sliderule
engineering works, llc

Buxton Residence

8097 West Merce Way
Mercer Island, Washington 98040

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Design Criteria: 2018 International Building Code

Roof	Dead Load: 15 psf Live Load: 35 psf (snow)	Floor	Dead Load: 15 psf Live Load: 40 psf	Deck	Dead Load: 10 psf Live Load: 60 psf

Wind Speed: 110 mph, Exposure C
50 year MRI 85 mph
Kzt =1.3

Seismic Criteria: D-2
R = 6 (wood shear walls)
Ss = 1.473, S1 = 0.508

Allowable Soil Pressure: 1500 psf (assumed)

Concrete and Reinforcing Bar: 28 day strength for walls, slabs, and footings = 2500 psi (5-1/2 sack mix) for engineering purposes, 3000 psi for weathering purposes, 40 ksi reinforcing bar for #4 and smaller, 60 ksi for #5 and larger.

Use: Simpson Strong-Tie Connectors per plans and details. Install per manufacturer's specification unless noted otherwise.
All metal connectors exposed to weather shall be galvanized.
All nails and/or bolts exposed to weather shall be galvanized.
A-307 bolts and lag bolts at connections and embedded anchor bolts, unless noted otherwise.
2x Lumber DF#2 KD Fb=1155 psi (min), E=1,300,000 psi (min).
4x Lumber DF#2 KD Fb=1200 psi (min), E=1,600,000 psi (min).
LSL Beam, Fv = 190 psi, Fb = 2325 psi, E = 1,550 ksi
PSL Beam, Fv = 285 psi, Fb = 2800 psi, E = 2,200 ksi
Glue Laminated Beams 24F-V4
Wedge Anchor – 1/2" diameter x 4" (embed,min) Hilti TZ anchor per ESR 1917 or equal

Buxton Residence Addn
8097 Mercer Wy
Mercer Island, WA
98040

Roof LL = 25psf
DL = 15psf

Floor LL = 40psf
DL = 15psf

Deck LL = 60psf
DL = 10psf

ASCE 7-10 Wind
MRI 50yr 85mph
Risk Category II 110mph
I = 1.0 Exp C k_{zt} = 1.3

ASCE 7-10 Seismic
S_s = 1.473
S_1 = 0.508
I = 1.0
Site Class D
Risk Category II
V = 0.16 wt

Ridge Beam @ Master
L = 19.5' trib = 18'
w = 18(15+25)
= 720 #/'
V = 7020#
M = 34223 ft-#
f_v = 120psi okay
f_b = 1755psi okay

5½x16
A = 88 in²
S_x = 234 in³
I_x = 1877 in⁴

Δ_{TL} = 0.57"
L/412

Δ_{LL} = 0.36"
L/657 okay

Δ_{DL} = 0.21"

Roof Rafters
L = 23' @ 12" oc
w = 40#/'
V = 460#
M = 2645 ft-#
A = 16.8 in²
S_x = 31.6 in³
I_x = 172.9 in⁴
f_v = 41psi
f_b = 1004psi
Δ_{TL} = 1.18" L/234

consider intermediate Beam
trib = 11.5'
w = 11.5(15+25) = 460#/'
L = 18'
V = 4140#
M = 18630 ft-#
6x12
f_v = 98psi NG
A = 63 in²
S_x = 121 in³
I_x = 697 in⁴
f_v' w/ C_D = 86psi
V @ dist = 3700#
f_v' @ 'd' dist
$1.5\left(\frac{3700\#}{63}\right)$ = 88psi
w/ C_D = 77psi okay

$f_b' = 1606 psi$ NG

try $5\frac{1}{2} \times 14$ 2.2E PSL

$A = 77 in^2$

$S_x = 179 in^3$

$I_x = 1257 in^4$

$f_v = 81 psi$ okay

$f_b = 1249 psi$ okay

$\Delta_{TL} = 0.39"$ L/549

use $5\frac{1}{2} \times 14$ 2.2E PSL @ intermediate beam

RESIZE ridge beam

$L = 19.5'$ trib = 12'

$w = 480 \#/'$

$V = 4680 \#$ try $5\frac{1}{2} \times 14$

$M = 22815$ ft-#

$f_v = 91 psi$ okay

$f_b = 1530 psi$ okay

$\Delta_{TL} = 0.57"$ L/414 okay

use $5\frac{1}{2} \times 14$ 2.2E PSL @ Ridge Beam

Rafters w/ intermediate beam

$L = 12'$ @ 2' oc $w = 80 \#/'$

$V = 480 \#$ $f_v = 43 psi$ okay

$M = 1440$ ft-# $f_b = 546 psi$ okay

$\Delta_{TL} = 0.17"$ L/823

2x12 valleys adequate

2x10

$f_v = 52 psi$ okay $A = 13.8 in^2$

$f_b = 811 psi$ okay $S_x = 21.3 in^3$

$\Delta_{TL} = 0.31"$ $I_x = 98.9 in^4$

L/457 okay

use HF #2 2x10 @ 24" oc

Point load to Header @ pocket door

$P = 4680 \#$ seq @ midspan

$L = 5'$ $3\frac{1}{2} \times 11\frac{7}{8}$

$V = 2340 \#$ $A = 41 in^2$

$M = 5850$ ft-# $S_x = 82 in^3$

$f_v = 85 psi$ okay $I_x = 488 in^4$

$f_b = 856 psi$ okay

$3\frac{1}{2} \times 9$

$A = 31 in^2$

$f_v = 113 psi$ okay $S_x = 47 in^3$

$f_b = 1494 psi$ okay $I_x = 212 in^4$

use $3\frac{1}{2} \times 9$ 1.55E LVL @ HDR

Header @ Door

$L = 5'$ trib = $\frac{12}{2} + 2 = 8'$

$w = 8'(15+25) = 320 \#/'$

$V = 800 \#$

$M = 1000$ ft-#

Lateral considerations

Wind Loads / Envelope

Infill addition over/at existing Attic does not increase wind envelope, no increase of wind load to existing structure

Seismic Loads

Both Addition areas have existing attic floors to be removed or reinforced, so minimal floor load increase +/- 3psf. walls become full ht so allowance for new/remodel walls ≅ 1psf

173 sq ft @ walk in closet/ bathroom

211 sq ft @ primary

384 sq ft (3+1)

= 1536 #

main floor area = 1800 ϕ
upper floor area = 1730 ϕ
roof area = 2260 ϕ

main flr wt = 31.5K (17 psf)
upper flr wt = 29.4K (17 psf)
roof wt 33.9K (15psf)

94.8K

use 17 psf @ main & upper
15 psf + 2.0 psf = 17 psf
floor walls

wt increase ≅ 1.5K

New total wt = 96.3K

increase 1.01S

1.5% increase

seismic increase insignificant

Install md sheath new walls for 350 #/1 capacity

VERIFY EXISTING anchor bolts and load paths are adequate during construction

Header @ Roof (cont)

$f_v = 57$ psi ok
$f_b = 461$ psi ok
$\Delta_{TL} = 0.04''$ L/1520 ok

(2) 2x8
$A = 21 in^2$
$S_x = 26 in^3$
$I_x = 95 in^4$

Use (2) 2x8 @ header

Deck Beam

$L = 18'$ trib $= \frac{4.5}{2} = 2.25'$

$w = 2.25' (10 + 60)$
$= 158 \#/'$

$V = 1422 \#$
$M = 6400$ ft.#

$f_v = 34$ psi
$f_b = 635$ psi
$\Delta_{TL} = 0.49''$ L/443 ok

$f_v = 41$ psi
$f_b = 937$ psi
$\Delta_{TL} = 0.87''$
L/248

6x12
$A = 63 in^2$
$S_x = 121 in^3$
$I_x = 697 in^4$

6x10
$A = 52 in^2$
$S_x = 82 in^3$
$I_x = 392 in^4$

EXIST'G HEADER @ Panel door $L = 12'$
Existing flr trib $= 7.5' (15+40)$
Roof trib $= 8' (15+25)$
$w = 733 \#/'$
$V = 4398 \#$
$M = 13194$ ft.#

$f_v = 168$ psi ok
$f_b = 193$ psi ok
$\Delta_{TL} = 0.45''$
$\Delta_{TL} = 0.45''$ L/320
$\Delta_{LL} = 0.31''$ L/465

$3\frac{1}{2} \times 11\frac{7}{8}$
$A = 41 in^2$
$S_x = 82 in^3$
$I_x = 488 in^4$

replace existing hdr w/ $3\frac{1}{2} \times 11\frac{7}{8}$ 2.2E PSL

Flr framing (new)

$L = 11.5'$ @ 16" oc
$w = 74 \#/'$

$V = 419 \#$
$M = 1177$ ft.#
$f_v = 58$ psi
$f_b = 1078$ psi
$\Delta_{TL} = 0.48''$ L/282
go to 12" oc
$w = 55 \#/'$

$\Delta_{TL} = 0.36''$ L/381

2x8
$A = 10.8 in^2$
$S_x = 13.1 in^3$
$I_x = 47.6 in^4$

use 2x8 @ 12" oc

2018 International Building Code (Section 1613.5)

Section 12.8 of ASCE 7-16

Site Class =	D				
S_s =	1.47	figure 1613.5 (1)	F_a =	1.0	table 1615.1.2(1)
S_1 =	0.51	figure 1613.5 (2)	F_v =	1.5	table 1615.1.2(2)
R =	6.0	ASCE 7-10 table 12.2-1	S_{MS} =	1.473	equation 16-37
I =	1.00	ASCE 7-10 table 11.5-1	S_{M1} =	0.76	equation 16-38
h_n =	18.00	building height (ft)	S_{DS} =	0.98	equation 16-39
C_t =	0.02	ASCE 7-10 table 12.8-2	S_{D1} =	0.51	equation 16-40
			C_u =	1.4	ASCE 7-10 table 12.8-1
			T =	0.24	ASCE 7-10 12.8.2

Calculated Seismic Response Coefficient (ASCE 7-10)	C_s =	0.16	equation 12.8-2	governs
	$C_{s\ max}$ =	0.35	equation 12.8-3	
	$C_{s\ min}$ =	0.04	equation 12.8-4	
Approximate Fundamental Period (ASCE 7-10 9.5.5.3.2)	T_a =	0.17	equation 12.8-7	
	x =	0.75	ASCE 7-10 table 12.8-2	
Seismic Base Shear (ASCE 7-10 9.5.5.2)	$V = C_s W$		equation 12.8-1	
	V =	0.16	W	

Hazards by Location

Search Information

Address:	8097 W Mercer Way, Mercer Island, WA 98040, USA
Coordinates:	47.5288647, -122.2349732
Elevation:	30 ft
Timestamp:	2023-04-29T10:22:58.627Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	D-default

Basic Parameters

Name	Value	Description
S_S	1.473	MCE_R ground motion (period=0.2s)
S_1	0.508	MCE_R ground motion (period=1.0s)
S_{MS}	1.767	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	1.178	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	0.898	Coefficient of risk (1.0s)
PGA	0.63	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.756	Site modified peak ground acceleration
T_L	6	Long-period transition period (s)
SsRT	1.473	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.633	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	4.316	Factored deterministic acceleration value (0.2s)
S1RT	0.508	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.565	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	1.633	Factored deterministic acceleration value (1.0s)
PGAd	1.421	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.

Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Disclaimer

2018 International Building Code (Section 1609)
ASCE 7-16 (Chapters 26-31)

Simplified Wind Load Method (2609.6)

Shall not apply to buildings sited on the upper half of an isolated hill or escarpment with the following conditions:

Hill or escarpment is equal or greater than 60' in Exposure B, 30' in Exposure C
Maximum average slope of the hill exceeds 10%
Hill or escarpment is unobstructed upwind by other topographhic features for a distance 50x the height of the hill or 1 mile, whichever is less.

Shall apply to buildings with the following conditions:

Simple diaphragm: Wind loads are transmitted through horizontal floor and roof diaphragms to vertical lateral-force-resisting systems.
Building has a fundamental natural frequency less than 1 hertz
Response charateristics do not include: Across wind loading, vortex shedding, instability caused by gallopoing or flutter.
Site characteristics do not create wind channeling or buffeting caused by upwind obstructions
No expansion joints or seperations
Regular shape with approximate symmentrical cross section and roof slopes not exceeding 45 degrees.

Enclosed Building (see 2609.2 eqns 26-31 and 26-32)

Basic Wind Speed (ASCE 6.5.4, figure 6-1)	**85**
Importance Factor (ASCE 7-05 table 6-1) I_w	**1.00**
Exposure (ASCE 6.5.6.3)	**C**
Roof Slope (x / 12)	**9.5**
Topographic Effects K_{zt} (ASCE 7-05 6.5.7)	**1.30**

$p_s = \lambda K_{zt} I_w p_{s30}$ (eqn 16-34)

Height and Exposure Adjustment coefficient = λ

Simplified Design Wind Pressure (load case 1)										
	horizontal				vertical				overhangs	
level	A	B	C	D	E	F	G	H	E_{oh}	G_{oh}
p_{s15} =	20.3	13.8	16.0	11.0	1.2	-9.4	0.4	-8.1	-5.4	-6.3
p_{s20} =	21.6	14.8	17.1	11.7	1.3	-10.1	0.4	-8.6	-5.8	-6.7
p_{s25} =	22.6	15.4	17.9	12.3	1.4	-10.5	0.4	-9.0	-6.1	-7.0
p_{s30} =	23.5	16.0	18.6	12.7	1.4	-10.9	0.4	-9.4	-6.3	-7.3
p_{s35} =	24.3	16.6	19.2	13.2	1.5	-11.3	0.4	-9.7	-6.5	-7.5
p_{s40} =	25.0	17.0	19.8	13.6	1.5	-11.6	0.4	-10.0	-6.7	-7.7
p_{s45} =	25.7	17.5	20.3	13.9	1.5	-11.9	0.5	-10.3	-6.9	-8.0
p_{s50} =	26.2	17.8	20.7	14.2	1.6	-12.2	0.5	-10.5	-7.0	-8.1
p_{s55} =	26.7	18.2	21.1	14.5	1.6	-12.4	0.5	-10.7	-7.2	-8.3
p_{s60} =	27.2	18.5	21.5	14.7	1.6	-12.6	0.5	-10.9	-7.3	-8.4

1609.6.2.1.1 Minimum loading in zones A, B, C, D shall not be less than 10psf.

Minimum loading in zones E, F, G, H shall not be greater than or equal to ZERO psf.

Hazards by Location

Search Information

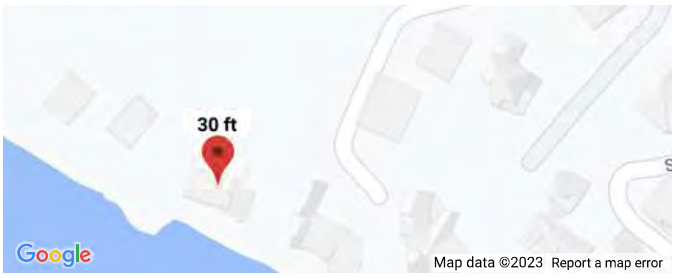
Address: 8097 W Mercer Way, Mercer Island, WA 98040, USA

Coordinates: 47.5288647, -122.2349732

Elevation: 30 ft

Timestamp: 2023-04-29T10:16:21.373Z

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.