

2720 Residence

2720 71st Avenue SE
Mercer Island, Washington 98040

Structural Engineering Calculations

Supplement Calculations for HOUSE Lateral System Design



By

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April 28, 2022

Seismic Mass Calculation

Seismic Base at Main Floor with Concrete Base

Floor areas (sqft)

2nd	2388
roof	1636

Roof Framing Seismic Mass (psf)

roof framing	14.00
roofing (4.00 psf future PV panels)	6.00
wall framing to diaphragm	5.00
total	<u>25.00</u> psf

Floor Framing Seismic Mass (psf)

floor framing	15.00
wall framing to diaphragm	10.00
total	<u>25.00</u> psf

2nd

seismic mass (area x floor framing seismic mass) **59.70 kips**

roof

seismic mass (area x roof framing seismic mass) **40.90 kips**

Seismic Forces

(per attached spreadsheet calculations)

roof	9.50 kips
2nd	7.90
total	<u>17.40</u> kips

ASD = Seismic Force/1.4

roof	6.79
2nd	5.64
total	<u>12.43</u> kips

NS	EW
Cumulative	Cumulative
6.79 kips	6.79 kips
12.43 kips	12.43 kips

Wind Forces

(per attached spreadsheet calculations)

NS	32.53 kips	1.12
EW	36.29 kips	

ASD = Wind Force/1.4

NS	23.24 kips
EW	<u>25.92</u> kips

NS

roof = ((3'+12'/2)/28') x 23.24 kips	7.47
2nd = (((12'+13')/2)/28') x 23.24 kips	10.38
total	<u>17.85</u> kips

EW

roof = ((3'+12'/2)/28') x 25.92 kips	8.33
2nd = (((12'+13')/2)/28') x 25.92 kips	11.58
total	<u>19.91</u> kips

NS	EW
Cumulative	
7.47 kips	
17.85 kips	
	Cumulative
	8.33 kips
	19.91 kips

Lateral Force Summary (ASD)

	NS	EW
	Cumulative	Cumulative
WIND/WIND	7.47 kips	8.33 kips
WIND/WIND	17.85 kips	19.91 kips

INPUT DATA

Typical floor height h = 10.0 ft
 Typical floor weight w_x = 60 k
 Number of floors n = 2
 Importance factor (ASCE 11.5.1) I = 1.00 (IBC Tab.1604.5)
 Building location Zip Code 98040
 Site class (A, B, C, D, E, F) D (If no soil report, use D)
 The coefficient (ASCE Tab 12.8-2) C_t = 0.02
 The coefficient(ASCE Tab. 12.2.1) R = 6.50

DESIGN SUMMARY

Total base shear V = 0.17 W, (SD) = 17 k, (SD)
 = 0.12 W, (ASD) = 12 k, (ASD)
 Seismic design category = D
 Latitude: 47.562605
 Longitude: -122.2254

S_{DS} = 1.119 g

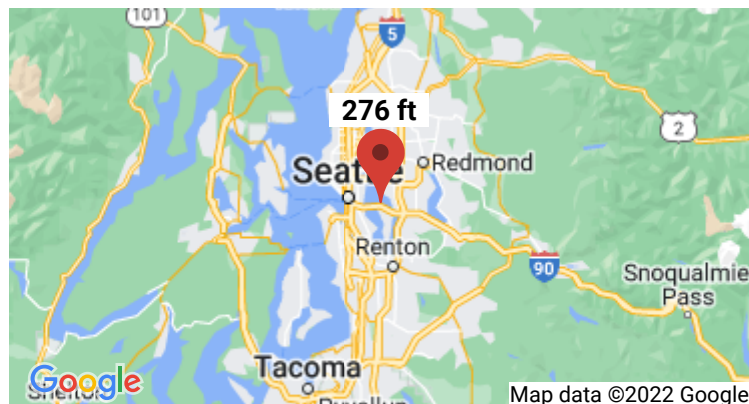
h_n = 23.0 ft k = 1.00 (ASCE 12.8.3, pg 130) x = 0.75 (ASCE Tab 12.8-2)
 W = 101 k Σw_xh^k = 1,723 T_a = C_t(h_n)^x = 0.21 Sec, (ASCE 12.8.2.1)

VERTICAL DISTRIBUTION OF LATERAL FORCES

Level No.	Level Name	Floor to floor Height ft	Height h _x ft	Weight		Lateral force @ each level				Diaphragm force				
				w _x k	w _x h _x ^k	C _{v_x}	F _x k	V _x k	O. M. k-ft	ΣF _i k	ΣW _i k	F _{px} k		
2	Roof	10.00	23.0	41	943	0.547	9.5					9.5	41	10
1	2nd	13.00	13.0	60	780	0.453	7.9	9.5		95		17.4	101	13
	Ground		0.0					17.4		321				

Search Information

Address:	2720 71st Ave SE, Mercer Island, WA 98040, USA
Coordinates:	47.5861883, -122.2437783
Elevation:	276 ft
Timestamp:	2022-04-25T07:12:53.539Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	D-default



Basic Parameters

Name	Value	Description
S_S	1.398	MCE_R ground motion (period=0.2s)
S_1	0.487	MCE_R ground motion (period=1.0s)
S_{MS}	1.678	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	1.119	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.902	Coefficient of risk (0.2s)
CR_1	0.896	Coefficient of risk (1.0s)
PGA	0.598	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.718	Site modified peak ground acceleration

T_L	6	Long-period transition period (s)
SsRT	1.398	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.55	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	3.234	Factored deterministic acceleration value (0.2s)
S1RT	0.487	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.543	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	1.319	Factored deterministic acceleration value (1.0s)
PGAd	1.116	Factored deterministic acceleration value (PGA)

* See Section 11.4.8

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

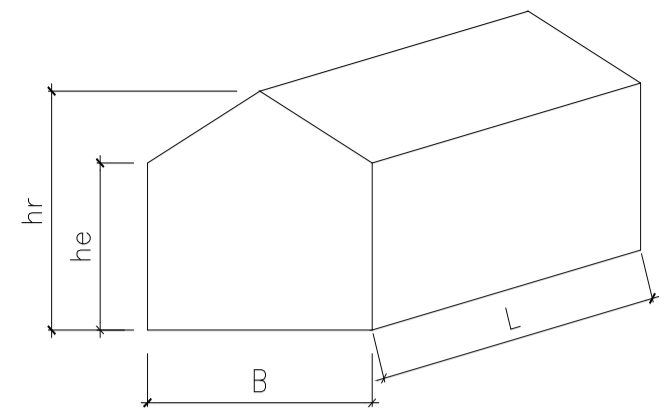
Hazard loads are provided by the U.S. Geological Survey [Seismic Design Web Services](#).

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INPUT DATA

Exposure category (B, C or D)
 Importance factor, pg 77, (0.87, 1.0 or 1.15)
 Basic wind speed (IBC Tab 1609.3.1V_{3S})
 Topographic factor (Sec.6.5.7.2, pg 26 & 45)
 Building height to eave
 Building height to ridge
 Building length
 Building width
 Effective area of components

B
 I = 1.00 **Category II**
 V = 98 mph
 K_{zt} = 1.9
 h_e = 28 ft
 h_r = 28 ft
 L = 62 ft
 B = 55 ft
 A = 10 ft²



DESIGN SUMMARY

Max horizontal force normal to building length, L, face = 36.29 kips
 Max horizontal force normal to building length, B, face = 32.53 kips
 Max total horizontal torsional load = 299.46 ft-kips
 Max total upward force = 72.41 kips

ANALYSIS

Velocity pressure

$$q_h = 0.00256 K_h K_{zt} K_d V^2 I = 27.79 \text{ psf}$$

where: q_h = velocity pressure at mean roof height, h. (Eq. 6-15, page 27)

K_h = velocity pressure exposure coefficient evaluated at height, h, (Tab. 6-3, Case 1,pg 79) = 0.70

K_d = wind directionality factor. (Tab. 6-4, for building, page 80) = 0.85

h = mean roof height = 28.00 ft

< 60 ft, [Satisfactory]

Design pressures for MWFRS

$$p = q_h [(G C_{pf}) - (G C_{pi})]$$

where: p = pressure in appropriate zone. (Eq. 6-18, page 28).

G C_{pf} = product of gust effect factor and external pressure coefficient, see table below. (Fig. 6-10, page 53 & 54)

G C_{pi} = product of gust effect factor and internal pressure coefficient.(Fig. 6-5, Enclosed Building, page 47)

= 0.18 or -0.18

a = width of edge strips, Fig 6-10, note 9, page 54, MAX[MIN(0.1B, 0.4h), 0.04B,3] = 5.50 ft

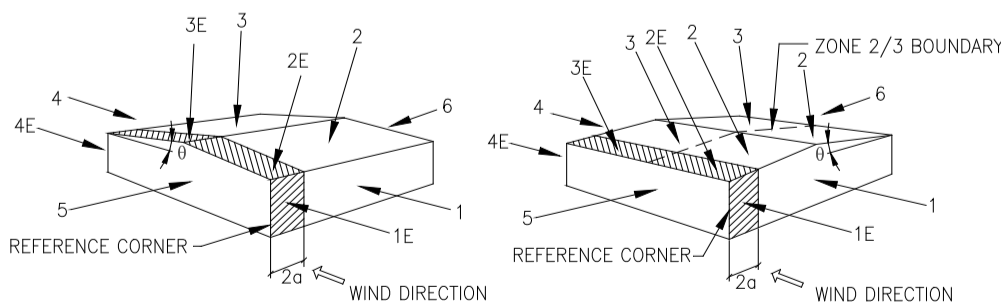
Net Pressures (psf), Basic Load Cases

Surface	Roof angle θ = 0.00			Roof angle θ = 0.00		
	G C _{pf}	Net Pressure with		G C _{pf}	Net Pressure with	
		(+G C _{pi})	(-G C _{pi})		(+G C _{pi})	(-G C _{pi})
1	0.40	6.11	16.12	0.40	6.11	16.12
2	-0.69	-24.18	-14.18	-0.69	-24.18	-14.18
3	-0.37	-15.29	-5.28	-0.37	-15.29	-5.28
4	-0.29	-13.06	-3.06	-0.29	-13.06	-3.06
1E	0.61	11.95	21.96	0.61	11.95	21.96
2E	-1.07	-34.74	-24.74	-1.07	-34.74	-24.74
3E	-0.53	-19.73	-9.73	-0.53	-19.73	-9.73
4E	-0.43	-16.95	-6.95	-0.43	-16.95	-6.95
5	-0.45	-17.51	-7.50	-0.45	-17.51	-7.50
6	-0.45	-17.51	-7.50	-0.45	-17.51	-7.50

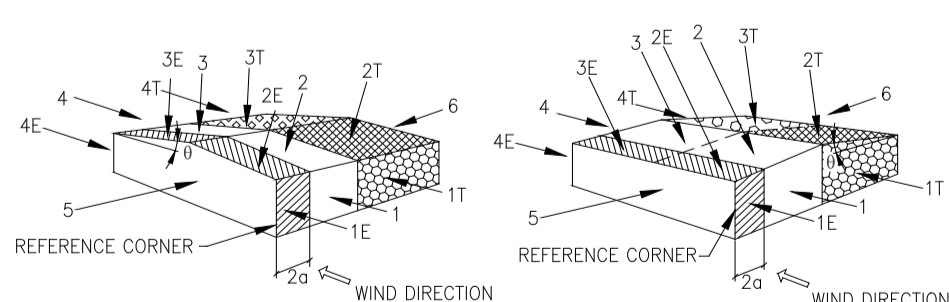
Net Pressures (psf), Torsional Load Cases

Surface	Roof angle θ = 0.00		
	G C _{pf}	Net Pressure with	
		(+G C _{pi})	(-G C _{pi})
1T	0.40	1.53	4.03
2T	-0.69	-6.05	-3.54
3T	-0.37	-3.82	-1.32
4T	-0.29	-3.27	-0.76

Surface	Roof angle θ = 0.00		
	G C _{pf}	Net Pressure with	
		(+G C _{pi})	(-G C _{pi})
1T	0.40	1.53	4.03
2T	-0.69	-6.05	-3.54
3T	-0.37	-3.82	-1.32
4T	-0.29	-3.27	-0.76



Transverse Direction Longitudinal Direction
 Basic Load Cases



Transverse Direction Longitudinal Direction
 Torsional Load Cases

Basic Load Cases in Transverse Direction

Surface	Area (ft ²)	Pressure (k) with	
		(+GC _p i)	(-GC _p i)
1	1428	8.73	23.02
2	1403	-33.91	-19.88
3	1403	-21.44	-7.41
4	1428	-18.65	-4.37
1E	308	3.68	6.76
2E	303	-10.51	-7.48
3E	303	-5.97	-2.94
4E	308	-5.22	-2.14
Σ	Horiz.	36.29	36.29
	Vert.	-71.83	-37.71
10 psf min. Sec. 6.1.4.1	Horiz.	17.36	17.36
	Vert.	-34.10	-34.10

Basic Load Cases in Longitudinal Direction

Surface	Area (ft ²)	Pressure (k) with	
		(+GC _p i)	(-GC _p i)
1	1232	7.53	19.86
2	1364	-32.98	-19.34
3	1364	-20.85	-7.20
4	1232	-16.09	-3.77
1E	308	3.68	6.76
2E	341	-11.85	-8.44
3E	341	-6.73	-3.32
4E	308	-5.22	-2.14
Σ	Horiz.	32.53	32.53
	Vert.	-72.41	-38.29
10 psf min. Sec. 6.1.4.1	Horiz.	15.40	15.40
	Vert.	-34.10	-34.10

Torsional Load Cases in Transverse Direction

Surface	Area (ft ²)	Pressure (k) with		Torsion (ft-k)	
		(+GC _p i)	(-GC _p i)	(+GC _p i)	(-GC _p i)
1	560	3.42	9.03	44	115
2	550	-13.30	-7.80	0	0
3	550	-8.41	-2.90	0	0
4	560	-7.32	-1.71	93	22
1E	308	3.68	6.76	94	172
2E	303	-10.51	-7.48	0	0
3E	303	-5.97	-2.94	0	0
4E	308	-5.22	-2.14	133	55
1T	868	1.33	3.50	-21	-54
2T	853	-5.15	-3.02	0	0
3T	853	-3.26	-1.13	0	0
4T	868	-2.83	-0.66	-44	-10
Total Horiz. Torsional Load, M _T				299	299

Torsional Load Cases in Longitudinal Direction

Surface	Area (ft ²)	Pressure (k) with		Torsion (ft-k)	
		(+GC _p i)	(-GC _p i)	(+GC _p i)	(-GC _p i)
1	462	2.83	7.45	23	61
2	1023	-24.74	-14.50	0	0
3	1023	-15.64	-5.40	0	0
4	462	-6.04	-1.41	50	12
1E	308	3.68	6.76	81	149
2E	341	-11.85	-8.44	0	0
3E	341	-6.73	-3.32	0	0
4E	308	-5.22	-2.14	115	47
1T	770	1.18	3.10	-16	-43
2T	1364	-8.25	-4.83	0	0
3T	1364	-5.21	-1.80	0	0
4T	770	-2.51	-0.59	-35	-8
Total Horiz. Torsional Load, M _T				218.2	218.2

Design pressures for components and cladding

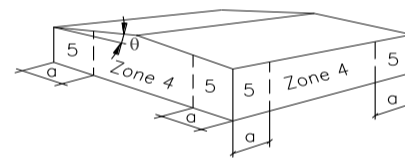
$p = q_n [(G C_p) - (G C_{pi})]$

where: p = pressure on component. (Eq. 6-22, pg 28)

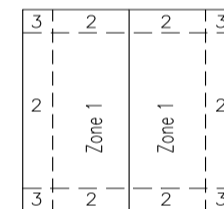
p_{min} = 10 psf (Sec. 6.1.4.2, pg 21)

G C_p = external pressure coefficient.

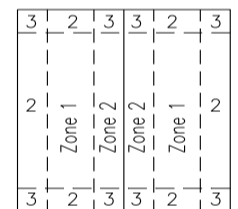
see table below. (Fig. 6-11, page 55-58)



Walls



Roof θ ≤ 7°



Roof θ > 7°

	Effective Area (ft ²)	Zone 1		Zone 2		Zone 3		Zone 4		Zone 5	
		GC _p	- GC _p	GC _p	- GC _p	GC _p	- GC _p	GC _p	- GC _p	GC _p	- GC _p
Comp.	10	0.30	-1.00	0.30	-1.80	0.30	-2.80	0.90	-0.99	0.90	-1.26

(Walls reduced 10 %, Fig. 6-11A note 5.)

Comp. & Cladding Pressure (psf)	Zone 1		Zone 2		Zone 3		Zone 4		Zone 5	
	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
	13.34	-32.80	13.34	-55.03	13.34	-82.83	30.02	-32.52	30.02	-40.02

Search Information

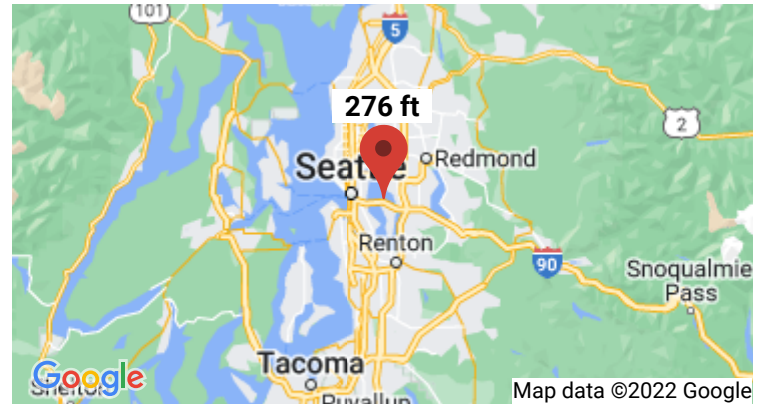
Address: 2720 71st Ave SE, Mercer Island, WA 98040, USA

Coordinates: 47.5861883, -122.2437783

Elevation: 276 ft

Timestamp: 2022-04-25T07:11:33.708Z

Hazard Type: Wind



ASCE 7-16

MRI 10-Year 67 mph

MRI 25-Year 73 mph

MRI 50-Year 78 mph

MRI 100-Year 83 mph

Risk Category I 92 mph

Risk Category II 97 mph

Risk Category III 104 mph

Risk Category IV 108 mph

ASCE 7-10

MRI 10-Year 72 mph

MRI 25-Year 79 mph

MRI 50-Year 85 mph

MRI 100-Year 91 mph

Risk Category I 100 mph

Risk Category II 110 mph

Risk Category III-IV 115 mph

ASCE 7-05

ASCE 7-05 Wind Speed 85 mph

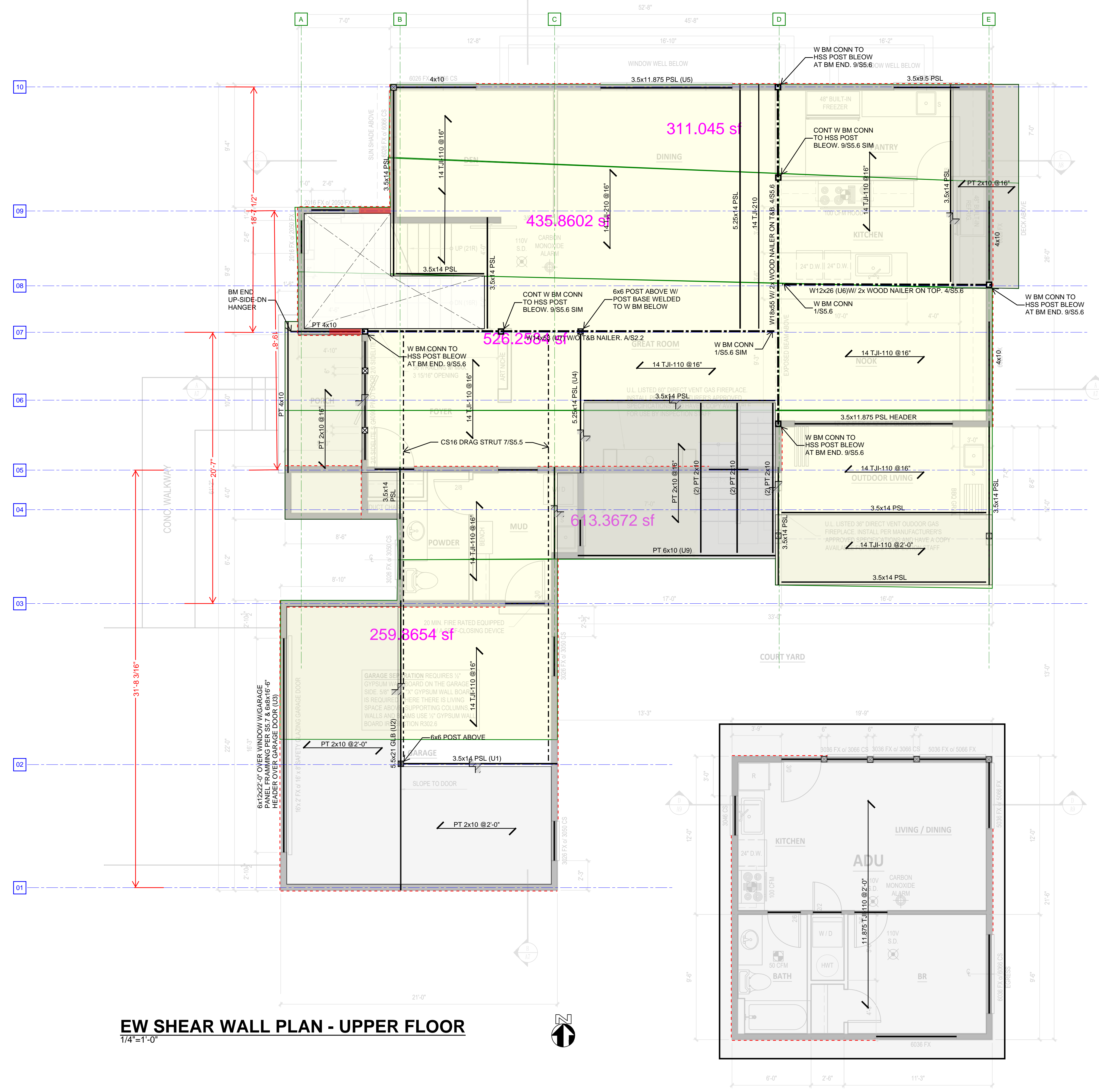
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Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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EW SHEAR WALL PLAN - UPPER FLOOR

1/4"=1'-0"

DHS ENGINEERS
 1201 3RD AVE, 2200
 SEATTLE, WA 98101
 (206) 734-5858



2720 RESIDENCE
 2720 71ST AVENUE SE
 MERCER ISLAND WA 98040

NUMBER	DATE	DESCRIPTION OF REVISIONS

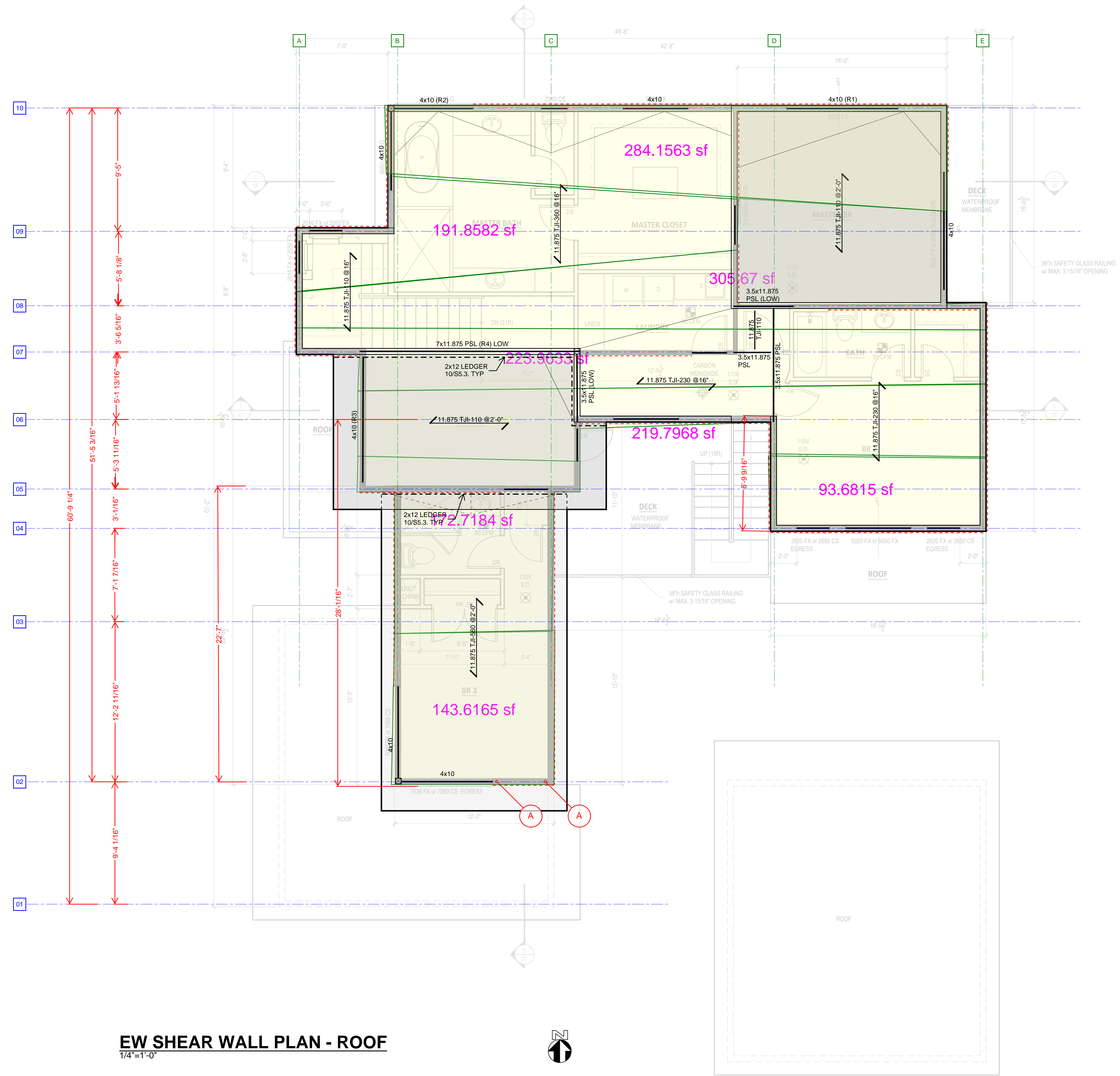
SHEET TITLE
UPPER FLOOR & LOWER ROOF FRAMING PLAN

JOB NUMBER

SHEET NUMBER

S2.2

CITY STAMP



EW SHEAR WALL PLAN - ROOF
 1/4"=1'-0"

DHS ENGINEERS



1201 3RD AVE, 2200
 SEATTLE, WA 98101
 (206) 734-5858



2720 RESIDENCE
 2720 71ST AVENUE SE
 MERCER ISLAND WA 98040

NUMBER	DATE	DESCRIPTION OF REVISIONS

SHEET TITLE
ROOF FRAMING PLAN

JOB NUMBER
 SHEET NUMBER

S2.3

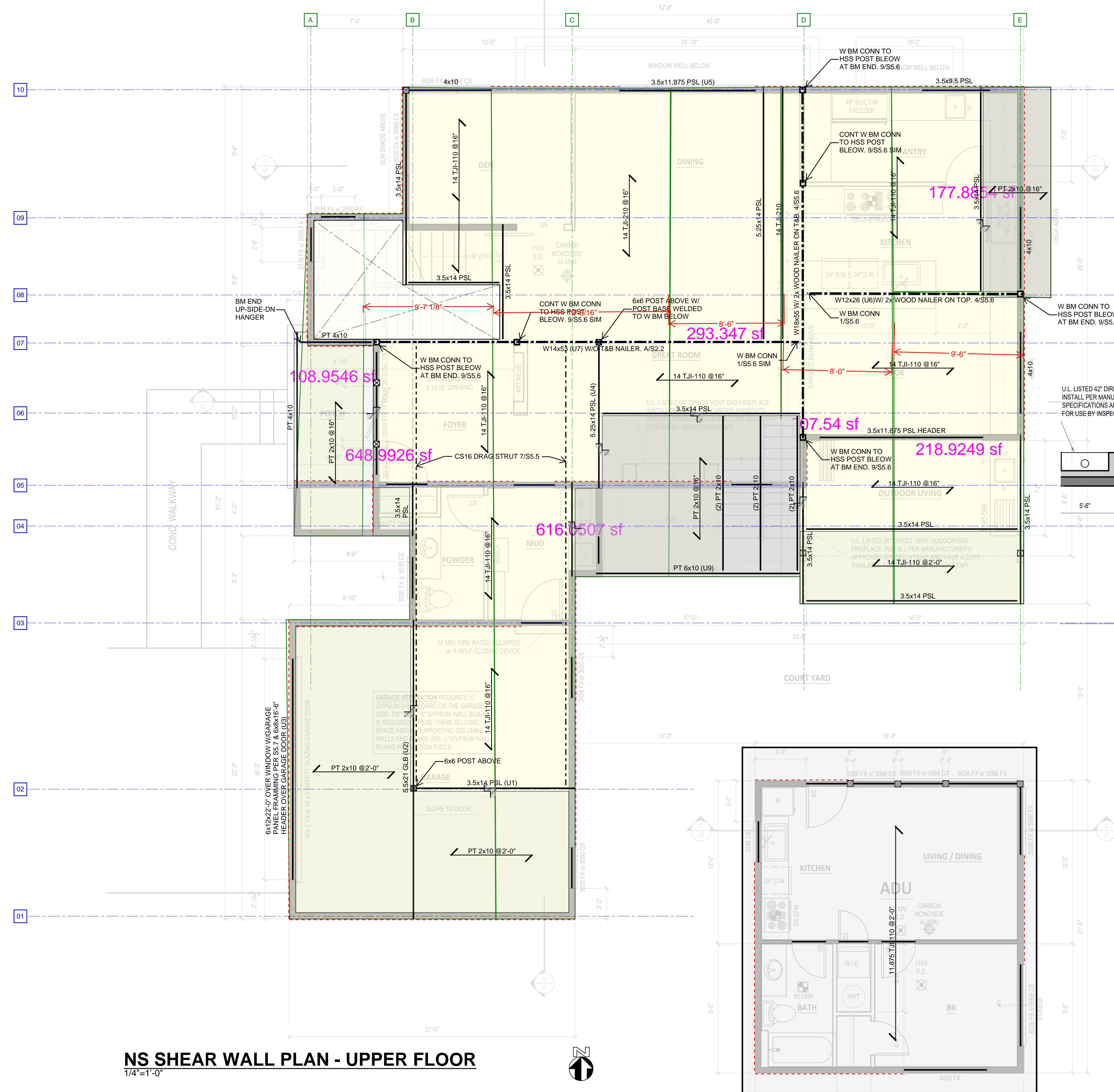
CITY STAMP

EW Shear Wall Design

shear wall location:	1	roof diaphragm	2nd flr diaphragm
shear force (kips)		0.00	3.18
floor height (ft)		10.00	13.00
wall length without opening (ft)		9.00	21.00
wall length with opening (ft)		9.00	21.00
wall segment length (ft)		9.00	21.00
shear flow (plf)		0.00	151.43
shear wall type per schedule on GN		NA	SW6
dead loads from floor/roof framing (plf)		30.00	30.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		-0.35	0.61
hold down type per schedule on GN		NA	4
shear wall location:	2	roof diaphragm	2nd flr diaphragm
shear force (kips)		1.63	0.00
floor height (ft)		10.00	13.00
wall length without opening (ft)		4.50	5.00
wall length with opening (ft)		4.50	5.00
wall segment length (ft)		4.50	5.00
shear flow (plf)		362.22	0.00
shear wall type per schedule on GN		SW4	NA
dead loads from floor/roof framing (plf)		165.00	75.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		3.26	2.96
hold down type per schedule on GN		B	NA
shear wall location:	3	roof diaphragm	2nd flr diaphragm
shear force (kips)		0.00	4.63
floor height (ft)		10.00	13.00
wall length without opening (ft)		22.00	16.50
wall length with opening (ft)		22.00	16.50
wall segment length (ft)		22.00	16.50
shear flow (plf)		0.00	280.61
shear wall type per schedule on GN		NA	SW6
dead loads from floor/roof framing (plf)		60.00	165.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		-1.06	1.13
hold down type per schedule on GN		NA	2
shear wall location:	4	roof diaphragm	2nd flr diaphragm
shear force (kips)		0.58	0.00
floor height (ft)		10.00	13.00
wall length without opening (ft)		16.00	21.00
wall length with opening (ft)		6.00	21.00
wall segment length (ft)		16.00	21.00
shear flow (plf)		96.67	0.00
shear wall type per schedule on GN		SW6	NA
dead loads from floor/roof framing (plf)		135.00	2.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		-0.16	-0.99
hold down type per schedule on GN		NO HD	NA

shear wall location:	5	roof diaphragm	2nd flr diaphragm
shear force (kips)		2.03	5.50
floor height (ft)		10.00	13.00
wall length without opening (ft)		11.00	13.00
wall length with opening (ft)		11.00	13.00
wall segment length (ft)		11.00	13.00
shear flow (plf)		184.55	423.08
shear wall type per schedule on GN		SW6	SW4
dead loads from floor/roof framing (plf)		165.00	90.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		0.97	5.61
hold down type per schedule on GN		A	8
shear wall location:	6	roof diaphragm	2nd flr diaphragm
shear force (kips)		0.91	0.00
floor height (ft)		10.00	13.00
wall length without opening (ft)		15.00	10.00
wall length with opening (ft)		10.00	10.00
wall segment length (ft)		15.00	10.00
shear flow (plf)		91.00	0.00
shear wall type per schedule on GN		SW6	NA
dead loads from floor/roof framing (plf)		30.00	30.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		0.03	-0.46
hold down type per schedule on GN		NO HD	NA
shear wall location:	7	roof diaphragm	2nd flr diaphragm
shear force (kips)		0.93	4.72
floor height (ft)		10.00	7.00
wall length without opening (ft)		13.50	4.50
wall length with opening (ft)		13.50	4.50
wall segment length (ft)		4.50	4.50
shear flow (plf)		68.89	1048.89
shear wall type per schedule on GN		SW6	STRONG WALL
dead loads from floor/roof framing (plf)		67.50	150.00
wall weight (plf)		100.00	70.00
hold down force (kips) with 0.6DL		0.06	7.11
hold down type per schedule on GN		NO HD	STRONG WALL
shear wall location:	8	roof diaphragm	2nd flr diaphragm
shear force (kips)		1.27	0.00
floor height (ft)		10.00	13.00
wall length without opening (ft)		11.50	3.50
wall length with opening (ft)		11.50	3.50
wall segment length (ft)		11.50	3.50
shear flow (plf)		110.43	0.00
shear wall type per schedule on GN		SW6	NA
dead loads from floor/roof framing (plf)		240.00	120.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		-0.07	-0.33
hold down type per schedule on GN		NO HD	NA


shear wall location:	9	roof diaphragm	2nd flr diaphragm
shear force (kips)		1.09	3.91
floor height (ft)		10.00	7.00
wall length without opening (ft)		7.00	4.50
wall length with opening (ft)		7.00	4.50
wall segment length (ft)		7.00	4.50
shear flow (plf)		155.71	868.89
shear wall type per schedule on GN		SW6	STRONG WALL
dead loads from floor/roof framing (plf)		71.25	30.00
wall weight (plf)		100.00	70.00
hold down force (kips) with 0.6DL		1.20	7.14
hold down type per schedule on GN		A	STRONG WALL
shear wall location:	10	roof diaphragm	2nd flr diaphragm
shear force (kips)		1.20	2.79
floor height (ft)		10.00	13.00
wall length without opening (ft)		36.00	20.00
wall length with opening (ft)		20.00	15.00
wall segment length (ft)		36.00	20.00
shear flow (plf)		60.00	186.00
shear wall type per schedule on GN		SW6	SW6
dead loads from floor/roof framing (plf)		120.00	135.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		-1.78	-0.95
hold down type per schedule on GN		NO HD	NO HD



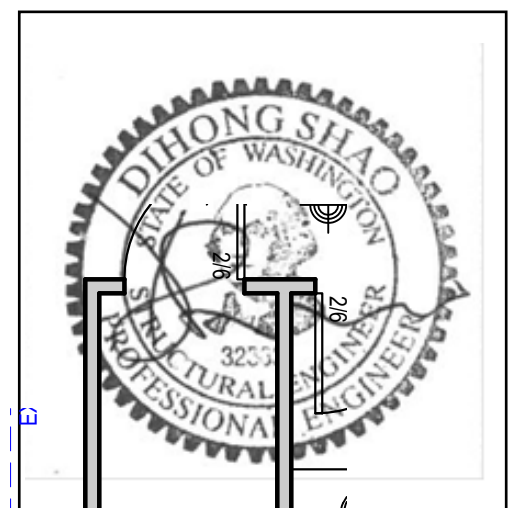
NS SHEAR WALL PLAN - UPPER FLOOR
1/4"=1'-0"



DHS ENGINEERS



1201 3RD AVE, 2200
SEATTLE, WA 98101
(206) 734-5858



2720 RESIDENCE
2720 71ST AVENUE SE
MERCER ISLAND WA 98040

OUTDOOR FLOOR PLAN

NUMBER	DATE	DESCRIPTION OF REVISIONS

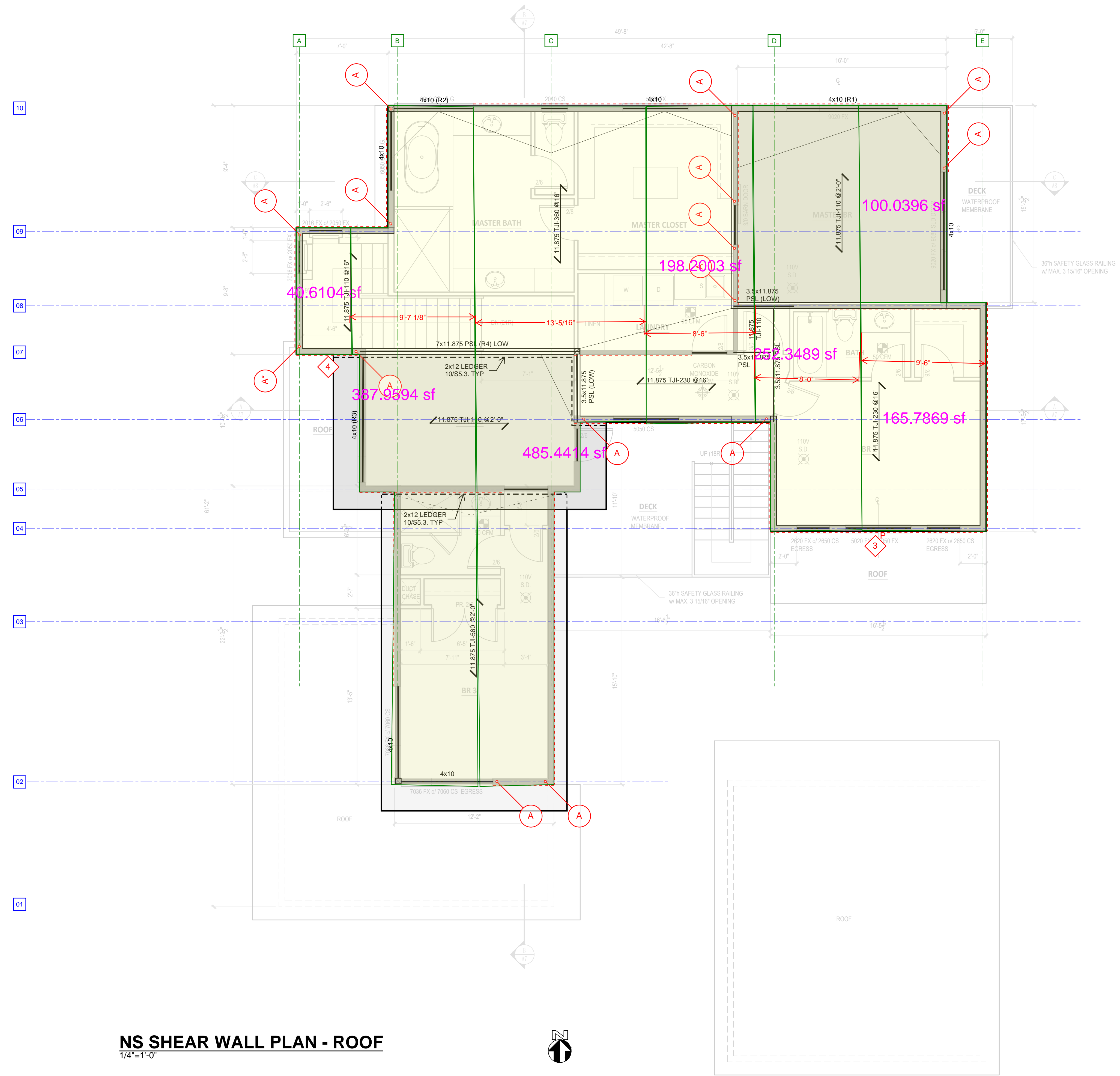
SHEET TITLE
UPPER FLOOR & LOWER ROOF FRAMING PLAN

JOB NUMBER

SHEET NUMBER

S2.2

CITY STAMP



NS SHEAR WALL PLAN - ROOF
 1/4"=1'-0"



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 SEATTLE, WA 98101
 (206) 734-5858



2720 RESIDENCE
 2720 71ST AVENUE SE
 MERCER ISLAND WA 98040

NUMBER	DATE	DESCRIPTION OF REVISIONS

SHEET TITLE
ROOF FRAMING PLAN

JOB NUMBER

SHEET NUMBER

S2.3

CITY STAMP

NS Shear Wall Design

shear wall location:	A	roof diaphragm	2nd flr diaphragm
shear force (kips)		0.50	1.80
floor height (ft)		10.00	13.00
wall length without opening (ft)		9.00	9.00
wall length with opening (ft)		6.00	6.00
wall segment length (ft)		9.00	9.00
shear flow (plf)		83.33	300.00
shear wall type per schedule on GN		SW6	SW6
dead loads from floor/roof framing (plf)		30.00	30.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		0.48	3.95
hold down type per schedule on GN		A	4
shear wall location:	B/(GARAGE DOOR)	roof diaphragm	2nd flr diaphragm
shear force (kips)		1.61	3.50
floor height (ft)		10.00	5.00
wall length without opening (ft)		17.00	5.00
wall length with opening (ft)		17.00	5.00
wall segment length (ft)		14.00	2.50
shear flow (plf)		94.71	700.00
shear wall type per schedule on GN		SW6	GARAGE PANEL
dead loads from floor/roof framing (plf)		60.00	75.00
wall weight (plf)		100.00	50.00
hold down force (kips) with 0.6DL		-0.02	3.38
hold down type per schedule on GN		NO HD	GARAGE PANEL
shear wall location:	C	roof diaphragm	2nd flr diaphragm
shear force (kips)		2.01	6.93
floor height (ft)		10.00	13.00
wall length without opening (ft)		22.00	20.00
wall length with opening (ft)		22.00	17.00
wall segment length (ft)		22.00	20.00
shear flow (plf)		91.36	407.53
shear wall type per schedule on GN		SW6	SW4
dead loads from floor/roof framing (plf)		60.00	60.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		-0.14	4.02
hold down type per schedule on GN		NO HD	4
shear wall location:	C.8	roof diaphragm	2nd flr diaphragm
shear force (kips)		1.21	0.00
floor height (ft)		10.00	13.00
wall length without opening (ft)		11.50	21.00
wall length with opening (ft)		11.50	21.00
wall segment length (ft)		7.00	21.00
shear flow (plf)		105.22	0.00
shear wall type per schedule on GN		SW6	NA
dead loads from floor/roof framing (plf)		60.00	2.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		0.72	-0.12
hold down type per schedule on GN		A	NA

shear wall location:	D	roof diaphragm	2nd flr diaphragm
shear force (kips)		1.14	5.55
floor height (ft)		10.00	7.00
wall length without opening (ft)		8.00	3.50
wall length with opening (ft)		8.00	3.50
wall segment length (ft)		8.00	3.50
shear flow (plf)		142.50	1585.13
shear wall type per schedule on GN		SW6	STRONG WALL
dead loads from floor/roof framing (plf)		30.00	120.00
wall weight (plf)		100.00	70.00
hold down force (kips) with 0.6DL		1.11	12.01
hold down type per schedule on GN		A	STRONG WALL
shear wall location:	D.8	roof diaphragm	2nd flr diaphragm
shear force (kips)		0.64	0.00
floor height (ft)		10.00	13.00
wall length without opening (ft)		5.00	10.00
wall length with opening (ft)		5.00	10.00
wall segment length (ft)		5.00	10.00
shear flow (plf)		128.00	0.00
shear wall type per schedule on GN		SW6	NA
dead loads from floor/roof framing (plf)		30.00	30.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		1.09	0.61
hold down type per schedule on GN		A	NA
shear wall location:	E	roof diaphragm	2nd flr diaphragm
shear force (kips)		1.33	3.56
floor height (ft)		10.00	13.00
wall length without opening (ft)		17.50	26.00
wall length with opening (ft)		17.50	14.00
wall segment length (ft)		17.50	26.00
shear flow (plf)		75.72	254.48
shear wall type per schedule on GN		SW6	SW6
dead loads from floor/roof framing (plf)		30.00	120.00
wall weight (plf)		100.00	130.00
hold down force (kips) with 0.6DL		0.07	1.43
hold down type per schedule on GN		NO HD	2

Wood Shear Wall with an Opening Based on NDS

window width = total wall pier length = 340/2=170 plf

INPUT DATA

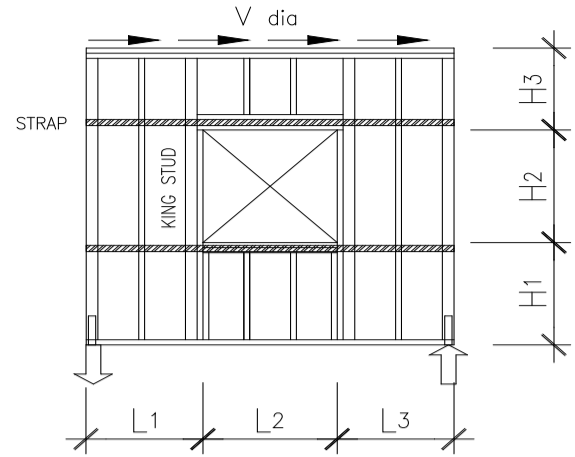
LATERAL FORCE ON DIAPHRAGM: $V_{dia, WIND} = 170$ plf, for wind
 (SERVICE LOADS) $V_{dia, SEISMIC} = 170$ plf, for seismic

DIMENSIONS: $L_1 = 3$ ft, $L_2 = 6$ ft, $L_3 = 3$ ft
 $H_1 = 2$ ft, $H_2 = 5$ ft, $H_3 = 2$ ft

KING STUD SECTION 1 pcs, $b = 2$ in, $h = 6$ in
 EDGE STUD SECTION 2 pcs, $b = 2$ in, $h = 6$ in

PANEL GRADE (0 or 1) = 1 <= Sheathing and Single-Floor

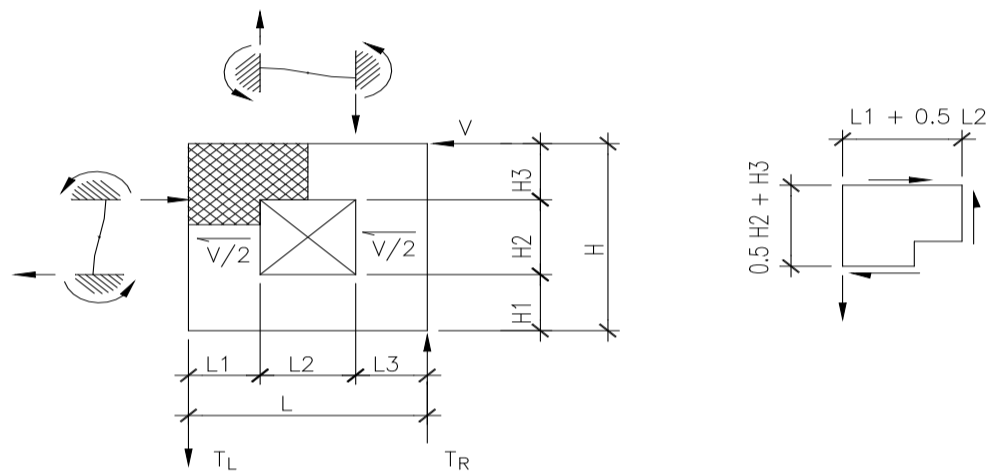
MINIMUM NOMINAL PANEL THICKNESS = 15/32 in
 COMMON NAIL SIZE (0=6d, 1=8d, 2=10d) 2 10d
 SPECIFIC GRAVITY OF FRAMING MEMBERS 0.5
 STORY OPTION (1=ground level, 2=upper level) 2 upper level shear wall



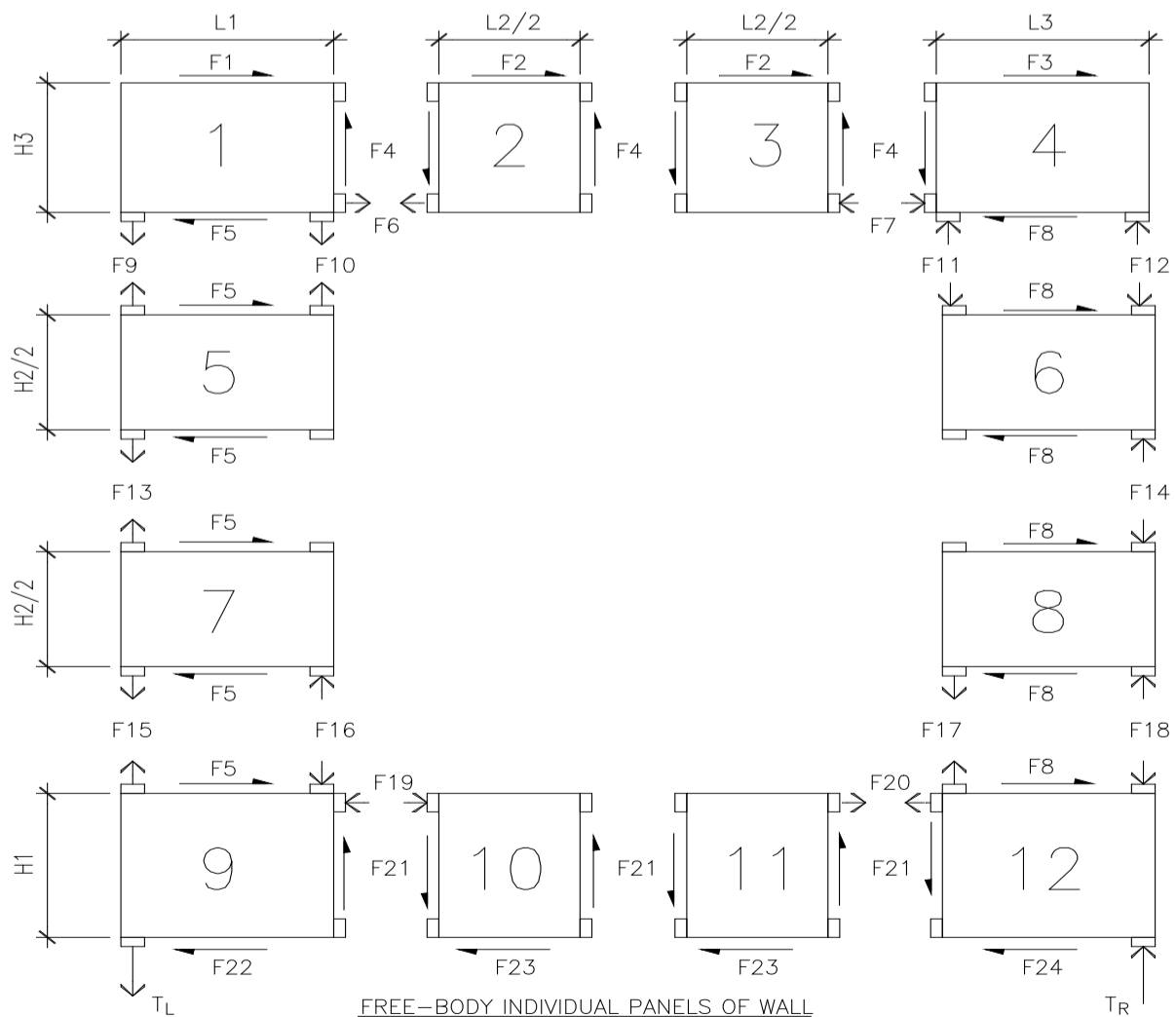
DESIGN SUMMARY

BLOCKED 15/32 SHEATHING WITH 10d COMMON NAILS
 @ 4 in O.C. BOUNDARY & ALL EDGES / 12 in O.C. FIELD,
 SILL PLATE ATTACHMENT 16d AT 6" O.C.

HOLD-DOWN FORCES: $T_L = 1.59$ k, $T_R = 1.59$ k (USE CS16 SIMPSON HOLD-DOWN)
 MAX STRAP FORCE: $F = 1.15$ k (USE SIMPSON CS18 OVER WALL SHEATHING WITH FLAT BLOCKING)
 KING STUD: 1 - 2" x 6" DOUGLAS FIR-LARCH No. 1, CONTINUOUS FULL HEIGHT.
 EDGE STUD: 2 - 2" x 6" DOUGLAS FIR-LARCH No. 1, CONTINUOUS FULL HEIGHT.
 SHEAR WALL DEFLECTION: $\Delta = 0.63$ in



ASSUME INFLECTION POINT AT MIDDLE OF WINDOW



FREE-BODY INDIVIDUAL PANELS OF WALL

ANALYSIS

CHECK MAX SHEAR WALL DIMENSION RATIO $h/w = 1.7 < 2$ [Satisfactory]

DETERMINE FORCES & SHEAR STRESS OF FREE-BODY INDIVIDUAL PANELS OF WALL

INDIVIDUAL PANEL	W (ft)	H (ft)	MAX SHEAR STRESS (plf)	NO.	FORCE (lbf)	NO.	FORCE (lbf)
1	3.00	2.00	-43	F1	-128	F13	765
2	3.00	2.00	383	F2	1148	F14	765
3	3.00	2.00	383	F3	-128	F15	1615
4	3.00	2.00	-43	F4	765	F16	850
5	3.00	2.50	340	F5	1020	F17	850
6	3.00	2.50	340	F6	1148	F18	1615
7	3.00	2.50	340	F7	1148	F19	1050
8	3.00	2.50	340	F8	1020	F20	1050
9	3.00	2.00	-10	F9	-85	F21	830
10	3.00	2.00	415	F10	850	F22	-30
11	3.00	2.00	415	F11	850	F23	1050
12	3.00	2.00	-10	F12	-85	F24	-30

DETERMINE REQUIRED CAPACITY $v_b = 415$ plf, (1 Side Panel Required, the Max. Nail Spacing = 4 in)

THE SHEAR CAPACITIES PER IBC Table 2306.4.1 / UBC Table 23-II-1 :

Panel Grade	Common Nail	Min. Penetration (in)	Min. Thickness (in)	Blocked Nail Spacing Boundary & All Edges			
				6	4	3	2
Sheathing and Single-Floor	10d	1 5/8	15/32	310	460	600	770

Note: The indicated shear numbers have reduced by specific gravity factor per IBC note a / UBC note 1 of the table.

DETERMINE FLOOR SILL PLATE ATTACHMENT (NDS 2005, Table 11Q & Table 11L)

SILL PLATE ATTACHMENT 16d AT 6" O.C.

THE HOLD-DOWN FORCES:

	V_{dia} (plf)	Wall Seismic at mid-story (lbs)	Overturning Moments (ft-lbs)		Resisting Moments (ft-lbs)	Safety Factors	Net Uplift (lbs)	Holddown SIMPSON
SEISMIC	170	173	19138	Left	0	0.9	$T_L = 1595$	CS16
				Right	0	0.9	$T_R = 1595$	
WIND	170		18360	Left	0	2/3	$T_L = 1530$	
				Right	0	2/3	$T_R = 1530$	

(T_L & T_R values should include upper level UPLIFT forces if applicable)

DETERMINE MAXIMUM SHEAR WALL DEFLECTION: (IBC Section 2305.3.2)

$$\Delta = \Delta_{shear} + \Delta_{nail\ slip} + \Delta_{chord\ splice\ slip} = \frac{8v_b h^3}{EA L_w} + \frac{v_b h}{Gt} + 0.75 h e_n \frac{h d_a}{L_w} = 0.628 \text{ in}$$

Where: $v_b = 415$ plf, $L_w = 6$ ft, $E = 1.7E+06$ psi
 $A = 16.50$ in², $h = 9$ ft, $G = 9.0E+04$ psi
 $t = 0.298$ in, $e_n = 0.037$ in, $d_a = 0.15$ in

CHECK KING STUD CAPACITY

$P_{max} = 0.85$ kips
 $F_c = 1500$ psi, $C_D = 1.60$, $C_P = 0.43$, $A = 8.25$ in²
 $E = 1700$ ksi, $C_F = 1.10$, $F'_c = 1146$ psi, $f_c = 103$ psi

[Satisfactory]

CHECK EDGE STUD CAPACITY

$P_{max} = 1.59$ kips, (this value should include upper level DOWNWARD loads if applicable)
 $F_c = 1500$ psi, $C_D = 1.60$, $C_P = 0.43$, $A = 16.50$ in²
 $E = 1700$ ksi, $C_F = 1.10$, $F'_c = 1146$ psi, $f_c = 97$ psi

[Satisfactory]

Technical References:

- "National Design Specification, NDS", 2005 Edition, AF & PA, AWC, 2005.