QUALITY ENGINEERING & DESIGN

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FILE NO. **210426**

TITLE
Nakamura Residence
Garage Addition
Lateral Load Analysis

4245 90th Ave SE
Mercer Island, WA

PREPARED BY Tom Wolfe, PE

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REV. 0

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Introduction

The following calculations provide lateral analysis for the referenced garage addition to existing single family structure for size and configuration of shear walls, hold-downs and connections. Additionally, reviewer comments from a previous review will be addressed.

See following page for a description of the analysis methodology and assumptions incorporated on the following pages.

SUMMARY OF DESIGN PARAMETERS

SEISMIC		WIND		
Analysis Procedure:	Equivalent Lateral Force Procedure	Basic Wind Speed:	110	mph
Short Period Response, Ss:	1.408	Wind Exposure:	B	
Short Period Response S_{DS}:	0.93867	Topographic Factor, Kzt:	1.60	
Base Shear Coeff, Cs:	0.14441			
Seismic Design Category:	D			

The following Codes and references are used to develop loads and allowables:

[1] "International Building Code (IBC)", 2018 Edition, International Code Council

[2] ASCE 7-16, "Minimum Design Loads for Buildings and Other Structures", American Society of Civil Engineers

[3] National Design Specification (NDS), "Design Allowables for Wood Construction", American Forest & Paper Association, American Wood Council

[4] Simpson Strong-Tie, Catalog C-C-2017, "Wood Construction Connectors"

[5]

The following computer programs were utilized in the completion of this report:

PROFIS Anchor, Version 2.6.2, produced by Hilti Corporation
FORTE, Version 5.1, produced by Weyerhaeuser Corporation

Introduction

Referring to the sketch on the following page, the lateral load will be distributed along 2 shear lines in the North/South direction (S/L a, S/L b), and 3 shear lines in the East/West direction (S/L 1, S/L 2, S/L 3).

LATERAL ANALYSIS PROCEDURE

NORTH / SOUTH DIRECTION:

For wind and seismic loading in the North/South direction, the garage addition will be treated as a stand-alone structure in that all lateral loads will be reisted by shear walls in the new garage and no new loads will be imparted on the existing structure in this direction

Along Shear Line b, the lateral resistance will be provided by a combination of (1) 7' shear wall and (2) PFH Single Portal Frames. A detail is provided for the PFH frames and associated anchorage.

EAST / WEST DIRECTION

For wind and seismic loading in the East/West direction, lateral loads will be distributed to 3 shear lines (S/L 1, S/L 2, S/L 3) based on tributary area. There is no change to loads on Shear Line 3 so, while the loads are calculated here, it is not included in the scope of this analysis.

Shear Line 2 is common to both the existing structure and the proposed garage addition. On this shear line, loads are calculated for the existing 2-story structure as well as the portion of the new gargae that are tributary to S/L 2. It is then verified that there is adequate shear wall capability to resist the loads due to existing plus new structure.

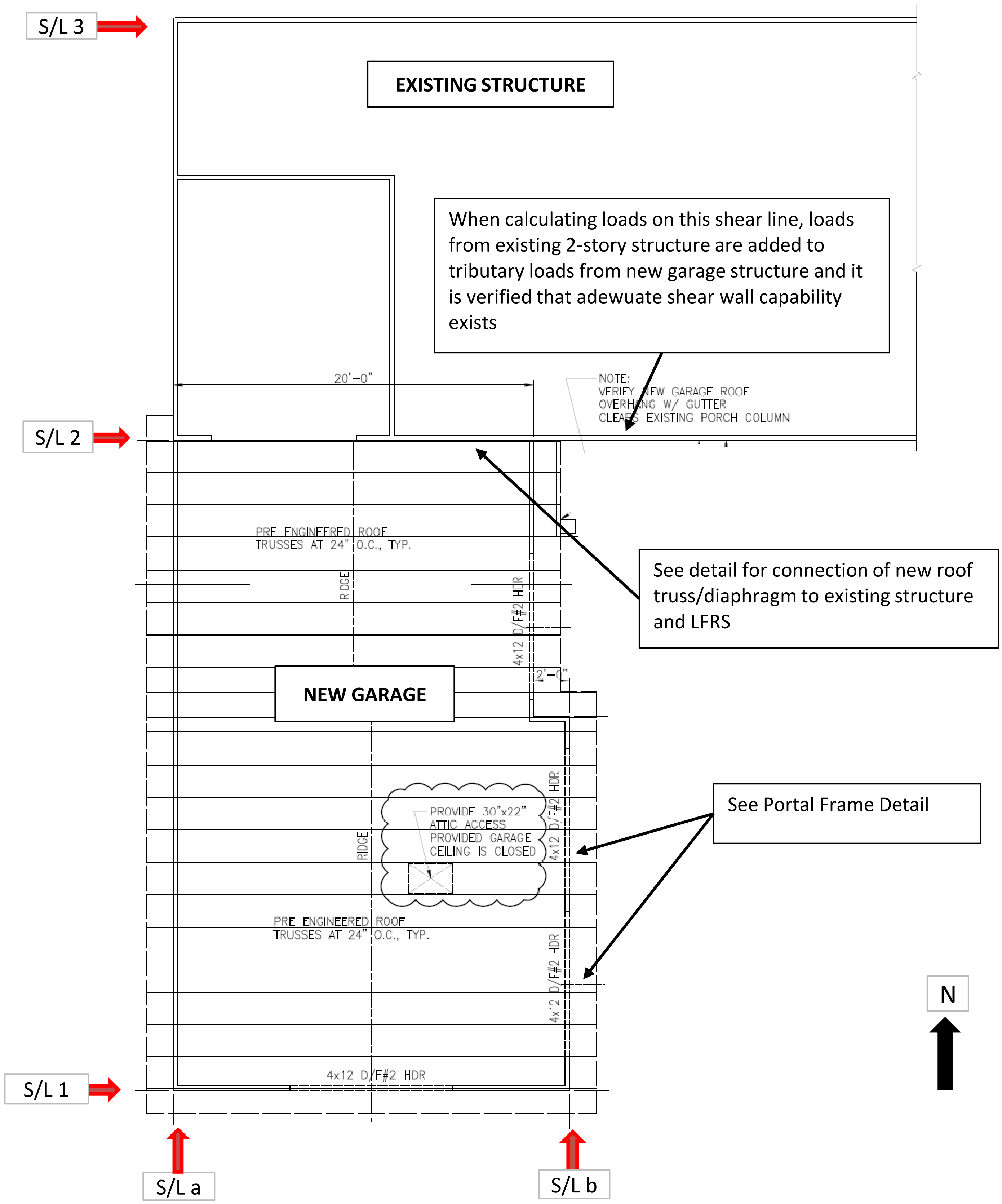
Shear Line 1 is common to only the new structure and will have no affect on the existing structure.

As was noted in the initial review comments, there is a horizontal structural irregularity of Type 2, Reentrant Corner Irregularity. This requires that forces in connections of diaphragms to vertical elements and collectors to the SFRS be increased by 25%. To account for this, the seismic loads on the structure have been globally multipled by an irregularity amplification factor of 1.25 as shown at the bottom of page 12. Per Table 12.6-1 of ASCE 7, the Equivalent Lateral Force Procedure for analysis is still acceptable with a Type 2 irregularity.

Additional items from the previous review related to the structural design are addressed below:

- Provide a detail where the new roof meets existing structure. Provide load path to LFRS
  - Detail has been provided based on load magnitudes in the following analysis
- Verify that tributary load from calculated lateral forces can be resolved to existing structure.
  - the analysis approach for this was described above and is further demonstrated in the analysis on the following pages
- Provide detail showing how portions of thestructure are interconnected in accordance with ASCE 12.1.3, SDPWS Section 4.1.4, ASCE 7-10 Section 12.10.1
  - See following analysis and sketches provided
- Wind load has been evaluated for a basic wind speed of 110 mph
- Lateral design for new garage is provided:
  - includes a detail for the portal frames at garage doors
  - wind load includes a speed up factor, Kzt, of 1.6 per reviewer comment

Introduction



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Seismic Loads

Ref.: Default Values

Site Class: D

Site Classification, Ref. ASCE 7, Chapter 20

Site	Description	Site	Description
A	Hard rock	D	Stiff soil
B	Rock	E	Soft clay soil
C	Very dense soil and soft rock	F	Soils requiring site response analysis

Note: Typically, Site Class "D" can be assumed if no soils report is available, Ref. ASCE 7 Section 11.4.2

Latitude and Longitude of Site

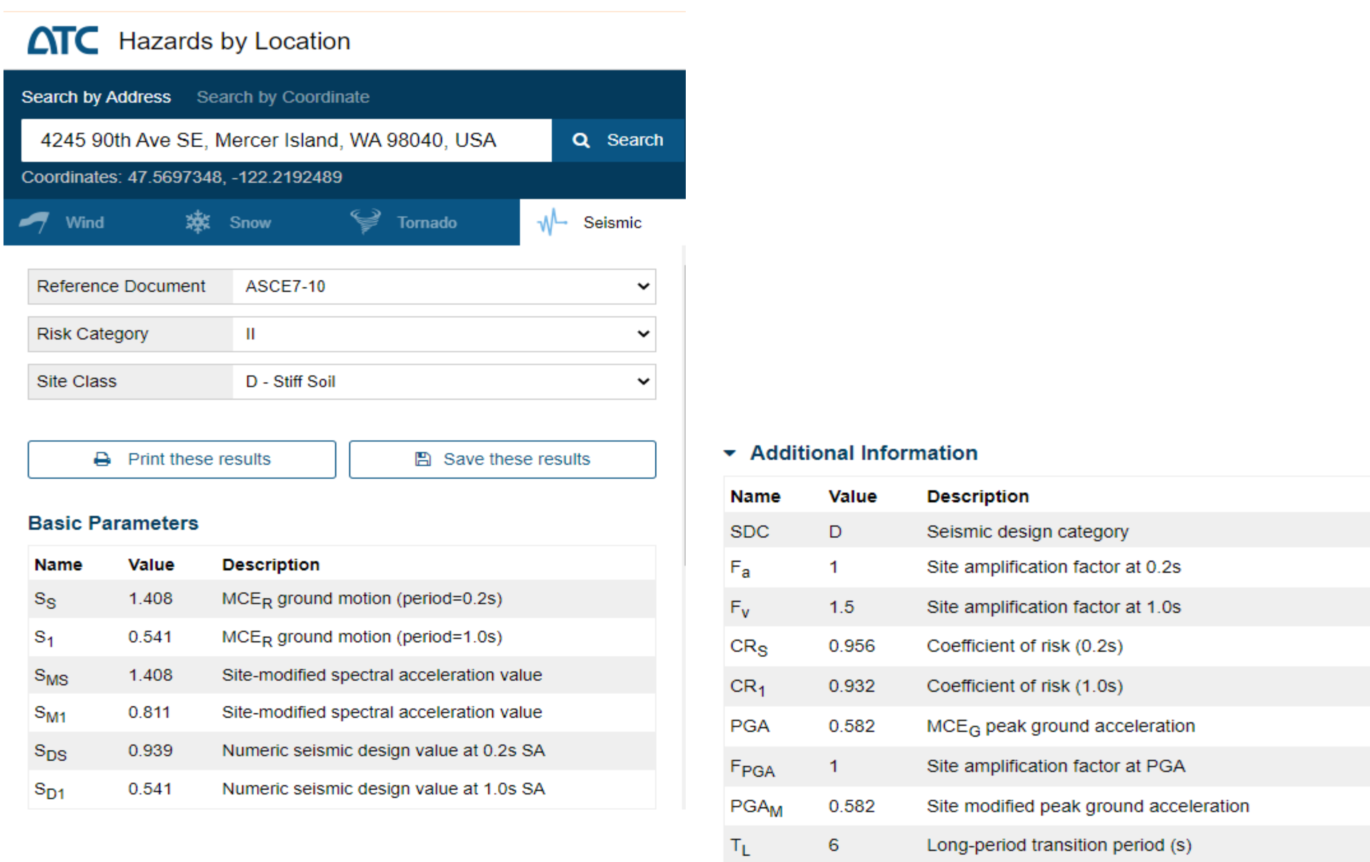
Site: 4245 90th Ave SE
Mercer Island, WA

Latitude: 47.56973 °
Longitude: -122.21925 °

Site-Specific Seismic Parameters: (or use data from Geotech Report)

Ref.: http://earthquake.usgs.gov/hazards/designmaps/

Code: 2010 ASCE 7 (w/March 2013 errata)



ATC Hazards by Location

Search by Address | Search by Coordinate

4245 90th Ave SE, Mercer Island, WA 98040, USA — Search

Coordinates: 47.5697348, -122.2192489

Wind | Snow | Tornado | Seismic

Reference Document	ASCE7-10
Risk Category	II
Site Class	D - Stiff Soil

Print these results | Save these results

Basic Parameters

Name	Value	Description
S_S	1.408	MCE_R ground motion (period=0.2s)
S_1	0.541	MCE_R ground motion (period=1.0s)
S_{MS}	1.408	Site-modified spectral acceleration value
S_{M1}	0.811	Site-modified spectral acceleration value
S_{DS}	0.939	Numeric seismic design value at 0.2s SA
S_{D1}	0.541	Numeric seismic design value at 1.0s SA

Additional Information

Name	Value	Description
SDC	D	Seismic design category
F_a	1	Site amplification factor at 0.2s
F_v	1.5	Site amplification factor at 1.0s
CR_S	0.956	Coefficient of risk (0.2s)
CR_1	0.932	Coefficient of risk (1.0s)
PGA	0.582	MCE_G peak ground acceleration
F_{PGA}	1	Site amplification factor at PGA
PGA_M	0.582	Site modified peak ground acceleration
T_L	6	Long-period transition period (s)

Spectral Response Acceleration Parameters:

short period:	S_s =	1.408	g
1 sec period:	S_1 =	0.541	g
Transition period:	T_L =	6	sec

< Long Period transition period, Ref. ASCE 7, Fig. 22-12

Seismic Loads

Seismic Parameters:

Select	Risk Category:	Non substantial risk to human life		II	Ref. ASCE 7 Table 1.5-1
I_e =	Seismic Importance Factor	for Risk Category II	$I_{e,Risk}$ =	1.00	Ref. ASCE 7 Table 1.5-2
	Site Class			D	Ref. previous page
S_S =	Spectral Response Accel Param, short period		S_S =	1.408 g	Ref. previous page
S_1 =	Spectral Response Accel Param, 1 sec period		S_1 =	0.541 g	Ref. previous page
F_a =	Site Coefficient	(based on S_s and Site Class)	F_a =	1	Ref. ASCE 7 Table 11.4-1
F_v =	Site Coefficient	(based on S_1 and Site Class)	F_v =	1.5	Ref. ASCE 7 Table 11.4-2
S_{MS} =	MCE_R Spectral Response, short period		$S_{MS} = F_aS_S$ =	1.408	Ref. ASCE 7 Eqn. 11.4-1
S_{M1} =	MCE_R Spectral Response, 1 sec period		$S_{M1} = F_vS_1$ =	0.8115	Ref. ASCE 7 Eqn. 11.4-2
S_{DS} =	Design Spectral Response, short period		$S_{DS} = 2/3*S_{MS}$ =	0.939	Ref. ASCE 7 Eqn. 11.4-3
S_{D1} =	Design Spectral Response, 1 sec period		$S_{D1} = 2/3*S_{M1}$ =	0.541	Ref. ASCE 7 Eqn. 11.4-4
	Seismic Design Category	based on S_{DS}: D		D	Ref. ASCE 7 Table 11.6-1,2
	(A = low, F = High)	based on S_{D1}: D	(use worst case)		

Seismic Coefficients: Ref. ASCE 7, Table 12.2-1

Can be different in X & Z directions.

		X		Z	
	Structure Type	Building Structure			
	Description:	Light Framed Wood Shear Walls		Light Framed Wood Shear Walls	
R =	Response Modification Factor:	R_x =	6.50	R_z =	6.50
Ω_0 =	Overstrength Factor:	$\Omega_{0,x}$ =	3.00	$\Omega_{0,z}$ =	3.00
C_d =	Deflection Amplification Factor:	$C_{d,x}$ =	4.00	$C_{d,z}$ =	4.00

N = Number of Stories = N = 1

Seismic Loads

Calculate Fundamental Period of Strucure:

h_n =	Highest point on structure	15.5	Ft.
Cu =		1.4	Ref ASCE 7 Table 12.8-1
C_t =	for "all other structural systems"	0.02	Ref ASCE 7 Table 12.8-2
x =	for "all other structural systems"	0.75	Ref ASCE 7 Table 12.8-2
T_a =	Approx Period = $(C_t)\ (h_n^x)$ =	0.16	Ref ASCE 7 Eq 12.8-7
T_{max} =	Maximum Period = (Cu) (Ta) =	0.22	Ref ASCE 7 Sec 12.8.2
T =	Period = greater of T_{max} and T_a	0.22	
T_o =	$(0.2)\ (S_{D1} / S_{DS})$ =	0.12	Ref ASCE 7 Sec 11.4.5
T_S =	(S_{D1} / S_{DS}) =	0.58	
T_L =	Long Transition Period	6	Ref. ASCE 7, Fig. 22-12

Design Spectral Response Acceleration:

S_a =	Design Spectral Response Acceleratic	0.94	Ref ASCE 7 Sec 11.4.5

Seismic Design Procedure:

Seismic Design Category = D
Risk Category = II
Structure Type is Light Framed Wood Shear Walls
Number of Stories = 1

Based on these conditions, from Table 12.6-1:
Equivalent Lateral Force Procedure is Acceptable

Determine C_s:

$$C_s = \frac{SDS}{R / I_{seismic}} = 0.144$$

C_{sMax} = 0.381 Ref ASCE 7 Eq 12.8-3 and 12.8-4
C_{sMin} = 0.041 Ref ASCE 7 Eq 12.8-5 and 12.8-6

Governing Value for Cs = 0.144

Seismic Base Shear = V = C_s x W

For Allowable Stress Procedure (ASD), Fs = 0.7 x Cs = 0.101
Seismic Base Shear = $0.7C_s$ x W

Seismic Loads

Shear wall loads

S/W Designation	Allowable Load Lb. / Ft.	
P1-6	242	
P1-4	353	
P1-3	456	
P1-2	595	
P2-6	484	
P2-4	707	
P2-3	911	
P2-2	1190	

Calculated Shear Wall values from SDPWS:

a) use lower values for Seimic
b) Use values for 15/32" structural panels per Footnote 2
c) Assume Hem-fir #2 framing with G = 0.43 per Footnote 3

Wall Type	Tabulated Value (Table 4.3A)	Tabulated Value x 0.5 x 0.93	
P1-6	520	242	
P1-4	760	353	
P1-3	980	456	
P1-2	1280	595	
P2-6	1040	484	See Section 4.3.3.3
P2-4	1520	707	See Section 4.3.3.3
P2-3	1960	911	See Section 4.3.3.3
P2-2	2560	1190	See Section 4.3.3.3

Seismic Vertical Load Dist

Determine Seismic Weight:

Level	Area	Roof	Floor	Ext Wall	Int Wall	Total
	Ft^2	Lb.	Lb.	Lb.	Lb.	Lb.
Upper	2100	14520	0	7480	918	22918
Main	1850	4100	14520	3740	459	22819
Lower						

Total Seismic weight 45737

Seismic Base Shear = 0.7(Cs)(W) = 0.7(0.144)(W) = 4623.4

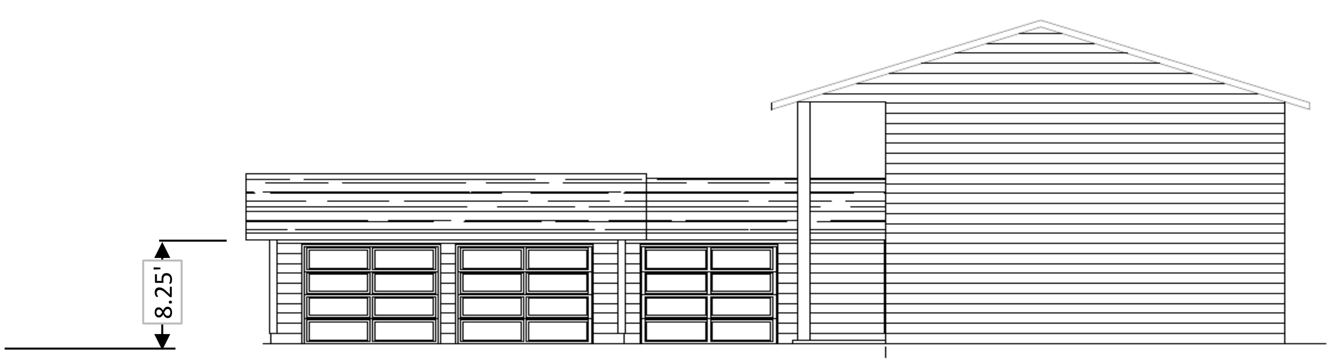
VERTICAL DISTRIBUTION OF SEISMIC FORCE

Level	w_x	h_x	$w_x h_x^k$	C_{vx}	F_x
Upper	22918	8.5	194803	1.000	4623.4
Main	22819	0	0	0.000	0.0
Lower	0	0	0	0.000	0.0
SUM =	45737		194803		4623.4

k = 1 for T < 0.5

$$C_{vx} = \frac{w_x h_x^k}{\sum_{i=1}^{n} w_i h_i^k}$$

$$F_x = C_{vx} V$$



Wind Parameters

Use Directional Procedure per ASCE 7 Chapter 27

Per Section 27.4.6, for buildings meeting the requirements of Appendix D, paragraph D1.1, only Case 1 and 3 of Figure 27.4-8 need to be considered. Additionally, for flexible diaphragm structure, Case 1 will govern for shear wall design. Therefore, only Case 1 is considered.

Basic Wind Parameters:

	Risk Category:	Non substantial risk to human life	II	ASCE 7 Table 1.5-1
I_w =	Wind Importance Factor	for Risk Category II	1.00	ASCE 7 Table 1.5-2
	Exposure		B	
V =	Basic Wind Speed		110	ASCE 7 Figure 26.5-1
K_{zt} =	topographic factor		1.60	Per plan reviewer comment
K_d =			0.85	ASCE 7 Table 26.2-1
G =	Gust Factor		0.85	ASCE 7 Sec 26.9.1 & 26.9.2
G_{cpi} =	Site Coefficient (positive & Negative)		0.18	ASCE 7 Table 26.11-1

Story Heights:

0		6.5	Ft., Roof Height
0		11.75	Ft. Mean Roof Height
8.5	Ft., Main Floor		

Wind Pressure:

z = $\frac{\text{Upper Floor} + \text{Main} + \text{Lower}}{2}$ = 4.25 Ft. = Mean wall height at upper floor

z_g = 1200 from Table 26.9-1

α = 7 from Table 26.9-1

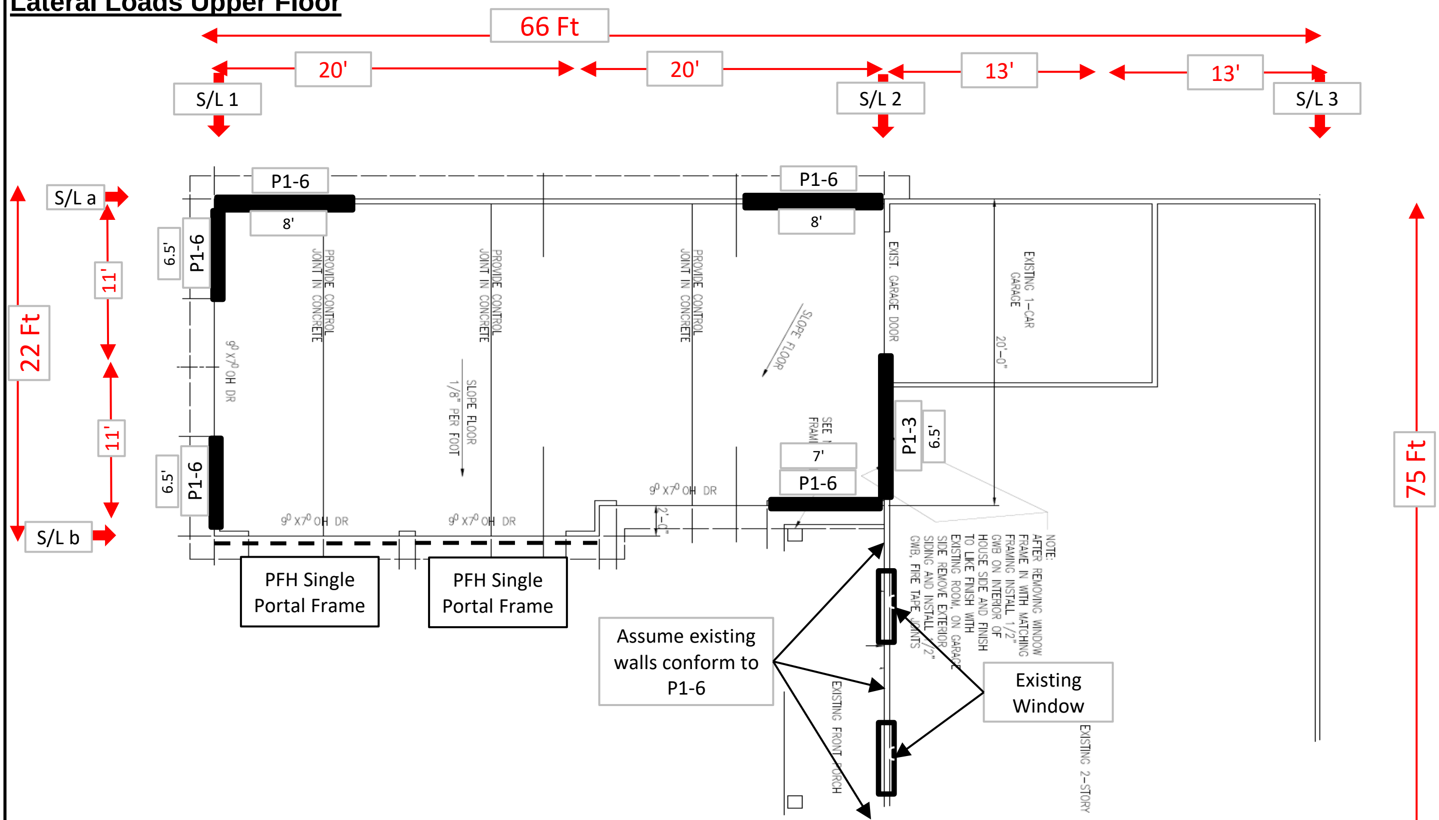
$K_z = 2.01 \times (z / z_g)^{(2/\alpha)}$ = 0.401

$K_h = 2.01 \times (h / z_g)^{(2/\alpha)}$ = 0.536

$q_z = 0.00256(K_z)(K_{zt})(K_d)(V^2)$ = 16.89

$q_h = 0.00256(K_h)(K_{zt})(K_d)(V^2)$ = 22.58

Lateral Loads Upper Floor



Upper Floor Plan

Determine seismic weights per Shear Line (S/L):

Longitudinal Overall Length =	66	Ft
Transverse Overall Width =	22	Ft

Dead Load for Floor & Roof weight calculations =	10	psf
Dead Load for Exterior Wall weight calculations =	10	psf
Dead Load for Interior Wall weight calculations =	8	psf

Tributary Widths		
S/L a	11	Ft
S/L b	11	Ft
S/L c	0	Ft
S/L d	0	Ft
S/L 1	20	Ft
S/L 2	33	Ft
S/L 3	13	Ft
S/L 4	0	Ft

SEISMIC WEIGHTS AND FORCE UPPER FLOOR

S/L	Roof Area x 10	Floor (above) Area x 10	Exterior Walls = Lngth x Story Ht x 10	Interior Walls
a	7260	0	7480	1836
b	7260	0	7480	0
c	0		0	0
d	0		0	0
TOTAL	14520	0	14960	1836

Seismic Load Upper Floor = 4623.42

$$\text{Force per S/L} = \rho F_{upper} \times A \times \frac{\text{Trib L}}{\text{Total L}}$$

SEISMIC LOAD PER S/L

Longitudinal		Transverse	
a	2889.64	1	1751.3
b	2889.64	2	4027.64
c	0	3	2276.34
d	0	4	0

Rho = 1 for Upper Floor Longitudinal — **A =** 1.25 Irregularity amplification factor

Rho = 1 for Upper Floor Transverse — **A =** 1.25 Irregularity amplification factor

Lateral Loads Upper Floor

WIND LOAD Cp FACTOR

LONGITUDINAL DIRECTION Parallel to Ridge

WALLS			ROOF				
L / B	**Cp** Windward	**Cp** Leeward	**h / L**	**Pitch** inch/Ft	**Angle** Deg	**Cp** Windward	**Cp** Leeward
66/22= 3.0	0.8	-0.2	11.75/66= 0.2	4	18.43	-0.5	-0.18

TRANSVERSE DIRECTION Normal to Ridge

22/66= 0.3	0.8	-0.5	11.75/22= 0.5	4	18.43	-0.4	-0.6

CALCULATED WIND PRESSURE

LONGITUDINAL DIRECTION Parallel to Ridge

Windward Wall	Leeward Wall	**Total Wall** Windward - Leeward	**Windward Roof**	**Leeward Roof**	Total Roof Horiz Comp
(qzGCp) - (qhGcpi)	(qhGCp) - (qhGcpi)	15.32	(qhGCp) - (qhGcpi)	(qhGCp) - (qhGcpi)	-11.28

TRANSVERSE DIRECTION Normal to Ridge

(qzGCp) - (qhGcpi)	(qhGCp) - (qhGcpi)	21.08	(qhGCp) - (qhGcpi)	(qhGCp) - (qhGcpi)	-6.81

GOVERNING WIND LOAD - COMPARE CALCULATED PRESSURE W/ MINIMUM ALLOWED

LONGITUGINAL	Wall	16.0	Min per 27.4-1	**TRANSVERSE**	Wall	21.1	
	Roof	8.0	Min per 27.4-1		Roof	8.0	Min per 27.4-1

WIND LOADS PER SHEAR LINE

S/L	TRIBUTARY WIDTH	STORY HEIGHT	WALL WIND LOAD =W x Hw x Pw	ROOF WIND LOAD =W x Hr x Pr	**TOTAL** = (0.6)W *
a	11	8.5	1496.0	572	1,240.8
b	11	8.5	1496.0	572	1,240.8
c	0	8.5	0.0	0	0.0
d					
				Total Longitudinal Wind Load =	2,481.6

1	20	8.5	3583.4	1040.0	2,774.1
2	33	8.5	7680.7	1716.0	5,638.0
3	13	8.5	4097.2	676.0	2,863.9
4	0	8.5	0.0	0.0	0.0
				Total Transverse Wind Load =	11,276.0

* Per Load Case 6 in ASCE 7 Max wind load considered = 0.6W

COMPARING SEISMIC AND WIND LOADS:

Longitudinal Direction: SEISMIC GOVERNS

Transverse Direction: WIND GOVERNS

Governing loads per shear line:

S/L	LOAD		S/L	LOAD
a	2,890		1	2,774
b	2,890		2	5,638
c	0		3	2,864
d	0		4	0

Wall Aspect Ratio

Min Allowed Wall Length = 8.5/3.5 = 2.4 Ft

For walls < 8.5/2 = 4.3 Ft, Strength reduction =:

(2b)/h per SDPWS 4.3.4.3

For L =	3.5	➡	0.82
For L =	4	➡	0.94
For L =	3	➡	0.71

Lateral Loads Upper Floor

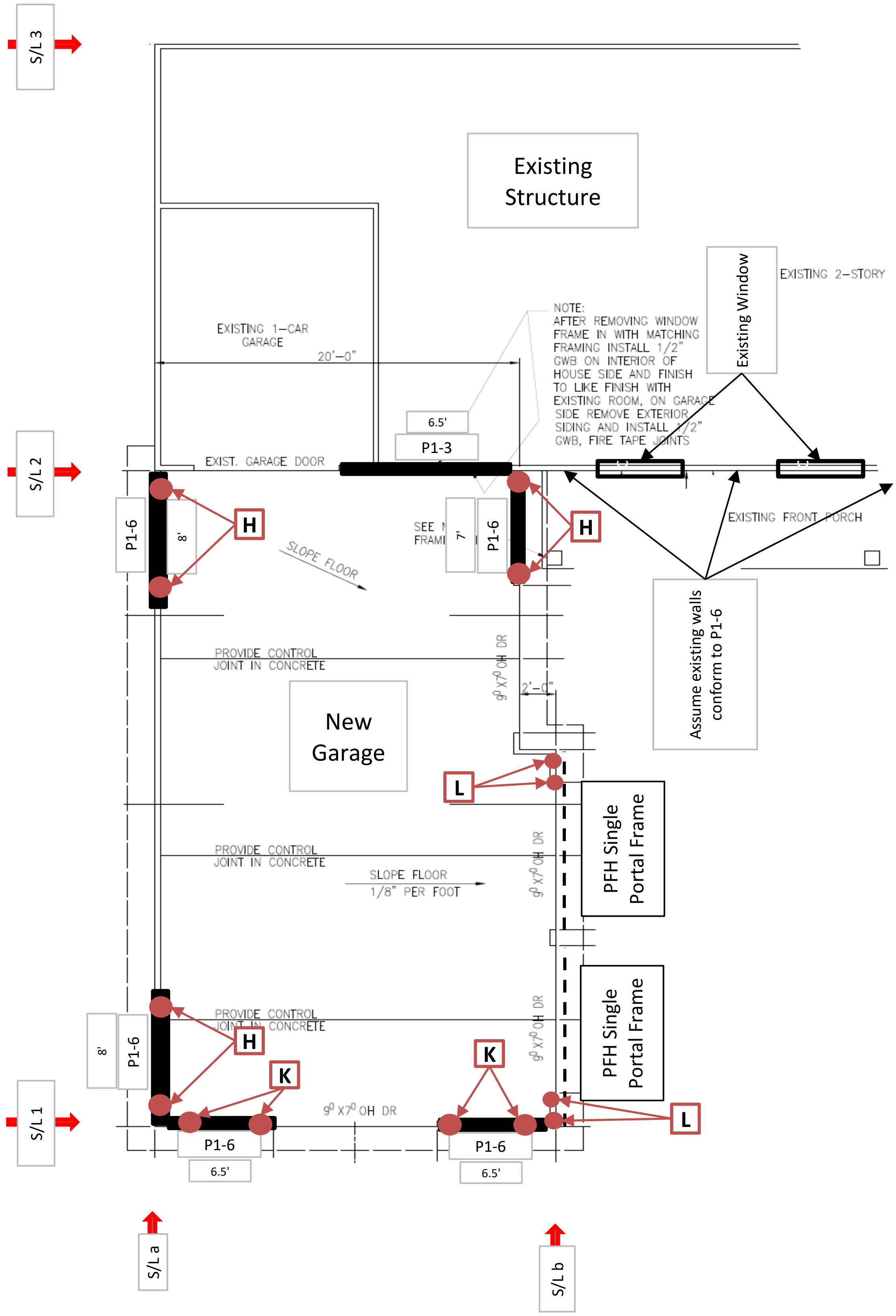
UNIT LATERAL LOADS PER S/L				
S/L	S/W LENGTHS (ft)	TOTAL (ft.)	UNIT LOAD (plf)	S/W TYPE
a	8' + 8'	16	180.60	P1-6
b	7' + 4'* + 4'*	39.5	73.16	P1-6
c				
d				
	* PFH Single Portal Frame is equivalent to 4' Shear Wall			
1	6.5' + 6.5'	13	213.39	P1-6
2	9.5' + 3'+5.5'+8.75'+8.75'+5.5'+3.5'	44.5	126.70	P1-6
3	Not in Scope of Addition			
4				

CALCULATE SHEAR WALL UPLIFT & HOLD-DOWNS

For resisting weight use 10 psf x 60% = 6 psf (60% of dead load resists overturning)

S/L	WALL LENGTH	WALL WEIGHT*	WALL HEIGHT	UPLIFT (Unit Load x L)(H) - (Weight)(L / 2)	HOLD-DOWN TYPE
a	8	912	8.5	1079.1	LSTHD8 (1695#)
	8	912	8.5	1079.1	LSTHD8 (1695#)
b	7	798	8.5	222.8	LSTHD8 (1695#)
	4	456	8.5	See portal Frame Detail	
	4	456	8.5	See portal Frame Detail	
c					
1	6.5	325	8.5	1651.3	STHD10 (3725#)
	6.5	325	8.5	1651.3	STHD10 (3725#)
2	9.5	1653	8.5	250.4	No Holddown Req'd
3	Not in Scope of Addition				

Lateral Sketches



UPPER FLOOR LEVEL
Showing shear walls and hold-downs

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Lateral Sketches

SHEAR WALL SCHEDULE

DESIGNATION	NAIL SIZE	NAIL SPACING EDGE	NAIL SPACING FIELD	BLOCKING Y / N	BOTTOM PLATE ANCHORAGE	DESIGN LOAD (PLF)
P1-6	8d	6"	12"	YES	(2) 16d AT 6" O.C. OR 5/8" BOLTS AT 32" O.C.	242
P1-4	8d	4"	12"	YES	(2) 16d AT 6" O.C. OR 5/8" BOLTS AT 24" O.C.	353
P1-3	8d	3"	12"	YES	(3) 16d AT 5" O.C. OR 5/8" BOLTS AT 24" O.C.	456
P1-2	8d	2"	12"	YES	(3) 16d AT 5" O.C. OR 3/4" BOLTS AT 24" O.C.	595
P2-6	8d	6"	12"	YES	(2) 16d AT 5" O.C. OR 5/8" BOLTS AT 24" O.C.	484
P2-4	8d	4"	12"	YES	(3) 16d AT 5" O.C. OR 3/4" BOLTS AT 24" O.C.	707
P2-3	8d	3"	12"	YES	(4) 16d AT 5" O.C. OR 3/4" BOLTS AT 20" O.C.	911
P2-2	8d	2"	12"	YES	(4) 16d AT 4" O.C. OR 3/4" BOLTS AT 16" O.C.	1190

SHEAR WALL SCHEDULE NOTES

1. P1 SHEAR WALL TO HAVE 7/16" A.P.A. RATED PLYWOOD OR ORIENTED STRAND BOARD (O.S.B.) ON ONE SIDE
   P2 SHEAR WALL TO HAVE 7/16" A.P.A. RATED PLYWOOD OR ORIENTED STRAND BOARD (O.S.B.) ON BOTH SIDES
2. FOR P1-3 THROUGH P2-4 WALLS, 3X STUDS ARE REQUIRED AT ALL PANEL EDGES
3. NAILS ARE COMMON IN THE SIZE INDICATED
4. FOR DOUBLE SIDED SHEAR WALLS (P2-X), SEAMS SHALL BE STAGGERED ON EACH SIDE (NO TWO SEAMS ON SAME STUD).
5. PANEL EDGES TO BE BLOCKED WITH FULL WIDTH 2X NOMINAL FRAMING FOR P1-6 AND P1-4 WALLS. PANEL EDGES FOR P1-3 THROUGH P2-4 WALLS SHALL BE BLOCKED WITH 3X NOMINAL FRAMING. PANELS MAY BE INSTALLED EITHER VERTICALLY OR HORIZONTALLY.
6. ANCHOR BOLTS SHALL BE EMBEDED IN CONCRETE A MINIMUM OF 7", AND SHALL BE INSTALLED WITH 3" SQUARE X 0.229" WASHERS.

KEY TO LATERAL ENGINEERING SKETCHES

Designates Hold-Down Location
See schedule on following page for hold-down type

Shear Wall Location

P#-# Shear Wall Type. See schedule for construction details

Lateral Sketches

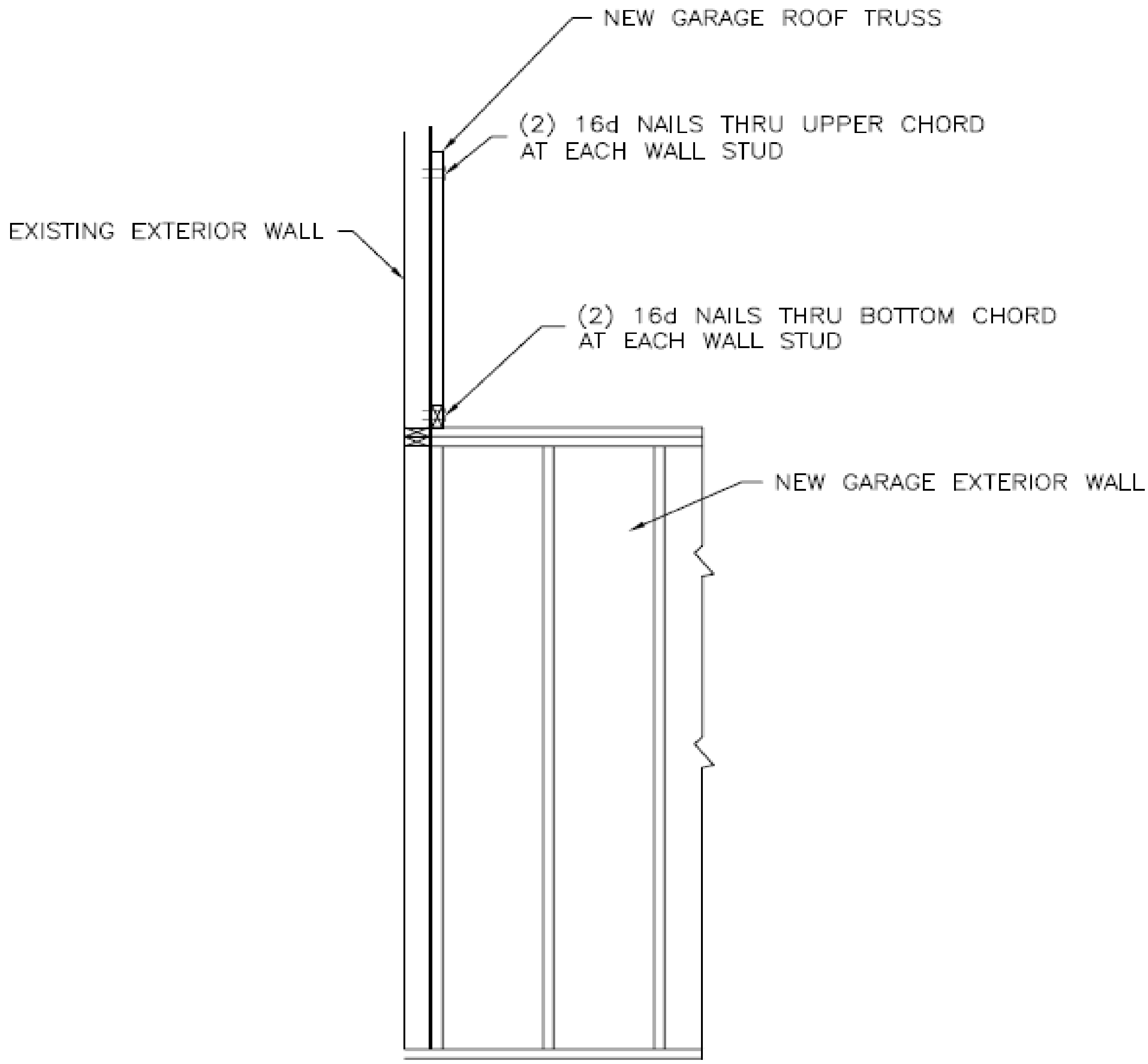
HOLDDOWN SCHEDULE

DESIGNATION	DESCRIPTION	ALLOWABLE DESIGN LOAD (lb)		
A	CMST12	9,215 (End length =44" w/ (49) 10d each end)		WOOD TO WOOD CONNECTION
B	CMST14	6,490 (End Length = 34" w/ (38) 10d each end)		
C	CS16	1,700 (End Length = 12" w/ (11) 10d each end)		
D	CS14	2,490 (End Length = 16" w/ (15) 10d each end)		
E	MST37	3,815		
F	MST48	4,460		
G	MST60	5,800		
		6" Wall	8" Wall	
H	LSTHD8	1,695	1,695	CONCRETE STRAP (Based on 2000 psi Concrete)
J	STHD8	2,345	3,195	
K	STHD10	3,185	3,725	
L	STHD14	4,805	5,785	
M	HDU2-SDS2.5	3,075		BOLTED TO CONCRETE NAILED TO STUDS
O	HDU4-SDS2.5	4,565 (5/8" bolt)		
P	HDU5-SDS2.5	5,645 (5/8" bolt)		
Q	HDU8-SDS2.5	6970 (w/ 3 1/2" thick end studs**)		BOLTED TO CONCRETE SCREWED TO STUDS
R1	HDU11-SDS2.5	9535 (w/ 5 1/2" thick end studs**)		
R2	HDU11-SDS2.5	11175 (w/ 7 1/4" thick end studs**)		
S1	HDU14-SDS2.5	14390 (w/ 7 1/4" thick end studs**)		
S2	HDU14-SDS2.5	14925 (w/ 5 1/2 x 5 1/2 thick end studs)		

** Dimension shown is in direction parallel to SDS screws. Dimension perpendicular to screws (wall thickness) is 3 1/2" minimum except for Type S2 which requires a 6x6 post

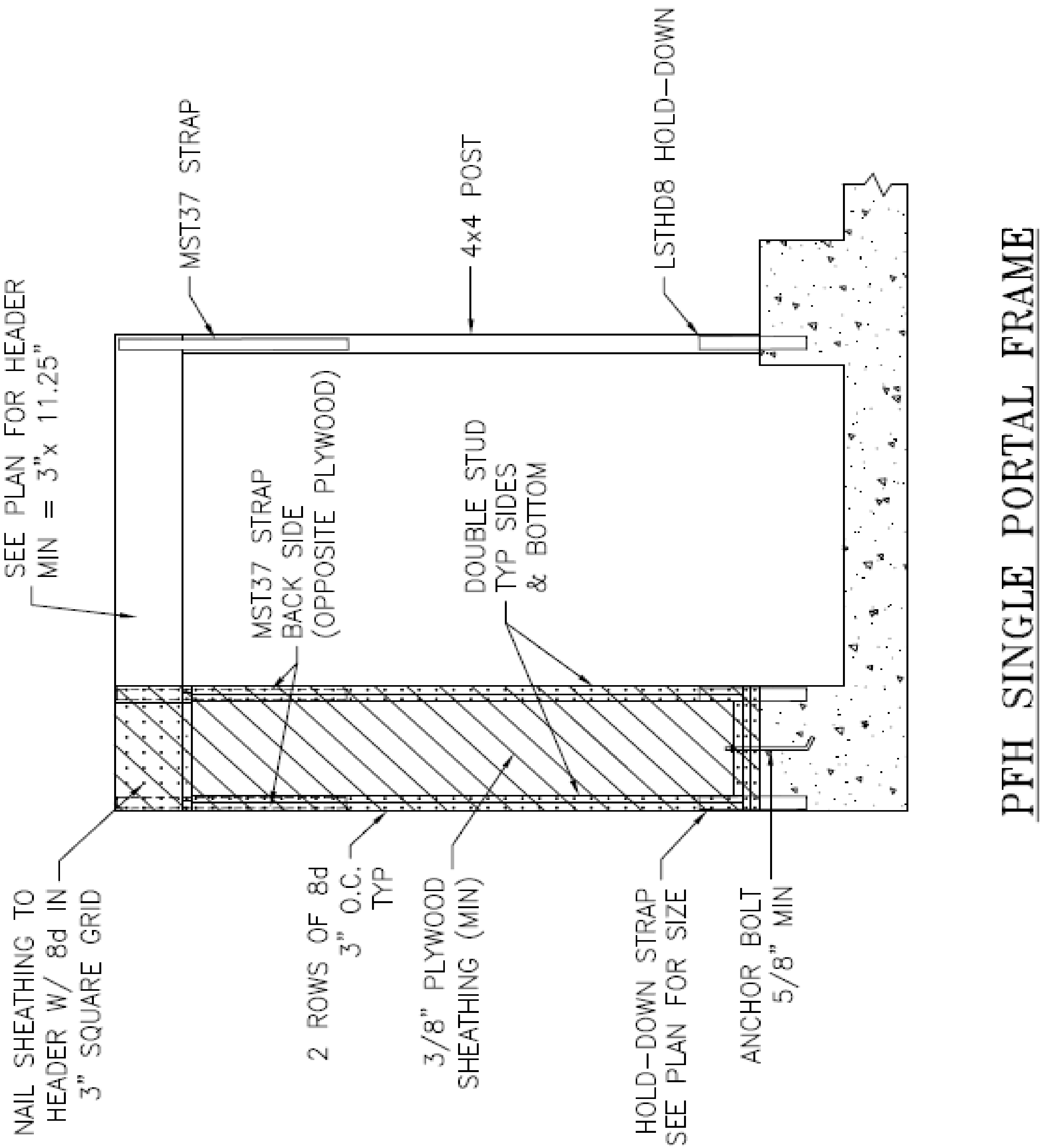
HOLD-DOWNS LISTED ABOVE ARE SIMPSON STRONG-TIE

Lateral Sketches

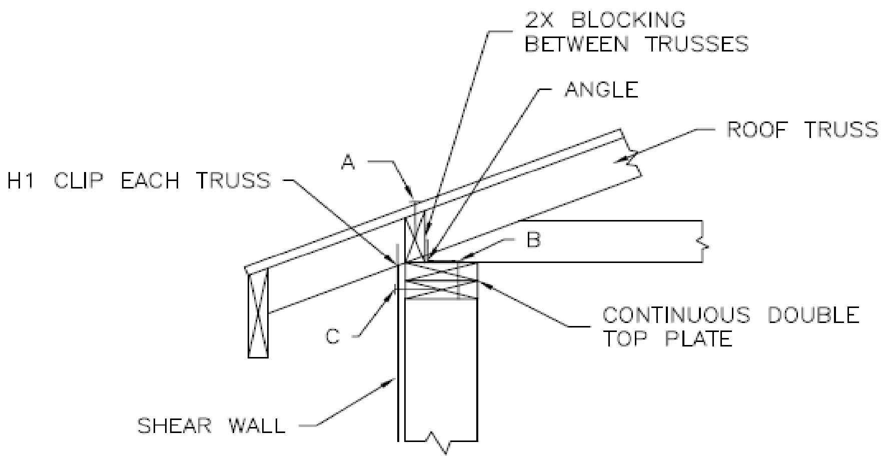


CONNECTION DETAIL
NEW ROOF TO EXISTING STRUCTURE

Lateral Sketches

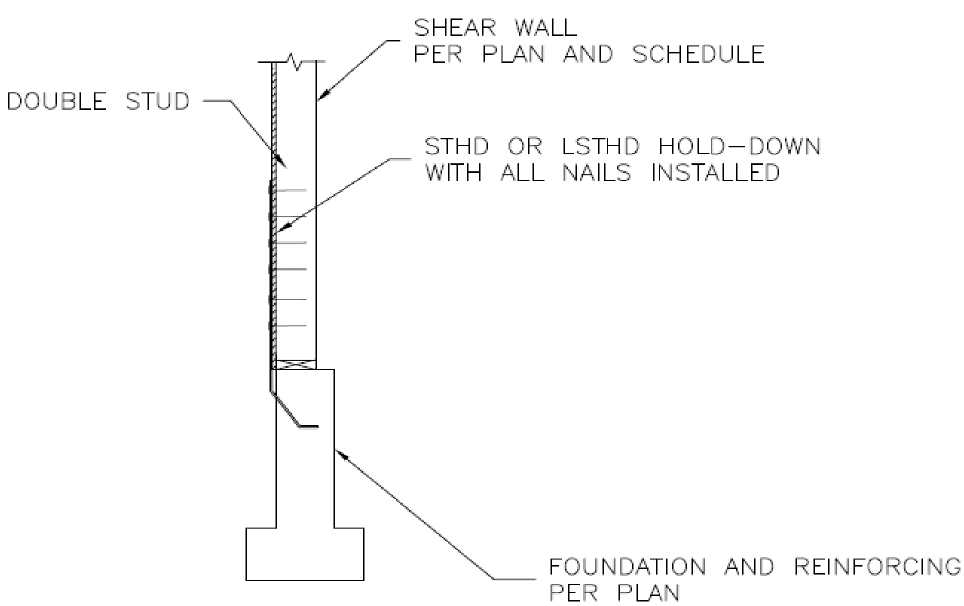


Lateral Sketches



ROOF DIAPHRAGM TO EXTERIOR SHEAR WALL

SHEAR WALL	ANGLE		NAIL					
			A		B		C	
TYPE	TYPE	SPACING	SIZE	SPACING	SIZE	SPACING	SIZE	SPACING
P1−6	A34	18"	8d	6"	10d	6"	8d	6"
P1−4	A34	12"	8d	4"	10d	4"	8d	4"
P1−3	A23	12"	8d	3"	10d	3"	8d	3"
P1−2	A23	9"	8d	2"	10d	2"	8d	2"



STHD AND LSTHD CONNECTION

RHO Calculation

Determine if Rho per ASCE 7 Section 12.3.4

Rho Calculation for Main Floor

Longitudinal Direction; Rho =	1	see following justification	Story Height =	8.5
Transverse Direction; Rho =	1	see following justification	Story Height =	8.5

For N/S direction (Shear Lines 1 and 2):

From ASCE 7 Section 12.3.4.2(b):

Each side of structure must have at least (2) bays of seismic force resisting perimeter framing.

Where # Bays present = (2x Length of Shear Wall) / Story Height:

For East Side:	$\frac{(9.5) \times 2}{8.5}$	2.2	**> 2, Use Rho =1**
For West Side:	$\frac{(6.5+6.5) \times 2}{8.5}$	3.1	**> 2, Use Rho =1**

For E/W direction (Shear Lines a and b):

For North Side:	$\frac{(8+8) \times 2}{8.5}$	3.8	**> 2, Use Rho =1**
For South Side:	$\frac{(7+4+4) \times 2}{8.5}$	3.5	**> 2, Use Rho =1**

Appendix 1

Table 12.3-1 Horizontal Structural Irregularities

Type	Description	Reference Section	Seismic Design Category Application
1a.	**Torsional Irregularity:** Torsional irregularity is defined to exist where the maximum story drift, computed including accidental torsion with $A_x = 1.0$, at one end of the structure transverse to an axis is more than 1.2 times the average of the story drifts at the two ends of the structure. Torsional irregularity requirements in the reference sections apply only to structures in which the diaphragms are rigid or semirigid.	12.3.3.4 12.7.3 12.8.4.3 12.12.1 Table 12.6-1 Section 16.2.2	D, E, and F B, C, D, E, and F C, D, E, and F C, D, E, and F D, E, and F B, C, D, E, and F
1b.	**Extreme Torsional Irregularity:** Extreme torsional irregularity is defined to exist where the maximum story drift, computed including accidental torsion with $A_x = 1.0$, at one end of the structure transverse to an axis is more than 1.4 times the average of the story drifts at the two ends of the structure. Extreme torsional irregularity requirements in the reference sections apply only to structures in which the diaphragms are rigid or semirigid.	12.3.3.1 12.3.3.4 12.7.3 12.8.4.3 12.12.1 Table 12.6-1 Section 16.2.2	E and F D B, C, and D C and D C and D D B, C, and D
2.	**Reentrant Corner Irregularity:** Reentrant corner irregularity is defined to exist where both plan projections of the structure beyond a reentrant corner are greater than 15% of the plan dimension of the structure in the given direction.	12.3.3.4 Table 12.6-1	D, E, and F D, E, and F
3.	**Diaphragm Discontinuity Irregularity:** Diaphragm discontinuity irregularity is defined to exist where there is a diaphragm with an abrupt discontinuity or variation in stiffness, including one having a cutout or open area greater than 50% of the gross enclosed diaphragm area, or a change in effective diaphragm stiffness of more than 50% from one story to the next.	12.3.3.4 Table 12.6-1	D, E, and F D, E, and F
4.	**Out-of-Plane Offset Irregularity:** Out-of-plane offset irregularity is defined to exist where there is a discontinuity in a lateral force-resistance path, such as an out-of-plane offset of at least one of the vertical elements.	12.3.3.3 12.3.3.4 12.7.3 Table 12.6-1 Section 16.2.2	B, C, D, E, and F D, E, and F B, C, D, E, and F D, E, and F B, C, D, E, and F
5.	**Nonparallel System Irregularity:** Nonparallel system irregularity is defined to exist where vertical lateral force-resisting elements are not parallel to the major orthogonal axes of the seismic force-resisting system.	12.5.3 12.7.3 Table 12.6-1 Section 16.2.2	C, D, E, and F B, C, D, E, and F D, E, and F B, C, D, E, and F

Type 2 Irregularity applies to re-entrant corner near garage. Per Section 12.3.3.4 increase loads by 25% for connections of diaphragms to vertical elements and collectors and their connections.
To account for this increase, the capacity of connection details has been increased by 25%

Type 3 Irregularity exists at large opening in 2nd floor diaphragm. Same requirements as for Type 2 apply

Type 4 Out of plane wall irregularity (longitudinal direction on upper floor).
Same requirements as for Type 2 apply

Appendix 1

From NDS (National Design Specification for Wood Structures):

Allowable Nail Shear = (Tabulated Value)(CD)(CM)(Ct)(Ctm)
= 80.1 lb. for Normal Duration
= 142.4 lb. for Earthquake Loads

Tabulated Value =	89	lb. shear for 16d
For Normal Duration: CD =	0.9	for earthquake loading per NDS 2.3.2
For Earthquake Loads: CD =	1.6	
CM =	1	Wet Service Factor
Ct =	1	Temperature Factor
Ctn =	1	Toe Nail Factor
Cg =		Group Factor (See Table 10.3.6A/B/C/D)
C∆ =		Geometry Factor
Ceg =		End Grain Factor
Cdi =	1	= 1 (except = 1.1 for nails or spikes in diaphragm construction)