STRUCTURAL CALCULATIONS FOR:

HARPER RESIDENCE

6551 81ST AVE SE
MERCER ISLAND, WA 98040

ARCHITECT: FLOISAND STUDIO

MAY 12, 2021

MALSAM TSANG
STRUCTURAL ENGINEERING

122 S JACKSON ST | SUITE 210 | SEATTLE WA 98104 | 206.789.6038 T | 206.789.6042 F

DESIGN CRITERIA IBC 2018

DEAD LOADS

ROOF		ATTIC		SECOND FLOOR		MAIN FLOOR	
Composition	2.5 psf	2x @ 16" o.c	2.9 psf	3/4" Plywood	2.4 psf	3/4" Plywood	2.4 psf
3/4" Plywood	2.4 psf	3/4" Plywood	2.4 psf	TJI @ 16" o.c.	2.3 psf	TJI @ 16" o.c.	2.3 psf
2x @ 24" o.c.	2.0 psf	Gyp Board (5/8")	2.8 psf	Flooring	1.0 psf	Flooring	1.0 psf
Insulation	1.0 psf	MEP	1 psf	Gyp Board (5/8")	2.8 psf	Gyp Board (5/8")	2.8 psf
Gyp Board (5/8")	2.8 psf			MEP	1.5 psf	MEP	1.5 psf
MEP	1.5 psf						
Solar Panels	5.0 psf						
Total	17.2 psf	Total	9.1 psf	Total	10.0 psf	Total	10.0 psf
Use	20.0 psf	Use	10.0 psf	Use	15.0 psf	Use	15.0 psf

LIVE LOADS/OCCUPANCY

		ROOF LIVE		FLOOR LIVE		ATTIC LIVE	
Risk Category	II	Snow =	25 psf	Occupancy =	40 psf	w/Storage=	20 psf
Roof Deck	No			Stair/Corridor =	40 psf		
Common Access	No						

SEISMIC CRITERIA ASCE 7-16 Ch. 11 & Ch. 12

Imp. Factor =	1.00	Seismic Ht, hn=	15 ft	
Site Class =	D(Default)	T, Building=	0.2	
R Value =	6.5	Ts=	0.5	
Geo. Ground Hazard?		**No w/ASCE 11.4.8 Excep's**		
S_s =	1.467	F_a =	1.200	Table 11.4-1
S_1 =	0.508	F_v =	NULL	Table 11.4-2
S_{ms} =	1.760	x 2/3 = S_{ds} =	**1.174**	Eqn. 11.4-3
S_{m1} =	NULL	x 2/3 = S_{d1} =	**NULL**	Eqn. 11.4-4

C_{SULT} = 0.181
C_{SALL} = 0.127

T/Ts= 0.295 ≤ 1.5

Okay, Cs Eqn. 12.8-2

SEISMIC WEIGHT ASCE 7-16 12.7.2

Partitions = 15 psf

***Roof weight = 1/2 Partition + Roof DL**

***Floor weight = Full Partition + Floor DL**

ROOF 25.0 psf

SECOND FLOOR 25.0 psf

SEISMIC DESIGN CATEGORY IBC 1613.2.5

Seismic DC= D

WIND CRITERIA ASCE 7-16 Ch. 27 Directional Procedure

V =	110 mph	K_d =	0.85
Exposure =	C Per M.I. Map	G =	0.85
h =	25 ft	K_{zt} =	1.60 Per Map

Roof Slope = 6 : 12 = 27 °

PRESSURE COEFFICIENTS (Cp)

Windward Wall =	0.8	Windward Roof =	0.3
Leeward Wall =	-0.5	Leeward Roof =	-0.6

PRESSURE (PSF) $q = 0.00256K_zK_{zt}K_dV^2$

Ht	K_z	q_z	$0.6xq_z$ [1]	q_h	P_{WW}	P_{LW}	P_{WALL}	P_{ROOF}
0-15	0.85	35.8	21.5		14.6	10.1	**24.7**	
15-20	0.90	37.9	22.7		15.5	10.1	**25.6**	
20-25	0.94	39.6	23.8	23.8	16.2	10.1	**26.3**	**18.2**
25-30	0.98	41.3	24.8		16.8	10.1	**26.9**	
30-35	1.02	43.0	25.8		17.5	10.1	**27.6**	
35-40	1.04	43.8	26.3		17.9	10.1	**28.0**	
40-45	1.07	45.1	27.0		18.4	10.1	**28.5**	
45-50	1.09	45.9	27.6		18.7	10.1	**28.8**	

[1] Per IBC 2018 1605.3.1 Basic Load Combinations

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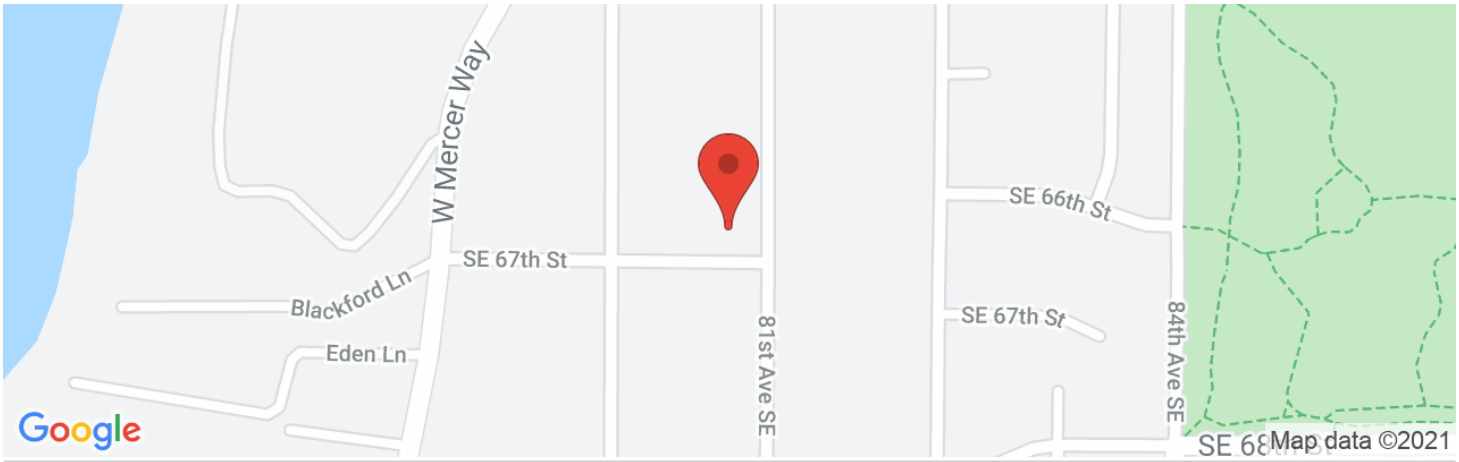
Harper Residence
Project
6551 81st Ave SE
Mercer Island, WA 98040

5/12/2021
Date
189-2020-04-01
Proj. No.
WAI
Design
DC1
Sheet

Harper Residence

6551 81st Ave SE, Mercer Island, WA 98040, USA

Latitude, Longitude: 47.5434242, -122.2312794



Date	3/30/2021, 11:41:33 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	1.467	MCE_R ground motion. (for 0.2 second period)
S_1	0.508	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.76	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.173	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.628	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.754	Site modified peak ground acceleration
T_L	6	Long-period transition period in seconds
SsRT	1.467	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.627	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	4.267	Factored deterministic acceleration value. (0.2 second)
S1RT	0.508	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.565	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	1.641	Factored deterministic acceleration value. (1.0 second)
PGAd	1.42	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.902	Mapped value of the risk coefficient at short periods
C_{R1}	0.898	Mapped value of the risk coefficient at a period of 1 s

LATERAL LOADS

SEISMIC LOADS:

	A(SF)	w(psf)	W(kips)	ht	$W_x h_x$	C_x	$0.7F_x$
UPPER ROOF	700	25	17.5	21'	368	0.25	3.7^k
LOWER ROOF	3200	25	80.0	12'	960	0.64	9.4^k
ATTIC	690	10	6.9	8'	55	0.04	0.6^k
2nd FLOOR	450	25	11.3	9.5'	107	0.07	1.0^k
			115.7		1490		$\Sigma = 14.7^k$ ✓

$V_{SDS} = 0.181 \times 115.7^k = 20.9^k$

$0.7V_{SDS} = 0.127 \times 115.7^k = 14.7^k$

WIND LOADS: (BOTH DIRECTIONS ARE SIM FOR GLOBAL MWFRS)

UPPER ROOF: $18.2psf \times 5' + 25.6psf \times 4' = 193.4psf$

LOWER ROOF: $18.2psf \times 8' + 4' \times 24.7psf = 244.4plf$

2nd FLOOR: $25.6psf \times 1' + 8' \times 24.7psf = 223.2plf$

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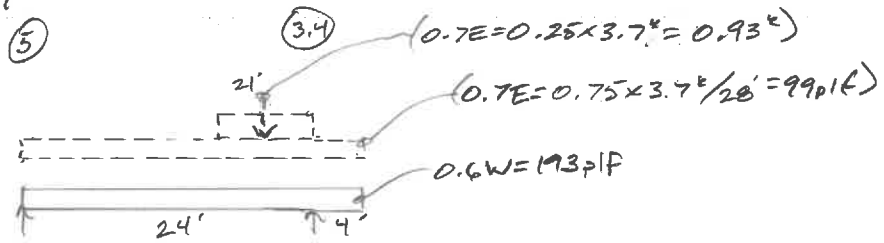
SEISMIC IN (x's)
$\Omega = 1.0$

UPPER ROOF

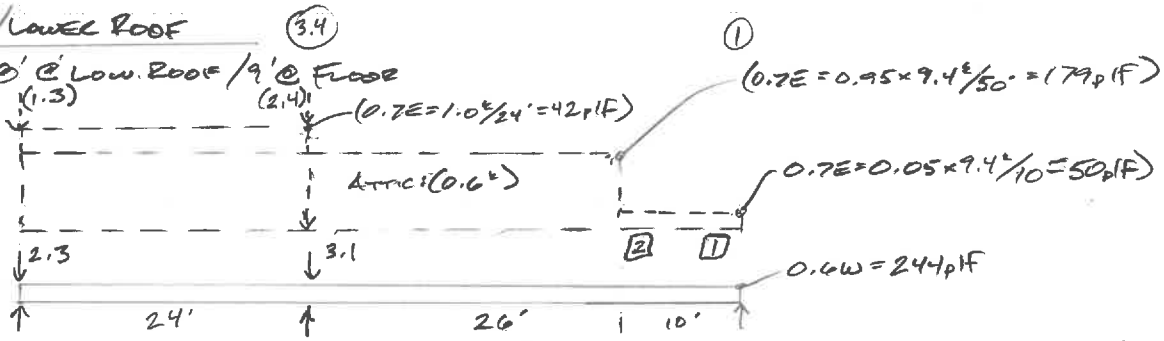
R HT ≈ 9'



R	2.3(1.3)	3.1(2.4)
L	3.5'+3.5'=7'	14'
V	329(186)	221(171)
SWX	SW4(USE SW3) 2#/ft=0.78	SW6
OT	3.0(1.7)	2.0(1.5)
HD	(2)CS16	CS16

2nd FLR/LOWER ROOF

R HT = 8' @ LOW ROOF / 9' @ FLOOR



R	5.2(4.0)	10.4(8.9)	4.4(1.8)
L	3'+8.5'+5.5'=17'	9'+11.5'+11.5'+5.5'=37.5'	9.5'
V	308(288)	277(237)	463(189)
SWX	SW4(USE SW3)	SW4	SW3 (USE SW2)
ht	USE 9' 3' PIER ht=8' 2#/ft=0.75	USE 9'	11.0'
OT	2.8(2.6)	2.5(2.1)	5.0(2.1)
OT STACK	5.8(4.3)	9.5(3.6)	-
HD	HDU5/HDU8 STACK	HDU5/HDU8 STACK	HDU8

[1] DIAPH CHECK: $v = 4.4^k/14' = 314$plf (0.6W) → BLOCK DIAPH

[2] CHORD FORCE: $T=C = 4.4^k \times 10'/14.5' = 3.0^k$ → (2)CS16

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PROJECT

3/31/21
DATE

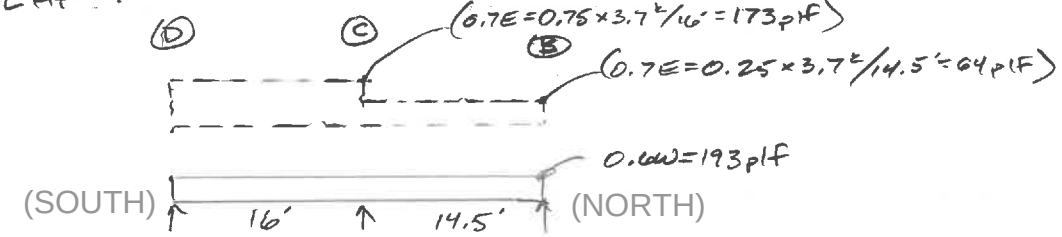
PROJECT NO
WA1

DESIGN

SEISMIC IN(X's) Δ=1.0 | LATERAL DESIGN | E-W

Upper Floor

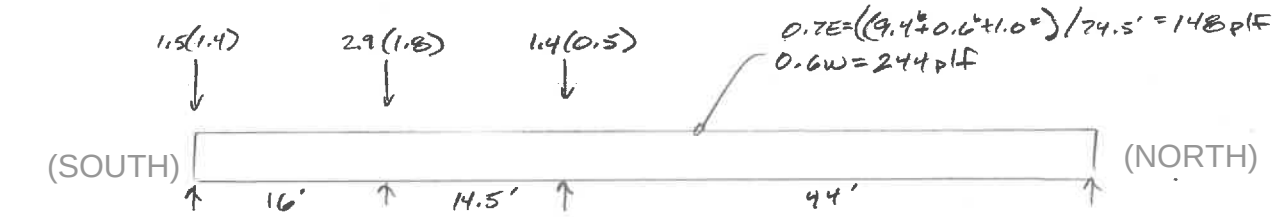
RHt ≅ 9'



R	1.5 (1.4)	2.9 (1.8)	1.4 (0.5)
L	8'+8.5'=16.5'	8.25'	8.25'
V	91 (85)	352 (218)	170 (61)
SWX	SW6	SW4	SW6
OT	0.8 (0.8)	3.2 (2.0)	1.5 (0.5)
HD	NONE REQ'D	(2) CS16	CS16

2nd Flr / Lower Roof / Attic

RHt ≅ 9'



R	3.5 (2.6)	6.6 (4.1)	8.5 (4.8)	5.4 (3.3)
L	20.5'	15'+11'=26'	5.25'+11'+6'+6'=28.25'	38'
V	171 (127)	253 (158)	301 (170)	142 (87)
SWX	SW6	SW4	SW4	SW6
OT	1.5 (1.1)	2.3 (1.4)	2.7 (1.5)	1.3 (0.8)
OT STACK	–	5.5 (3.4)	–	–
	-0.45D=2.2k			
HD	NONE REQ'D	HDU4/ HDU8	HDU4	NONE REQ'D

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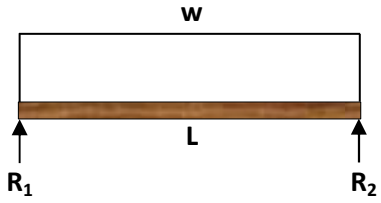
DESIGN

SHEET

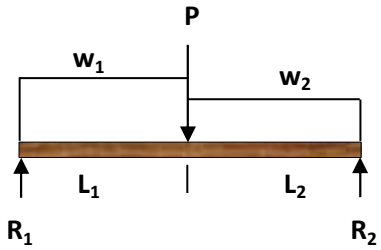
TYPICAL BEAM CASES

***ASSUME CASE 1 FOR ALL BEAMS U.N.O.**

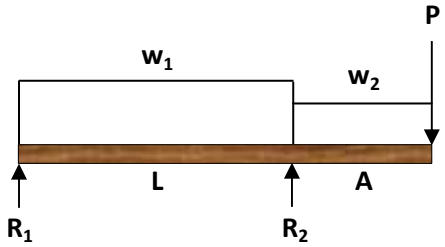
CASE #1: (C1)



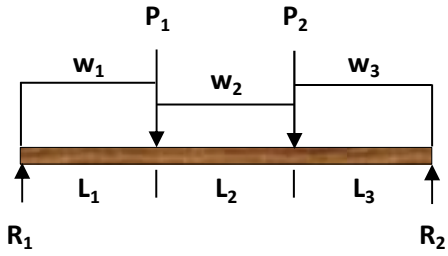
CASE #2: (C2)



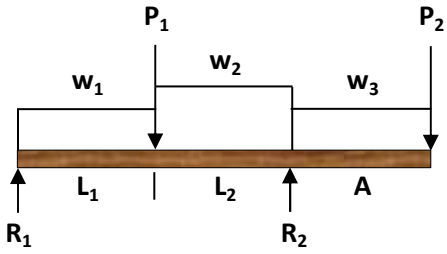
CASE #3: (C3)



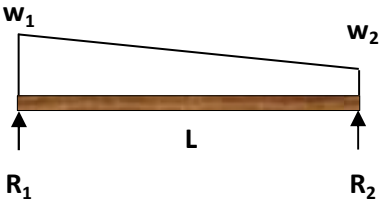
CASE #4: (C4)



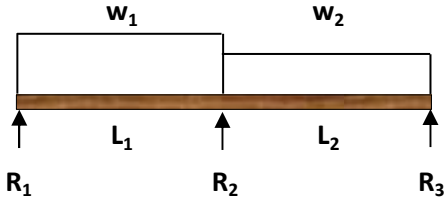
CASE #5: (C5)



CASE #6: (C6)



CASE #7: (C7)



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Date	5/12/2021
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Design	WAI
Sheet	DC4

VERTICAL DESIGN

UPPER ROOF

#201 EAST RIDGE BM

L=4', w=45psf x 8' = 360plf
R=0.72k
M=0.72'k f_b=0.2ksi
V=0.7k f_v=24psi
(2)2x10 Δ=0.01" ✓

#202 EAST HEADER

L_1=5', L_2=1.5'
$w_1=w_2$=45plf
P=0.72k
R_1=0.3k
R_2=0.7k
M=1.0'k f_b=0.4ksi
V=0.7k f_v=40psi
4x8 MIN Δ=0.04" ✓

#203 RIDGE BM AT STAIR

L=14', w=4.5' x 45psf = 203plf
R=1.4k
M=5.0'k f_b=1.0ksi
V=1.3k f_v=57psi
GL3 1/8 x 10 1/2 Δ=0.32" L/520 ✓

#204 BM OVER STAIR

DESIGN FOR SINGLE-SPAN (CONSERV)

L_1=4.25', L_2=4.25'
$w_1=w_2$=8' x 45psf = 360plf
R=1.4k (#203)
$R_1=R_2$=2.2k
M=6.2'k f_b=1.8ksi
V=2.0k f_v=105psi
GL3 1/8 x 9 Δ=0.21" L/476

#205 TYPICAL HDRS

DESIGN FOR SINGLE SPAN (CONSERV.)

L_1=3.5', w_1=8' x 45psf = 360plf
R=0.6k
M=0.6'k f_b=0.44ksi
V=0.315k f_v=42psi
(2)2x6 (MIN) Δ=0.02"

#206 WEST HDR OUT-OF-PLANE

L=9', w=35psf x 5.5' = 193plf
R=0.87k
M=1.96'k f_b=1.2ksi ✓
V=0.8k f_v=37psi
4x10 (FLAT) Δ=0.4" w/ 0.75x0.6LL
L/267 ✓ OK

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4/2/21
DATE

PROJECT NO
WA1
DESIGN

VERTICAL DESIGN

UPPER FLOOR/ LOWER ROOF

#101 BPOSED KITCHEN Bm

L=12', w=13.75'×45psf=620plf

R=3.7k

M=11.2k' f_b=1.3ksi

V=3.3k f_v=83psi

GLS 1½×10½ Δ=0.3" L/475

#102 SLIDING DOOR HDR

L=12', w=620plf

R=3.7k

M=11.2k' f_b=1.6ksi

V=3.3k f_v=112psi

PSL 3½×11⅞ Δ=0.296" L/486

#103 EAST BDRM WINDOW HDR

L=6.25', w=11.5'×45psf=520plf

R=1.6k

M=2.5k' f_b=611psi

V=1.1k f_v=57psi

4×10 Δ=0.05" OK ✓

#104 MSTR BDRM POCKET DOOR HDR

CASE 2

L_1=4', L_2=2.25'

w_1=8'×60psf=480plf

w_2=480plf + 7'×60psf=900plf

R_1=1.7k

R_2=2.3k

M=2.9k' f_b=0.7ksi

V=1.6k f_v=73psi

4×10 Δ=0.06" ✓

#105 CLG BEAM AT S BDRMS

L=14', w=12.5'×45psf=563plf

+12.5×30psf=375plf

938plf

R=6.6k

M=23.0k' f_b=2.1ksi

V=5.6k f_v=128psi

GL 5½×15 Δ=0.57" L/295

#106 BDRM RIDGE Bm

L=13.5', w=315plf

R=2.1k

M=7.2k' f_b=1.2ksi

V=1.9k f_v=61psi

GL 5⅛×9 M.n Δ=0.42" L/386

#107 SOUTH BDRM WINDOW HDR

L=6.5', w=5'×45psf=225plf

R=0.7k

M=1.2k' f_b=0.54ksi

V=0.6k f_v=41psi

(2)2×8 Δ=0.07"

#108 FRONT BDRM

L=9.25', w=9.5'×45psf=428plf

R=2.0k

M=4.6k' f_b=1.3ksi

V=1.7k f_v=88psi

GL 3⅛×9 M.n Δ=0.21" L/538

VERTICAL DESIGN

UPPER FLOOR/ LOWER ROOF

#109 ENTRY DOOR HDR

L = 7.25' w = 12.5' × 45 psf = 563 plf
R = 2.0^k
M = 3.7^k' f_b = 0.89 ksi
V = 1.6^k f_v = 74.5 psi
4×10 Δ = 0.1" ✓

#110 (E) D.B. OVER PORCH

L = 9' w = 7' × 45 psf = 315 plf
R = 1.4^k
M = 3.2^k' f_b = 1.2 ksi
V = 1.2^k f_v = 73 psi
4×8 MIN Δ = 0.26" L/413

#111 (E) GARAGE HDR

L = 16.5', w = 11' × 45 psf = 495 plf
R = 4.1^k
M = 16.8^k' f_b = 1.9 ksi
V = 3.8^k f_v = 112 psi
GL 3½×13½" MIN Δ = 0.64"
L/310

#112 INTERIOR ATTIC BRG BM OVER KITCHEN

L = 12.25', w = 15' × 45 psf = 675 plf
+ 2.5' × 30 psf = 75 plf
= 750 plf
R = 4.6^k
M = 14.1^k' f_b = 1.8 ksi
V = 3.9^k f_v = 110 psi
GL 5⅛×10½ (MIN) Δ = 0.43"
L/344

#113 GARAGE CLOSET HDR

L = 6.5', w = 7.5' × 30 psf = 225 plf
R = 0.7^k
M = 1.2^k' f_b = 0.5 ksi
V = 0.6^k f_v = 41 psi
(2)2×8 Δ = 0.07" OK

#114 ATTIC BRG WALL BM @ ENTRY

L = 6.25', w = 12' × 45 psf
+ 3' × 30 psf
630 plf
R = 2.0^k
M = 3.1^k' f_b = 1.2 ksi
V = 1.6^k f_v = 94 psi
4×8 Δ = 0.12"

#115 ATTIC BRG WALL OVER LAUNDRY

L = 6.5', w = 9.5' × 45 psf
+ 7.5' × 30 psf
652 plf
R = 2.1^k
M = 3.44^k' f_b = 1.35 ksi OK
V = 1.7^k f_v = 102 psi
4×8 Δ = 0.14" L/530 ✓

#116

L = 5', w = 12.5' × 45 psf
+ 4' × 30 psf
683 plf
R = 1.7^k
M = 2.1^k' f_b = 0.97 ksi
V = 1.3^k f_v = 89 psi
(2)2×8 Δ = 0.08" OK

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4/5/21
DATE

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WA1

DESIGN

VERTICAL DESIGN

UPPER FLOOR / LOWER ROOF

#117 BM OVER STAIR

CASE 2

$L_1 = 5'$, $L_2 = 4'$

$w_1 = w_2 = 150$ plf

$P = 1.4^k$ (From #203) $+ 1.3^k$ From Attic BM $= 2.7^k$

$R_1 = 1.9^k$

$R_2 = 2.2^k$

$M = 7.5^{k'}$ $f_b = 2.1$ ksi

$V = 2.1^k$ $f_v = 110$ psi

GL 3½x9 Min $\Delta = 0.27'' \; L/451$

#118 CLG BEAM AT SE BOBM

CASE 2

$L_1 = 7'$, $L_2 = 7'$

$w_1 = w_2 = 45$ psf x 3' Roof $= 135$ plf

$P = 2.1^k$ (From #106)

$R_1 = 2.0^k = R_2$

$M = 10.7^{k'}$ $f_b = 1.7$ ksi

$V = 1.9^k$ $f_v = 57$ psi

GL 5½x9 $\Delta = 0.49'' \; L/346$

#119 WALL BM NEAR STAIR

$L = 14'$, $w = 12.5' \times 45$ psf Roof $+ 100$ plf Wall $= 663$ plf

$R = 4.6^k$

$M = 16.2^{k'}$ $f_b = 1.5$ ksi

$V = 4.1^k$ $f_v = 90$ psi

GL 5½x12 $\Delta = 0.4''$

MAX RAFTER SPAN (EAST OF STAIR)

$L = 14.5'$, $w = 2' \times 45$ psf $= 90$ plf

$R = 0.65$

$M = 2.37^{k'}$ $f_b = 0.9$ ksi

$V = 0.6^k$ $f_v = 51$ psi

2x12 At 24" oc $\Delta = 0.39'' \; L/450$

MAX CLG JOIST SPAN (EAST OF STAIR)

$L = 14.5'$, $w = 1.33' \times 30$ psf $= 40$ plf

$R = 0.29^k$

$M = 1.1^{k'}$ $f_b = 0.96$ ksi

$V = 0.25^k$ $f_v = 37$ psi

2x8 At 16" oc $\Delta = 0.64'' \; L/270$

NEW FLOOR JOISTS

$L = 16'$, $w = 1.33' \times 55$ psf $= 73$ plf

$R = 0.6^k$

$M = 2.34^{k'}$ $M_{allow} = 3.8^{k'}$ ✓

$V = 0.5^k$ $V_{allow} = 1.7^k$ ✓

11 7/8" TJI 210 At 16" oc Min $\Delta = 0.34'' \; L/562$ ✓

#120 WEST SIDE AT MSTR BDRM

$L_1 = 3.5'$, $L_2 = 9'$, $w_1 = w_2 = 60$ plf

$P = 1.7^k \times 2.5 = 4.3^k$

$R_1 = 3.5^k$ ← Los

$R_2 = 1.6^k$

$M = 11.8^{k'}$ $f_b = 1.9$ ksi

$V = 3.4^k$ $f_v = 104$ psi

GL 5½x9 $\Delta = 0.43''$ OK

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HARPER
PROJECT

4/6/21
DATE

PROJECT NO
WA 1

DESIGN

SHEET

VERTICAL DESIGN

- [x] CRAWLSPACE FRAMING
- [x] BRG WALLS

#001 BM OVER (E) FIREPLACE FTG

CASE 2

$L_1 = 4'$, $L_2 = 1'$

$w_1 = w_2 = 8' \times 55 psf = 440 plf$

$P = 4.2^k + 0.3^k = 4.5^k$

$R_1 = 2.0^k$

$R_2 = 4.7^k$

$M = 4.5^{k'}$ $f_b = 1.16 ksi$

$V = 4.7^k$ $f_v = 208 psi$ ($C_D = 1.15$ ✓)

4x10 $\Delta = 0.05''$

#002 C.S. BM AT (E) FLOOR

$L = 6'$, $w = 9' \times 55 psf = 495 plf$

$R = 1.5^k$

$M = 2.2^{k'}$ $f_b = 0.87 ksi$

$V = 1.1^k$ $f_v = 70 psi$

4x8 $\Delta = 0.08''$

#003 C.S. BM AT SOUTH ADDITION

$L = 6.5'$, $w = 10' \times 55 psf = 550 plf$

$R = 1.8^k$

$M = 2.9^{k'}$ $f_b = 700 psi$

$V = 1.5^k$ $f_v = 63 psi$

4x10 $\Delta = 0.06''$

BEARING WALL CHECK:

WORST-CASE INTERIOR WALL: (LIVING/DINING/KITCHEN)

$w = 12' \times 45 psf$	ROOF	540 plf
$+ 3.5' \times 30 psf$	ATTIC	105 plf
$+$ 100 plf	WALL	100 plf
$+ 6.5' \times 55 psf$	FLOOR	330 plf
		1075 plf

2x4, 9' TALL:

$P_{allow} = 1.9^k \rightarrow$ 2x4 AT 16" OC:

$w_{allow} = 1,462 plf$

2x4 AT 16" OC OK ✓

WORST-CASE EXTERIOR WALL: (SOUTH EXT WALL)

$w: 9.5' \times 45 psf =$		428 plf
$8' \times 55 psf =$	FLOOR	440 plf
	WALL	200 plf
		1068 plf

2x4 OR 2x6 AT 16" OC OK ✓

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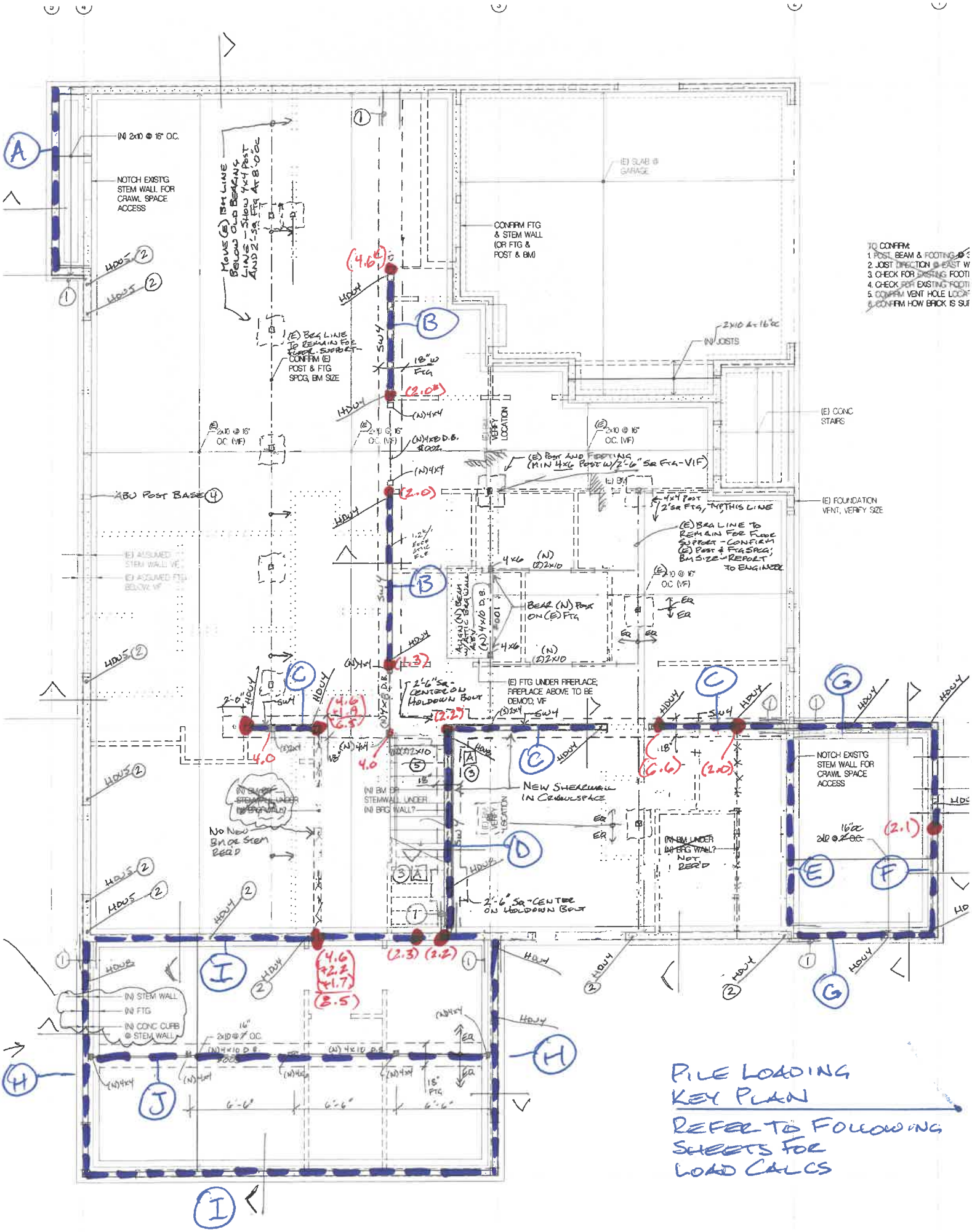
DESIGN


(N) 2x10 @ 16" O.C.
NOTCH EXISTG STEM WALL FOR CRAWL SPACE ACCESS
MOVE (E) BM LINE BELOW OLD BEARING LINE - SHIM 4x4 POST AND 2'-6" SQ FTG AT 8'-0" O.C.
(E) BEARING LINE TO REMAIN FOR FLOOR SUPPORT - CONFIRM (E) POST & FTG SPCG, BM SIZE
CONFIRM FTG & STEM WALL (OR FTG & POST & BM)
(E) SLAB @ GARAGE
(N) JOISTS
(E) CONC STAIRS
(E) FOUNDATION VENT, VERIFY SIZE
ABU POST BASE
(E) POST AND FOOTING (MIN 4x6 POST W/ 2'-6" SQ FTG - VIF)
4x4 POST 2'SQ FTG, TYP THIS LINE
(E) BEARING LINE TO REMAIN FOR FLOOR SUPPORT - CONFIRM (E) POST & FTG SPCG; BM SIZE - REPORT TO ENGINEER
BEAR (N) POST ON (E) FTG
(E) FTG UNDER FIREPLACE; FIREPLACE ABOVE TO BE DEMOD, VF
2'-6" SQ-CENTER ON HOLDOWN BOLT
NEW SHEARWALL IN CRAWLSPACE
NOTCH EXISTG STEM WALL FOR CRAWL SPACE ACCESS
No New Brg Stem Reqd
(N) STEM WALL
(N) FTG
(N) CONC CURB @ STEM WALL
TO CONFIRM:
1. POST, BEAM & FOOTING
2. JOIST DIRECTION
3. CHECK FOR EXISTING FOOTI
4. CHECK FOR EXISTING FOOTI
5. CONFIRM VENT HOLE LOCA
6. CONFIRM HOW BRICK IS SU
PILE LOADING KEY PLAN
REFER TO FOLLOWING SHEETS FOR LOAD CALCS

PILE LAYOUT / FTG DESIGN

2"ø PIPE PILE CAPACITY $R_{PILE} = 6.0^k$

(A) ← REFER TO KEY PLAN FOR LOCATION AT DIST LOADS AND PT LOADS

w = 150 plf (WALL/WINDOW)
100 plf (FLOOR)
525 plf (STEM/FTG)
775 plf

2" PILES @ 7.7' oc

(B): $w = 12' \times 45\,psf = 540\,plf$ (ROOF)
$+3.5' \times 30\,psf = 105\,plf$ (ATTIC)
$+$ 100 plf (WALL)
$+6.5' \times 55\,psf$ 330 plf (FLOOR)
$+$ 340 plf (FTG)
1415 plf TOTAL

2" PILES AT 4.2' oc

(C): w = 150 plf (WALL)
+ 100 plf (FLOOR)
+ 340 plf (FTG)
590 plf

2" PILES AT 10.1' ← LOCATE PILES AT POINT LOADS

(D) $w = 11.5' \times 45\,psf = 518\,plf$ (ROOF)
$7' \times 30\,psf = 210\,plf$ (ATTIC)
200 plf (WALL)
$6' \times 55\,psf = 330\,plf$ (FLOOR)
340 plf (FTG)
1.6 k/l

2" PILES AT 3.75' oc

(E) $w = 10' \times 55\,psf = 550\,plf$ (FLOOR)
$+$ 525 plf (STEM/FTG)
1075 plf

2"ø PILES AT 5.5' oc

(F) $w = 5' \times 55\,psf = 275\,plf$ (FLR)
$+$ 150 plf (WALL)
$+$ 525 plf (STEM/FTG)
950 plf

2"ø PILES AT 6.3' oc

(G) $w = 5' \times 45\,psf = 225\,plf$ (ROOF)
$+$ 100 plf (WALL)
$+$ 525 plf (STEM/FTG)
850 plf

2"ø PILES AT 7.1' oc

(H) w = 100 plf (ROOF)
100 plf (FLR)
100 plf (FLR)
200 plf (WALL)
525 plf (STEM/FTG)
1025 plf

2"ø PILES AT 5.9' oc

(I) $w = 8' \times 45\,psf = 360$ (ROOF)
$8' \times 55\,psf = 440$ (FLOOR)
$4' \times 55\,psf = 220$ (FLOOR)
200 (WALL)
400 (STEM/FTG)
1620 plf

2"ø PILES AT 3.75' oc

(J) $w = 10' \times 55\,psf = 550\,plf$ (FLOOR)
340 plf (FTG)
890 plf

2"ø PILES AT 6.7' oc

CHECK WORST-CASE FLEXURE/SHEAR (CONSERVATIVE)

$M_u = \frac{2.4^k/l \times 4.2^2}{8} = 5.3^{k'}$ → $d = 7.5''$, $f'_c = 2.5\,ksi$, $f_y = 60\,ksi$, $b = 18''$

(AT GRID I) $A_{s\,min} = 0.21\,in^2$
$A_{s\,req'd} = 0.16\,in^2$
$A_{s\,less} = 0.39\,in^2$ ← (3) #4 OK ✓

$V_u = 6.0^k \times 1.6 = 9.6^k$ → $\phi V_c = 0.75 \times 2 \times \sqrt{2500} \times 18'' \times 14'' = 18.9^k$
→ PROVIDE MIN TIES AT CRAWLSPACE

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