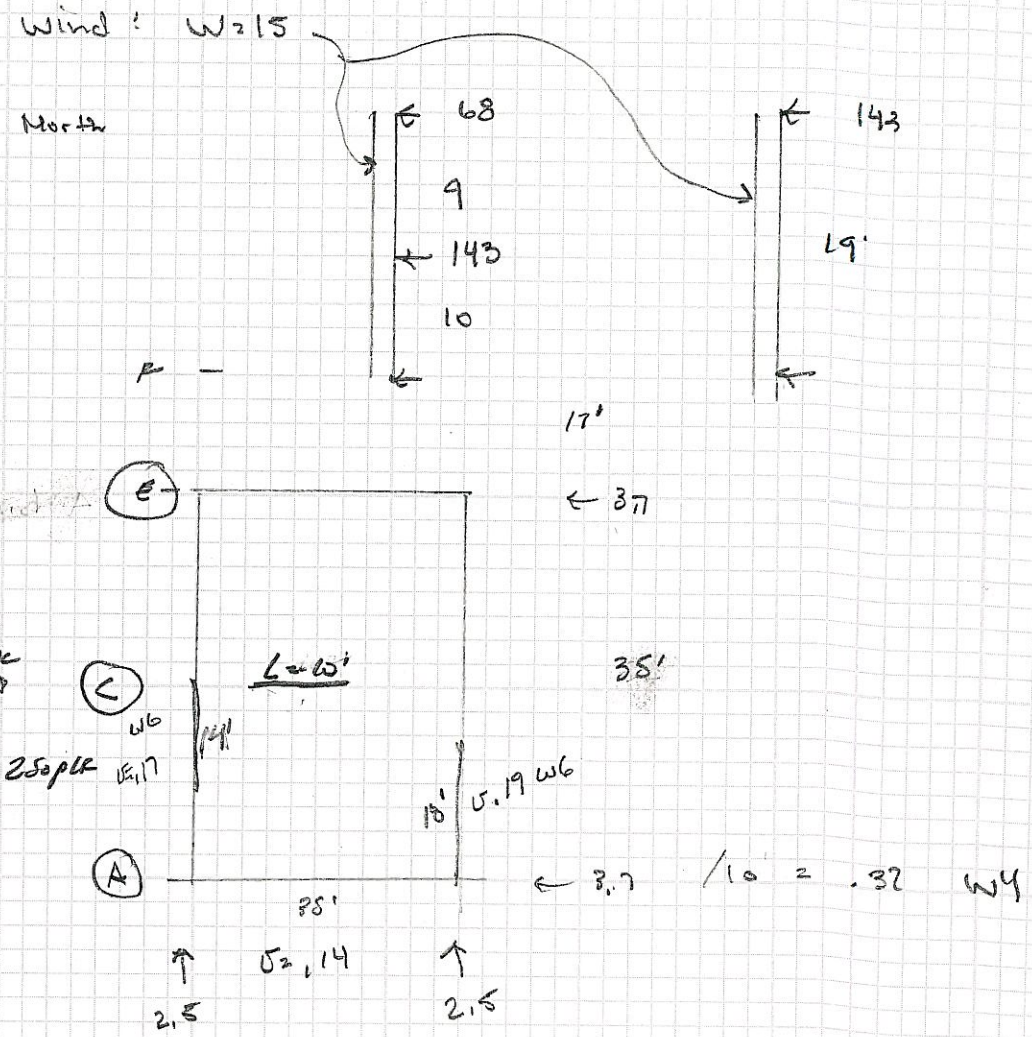
PROJ. #

DESIGN ENG

SHEET 6

Lateral

Wind: W=15



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PROJECT Fukano

DATE 9-18

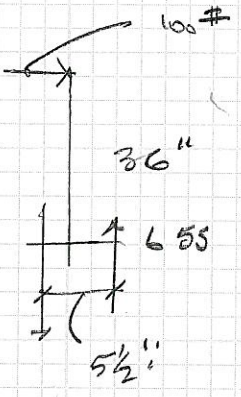
PROJ. #

DESIGN

SHEET

guard rail

w_2 200# distributed over 2 studs P_u 100#/ft



M_z 3600 "#

P_u = 3600/5.5 = 654

ST 22 = 1420#

L6x4x3/6 = 1640 @ wall

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SSF STRUCTURAL ENGINEERING

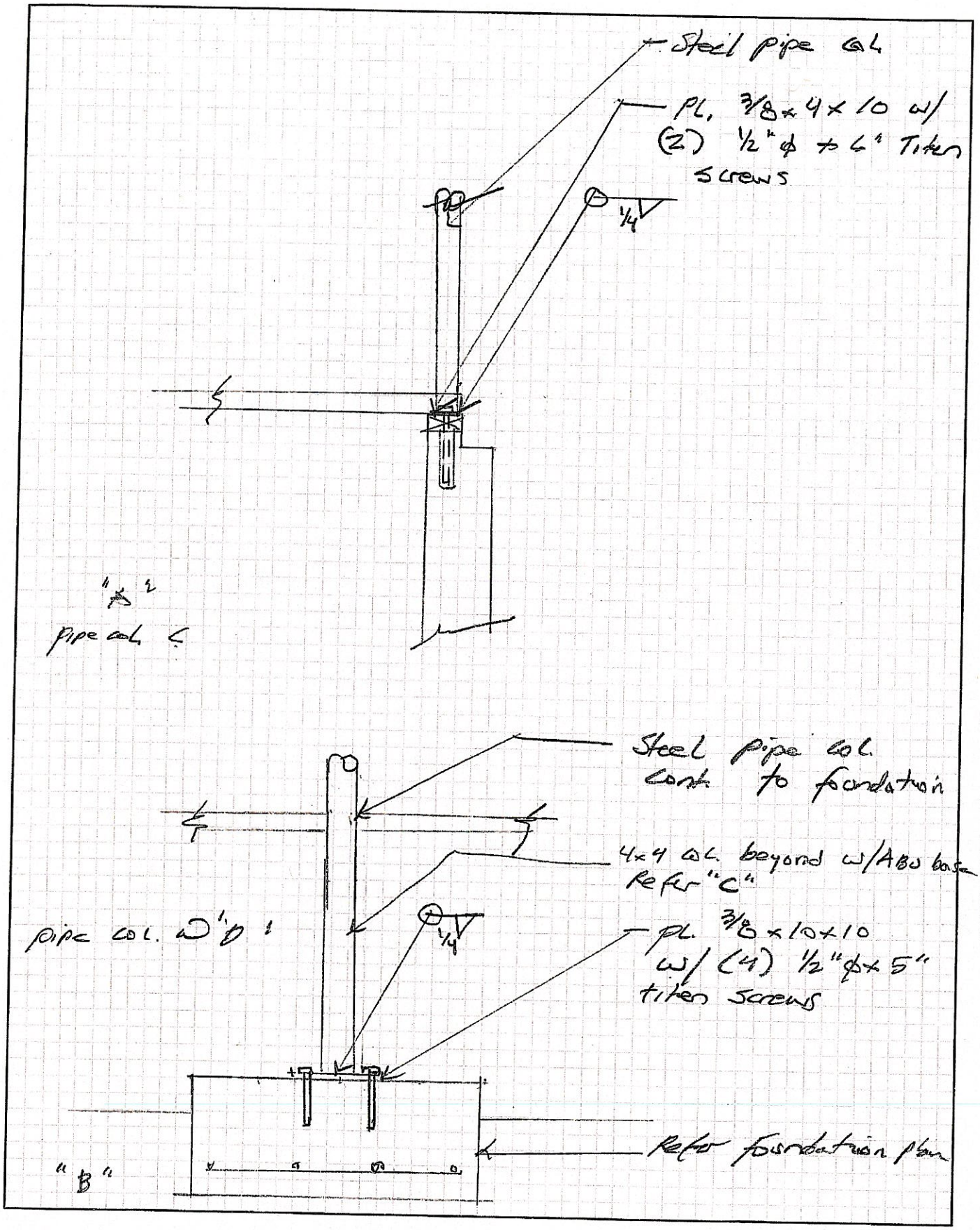
PROJECT Rukong

DATE 11-07-18

PROJ. #

DESIGN

SHEET



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PROJECT Fulcana

DATE 11-18

PROJ. #

DESIGN

SHEET

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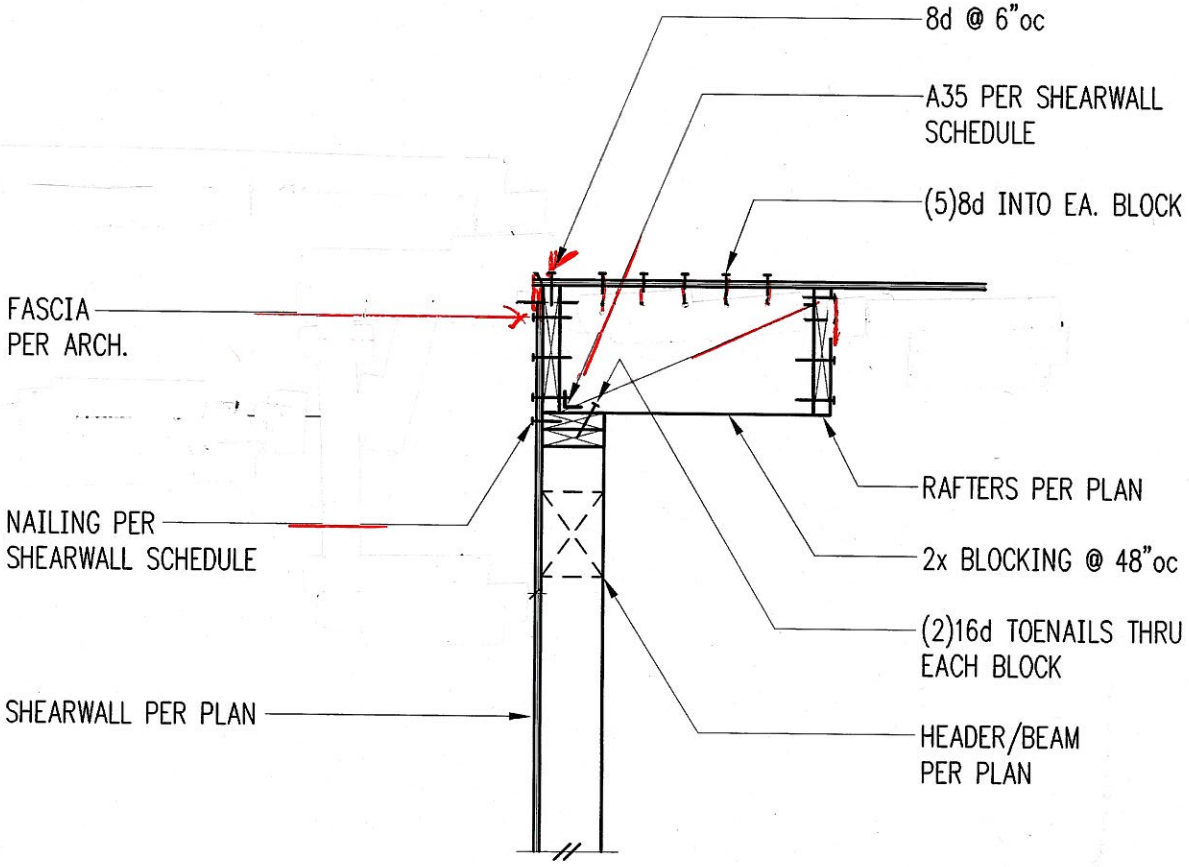

Exterior Non-Bearing Wall

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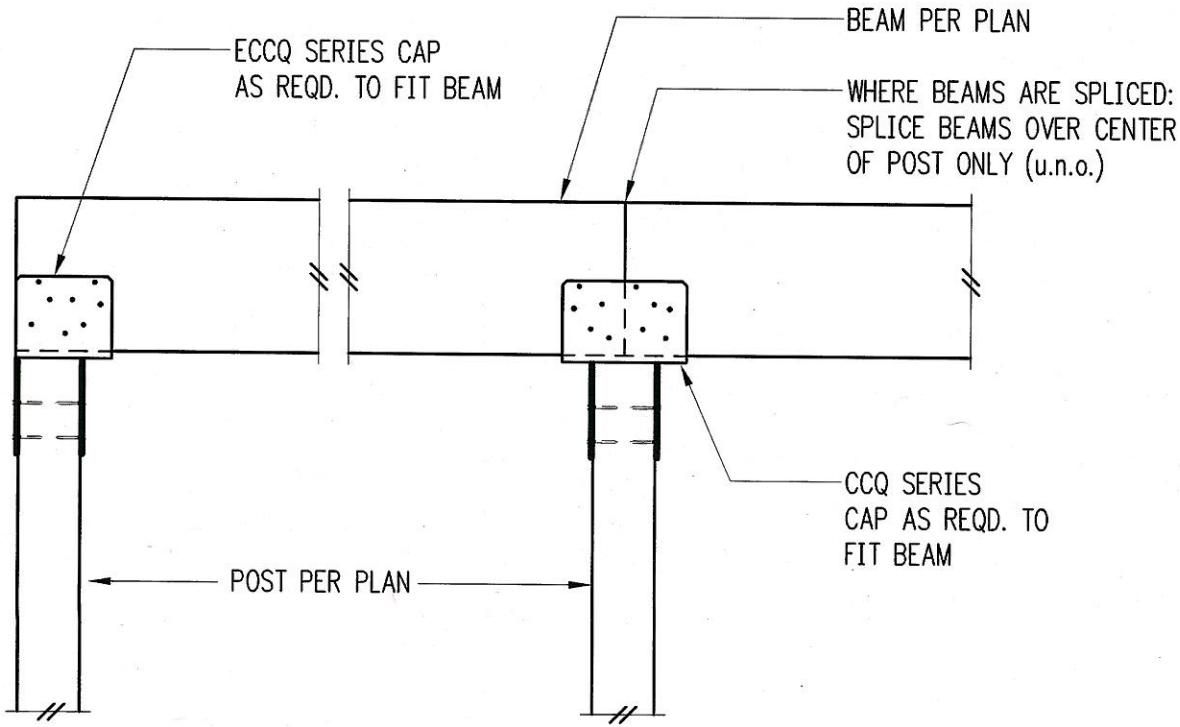
Fukano 15-11

File	Wo-08-02	Scale	3/4" = 1'-0"	Title	Exterior Non-Bearing Wall	Boxes	One



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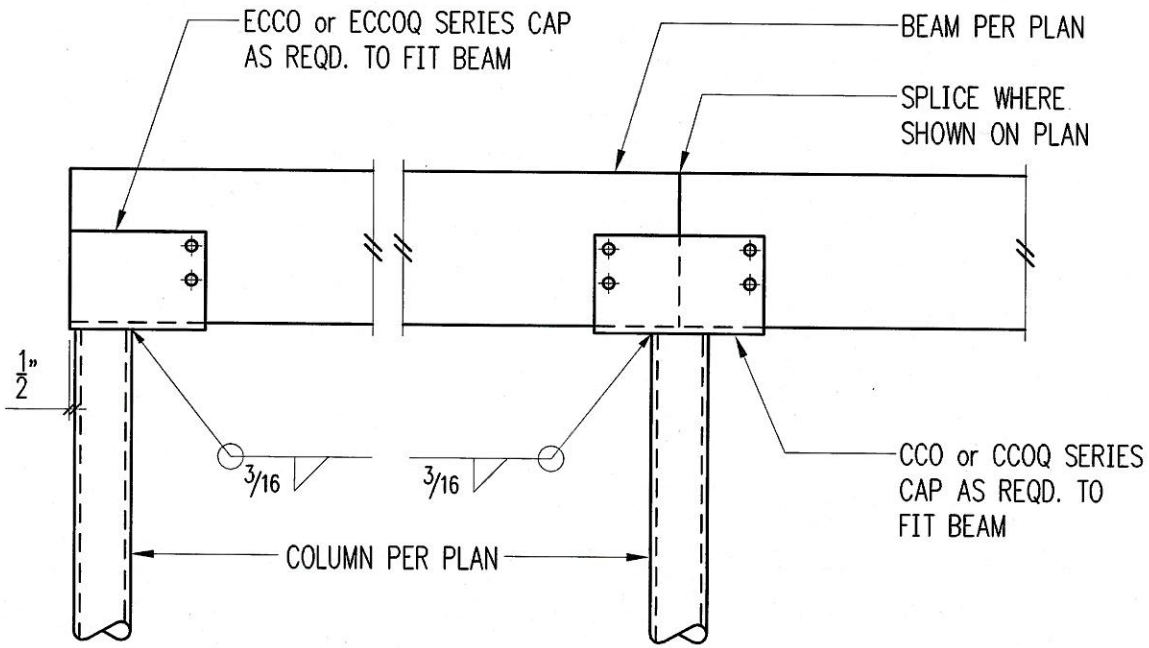
CC/CCQ Series Connection

File	Scale	Title	Boxes
Wo-05-01	3/4" = 1'-0"	CC/CCQ Series Connection	One



CC/CCQ Series Connection at Steel Column

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Fukami 10-4

File	Scale	Title	Boxes
Wo-05-02	3/4" = 1'-0"	CC/CCQ Series Connection at Steel Column	One

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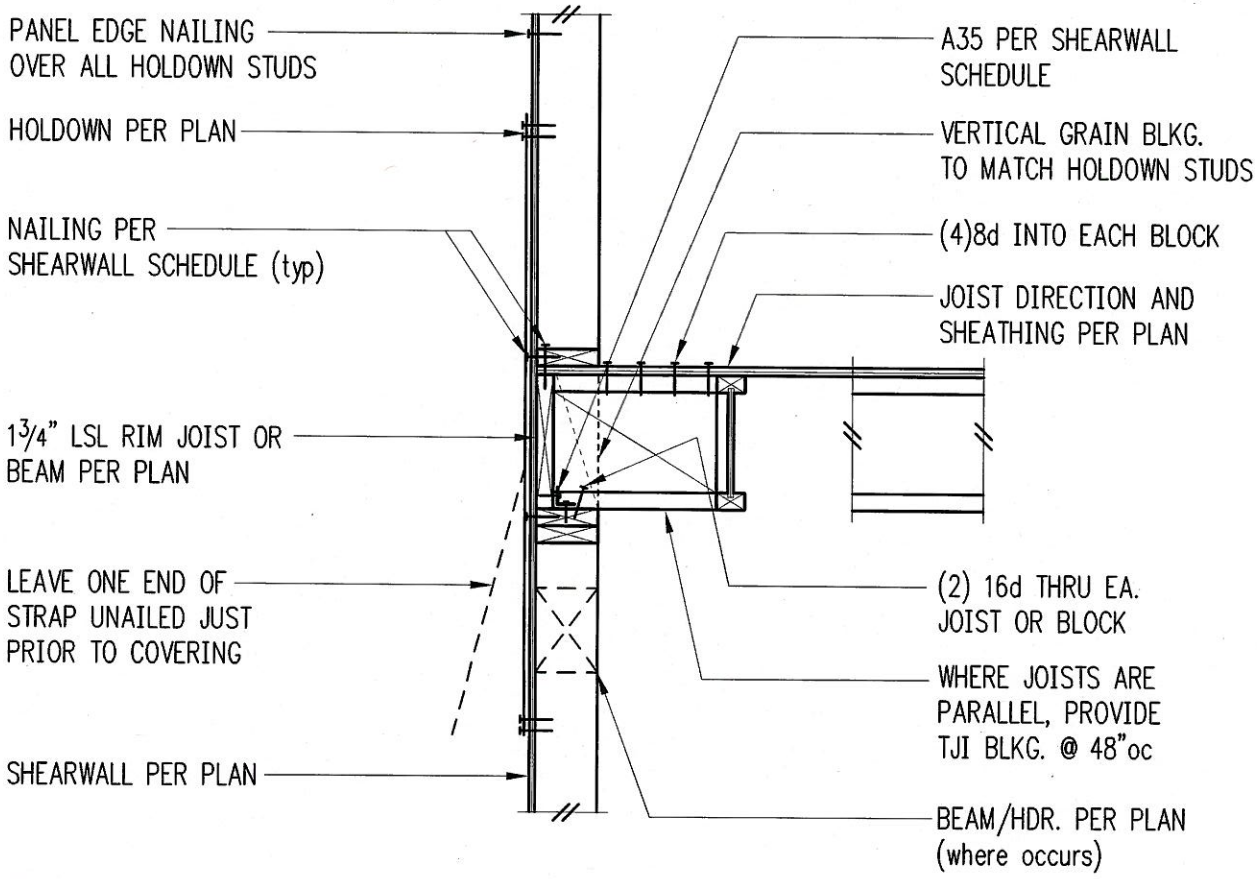

Exterior Floor Framing

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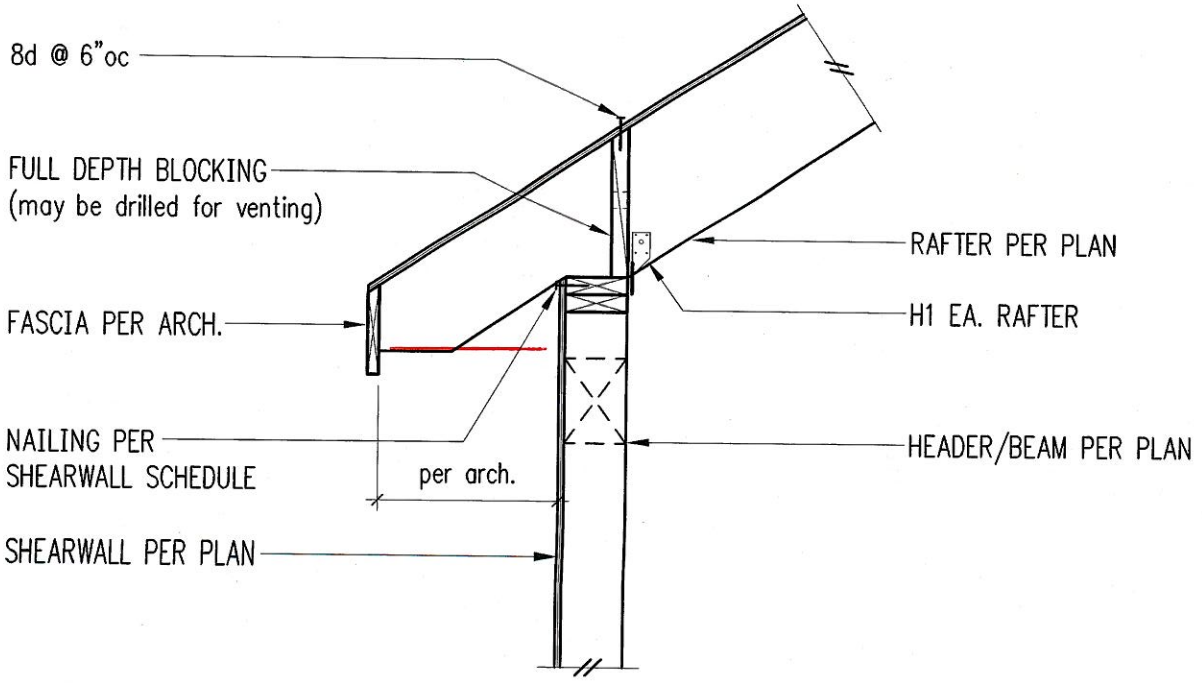
Fukan 10-11

File	Scale	Title	Boxes
Wo-06-01(tji)	3/4" = 1'-0"	Exterior Floor Framing (w/ TJI's)	One

F:\TYPICAL DETAILS\Wood\In Work\Wo-08-01.dwg, 7/26/2016 3:06:21 PM



Exterior Bearing Wall

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Fukan 12-11

File	Scale	Title	Boxes
Wo-08-01	3/4" = 1'-0"	Exterior Bearing Wall	One