Terry A. Nettles, P.E.
Consulting Engineer
structural engineering

Reviewed for code compliance
with IRC 2015
Kitsap County Building Department
gshapiro@co.kitsap.wa.us
09/08/2020

THE SAMPLE RESIDENCE

Gretchen Massee, Architect

Remodel

STRUCTURAL ENGINEERING CALCULATIONS REPORT

TERRY A. NETTLES
STATE OF WASHINGTON
13801
REGISTERED
STRUCTURAL ENGINEER

5/31/20

2015 International Building Code
Seismic Zone D2, Importance II, S_S = 1.63g
110 mph Wind (V_{ult}), Exposure B, k_{ZT} = 1.25
Floor Live Load - 40 psf, Sleeping 30 psf
Ground Snow Load, 30psf , C_D = 1.15
Soil Bearing Pressures – 1500 psf (prescriptive)

Site Address:
8582 Long Lake Rd. SE.
Port Orchard

7777 92nd Street NW Gig Harbor, WA 98332 Voice (253) 858-7777 Fax (253) 858-7777

Permit Number: 20-03436

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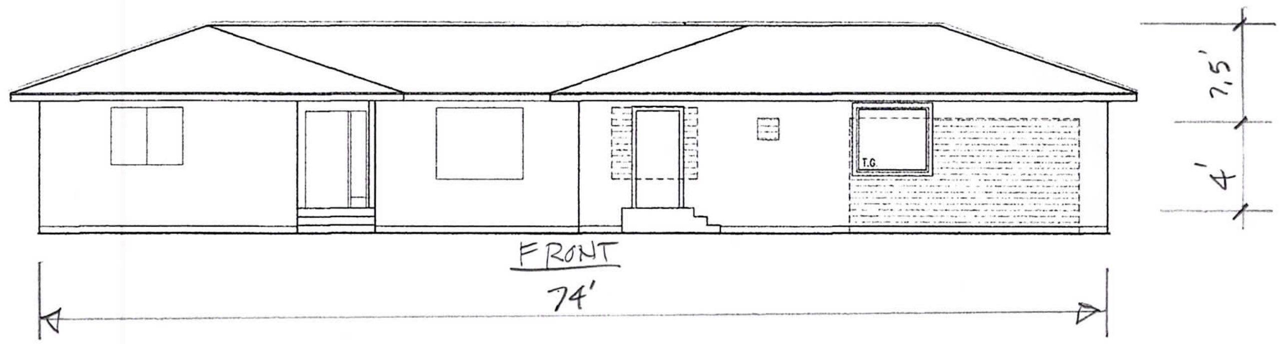
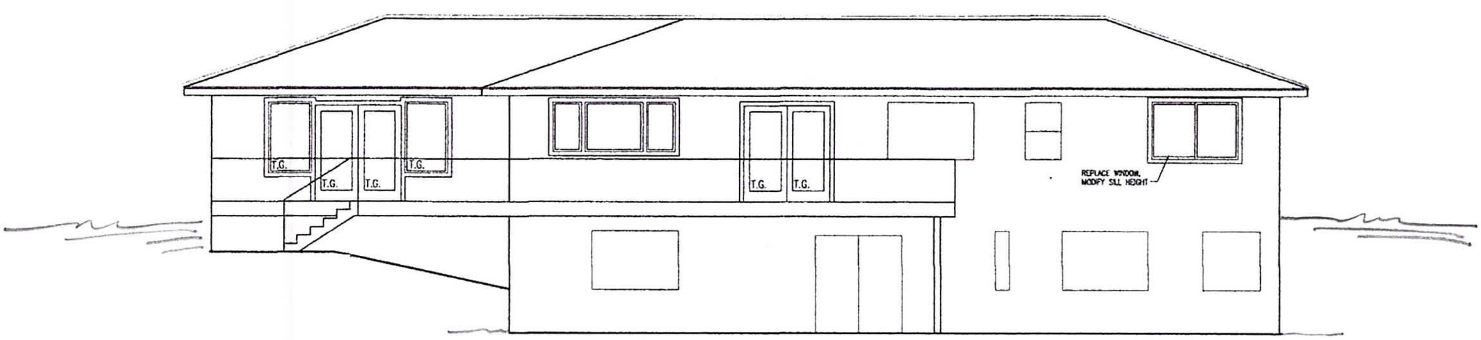
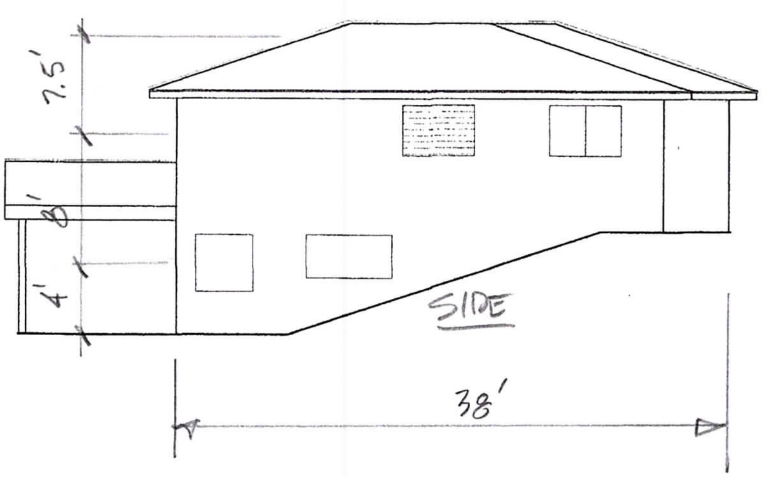
Project SAMPLE RESIDENCE
GR MASSEE - REMODEL
Subject REMODEL

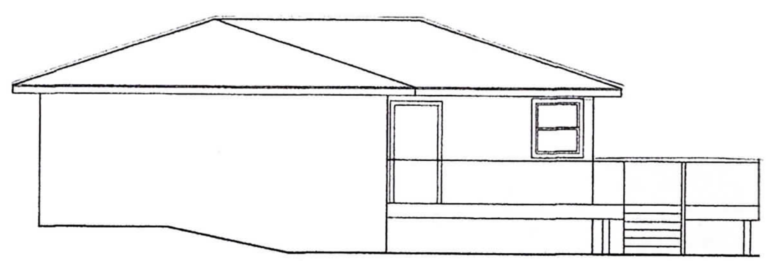
Sheet 1 of 13
Job No. 40068
Date 5/31/20





BACK





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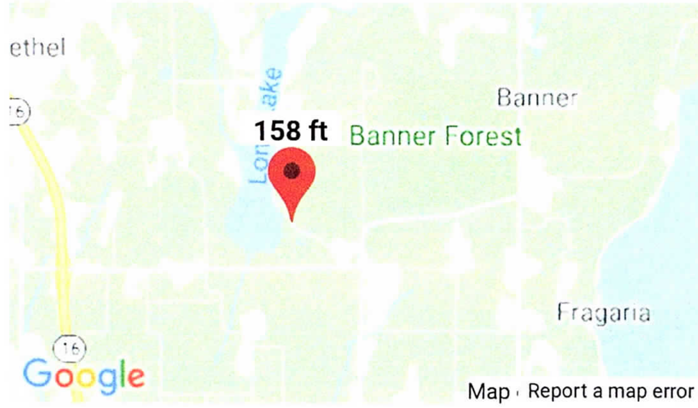
P2/13

Search Information



Address: 8582 Long Lake Rd SE, Port Orchard, WA 98367, USA

Coordinates: 47.4735046, -122.5852132

Elevation: 158 ft

Timestamp: 2020-05-25T20:32:05.741Z

Hazard Type: Seismic

Reference Document: ASCE7-16

Risk Category: II

Site Class: D-default

Basic Parameters

Name	Value	Description
S_S	1.627	MCE_R ground motion (period=0.2s)
S_1	0.559	MCE_R ground motion (period=1.0s)
S_{MS}	1.953	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	1.302	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	0.9	Coefficient of risk (0.2s)
CR_1	0.882	Coefficient of risk (1.0s)
PGA	0.693	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.832	Site modified peak ground acceleration

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The Sample Residence
Lateral Forces Analysis
Exposure B

Lateral Forces Analysis in accordance with the IBC 2015, chapter 16

This lateral forces analysis is being performed for a site with 25 psf ground snow loads, 85 mph wind speeds (K_{zt} = 1.15), with an Exposure B terrain condition. Seismic analysis shall use a site class D soil with site coefficient F_s for a site spectral response of S_s = 1.627 from ATC Worldwide Seismic "DesignMaps" Web, ASCE 7-16, Seismic Category Use Group I

Wind Alternate All Heights Method per IBC Section 1609.6.3, Exposure B, 85 mph (ASD) wind

$$P_{net} = q_s K_z C_{net} [I k_{zt}]$$

q_s = 22.5 psf K_{z25} = 0.70
C_{net} = 0.73 used for all (roofs and walls)
k_{zt} = 1.25 I = 1.0
for h $\leq$ 30' P_{net} = 14.9 psf **minimum on walls**
P_{net} = **use 8 psf minimum on sloping roof**

F f/b_1 = 74'[(4.5')8psf + (3')14.9psf] = 5972 lb
F s/s_1 = 38' [(4.5')8psf + (3')14.9psf] = 3067 lb
F f/b_0 = 54'(8')14.9psf + Ff/b_1 = 12409 lb
F s/s_0 = 18'(8')14.9 psf + 0.35 Fs/s1 = 3219 lb to rear wall

GRAVITY LOADS

	DL (psf)	LL (psf)	TOTAL (psf)
roof (composition)	20	25	45 psf
floors (gathering)	12	40	52 psf
floors (sleeping)	12	30	
exterior decks framed	10	60	70 psf
walls (8-ft height)	10	----	90 plf

SEISMIC FORCES

This building is 3-stories or less of plywood shearwall bracing
The seismic base shear V = C_sW
where C_s = [S_{DS} / R/I_e)] W
and from ASCE 7 Table 12.2-1, Section A 15, Light Wood Frame, R = 6.5
from ATC Seismic Hazards Map, S_s = 1.627
S_{DS} = 1.302
R = 6.5 for plywood sheathed framed walls
For working stress analysis, use 0.7E for seismic
W = dead load weight of building
so Veq = [(1.302)/6.5] W(.7) = 0.140 W for framed wall portions

P4/13

The Sample Residence
Lateral Forces Analysis
Exposure B

Where W is the gross weight of the part of the structure above the base of the shear resisting element. Therefore the floor weight does not add to the wall shears of the floor being calculated but only to the mass contributing to shears of the next story's bracing walls below it when it is calculated.
Dead Load + Live Load (floors) + Seismic (snow is not included when < 30psf) the net areas that can be loaded.

Calculate the maximum gross weight of the building using the sum of the net areas that can be loaded.

A roof	Wr	2370	17 psf	=	40290	lb
A floor 1	Wf_1	2195	12 psf	=	26340	lb
A floor 0	Wf_0	1338	slab on grade		0	lb
L walls 1	Ww_1	362	80 plf	=	28960	lb
L walls 0	Ww_0	254	80 plf	=	20320	lb

Veq_1 = $0.140(Wr + Ww_1)$ = 9702 lb
Veq_0 = $0.140(Wf_1 + Ww_0) + Veq_1$ = 16239 lb

SUMMARY OF CONTROLLING SHEARS

FLOOR 1

Maximum $F\ f/b_1$ = 9702 **Seismic controls**
Maximum $F\ s/s_0$ = 9702 **Seismic controls**

FLOOR 0

Maximum $F\ f/b_1$ = 16239 **Seismic controls**
Maximum $F\ s/s_0$ = 16239 **Seismic controls**

For Maximum Base Shears
Veq = $0.14(Wf_0) + Veq_1$ = 16239 lb
Vwind = $58'(5')14.9psf + Ff/b_0$ = **16672 lb CONTROLS**

Anchor Bolt Requirements (Cumulative)
Total foundation base length = 254 ft
By using the allowable compressive stress of the bolt face against the wood with 4/3 stress increase for short term loads, and assuming a Hem-fir species material with Fc = 500 psi, the 4/3(500) = 667 psi, then for
$^1/_2$" dia. bolts in $1^1/_2$" mudsills, gives a 500 lb/bolt capacity, and for
$^5/_8$" dia. bolts in $1^1/_2$" mudsills, gives a 625 lb/bolt capacity

Vbase = 16672 lb, so minimum number of bolts req'd = V/500 = 33
or = V/625 = 27

254/33 = 8 ft o.c. for $^1/_2$" bolts
254/27= 10 ft o.c. for $^5/_8$" bolts

Use minimum $^1/_2$" Φ anchor bolts @ 6' o.c. with 3"x 3"x $^1/_4$" plate washers
(See Shear wall schedule for local wall conditions requiring closer spacing.)

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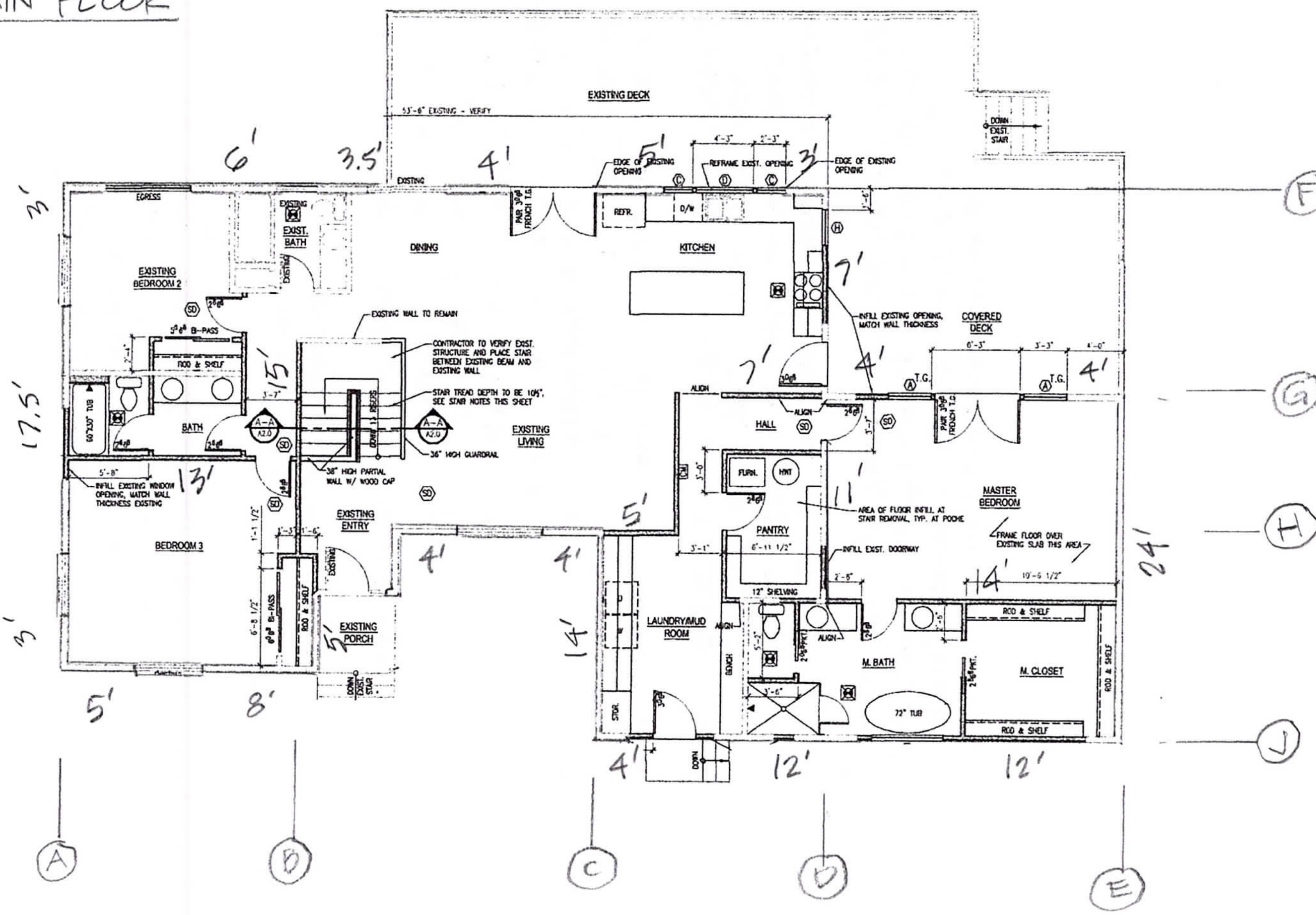
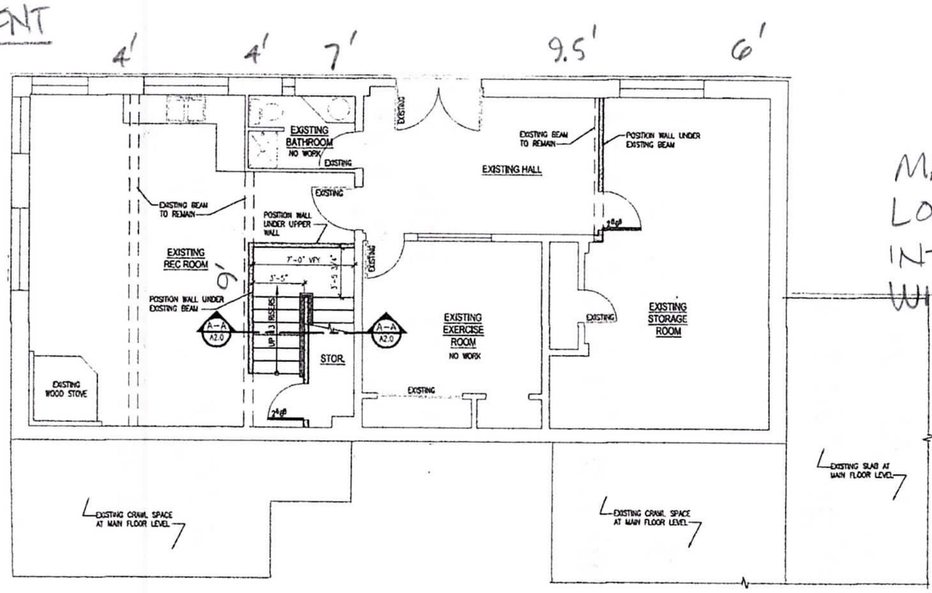
MAIN FLOOR



BASEMENT



MAIN FLOOR DIAPH.
LOCKS ALL UPPER STORY
INTERIOR BRACING WALLS
WITHIN THE FOUNDATION

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Project SAMPLE RESIDENCE

Subject LATERAL FORCES

Job No. 40068

Date 5/31/20

MAIN FLOOR

$F_{F/B} = 9700^{\#}$ (SEISMIC)/5 = $1940^{\#}$ TO EACH BRACE LINE (A) THRU (E)

BRACING WALLS

$fv_{(A)} = \dfrac{1940^{\#}}{(3'+17.5'+3')} = 83\,plf$ → existing adequate

(5d/7) $fv_{(B)} = \dfrac{1940^{\#}}{(5'+15')} = 97\,plf$ → existing exterior ok
½" GWB 2-sides interior wall 5d@7"

$fv_{(C)} = \dfrac{1940^{\#}}{14'} = 139\,plf$ → existing is adequate

(8d/6) (5d/7) $fv_{(D)} = \dfrac{1940^{\#}}{(7'+11')} = 108\,plf$ → 7/16" OSB exterior w/8d @ 6" oc
½" GWB interior w/5d @ 7" oc

$fv_{(E)} = \dfrac{1940^{\#}}{24'} = 81\,plf$ → existing is adequate

---

$F_{S/S} = 9700^{\#}$ (SEISMIC)/4 = $2425^{\#}$ TO (F) THRU (J)

BRACING WALLS

(8d/6) $fv_{(F)} = \dfrac{2425^{\#}}{(6'+3.5'+4'+3')} = 147\,plf$ → 7/16" OSB w/8d @ 6" o.c. VERIFY

(8d/6) (5d/7) $fv_{(G)} = \dfrac{2425^{\#}}{(4'+4'+7'+13')} = 87\,plf$ → ½" GWB w/5d@7" interior
7/16" OSB w/8d @6" exterior

(8d/6) (5d/7) $fv_{(H)} = \dfrac{2425^{\#}}{(4'+4'+5'+14')} = 90\,plf$ DO

(8d/6) $fv_{(J)} = \dfrac{2425^{\#}}{(5'+8'+4'+12'+12')} = 59\,plf$ → 7/16" OSB w/8d @ 6" oc

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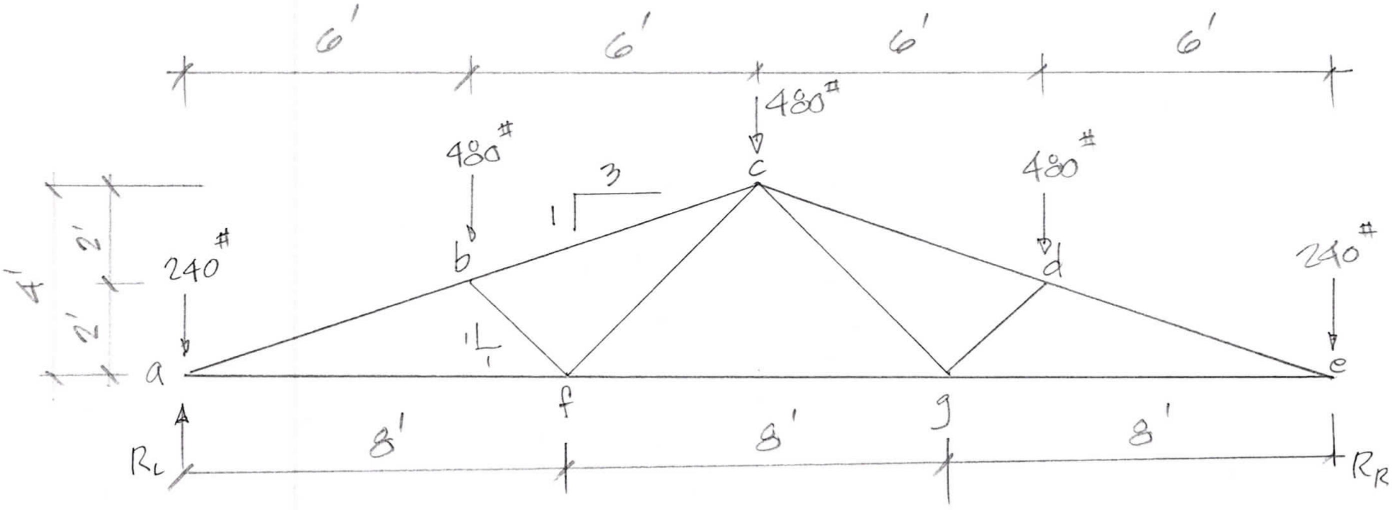
Project: SAMPLE RESIDENCE

Job No. 40068

Subject: ROOF FRAMING

Date: 5/31/20



TRUSSES @ 2' o.c. × 40 psf = 80 plf

$$R = \left(\frac{24'}{2}\right)80 = 960^{\#}$$

3
1
3.16

DETERMINE MEMBER FORCES & JOINT LOADS

FIND ab
$$\Sigma F_y = 0 = 960^{\#} - 240^{\#} - \frac{1}{3.16}ab \qquad ab = \left[\frac{960-240}{1/3.16}\right] = 2275^{\#}$$

joint b
$$\Sigma F_y = \frac{1}{3.16}(2275^{\#}) - 480^{\#} - \frac{1}{3.16}bc + \frac{1}{1.41}bf = 0$$

$$720 - 480 - \frac{bc}{3.16} + \frac{bf}{1.41} = 0$$

$$240 - \frac{bc}{3.16} + \frac{bf}{1.41} = 0$$

$$\frac{bc}{3.16} = 240 + \frac{bf}{1.41} \rightarrow bc = 758 + 2.24\,bf$$

$$\Sigma F_x = 0 = \left(\frac{3}{3.16}\right)2275 - \frac{1}{1.41}bf - \frac{3}{3.16}bc$$

$$2160 - \frac{bf}{1.41} - \frac{3}{3.16}(758 + 2.24\,bf) = 0$$

$$2160 = \frac{bf}{1.41} + 720 + 2.13\,bf$$

$$1440^{\#} = 2.84\,bf$$

$$bf = 508^{\#}$$

$$bc = 758 + 2.24(508) = 1895^{\#}$$

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Find af

$$F_x = 0 = \frac{3}{3.16} F_{ab} - F_{af}$$

$$F_{af} = \frac{3}{3.16}(2275^{\#}) = 2160^{\#}$$

Joint f

$$\Sigma F_y = 0 = -\frac{1}{1.41} F_{bf} + \frac{1}{1.41} F_{cf}$$

$$F_{bf} = F_{cf} = 508^{\#} \text{ tension}$$

Find fg

@f $\Sigma F_x = 0 = -F_{af} - \frac{F_{bf}}{1.41} + \frac{F_{cf}}{1.41} - F_{fg}$

$$-2635 - \frac{508}{1.41} + \frac{F_{cf}}{1.41} - F_{fg}$$

$$2995 = \frac{F_{cf}}{1.41} - F_{fg}$$

$$F_{fg} = 2995 - \frac{508}{1.41} = 2488^{\#}$$

USE 1/2" CDX PLYWOOD GUSSETS BOTH SIDES FOR ALL JOINTS

STAPLE w/ 14 ga - 1 3/4" WIRE STAPLES 7/16" CROWN VALUED @ 53#/STAPLE

JOINT a $2275^{\#}/53$ = 44 staples $2160^{\#}/53$ = 42 to bot chord

b $508^{\#}/53$ = 10 staples

c 1895/53 = 36 staples

d = b = 10

e = a 44 to top chord 42 to bot chord

f 508/53 = 10

g = f

ANY BOT CHORD SPLICE USE 50 MIN 3/4" SPACING

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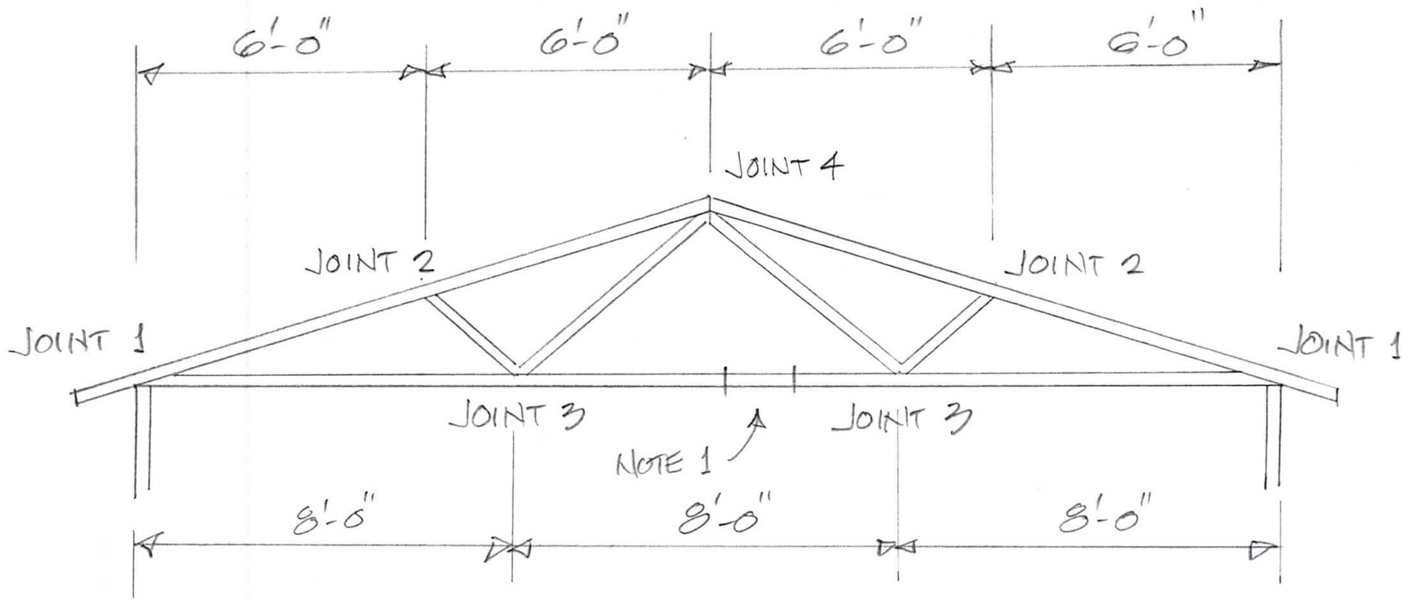

ROOF FRAMING RETROFIT

CONVERT EXISTING RAFTERS & CEILING JOISTS TO SITE FABRICATED STRUCTURAL TRUSSES WITH WEBS & CONNECTIONS PER DETAILS

ALL NEW MATERIAL #2 DF 2x4

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Project SAMPLE RESIDENCE

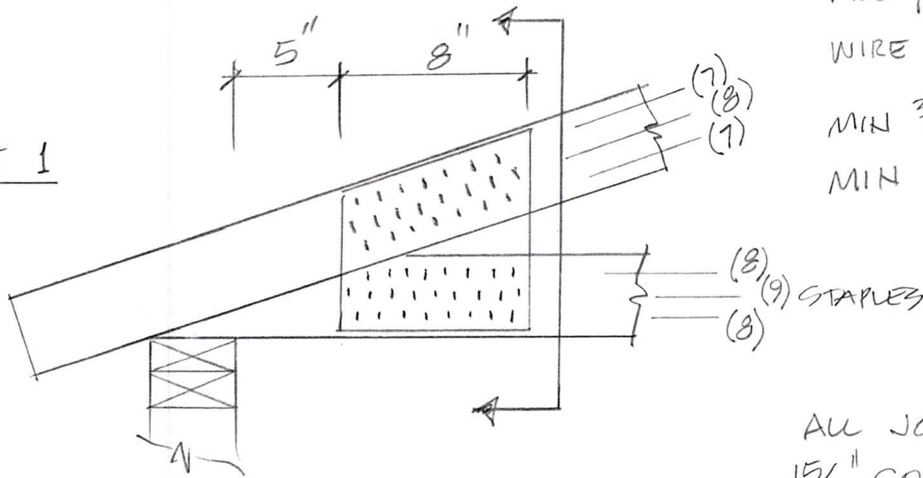
Job No. 40068

Subject TRUSS GUSSETS

Date 5/31/20

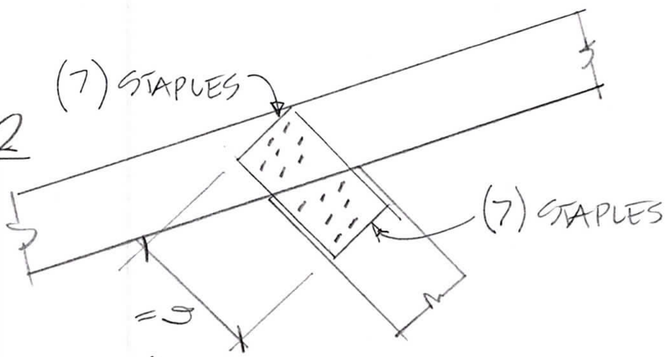
ALL FASTENERS 14 ga - 1 3/4" WIRE STAPLES w/ 7/16" CROWN
MIN 3/4" O.C. SPACING
MIN 1/2" EDGE & END DISTANCE

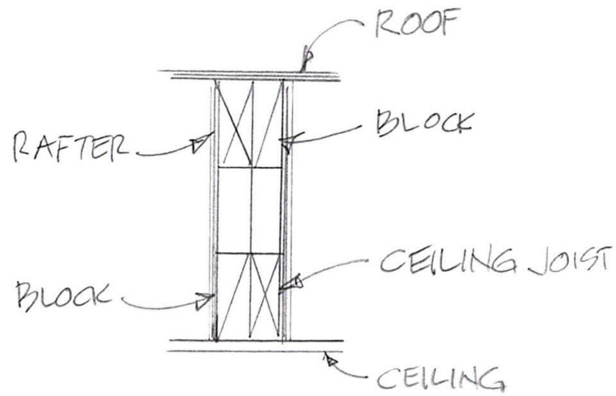
JOINT 1



ALL JOINTS FORMED WITH 5-PLY 15/32" CDX PLYWOOD - BOTH SIDES

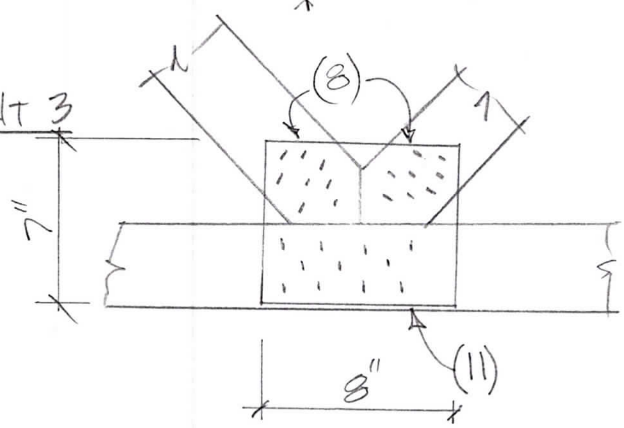
JOINT 2





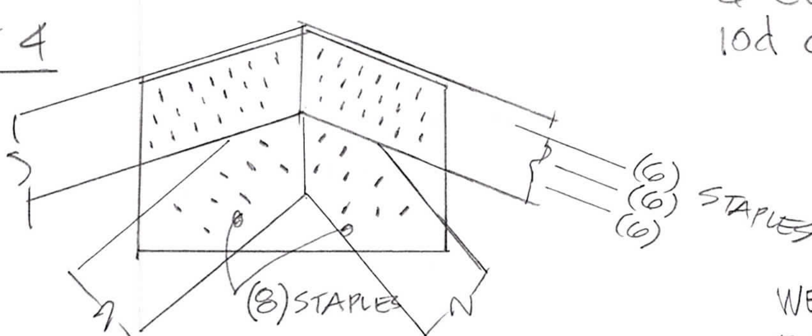
SECTION

JOINT 3



EXTEND MAKE-UP BLOCKS FROM INTERIOR FACE OF WALL TO 3'-6" BEYOND GUSSET EDGE AND NAIL TO EXISTING RAFTER & CEILING JOISTS WITH 2-ROWS 10d COMMON @ 3" O.C., STAGGER

JOINT 4



WEBS MAY BE PLACED FROM RAFTER TO CEILING JOIST WITHOUT MAKE-UP BLOCKING

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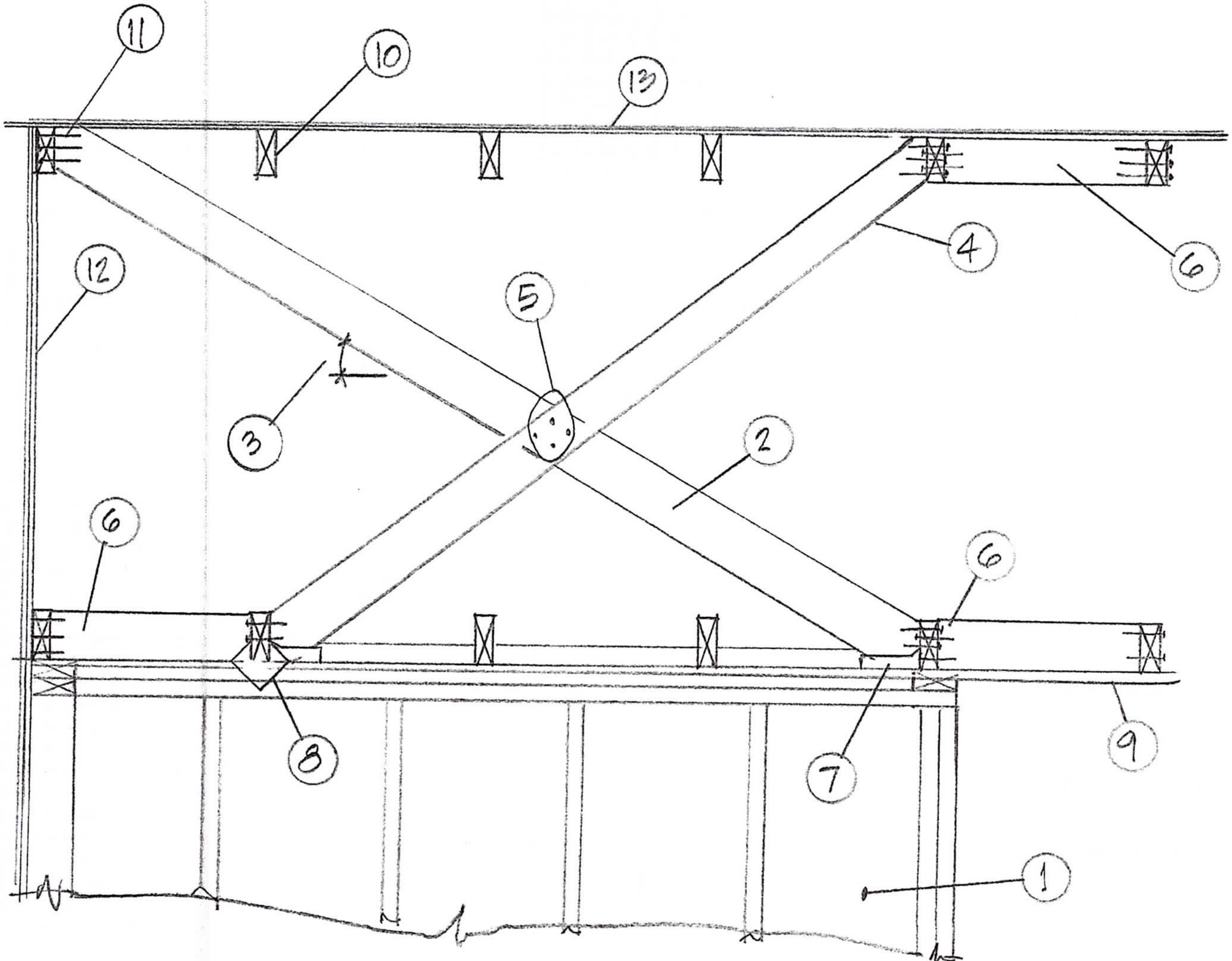

DETAIL X-BRACE

SEE PLANS FOR LOCATION

1. Designated shear wall below which is perpendicular to direction of roof framing.
2. 2x6 X-brace frame from top plate of wall to roof diaphragm.
3. Set angle of braces no less than 30° and no greater than 45° off horizontal.
4. Braces may be set up to 10° out of vertical plane to avoid truss webs.
5. Provide (4) 16d nails at crossing.
6. Install a 2x4 block at ends of braces to next roof framing member with (3) 16d.
7. Place Simpson LU26 flat on top plate to receive base of braces over wall.
8. Connect ceiling joist or truss bottom chord to wall with H1 at brace locations.
9. Typical ceiling gypsum board sheathing installation.
10. Rafters or roof trusses.
11. Install (3) 20d nails through truss or rafters into end of each X-brace.
12. Gable end wall sheathing where occurs.
13. Typical roof sheathing nail at 4-inches o.c. to blocks at brace ends.

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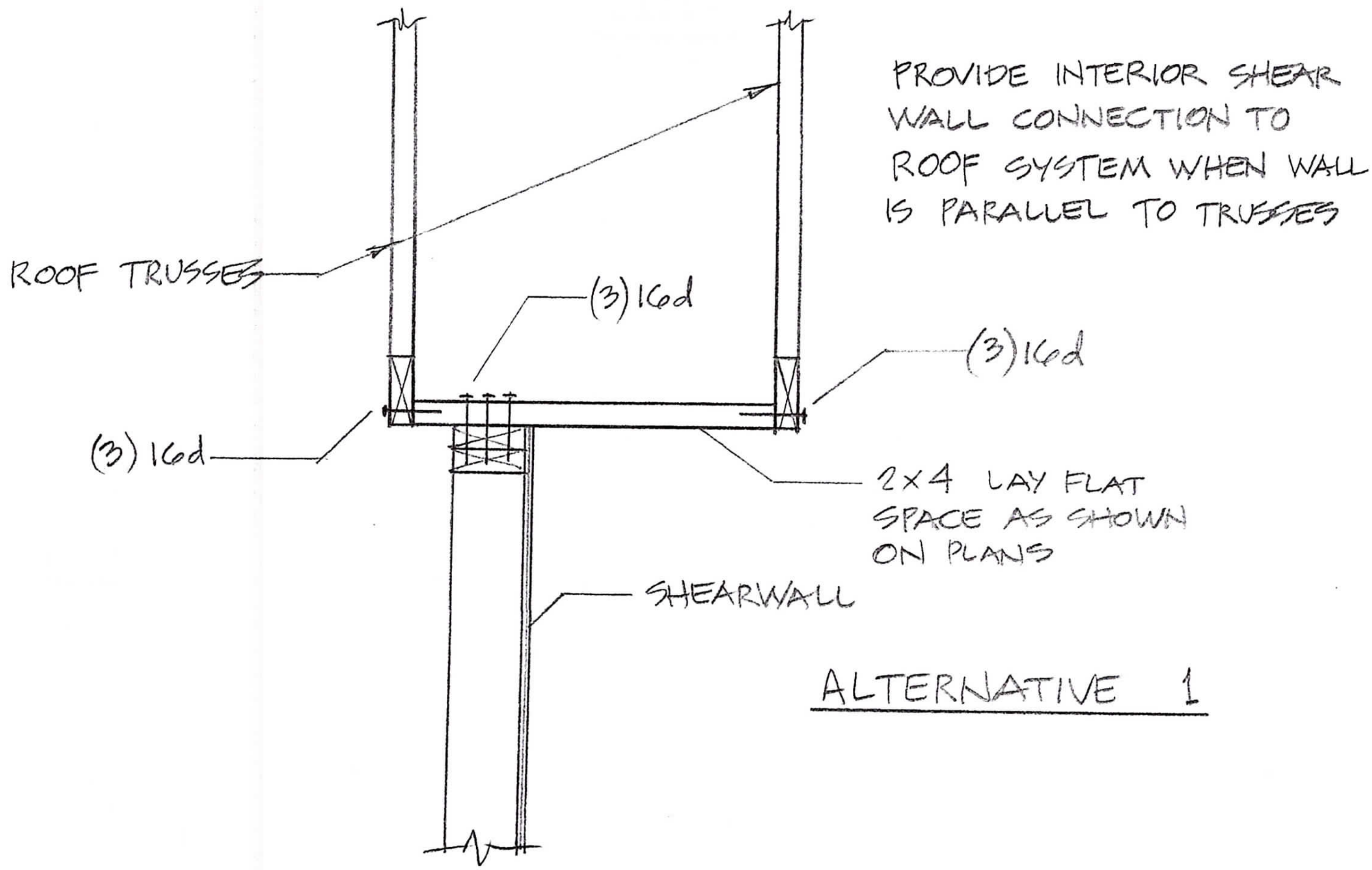
Project: SAMPLE RESIDENCE

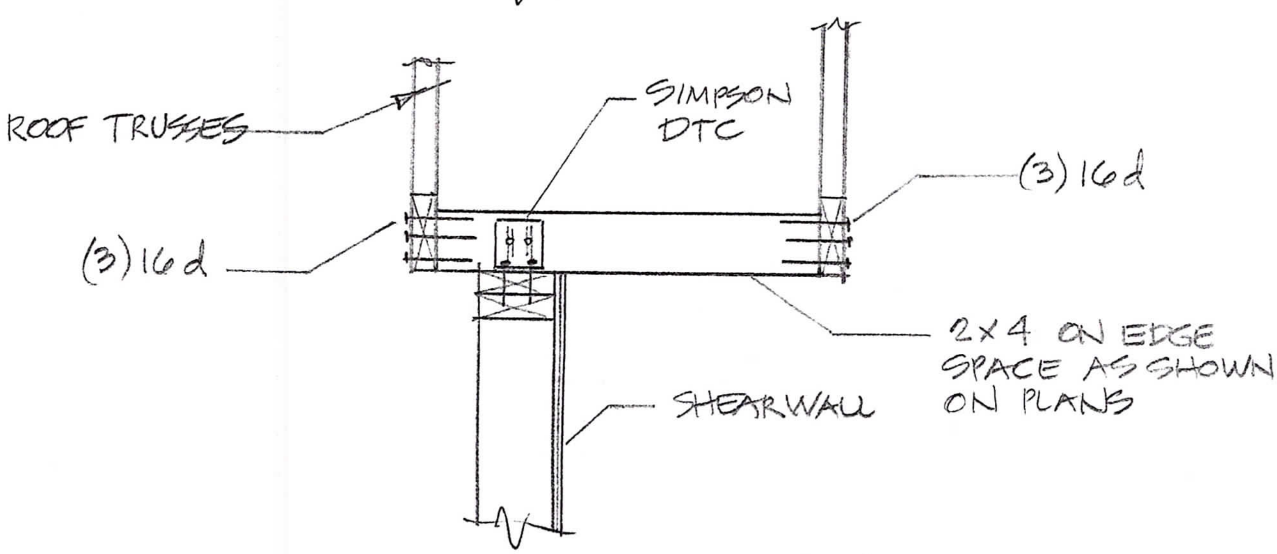
Subject: LADDER BLOCK DETAIL

Job No. 40068

Date 5/31/20



ALTERNATIVE 1



LADDER BLOCK DETAIL

ALTERNATIVE 2

(RECOMMENDED)

SHEATHING REQUIREMENTS FOR THE SAMPLE RESIDENCE REMODEL

Structural sheathing is required to provide adequate lateral bracing of the building system and as diaphragms of the roof and floor structures to transfer loads to lateral bracing elements and is specified by the following notes:

Assumptions of existing construction are that all exterior walls are presently sheathed with a recognized rated sheathing panel and attached to wood framing in accordance with the standard nailing schedule of the International Building Code. For any changes to the exterior walls and roofs use a <u>minimum</u> thickness $^{7}/_{16}$" APA rated sheathing panel for all exterior faces. For these panels, there shall be one row of nails at each plate and at least one row into each rim joist. Spacing of these nails in these rows shall be consistent with the panel designation nailings as defined below and indicated on the drawings. At the foundation line there shall be a row of nails continuous at 4" o.c. minimum. Sole plate nailing of all wood panel sheathed walls is specified below.

Any revised portions of the main floor shall use sheathing panels of a minimum $^{23}/_{32}$" APA Sturd-I-Floor, tongue and groove edged, rated panels likewise alternated by $^{1}/_{2}$ of a panel length in layout and glued and nailed with 10d galvanized or ring shanked nails at 6" o.c all edges, 12" in the field. Edges of floor diaphragms shall be nailed into solid blocking which fills the joist space in line with and directly above the bracing wall elements below. Current rafters and trusses shall be connected to the top plates with Simpson type H1 hurricane clips, OR SDWC 15600 screws, OR 6" TimberLOK screws at maximum 24" o.c. unless indicated otherwise on the plans. Modification to interrupted rafters and or ceiling joists through the central portion of the house where existing bearing walls are being removed shall be converted to site built structural trusses using the existing rafters and joists supplemented with webs and gussets as shown on the drawings.

Nailing and sheathing requirements for the new construction are specified on the drawings with the fastening indicated by spacing on the edges and along interior lines (through the field) in inches by the following symbols.

for 8d/6 Use a $^{7}/_{16}$"minimum thickness APA rated sheathing panel on one side with 8d common or galvanized box nails @ 6" o.c. edges and 12" through the field. Nail sole plates into solid material (blocking or joists) with 16d @ 12" o.c. Staples may be used, however, they shall be a 14 gauge 1-$^{3}/_{4}$" galvanized wire staple with crown placed parallel to the panel edge and spaced at 6" o.c. edges/9" o.c. field. Blocking is required at all unsupported edges of the sheathing. Provide ½" diameter x10-inch anchor bolts at 6-ft o.c. maximum.

for 5d/7 Sheath wall <u>both sides</u> with $^{1}/_{2}$" gypsum wallboard and nail edges supported by studs and plates with 5d cooler nails spaced at 7 inches on center. Nail sole plate to solid blocking or joists in the floor below using 16d nails spaced at 12-inches on center.

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