STRUCTURAL CALCULATIONS

FOR THE

STERLING ESTATES RESIDENTIAL PROJECT

The Noble Fir

December 13, 2018

Job No. : 14-042
Location: Lots 1 - 46, Silverthorne
Silverdale, Washington

SEGA Engineers
Structural & Civil Consulting Engineers

22939 SE 292nd PL
Black Diamond, WA 98010
(360) 886-1017

Established Basic Permit #
19-01655

Permit Number: 20-02212

STATEMENT OF WORK

SEGA Engineers was asked to provide a lateral loads analysis, shear wall design, review of major framing members and foundation, and drawing red-lines for a two-story wood framed single family residence. The roof framing is manufactured trusses, the floor framing is 2x dimensional or wood I-joists, and the foundation is typical concrete strip footings with a crawl space.

The application and use of these calculations is limited to a single site referenced on the cover sheet. The cover sheet should have an original signature in blue ink over the seal. The attached calculations may or may not apply to other sites and the contractor assumes all responsibility and liability for sites not expressly reviewed and approved. Please contact SEGA Engineers for use at other sites.

SEGA Engineers will use that degree of care and skill ordinarily exercised under similar circumstances by members of the engineering profession in this local. No other warranty, either expressed or implied is made in connection with our rending of professional services. For any dispute, claim, or action arising out of this design, SEGA Engineers shall have liability limited to the amount of the total fee received by SEGA Engineers.

Questions regarding the attached should be addressed to SEGA Engineers.

Greg Thesenvitz, PE/SE
SEGA Engineers

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Project Noble Fir

Job No. 14-042 By: GAT

Checked Date: 06/29/16 Sht 1

Design Criteria

International Building Code (IBC), 2015

LOADS

Roof

DL	15	psf
LL	30	psf

Floor

DL	12	psf
LL	40	psf

Wind

Risk Category	II		
Design Wind Speed	110	mph	(V_{ult})
K_{zt}	1.00		
Exposure	B		

Seismic

Design Category	D	
S_{DS}	1.00	
Response Factor	6.5	
	C_S = 0.154	
Importance Factor	1.00	

Soil

Allowable Bearing	1,500	psf

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LOADS

ROOF

DL	Roofing (Comp)	3.5 psf	
	1/2" OSB	1.8	
	2 x @ 24"	3.5	
	Insulation	1.1	
	5/8" GWB	2.8	
	Misc.	1.5	
		14.2 psf	
LL	Snow, P_f	30 psf	(115% Load Duration)
	Reduction, Cs	0.00	(C_t = 1.1, other surfaces)
	5/12 pitch = 23 deg		
	Total Roof Load	44.2 psf	

FLOOR

DL	Flooring	0.5 psf	
	3/4" Plywood	2.3	
	2 x 12 @ 16" oc	3.3	
	5/8" GWB	2.8	
	Misc.	1.5	
		10.4 psf	
LL	Residential	40 psf	
	Total Floor Load	50.4 psf	

DECKS

DL	2 x Decking	4.3 psf	
	2 x 10 @ 16" oc	2.8	
	Misc	1.5	
		8.6	
LL	Residential	60 ~~40~~ psf	
	Total Deck Load	686 ~~48.6~~ psf	

WALLS

DL	Siding	3.5	
	1/2" Plywood	1.5 psf	
	2 x 6 @ 16" oc	1.7	
	Insul	0.6	
	1/2" GWB	2.2	
		9.5 psf	

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FRAMING - ROOF

HDR @ O.H. GARAGE DOOR
$L = 16'$

$w = (\frac{16'}{2})(45^{PSF}) = 1,035^{PLF}$

$M = \frac{(1.05^{K/FT})(16')^2}{8} = 33.6^{K\,FT} / 1.15 = 29.2^{K\,FT}$ 3 1/2 x 16.5 GLB ←

$V = \frac{16}{2}(1.05^{K/FT}) - (\frac{16.5}{12})(1.05^{K/FT}) = 6.95^{K} / 1.15 = 6^{K}$ OK

$\frac{E\Delta}{I_{1240}} = 0.45(1.05^{K/FT})(16')^3 = 1,935 \times 10^3\ K/IN^2$ OK

HDR @ O.H. GARAGE DOOR (ATTIC TRUSS OPTION)
$L = 16\ FT$

$w = 1,035^{PLF} + (\frac{15}{2})(40^{PSF}) = 1,335^{PLF}$

$M = \frac{(1.335^{PLF})(16')^2}{8} = 43^{K\,FT} / 1.15 = 38^{K\,FT}$ 5 1/2 x 15 GLB

$V = \frac{16}{2}(1.35^{K/FT}) - (\frac{15}{12})(1.35^{K/FT}) = 9.1^{K} / 1.15 = 7.9^{K}$ OK

$\frac{E\Delta}{I_{1240}} = 0.45(1.35^{K/FT})(16')^3 = 2,488 \times 10^3\ K/IN^2$ OK.

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FRAMING - UPPER FLOOR

FLOOR Bm @ DIN. RM. / LIV. RM

$L = 19.5'$

$w = (\frac{16}{2})(50\,psf) + 100\,plf + (\frac{14}{2})(45\,psf) = 815\,plf$ (SIM @ OPTION)

$M = \frac{(0.82\,k/ft)(19.5')^2}{8} = 39\,k\text{-}ft / 1.15 = 34\,k\text{-}ft$ 5 1/2 x 15 GLB

$V = \frac{19.5'}{2}(0.82\,k/ft) = 8k$

$\frac{E\Delta}{L/240} = 0.45(0.82\,k/ft)(19.5')^3 = 2,736 \times 10^3\,k\text{-}in^2$ OK

FLUSH Bm @ DIN. RM (OPTIONAL UPPER)

$L = 14'$

$w = (\frac{19.5}{2})(45\,psf) + 100\,plf = 540\,plf$

$M = \frac{(0.55\,k/ft)(14')^2}{8} = 13.5\,k\text{-}ft$ 5 1/2 x 10.5 GLB ←

$V = \frac{14}{2}(0.55\,k/ft) = 3.9k$ OK

$\frac{E\Delta}{L/240} = 0.45(0.55\,k/ft)(14')^3 = 679 \times 10^3\,k\text{-}in^2$ OK

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Square Footing Design

Ftg Dining Room / Living Room

Design Parameters

f'_c = 2,500 psi Fy = 40,000 psi All. q = 1,500 psf

b = 6.0 in - short side of column
d = 6.0 in - long side of column

Loads:

Col DL = 2.5 kip (Service Load)
Col LL = 10.5 kip (Service Load)
Floor LL = 0 psf
Overburden = 0.0 in (120 pcf assumed)
Slab Thick. = 0.0 in (150 pcf assumed)

Size and Footing Pressure

h = 8.0 in ← Ftg. Thickness
q_n = 1.40 ksf

Req'd Area = 9.29 ft^2

Try 3.05 ft x 3.05 ft ← Min. Ftg. Size

Factored Net Soil Pressure = 2.13 ksf (1.2D + 1.6L)

Check for Two-Way Shear

Avg d = 4.00 in
V_u = 18.32 kips
b_o = 40.00 in (Critical Shear Perimeter)
B_c = 1 (Long Side/Short Side of Column)
phi V_c = 27.20 kips

Phi V_c > V_u OK

Check for One-Way Shear

V_u = 6.124 kips
Phi V_c = 12.44 kips

Phi V_c > V_u OK

Design Reinforcement

M_u = 5.29 kip-ft
A_s = 0.53 in^2 Use (3) - # 4 bars EW ← Reinforcement
a = 0.27 in 0.59 in^2
Phi M_n = 5.77 kip-ft

Phi M_n > M_u OK
A_s min = 0.53 in^2 OK

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LATERAL LOADS - (Alternate ASD)

SEISMIC

Maximum Base Shear, $V = \frac{F\ S_{DS}\ W}{R}$ Eq. 12.14-11

where,

F = 1.1 Two-Story Building

S_{DS} = 1.00 S_S = 1.5 Fa = 1.00 (Table 11.4-1, S_s > 1.25)

R = 6.5 Table 12.14-1

W = Seismic Weight

For W:

W_{roof} = (20 ft) (45 ft) (16 psf) + (2) (20 ft + 45 ft) (4.0 ft) (9.5 psf) = 19 kips

W_{floor} = (40 ft) (46 ft) (14 psf) + (2) (40 ft + 46 ft) (8.5 ft) (9.5 psf) = 40 kips

W_{total} = 59 kips

Design Base Shear , V = (.169) (59 kip) = 10.0 kip

$E = \frac{10.0\ kip}{1.4}$ = 7.1 kip

WIND

Design Wind Pressure, $p_s = \lambda\ K_{zt}\ p_{s30}$ Eq. 28.6-1, Sect. 28.6.3

where,

λ = 1.00 0 - 15 ft Exposure B Figure 28.6-1

= 1.00 20 ft

= 1.00 25 ft

K_{zt} = 1.00 Section 26.8

p_{30} = 17.7 psf 110 mph Figure 28.6-1 (ASD)

P_{0-15} = (1.00) (1.00) (17.7 psf) = 17.70 psf (x 0.6 = 10.62 psf)

P_{20} = (1.00) (1.00) (17.7 psf) = 17.70 psf (x 0.6 = 10.62 psf)

P_{25} = (1.00) (1.00) (17.7 psf) = 17.70 psf (x 0.6 = 10.62 psf)

Design Base Shear: (Wind)

$V_{f/b}$ = (40 ft) (10 ft) (17.7 psf) + (40 ft) (5 ft) (17.7 psf)

+ (40 ft) (3 ft) (17.7 psf) =12.7 x 0.6 = 7.6 kips

$V_{s/s}$ = (46 ft) (10 ft) (17.7 psf) + (46 ft) (5 ft) (17.7 psf)

+ (45 ft) (3 ft) (17.7 psf) =14.6 x 0.6 = 8.8 kips

Therefore,

Wind Loads Govern for Lateral Design - Front/Back
Wind Loads Govern for Lateral Design - Side/Side

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PROJECT NOBLE FIR - 3 CAR
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SHEAR WALL DESIGN

SHEAR WALL #1

ROOF:

$V_R = (\frac{40}{2})[(3')(10.0^{PLF}) + (5')(10.0^{PLF})] = 1,696^{\#}$

$l = 4.5' + 13.5' + 4' = 22^{FT}$

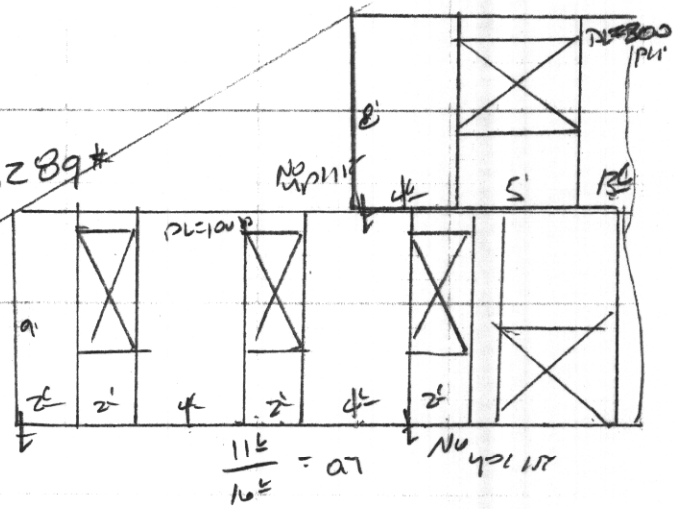
$q = 1,696^{\#} / 22' = 77^{PLF}$ (A)

FLOOR:

$V_F = 1,696^{\#} + (\frac{40}{2})(10')(40.0^{PSF}) = 2,289^{\#}$

$l = 2.5' + 4.5' + 4.5' + 4.5' + 4.5' + 2.5' = 23'$

$q = 2,289^{\#} / 23'' = 100^{PLF}$ (A)



SHEAR WALL #2

ROOF:

$V_R = 2,289^{\#}$

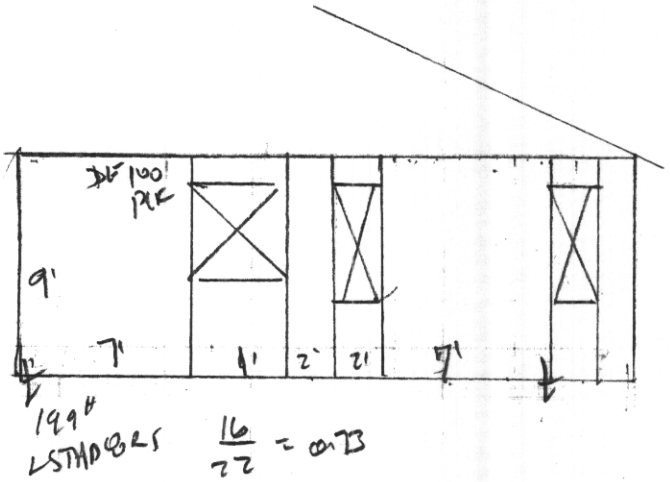
$l = 2.5' + 5' + 3' + 27.5' = 38^{FT}$

$q = 2,289^{\#} / 38 = 60^{PLF}$ (A)

@ 3-CAR:

$l = 7' + 2' + 7' = 16.0^{FT}$

$q = 2,289^{\#} / 16' = 143^{PLF}$



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SHEAR WALL DESIGN (CONT)

SHEAR WALL #3 (EXTENDED option worst)

ROOF:

$V_R = \left(\frac{46}{2}\right)[(3')(49.6\,PSF)+(5')(40\,PSF)] = 1{,}950^{\#}$

$\frac{15}{20} = 0.75$

$l = 3.5' + 11.5' = 15^{FT}$

$q = 1{,}950^{\#} / 15' = 130^{PLF}$ (A)

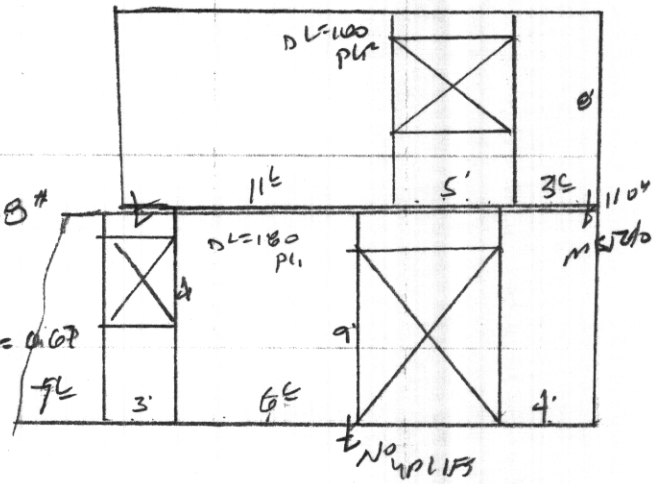
FLOOR:

$V_F = 1{,}950^{\#} + \left(\frac{46}{2}\right)(10)(40.6\,PSF) = 4{,}388^{\#}$

$l = 6.5' + 7.5' + 5.5' = 19.5'$

$q = 4{,}388^{\#} / 19.5 = 225^{PLF}$ (A)

$\frac{20}{30} = 0.67$



SHEAR WALL #4

ROOF: $V_R = 1{,}950^{\#}$

$l = 3.5' + 3.5' = 7^{FT}$

$q = 1{,}950^{\#} / 7' = 279^{PLF}$ (B)

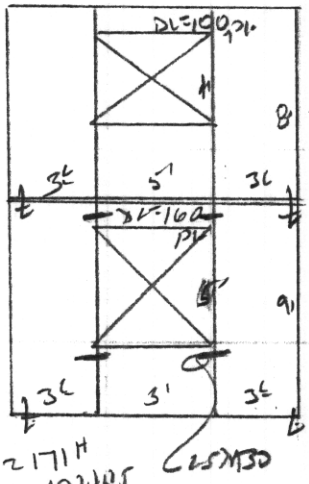
FLOOR:

$V_F = 4{,}388^{\#}$

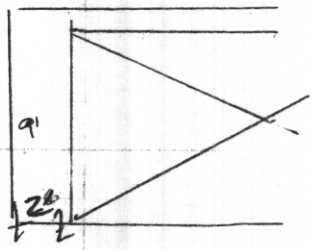
$l = 3.5' + 3.5' + 2' + 1.5' + 2' = 12.5^{FT}$

$q = 4{,}388^{\#} / 12.5' = 351^{PLF}$ (B/R)

$\frac{7}{12} = 0.58$



2171# STRAPS (2.5x350)



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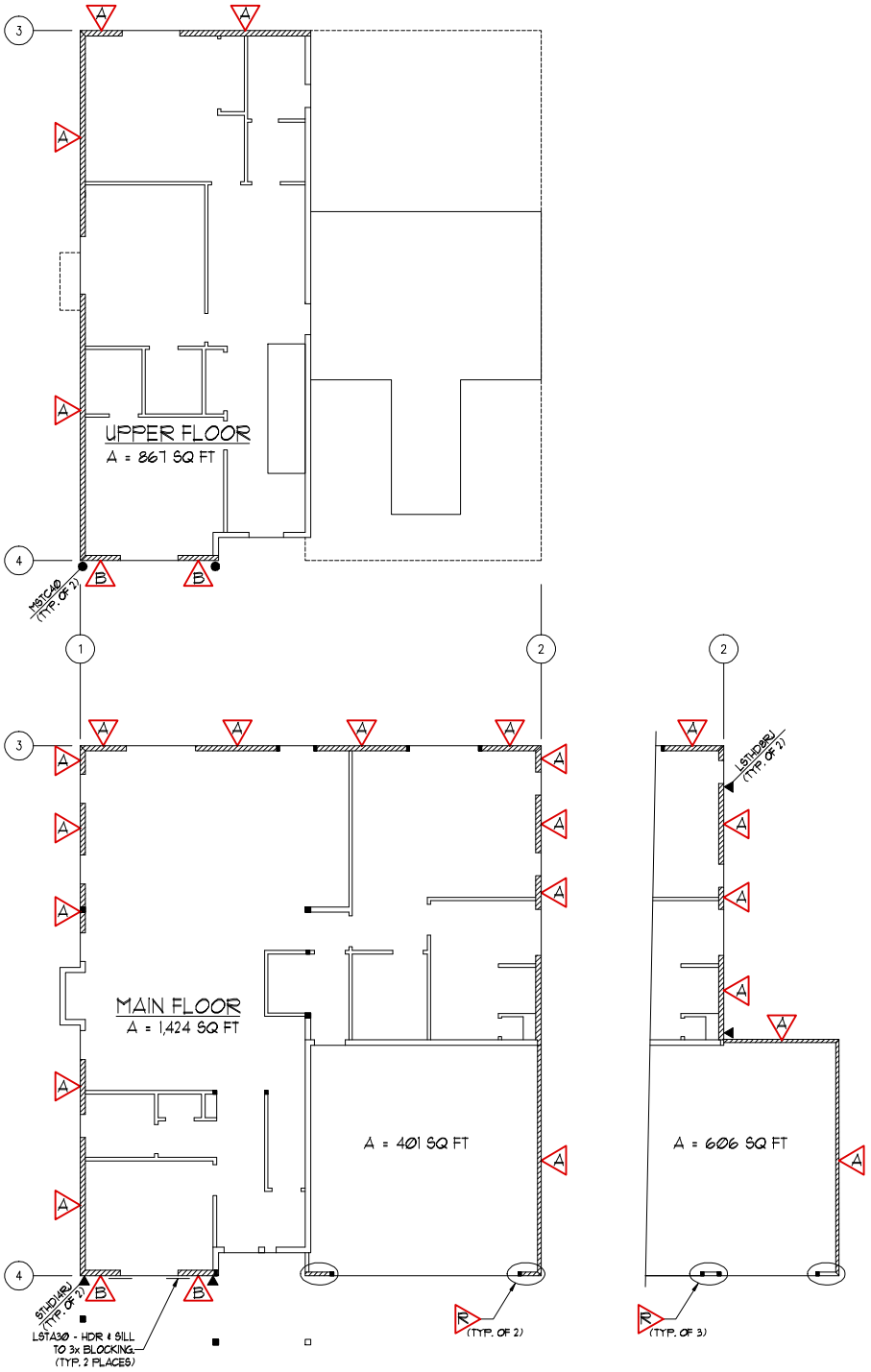
SHEAR WALL KEY PLAN



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SHEAR WALL SCHEDULE

Mark	Minimum Sheathing (1)	Sheathing Nailing (1)	Anchor Bolts (3)	Remarks (4)
A	$^5/_8$" T1-11 or $^1/_2$" OSB	8d @ 6" o.c.	$^5/_8$" @ 60" o.c.	Qall = 230 plf
B	$^1/_2$" CDX or OSB	8d @ 4" o.c.	5/8" @ 32" o.c.	Qall = 350 plf
R	See detail 12/S2.0 for Construction			

Notes:

1) All walls designated " ▷ " are shear walls. Exterior walls shall be sheathed with rated sheathing (24/0) and nailed at all panel edges (Blocked) per schedule (uno). Edge nailing at T1-11 shall be through each edge of each panel. Nailing at intermediate framing to be at 12" oc. Nailing not called out shall be per IBC Table 2304.9.1.

2) Holdowns and other framing hardware by Simpson or equal to be used per plan. Ends of shear walls shall use double studs minimum (UNO).

3) Use minimum of (2) bolts per sill piece with one bolt located not more than 12" nor less than 5" from each end of the piece. Embed bolts a minimum of 7" into concrete. Washers to be minimum 3" x 3" x $^1/_4$" and of hot-dipped zinc-coated galvanized steel.

4) Allowable loads are permitted to be increased by 40% for wind design in accordance with IBC Section 2306.3.

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