Weed, CA Housing Project

A Senior Project
Presented to the Architectural Engineering Department,
California Polytechnic State University, San Luis Obispo

In partial fulfillment of requirements for the
Degree of the Bachelor of Science

By Trenton Jay Pichel
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Project Description

The following provides background information of the overall purpose for this project as well as supporting architectural documents to aid the structural design.

**History:** In September of 2014, Siskiyous country and the City of Weed, CA was struck by a violent wild fire that burned through the town, destroying several office buildings and neighborhoods, along with two churches and caused damage to the local elementary school. High winds blow through Weed, which are particularly high during the late summer months, and spread the fire faster than what fire fighters could manage. In short, the City of Weed lost numerous amount of buildings due to the Boles fire and families were uprooted in its wake. Two years later, Cal Poly San Luis Obispo became involved in the cities rebuild.

**Who:** The following structural calculations and drawings were created for Great Northern Services (GNS) in the city of Weed, California. GNS is a non-profit organization dedicated to servicing its community by invigorating the cultural, environmental, social, and economical aspects of Siskiyou County. Alongside GNS, this project was developed for the College of Siskiyous, which is a community college servicing the same region GNS influences and is a secondary shareholder to this project.

**What:** The following content is the structural design for a 1000 square feet, single story, and single family residential home located in northern California, which is subjected to large snow and wind loads. With this in mind, the design intent was to provide a well-insulated space for the future homeowners through Passive House design aspects.

**Why:** Prefabricated passive housing was the focus of the design so that the future occupants could live comfortably in their home during all seasons of the year, especially in the winter since Weed can endure snowfall of up to six feet during the colder months. Passive housing not only provides a superior comfort of living, but the monthly energy savings on heating and cooling are extremely significant as well, providing up to a 75 percent reducing in monthly bills. Natural gas was not an option when determining the heating needs for the client and therefore electricity and diesel fuel are the primary means of energy for the area. The project team determined early on that diesel fuel was likely to be an inefficient design in terms of sustainability and maintenance costs, leaving electricity as the only viable option and furthering support for a passive concept.
spatial efficient
Open floorplan and circulation active arrangement of the rooms minimizes hallways and dead space. The Shelf a raised shelf system provides additional storage and allows more usable floor space below.

energy efficient
building shape aiming a A/V-ratio below 0.7 reduces surfaces through which heat can be lost. The well insulated wall assemblies and continuous insulating envelope reduces heat loss through the surfaces/walls. Airtightness reducing the air change rate leads to a lower exchange of hot and cold air.

affordable
simple but sophisticated floor plans reduces the amount of walls and constructive elements.

heating and cooling
The investment in higher quality building components is mitigated by the elimination of expensive heating and cooling systems.

passive house principles
Building to the Passive House Standard reduces our buildings’ operational energy demand to an optimized extent through passive measures and components such as insulation, airtightness, heat recovery, solar heat gains, solar shading and incidental internal heat gains. Passive House reliably delivers up to approximately a 90% reduction in heating and cooling demand and up to a 75% reduction in overall primary energy demand when compared to our existing building stock.

Regular home*
2015 average monthly consumption US = 901 kWh/household/month
Average price = $0.1699/kWh
901kWh/household/month*$0.1699/kWh=$153.08/month

Passive house
monthly consumption Passive house = 6200kWh/household/year (516kWh/household/month)
average price = $0.1699/kWh
516kWh/household/month*$0.1699/kWh = $87.67/month

Savings
$153.08/month-87.67$/ moth = $ 65.41/month = $ 784.92/year

Regular home* calculation:

- Monthly consumption: 901 kWh
- Average price: $0.1699/kWh
- Total cost: $153.08/month

Passive house calculation:

- Monthly consumption: 6200 kWh (516 kWh/month)
- Average price: $0.1699/kWh
- Total cost: $87.67/month

Savings:

- $153.08 - $87.67 = $65.41/month
- $65.41 * 12 months = $784.92/year
wind
Roof structure angled to take on high wind loads predominantly from the south and partially from the north while preserving the look of the neighborhood.

sunlight
Wide shape to be exposed to the sun for passive solar heating. Rotated towards true south for maximum exposure. Windows to heat the more spacious living room taking into consideration solar angle. High R-values mean more heat retention and reduced energy consumption due to heating.

site strategy
Slightly grading the exiting topography creates circulation and addresses several issues: The building orientation and roof shape not only maximizes solar exposure and provides thermal comfort but also protects the site of high wind from north and south. Also, the grading creates a downward flow for water management and irrigation.

Water Management
Heat Pump Water Heater
- Water is taken from the water line along the west side of the property to the technical room where the heater is located.
- Water is then heated as needed based on homeowners’ heating needs.
- One plumbing wall is needed.
- Waste water is then sent to the sewage pipe which will connect to the sewer line in parcel 2.

Heating Systems
Primary Heating Source
- A technical room, located at an exterior wall allows immediate heating and less connection for the systems.
- The Heat Pump is located in the garage.
- Ductless Mini-Split Heat Pumps
- Modulated heating based on temperature.
- One outdoor unit and three indoor units focused mainly on heating.
- Indoor units capable of 8,900 BTU/hr
- Outdoor unit capable of 28,600 BTU/hr
- Electricity and power will be provided by the line.

water management
Roof shape and material choice to effectively shed snow and direct water downhill.
HAPPY HOMES
BECK, LEE, LUNDHAL, PICHEL, VERGARA

ROOF R-62.66
- Corrugated metal R-0
- 3/4" battens R-1
- 3/4" counter battens R-1
- Waterproofing membrane R-0
- 3/8" Wood fibreboard (open to diffusion) R-0.74
- 2" XPS R-10
- 2" Insulated Sheeting R-12.4
- 9.25" Cellulose fibre insulation / timer joists R-35.15
- 1.5" Insulated Sheeting R-12.4
- 5/8" OSB board, interior finishing R-0.45

WALL ASSEMBLY R-66.266
- 5/8" Drywall/Gypsum R-0.45
- 5.5" High Density Cellulose R-20.9
- 2x6" StudWall
- 5/8" OSB, fluid applied at seams R-0.74
- 9.25" High Density Cellulose R-35.15
- 2" XPS Board R-10
- 2" DWD - vapor permeable sheathing R-0.14
- 3/4" furring and air space R-1
- 5/16" fibre cement R-0.15

FLOOR ASSEMBLY R-61.436
- 3/8" Linoleum resilient flooring R-0.4
- 3/8" OSB-Sheating R-0.74
- 7.25" Cellulose and Joists R-27.55
- 2" Insulated Sheeting R-12.4
- 2" Insulated Sheeting R-12.4
- 2" Diffusion Board R-12.4
- Waterproofing Membrane R-0

DRYWALL
LINOLIUM
METAL ROOFING
FIBRE CEMENT CLADDING
Examples for Fabrication of Passive Houses

Knox House by EcoCor
- Similar environmental design conditions: snow, wind, heating and cooling forest
- Hybrid Double Wall System
  - airtightness: 28 ACH50 and dropping

17 Carol Street by Michael Tolle
- Similar environmental design conditions: snow, wind, heating and cooling forest
- Uses similar methods of structural and mechanical systems: brand, sizing, and construction methods
- construction on sides
  - airtightness: 0.45 ARCH/50

R. House by Rual Design Architects
- Can be assembled and located elsewhere (modular)
- Installation of panelized wall assembly with crane
  - airtightness: n/a

The lower the grade of prefabrication the airtight is the building envelope

Penalization dividing the exterior wall into three layers ensures that the gaps differ and attains a seamless airtight envelope

1. Drywall, Stud-Wall, Insulation OSB
2. second Insulation layer DWD board
3. furring and counter furring fiber cement cladding

HAPPY HOMES
BECK, LEE, LUNDHAL, PICHEL, VERGARA
Weed, CA Housing Project

Structural Calculation and Drawing Package

Trenton Jay Pichel

December 1, 2017

ARCE 415 Cal Poly San Luis Obispo
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Design Maps Summary Report

User-Specified Input

Building Code Reference Document  ASCE 7-10 Standard
(which utilizes USGS hazard data available in 2008)

Site Coordinates  41.42891°N, 122.37939°W

Site Soil Classification  Site Class D - "Stiff Soil"

Risk Category  I/II/III

USGS-Provided Output

\[ S_s = 0.736 \text{ g} \quad S_{MS} = 0.891 \text{ g} \quad S_{DS} = 0.594 \text{ g} \]
\[ S_t = 0.328 \text{ g} \quad S_{M1} = 0.572 \text{ g} \quad S_{D1} = 0.381 \text{ g} \]

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.

For PGA_{MS}, T_{U}, C_{RS}, and C_{R1} values, please view the detailed report.

LOAD TAKE OFF

ROOF:

1½" VERCO N82-36
2.2 psf

6" CLOSED-CELL SPRAY INSULATION
CR 6 per inch thickness
→ (2 psf) (0.5 ft)
1.0 psf

2x10 DF-L RAFTERS @ 24" O.C.
→ 35 psf (1.5 in) (9.2 ft) (1 ft²) (17½ in) (12 ft)
6.7 psf

½" GYPSUM BOARD CEILING
→ (5.0 psf) (6½ in)
2.5 psf

MEP + SPRINKLERS
4.5 psf
16.9 psf

MISCELLANEOUS

TOTAL DEMO TO DEMO
20.0 psf

18" EXTERIOR WALL ASSEMBLY
→ (23 psf) (129 ft) (12½ in) (8 ft)
(41 ft) (23.5 ft)
19 psf

6" INTERIOR WALL ASSEMBLY
→ (15 psf) (128 ft) (1½ in) (8 ft)
(4 ft) (23.5 ft)
12.0 psf

SEISMIC LOAD TO ROOF
51 psf

PITCHED ROOF
20 psf

TOTAL LIVE TO ROOF (RECURSIBLE)
20 psf
FLOOR:

VINYL TILE FLOORING

3/4" OSB subflooring
3.0 psf

2x8 DF-L #2 Tieplate @ 16" O.C.

\[
\rightarrow (35 \text{pcf})(1.5^2)(225^2)(0.01^2) = 2.6 \text{ psf}
\]

6" Closed-cell spray insulation, @ R6 per inch thickness

\[
\rightarrow (2 \text{pcf})(0.5 \text{ ft}) = 1.0 \text{ psf}
\]

TOTAL DEAD TO BEAMS

2x8 DF-L H2 Beams

\[
\rightarrow (35 \text{pcf})(1.5^2)(7.5^2)(0.01^2) = 2.6 \text{ psf}
\]

MEP

2.0 psf

12.6 psf

MISCELLANEOUS

TOTAL DEAD TO WALLS

18" Exterior wall assembly

\[
\rightarrow (23 \text{ psf})(129 \text{ ft})(12^2)(10 \text{ ft})
\]

\[
(4 \text{ ft})(23.5 \text{ ft}) = 22.1 \text{ psf}
\]

6" Interior wall assembly

\[
\rightarrow (15 \text{ psf})(128 \text{ ft})(12^2)(10 \text{ ft})
\]

\[
(4 \text{ ft})(23.5 \text{ ft}) = 15.0 \text{ psf}
\]

SEISMIC LOAD TO FLOOR

ONE FAMILY DWELLING, NON-HABITABLE ATTIC W/STORAGE

20 psf

TOTAL LIVE TO FLOOR

20 psf
SEISMIC LOADING CRITERIA

SEISMIC WEIGHT:

\[
\text{Roof} = (51 \text{ psf}) \left( \frac{17 \text{ ft}}{4 \text{ ft}} + \frac{12 \text{ ft}}{9 \text{ ft}} \right) (4 \text{ ft})(23.5 \text{ ft}) = 121.21 \text{ kips}
\]

\[
\text{Floor} = (52 \text{ psf}) (4 \text{ ft})(23.5 \text{ ft})
\]

\[
\text{Total} = 50.10 \text{ kips}
\]

\[
171.31 \text{ kips}
\]

SEISMIC RESPONSE COEFFICIENT:

\[
C = \frac{S_D S}{R_i} = \frac{0.594}{6.51} = 0.09138
\]

\[
T = (0.02)(14 \text{ ft}) = 0.275
\]

\[
0.145 \leq 16 = T_L \checkmark
\]

BASE SHEAR:

\[
V = C_w W_{total} = (0.09138)(171.31 \text{ kips}) = 15.65 \text{ kips}
\]

REDUNDANCY FACTOR:

\[\text{For N-S Direction}\]

<table>
<thead>
<tr>
<th>Wall</th>
<th>Length</th>
<th>Height</th>
<th>H/L</th>
<th>L/2L</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8 ft</td>
<td>18 ft</td>
<td>2.25</td>
<td>0.25</td>
</tr>
<tr>
<td>B</td>
<td>8 ft</td>
<td>18 ft</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>C</td>
<td>8 ft</td>
<td>18 ft</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>D</td>
<td>24 ft</td>
<td>16 ft</td>
<td>&quot;</td>
<td>&quot;</td>
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</table>

\[\therefore N-S = 1.0\]

\[\text{For E-W Direction}\]

<table>
<thead>
<tr>
<th>Wall</th>
<th>Length</th>
<th>Height</th>
<th>H/L</th>
<th>L/2L</th>
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<tbody>
<tr>
<td>1</td>
<td>8 ft</td>
<td>10 ft</td>
<td>0.25</td>
<td>0.2</td>
</tr>
<tr>
<td>2</td>
<td>8 ft</td>
<td>10 ft</td>
<td>&quot;</td>
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<tr>
<td>3</td>
<td>8 ft</td>
<td>10 ft</td>
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</tr>
<tr>
<td>4</td>
<td>8 ft</td>
<td>10 ft</td>
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</tr>
<tr>
<td>5</td>
<td>8 ft</td>
<td>10 ft</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>D</td>
<td>40 ft</td>
<td>10 ft</td>
<td>&quot;</td>
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\[\therefore E-W = 1.0\]
LOADING
SEISMIC, WIND, SNOW

12.8.3

VERTICAL DISTRIBUTION OF BASE SHEAR

→ FOR ROOF
\[ C_{Vx} = \frac{w \cdot h^2}{2 \cdot w \cdot h} = \frac{(18.21 \text{kip})(14 \text{ft})}{(121.2 \text{kip})(14 \text{ft}) + (50.10 \text{kip})(1 \text{ft})} = 0.97 \]

→ FOR FLOOR
\[ C_{Vx} = \frac{(50.10 \text{kip})(1 \text{ft})}{(174.7 \text{kip})(4 \text{ft})} = 0.03 \]

= 1.00 ✓

STORY FORCES:
(NEGLIGENCE LOFT AND FLOOR SEISMIC LOADING)

\[ F_{x,roof} = \sum C_{Vx} V = (1.0)(0.97)(15.65 \text{kip}) = 15.18 \text{kip} \]

\[ F_{x,roof} = (1.0)(0.97)(15.65 \text{kip}) = 15.18 \text{kip} \]

HORIZONTAL DISTRIBUTION OF BASE SHEAR

→ FOR ROOF
\[ V_x = \frac{1}{2} F_x \]

\[ V_x = \frac{1}{2} F_x \]

= 15.18 kip

= 15.18 kip

EFFECTIVE LENGTHS

→ FOR N-S DIRECTION
WALL | HEIGHT | LENGTH | H/L | REDUCED CAPACITY | LEFT / RIGHT
--- | --- | --- | --- | --- | ---
H-C | 18 ft | 8 ft | 2.5 | 2 (8 ft) / 18 ft = 0.89 | 0.89 (8 ft) / 7.1 ft

→ FOR E-W DIRECTION
WALL | HEIGHT | LENGTH | H/L | REDUCED CAPACITY | LEFT / RIGHT
--- | --- | --- | --- | --- | ---
1-5 | 10 ft | 8 ft | 1.25 | 2 (8 ft) | 2 (8 ft)

OUT OF PLANE SEISMIC FORCES

\[ f_p = 0.95 \cdot 2.2 W = 0.9(0.594)(1.0)(19 \text{psf}) = 9.51 \text{psf} \]

ASCE 7-10
12.11.1
**WIND LOADING CRITERIA**

**RISK CATEGORY**

**BASIC WIND SPEED**

**EXPOSURE CATEGORY**

**TOPOGRAPHIC FACTOR, K_{27}**

**WIND Pressures, P_{net 30}**

**ADJUSTMENT FACTOR, \( \lambda \)**

**ADJUSTED WIND PressURES**

\[
P_{net} = \lambda K_{27} P_{net 30} = (1.21)(1)(20.8 \text{ psf})
\]

\[
P_{net} = 25.17 \text{ psf}
\]

\[
P_{net} = 25.17 \text{ psf} > 4.51 \text{ psf} = L_p
\]

**WIND GOVERNS FOR OUT OF PLANE FORCES**
SNOW LOADING CRITERIA

Snow Load, $P_f$

Roof Slope Factor
W/ Metal Decking, $C_r$

Design Snow Load

$$S = 0.7 \times 60 \text{ psf} = 0.9 \times 60 \text{ psf}$$

$$P_f = 60 \text{ psf}$$

$$C_r = 0.7 \text{ (warm)}$$

$$C_r = 0.9 \text{ (cold)}$$

$$S = 42 \text{ psf (warm)}$$

$$S = 54 \text{ psf (cold)}$$
TYPICAL 7:12 ROOF RAFTER (WARM ROOF)

\[ D = 20 \text{ psf} \left( \frac{24 \text{ in.}}{12 \text{ in.}} \right) \left( \frac{12.5 \text{ ft}}{12 \text{ in.}} \right) = 45 \text{ plf} \]

\[ L_1 = 20 \text{ psf} \left( \frac{24 \text{ in.}}{12 \text{ in.}} \right) = 40 \text{ plf} \]

\[ S = 42 \text{ psf} \left( \frac{24 \text{ in.}}{12 \text{ in.}} \right) = 84 \text{ plf} \]

LOAD COMBINATIONS:

\[ D + S = 45 \text{ plf} + 84 \text{ plf} = 129 \text{ plf} \]

DEMANDS:

\[ M = \frac{wle^2}{8} = \frac{(129 \text{ plf})(12 \text{ ft})^2}{8} = 2322 \text{ ft kips} \]

\[ V = \frac{wl}{2} = \frac{(129 \text{ plf})(12 \text{ ft})}{2} = 774 \text{ kips} \]

IBC 2015
T. 1604.3

\[ \text{l.c.} = \frac{E}{240}, \quad \text{t.c.} = \frac{E}{180} \]

\[ \Rightarrow \frac{\text{l.c.}}{\text{t.c.}} = \frac{180}{240} = 0.75 \]

\[ HND \]

\[ \frac{\text{l.c.}}{\text{t.c.}} = \frac{(60 \text{ psf} + 20 \text{ psf})}{(60 \text{ psf} + 20 \text{ psf} + 20 \text{ psf}(\frac{12}{12}))} = 0.76 \geq 0.75 \quad \text{USE} \frac{E}{240} \]

\[ \Delta = \frac{5wle^4}{384EI} = \frac{E}{240} \]

\[ \Rightarrow EI = \frac{5wle^3}{384} = \frac{5(130 \text{ plf})(12 \text{ in.})^3}{(120)(100)(12)^3} = 101 \times 10^6 \text{ in}^2 \]

\[ I_{req} = \frac{EI}{E'} = \frac{101 \times 10^6 \times 12 \text{ in.}^4}{1.6 \times 10^8 \text{ psi}} = 63.18 \text{ in}^4 \]
SIZE SELECTION:

* TRY 2 x 10 DF-L #2

\[
E = 1.60 \times 10^6 \text{ psi} \quad I_{xx} = 98.93 \text{ in}^4
\]
\[
F_b = 900 \text{ psi} \quad S_x = 21.39 \text{ in}^3
\]
\[
F_v = 180 \text{ psi} \quad A = 13.88 \text{ in}^2
\]
\[
F_{cd} = 62.5 \text{ psi}
\]

CAPACITY:

\[
F_{b1} = F_b (C_d C_f C_r) = (900 \text{ psi}) (1.15) (1.10) (1.15)
\]
\[
\sigma_{max} = M \quad \Rightarrow \quad M_{allow} = F_{b1} S = (1309.38 \text{ psi}) (21.39 \text{ in}^3)
\]
\[
F_v' = F_v (C_d) = (180 \text{ psi}) (1.15)
\]
\[
\gamma = \frac{VQ}{ET} \quad \Rightarrow \quad \gamma_{allow} = \frac{F_v'A}{1.5} = \frac{(207 \text{ psi}) (13.88 \text{ in}^2)}{1.5}
\]
\[
\frac{1915}{1.65} \geq 774 \frac{\text{ in}}{\text{ lb}}
\]

USE 2 x 10 DF-L #2 HANGERS
@ 24" O.C. FOR 7/12 ROOF
**Typical 3:12 Roof Rafter (Cold Roof)**

**Load Combination:**

1. $D + S = 57 \text{ psf} + 108 \text{ psf} = 165 \text{ psf}$

**Demands:**

\[
\sum M_{wall} = 0 = P_{r} + wLx - V_{wall}L
\]

\[
V_{wall} = \left[ \frac{774/165}{(15 \text{ ft})^2/4} \right] / 12 \text{ ft} = 2514 \text{ lbs}
\]

\[
\sum F_Y = 0 = -P - wL + V_{wall1} + V_{wall2}
\]

\[
V_{wall2} = \left( 774 \text{ lbs} \right) + \left( 165 \text{ psf} \right) \left( 15 \text{ ft} \right) = 2514 \text{ lbs}
\]

**Moments and Shear Diagrams:**

\[
D_{LL} = \frac{L}{240} = \frac{(12 \text{ ft})(12 \text{ in})}{240} = 0.61 \text{ in}
\]

\[
D_{TL} = \frac{L}{180} = \frac{(12 \text{ ft})(12 \text{ in})}{180} = 0.81 \text{ in}
\]
CAPACITY:

TRY 2x12 DF-6 #2

\[ F_x = 178.0 \text{ kips} \]
\[ S_x = 31.64 \text{ kips} \]
\[ A = 16.88 \text{ in}^2 \]

\[ F_0 = (900 \text{ psi})(1.15)(1.0)(1.15) = 1190 \text{ psi} \]
\[ M = (1190 \text{ psi})(31.64 \text{ in}^3)/12 \text{ in} = 3138 \text{ ftkips} \]
\[ F_0 = (180 \text{ psi})(1.15) \]
\[ V = (207/165)(16.88 \text{ in}^2)/1.5 = 2.329 \text{ kips} \]

\[ \Delta_{\text{between supports}} = \frac{F_0 x}{24EI} = \frac{(165 \text{ ftkips})(1.5 \text{ ft})(12 \text{ in})}{24(12 \times 10^6 \text{ psi})(178 \text{ in}^4)} \left[ (144 \text{ in})^2 - 2(144 \text{ in})(70 \text{ in}) + (70 \text{ in})^2 \right] 
+ (144 \text{ in})(70 \text{ in})^2 - 2(36 \text{ in})(144 \text{ in})^2 
+ 2(36 \text{ in}^2)(70 \text{ in})^2 \right] = 0.21 \text{ in} \]

USE 2x12 DF-6 #2 AFTER @ 24" O.C. FOR 4/12 ROOF
Typical Garage Roof Rafter (Cold Roof)

\[ D = 20 \text{psf} \left( \frac{24 \text{in}}{12 \text{in}} \right) \left( \frac{11.62 \text{ft}}{12 \text{in}} \right) = 39 \text{ plf} \]

\[ L_R = 20 \text{psf} \left( \frac{24 \text{in}}{12 \text{in}} \right) = 40 \text{ plf} \]

\[ S = 59 \text{psf} \left( \frac{24 \text{in}}{12 \text{in}} \right) = 108 \text{ plf} \]

Load Combinations

3. \( D + S = 39 \text{ plf} + 108 \text{ plf} = 147 \text{ plf} \)

Demands:

\[ M = (147 \text{ plf}) (10 \text{FD}^2/8) = 1838 \text{ ft kips} \]

\[ V = (147 \text{ plf})(10 \text{FT})/2 = 735 \text{ kips} \]

\[ EI = \frac{5(147 \text{ plf}/12 \text{in}) (10 \text{FT})(12 \text{in})^3(240)}{384} = 66.15 \times 10^4 \text{ in kips} \]

\[ I_{\text{eq}} = \frac{66.15 \times 10^4 \text{ in kips}}{1.6 \times 10^6 \text{ psi}} = 41.35 \text{ in} \]

Capacity:

* Try 2x10 DF-L #2

\[ M = \text{ SEE PREVIOUS} \]

\[ V = \text{ SEE PREVIOUS} \]

Use 2x10 DF-L H2 Rafter

@ 24" O.C. for Garage
RIDGE BEAM @ GUARD (COLD)

LOADING:

- A_f = (20 \text{ ft})(10 \text{ ft}) = 200 \text{ ft}^2
- D = 20 \text{ psf} (10 \text{ ft}) = 200 \text{ plf}
- LA = 20 \text{ psf} (10 \text{ ft}) = 200 \text{ plf}
- S = 54 \text{ psf} (10 \text{ ft}) = 540 \text{ plf}

LOAD COMBINATIONS:

- D + S = 200 \text{ plf} + 540 \text{ plf} = 740 \text{ plf}

DEMANDS:

- M = (740 \text{ plf})(20 \text{ ft})^2/8 = 37 \text{ ft kips}
- V = (740 \text{ plf})(20 \text{ ft})/2 = 740 \text{ kips}
- D = 5(740 \text{ plf}/\text{in})(20 \text{ ft})(10 \text{ in})^2(240) / 384 = 2664 +10^6 \text{ lb ft}
- \text{J}_{\text{req}} = \frac{(2664 +10^6 \text{ lb ft})}{1.8 \times 10^6 \text{ psi}} = 1480 \text{ in}^2

* T&Y 6 3/4" + 13 3/4" GLULAM
* Assume 24F-Y4 DF/DF

\[ f_{\text{req}} = 13.84 \text{ Mpsi} \]  
\[ E = E_{\text{min}} = 1.8 \times 10^6 \text{ psi} \]  
\[ S_x = 20.5 \text{ M}^3 \]  
\[ A = 91.13 \text{ M}^2 \]
CAPACITY:

\[ C_v = \left( \frac{2.1}{d} \right)^{1/4} \left( \frac{12}{10} \right)^{1/4} \left( \frac{5.125}{b} \right)^{1/4} \]

\[ = \left( \frac{2.1}{20} \right)^{1/4} \left( \frac{12}{13.81} \right)^{1/4} \left( \frac{5.125}{8.25} \right)^{1/4} \]

\[ = 0.97 \leq 1.0 \checkmark \]

\[ F_{v} = (2400 \text{ psi})(1.15)(0.97) \]

\[ = 2677.2 \text{ psi} \]

\[ M = (2677.2 \text{ psi})(205 \text{ in}^2) \]

\[ = 457 \text{ ft kips} \geq 3.7 \text{ ft kips} \checkmark \]

\[ V = (305 \text{ psi})(9613 \text{ in}^3)/1 \]

\[ = 18.5 \text{ kips} \geq 7.40 \text{ kips} \checkmark \]

\[ E' = (1.80 + 10^6 \text{ psi})(13841 \text{ in}^2) \]

\[ = 2491 + 10^6 \text{ lb in}^2 \]

* CHECK DEMANDS WITH SELF WEIGHT

\[ S_W = (35 \text{ kcf})(91.13 \text{ in}^3)/144 \text{ in}^2 \]

\[ = 22.15 \text{ plf} \]

\[ M = (22.15 \text{ plf})(20 \text{ ft})^2/8 \]

\[ = 1.11 \text{ ft kips} \]

\[ V = (22.15 \text{ plf})(20 \text{ ft})/2 \]

\[ = 0.22 \text{ kips} \]

\[ E_2 = 5(22.15 \text{ plf})(120 \text{ in}^3) \left( (20 \text{ ft})(20 \text{ in}) \right)^2 \left( 240 \right) \]

\[ = 79.74 \text{ in}^2 \]

DEMANDS + SELF WEIGHT

\[ M_T = 37 \text{ kip ft} + 1.11 \text{ kip ft} \]

\[ = 38.1 \text{ kip ft} \checkmark \leq 45.7 \text{ kip ft} \]

\[ V_T = 7.40 \text{ kip} + 0.22 \text{ kip} \]

\[ = 7.62 \text{ kip} \leq 18.5 \text{ kip} \checkmark \]

\[ E_{IT} = 2491 + 10^6 + 79.74 + 10^6 \]

\[ = 2570 + 10^6 \text{ lb in}^2 \leq 2664 + 10^6 \text{ lb in}^2 \checkmark \]

* USE 6 3/4" x 13 1/4" COLUMN

24 - 3/4" DF/DF RIDGE BEAM
Gravity Design

Typical Ceiling Joist

\[
\begin{align*}
D: 14 \text{ psf} \left( \frac{14 \text{ ft}}{12 \text{ ft}} \right) &= 19 \text{ plf} \\
L: 20 \text{ psf} \left( \frac{18 \text{ in.}}{12 \text{ in.}} \right) &= 27 \text{ plf}
\end{align*}
\]

Load Combinations:

\( D + L = 19 \text{ plf} + 27 \text{ plf} = 46 \text{ plf} \)

Demands:

\[
M (\text{between supports}) = \frac{wL}{2} \left( \frac{c^2 - a^2 - b^2}{a} \right)
\]

\[
= \frac{\left( 19 \text{ plf} \right) \left( 6 \text{ ft} \right)}{2} \left( \frac{(18 \text{ ft})^2 - (6 \text{ ft})^2 - (12 \text{ ft})^2}{12 \text{ ft}} \right) = 300 \text{ lb ft}
\]

\[
M (\text{at center}) = \frac{wL}{2} (a - c)^2 = \frac{\left( 46 \text{ plf} \right) \left( 3 \text{ ft} \right)}{2} (5 \text{ ft} - 1.5 \text{ ft})^2 = 51 \text{ lb ft}
\]

\[
V (\text{at supports}) = 8M = 0 = \left( 46 \text{ plf} \right) \left( 15 \text{ ft} \right) \left( 12 \text{ ft} \right) - \left( 25 \text{ plf} \right) \left( 18 \text{ ft} \right) = 425 \text{ plb}
\]

\[
E_I = 25 \text{ plb} \left( 15 \text{ ft} \right) + 425 \text{ plb} \left( 12 \text{ ft} \right) = 255 \text{ plb}
\]

\[
\delta (\text{between supports}) = \frac{wL}{24EI} \left( L^4 - 2L^2a^2 + a^4 \right)
\]

\[
= \left( 19 \text{ plf} \right) \left( 12 \text{ in.} \right) \left( 72 \text{ in.} \right) \left( 144 \text{ in.} \right)^4 - 2 \left( 144 \text{ in.} \right)^6 - \left( 72 \text{ in.} \right)^2
\]

\[
+ \left( 144 \text{ in.} \right)^2 \left( 72 \text{ in.} \right)^2 - 2 \left( 3 \text{ in.} \right)^2 \left( 144 \text{ in.} \right)^2 + 2 \left( 3 \text{ in.} \right)^2 \left( 72 \text{ in.} \right)^2
\]

\[
= 7.5 \times 10^6 \text{ in.}^4
\]

\[
\Rightarrow \quad E_I = \frac{7.5 \times 10^6 \text{ in.}^4}{2400 \text{ in.}^2} = 12.56 \text{ in.}^2
\]

\[
I_{eq} = \frac{12.56 \times 10^6 \text{ in.}^4}{1.60 \times 10^6 \text{ psi}} = 7.85 \text{ in.}^4
\]

Design:

2 x 6 plf-l h2

\[
I_{x} = 20.80 \text{ in.}^4
\]

\[
S_{y} = 7.56 \text{ in.}^2
\]

\[
A = 8.25 \text{ in.}^2
\]
CAPACITY:

\[ F_b' = (900 \text{ psi})(125)(1.3)(1.15) \]
\[ m_{\max} = (1681.88 \text{ psi})(7.56 \text{ in}^2) \]
\[ V_{\text{allow}} = (225 \text{ psi})(8.25 \text{ in}^2)/1.5 \]

\[ = 1681.88 \text{ psi} \]
\[ = 1060 \text{ psi} \]
\[ = 2 \text{ 300 FR/25} \]
\[ = 1238 \text{ psi} \]
\[ \geq 425 \text{ psi} \]

% USE 2x6 DF-L H2 @ M'noch.
FOR CANTILEVERED CEILING JOISTS
**TYPICAL FLOOR 501ST**

\[ D: 14 \text{ psf} \left(\frac{1610}{144}\right) = 19 \text{ psf} \]
\[ L: 20 \text{ psf} \left(\frac{1610}{144}\right) = 27 \text{ psf} \]

**LOAD COMBINATIONS**

\[ 0 < D + L = 19 \text{ psf} + 27 \text{ psf} = 46 \text{ psf} \]

**DEMANDS**

\[ M = \frac{(46 \text{ psf})(12 \text{ ft})^2}{8} = 828 \text{ kN} \cdot \text{m} \]
\[ V = \frac{(46 \text{ psf})(12 \text{ ft})}{2} = 276 \text{ kN} \]
\[ E2 = 5 \left(\frac{(46 \text{ psf})(12 \text{ in})}{(12 \text{ ft})(24 \text{ in})}\right)^3 \frac{(240)}{3.84} \]
\[ = 1.87 + 16 \times 16 \text{ in}^2 \]
\[ = 16 \times 10^6 \text{ psi} \]

**TAY 2x6 DF-L #2**

\[ f_{ty} = 20.8 \text{ ksi} \]
\[ S_{ty} = 7.58 \text{ in}^2 \]
\[ A = 8.25 \text{ in}^2 \]

\[ F_k = \text{ SEE PREVIOUS} \]
\[ M_{max} = \text{ SEE PREVIOUS} \]
\[ V_{max} = \text{ SEE PREVIOUS} \]

\[ \therefore \text{ USE 2x6 DF-L #2} \]
\[ @ 16" \text{ o.c. FLOOR TWISTS} \]
**Floor Beam**

\[ A_t = (15\text{ft})(12\text{ft}) = 180\text{ ft}^2 \]
\[ D: (14\text{psf})(12\text{ft}) = 168\text{ plF} \]
\[ L: (20\text{psf})(12\text{ft}) = 240\text{ plF} \]

**Load Combinations**

1. \[ D + L = 168\text{ plF} + 240\text{ plF} = 408\text{ plF} \]

**Demands:**

\[ M = (408\text{ plF})(12\text{ft})^2/8 = 7.3\text{ kip-ft} \]
\[ V = (408\text{ plF})(12\text{ft})/2 = 2.5\text{ kips} \]
\[ EI = 5\left(\frac{408\text{ plF}\text{in}}{16\text{ft}}\right)(12\text{ft})(12\text{ft})^3/384 = 620+10616\text{ in}^4 \]
\[ I_{	ext{eq}} = \frac{620+10616\text{ in}^4}{16+16\text{ psi}} = 387\text{ in}^4 \]

**Capacity:**

\[ x T A I: 4\times12\text{ DF-L #2} \]
\[ I_{xt} = 415.3\text{ in}^4 \]
\[ S_t = 73.15\text{ in}^2 \]
\[ A = 39.38\text{ in}^2 \]

\[ F_b = (180\text{ psi})(1.25)(1.1)(1.15) = 1423\text{ psi} \]
\[ M = (1423\text{ psi})(73.15\text{ in}^2) = 8.68\text{ kip-ft} \geq 7.3\text{ kip-ft} \checkmark \]
\[ F_v = (180\text{ psi})(1.25) = 225\text{ psi} \]
\[ V = (225\text{ psi})(39.38\text{ in}^2)/1.5 = 5.94\text{ kips} \geq 2.5\text{ kips} \checkmark \]

\% Use 4+12 DF-L #2

Floor Beams
**Continuous Wall Footing**

- **P:** 23.1 psf (6 ft) = 139 psf
- **L:** 20 psf (6 ft) = 120 psf
- **Pf:** 23.1 psf (6 ft) = 139 psf
- **Lf:** 20 psf (6 ft) = 120 psf

**Demands:**

\[ W = 139 \text{ psf} + 120 \text{ psf} = 259 \text{ psf} \]

**Assumptions:**
- Sedimentary & foliated rock

**Vertical Foundation Pressure:**

\[ = 1500 \text{ psf} \]

**Lateral Bearing Pressure:**

\[ = 100 \text{ psf/ft below grade} \]

**Coefficient of Friction:**

\[ = 0.25 \]

**Effective Unit Weight, \( \gamma \):**

\[ = 156 \text{ psf (worst case)} \]

**Size Selection:**

\[ b = \frac{(139 \text{ psf} + 120 \text{ psf})}{1500 \text{ psf}} \]

\[ = 0.35 \text{ ft} \]

**Use 1 ft wide, 2 ft deep footing**

**Rebar:**

\[ A_{s_{min}} = 0.0018(12in)(24in) = 0.518 \text{ in}^2 \]

**Use (2) #5 bars**

\[ A_s = 0.62 \text{ in}^2 \]
**Foundation Design**

**Pad Footing**

\[ A_T = (12 \text{ ft})(12 \text{ ft}) = 144 \text{ ft}^2 \]

\[ P = (35 \text{ psf} + 32 \text{ psf}) \times 144 \text{ ft}^2 = 9,654 \text{ kips} \]

**Size Selection**

\[ A = \frac{P}{f_y} = \frac{9,654 \text{ kips}}{1.5 \text{ ksf}} = 6,436 \text{ ft}^2 \]

Hence:

- Use **2.5 ft x 2.5 ft x 2 ft pad footing**

**Rebar:**

\[ A_{s,min} = 0.0018 \times (720 \text{ in}^2) = 1.30 \text{ in}^2 \]

- Use **2 #8 bars E.W.**
  \[ A_s = 1.6 \text{ in}^2 \]

**Check 18c 2015 180kbf + T 180kbf**

- Minimum Requirements
  \[ D = 12'' \text{ min} \leq 2 \text{ ft} \checkmark \]
  \[ B = 12'' \text{ min} \leq 2''-8'' \checkmark \]
  \[ T = 6'' \text{ min} \leq 12'' \checkmark \]
EXTERRA STUD WALL - OUT OF PLANE LOADING

\[ W = 25 \text{ psf} \]
\[ L = 20 \text{ psf} \]
\[ D = 23.19 \text{ psf} \]
\[ S = 54 \text{ psf} \] (Worst Case)

2x10 Studs @ 24" O.C.

8 ft

10' 6"

LOAD COMBINATIONS

\[
69 D + 0.75L + 0.75S + 0.75(23.19 + 0.75(20.0) + 0.75(25.0)) = 786 \text{ lbs}
\]

\[
0.75(0.6)W = 0.75(0.6)(25 \text{ psf})(2 \text{ ft}) = 22.5 \text{ pcf}
\]

DEMANDS:

\[
M = (22.5 \text{ pcf})(16.5 \text{ ft})^2 / 8 = 783 \text{ 10 ft}
\]

\[
V = (22.5 \text{ pcf})(16.5 \text{ ft})^2 / 2 = 186 \text{ 10 ft}
\]

\[
P = \text{ SEE LOAD COMBO ABOVE } = 786 \text{ lbs}
\]

CAPACITY:

\[
* TAP \quad 2 \times 10 \text{ DF-L 42 @ 24" O.C.}
\]

\[
F_{c} = \frac{P}{A} = \frac{786 \text{ lbs}}{13.875 \text{ in}^2} = 56.65 \text{ psi}
\]

\[
F_{ce} = \frac{0.822 \text{ 1 ft/sq in}}{(198.1/48.25)^2} = 1041 \text{ psi}
\]
LATERAL DESIGN

\[ F_{c} = 1350 \text{ psi} \times (1.6) = 2376 \text{ psi} \]

\[ \frac{F_{ce}}{F_{c}} = \frac{1041 \text{ psi}}{2376 \text{ psi}} = 0.438 \]

\[ C_{p} = \frac{1 + (0.438)}{1.6} \times \sqrt{\frac{1 + (0.438)}{1.6}} = \frac{(0.438)}{0.8} = 0.389 \]

\[ F_{c}' = (2376 \text{ psi}) \times (0.389) = 923 \text{ psi} \]

\[ \frac{F_{c}}{F_{c}'} = \frac{56.65 \text{ psi}}{923 \text{ psi}} \]

\[ F_{b} = \frac{783 \frac{1}{2} \text{ ft}(16\text{ in})}{21.56 \text{ in}^{2}} = 436 \text{ psi} \]

\[ F_{b}' = (900 \text{ psi}) \times (1.6) \times (1.3) \times (1.0) \times (1.15) = 2152.8 \text{ psi} \]

\[ \frac{F_{b}}{F_{b}'} = \frac{436 \text{ psi}}{2152.8 \text{ psi}} \]

Combined Loadings:

\[
\left( \frac{F_{c}}{F_{c}'} \right)^{2} + \frac{F_{b}}{F_{b}'} \left( \frac{F_{b}}{1.5} \frac{F_{c}}{F_{c}'} \right) = (0.061)^{2} + \frac{436 \text{ psi}}{2152.8 \text{ psi}} \left( \frac{1.5 \text{ psi}}{1041 \text{ psi}} \right) = 0.22 \leq 1.0 \checkmark
\]

2x10 DF-L #2 @ 18" O.C.
MAE ADEQUATE
**Lateral Design**

**Typical Shear Wall Design**

Note: N-S walls are worst case

\[
\begin{align*}
W &= 22.1 \text{psf (11 ft)} = 254 \text{ kips} \\
W &= 25 \text{psf (14 ft)} = 5.6 \text{ kips} \\
D &= 20 \text{psf (12 ft)} = 410 \text{ kips} \\
S &= 60 \text{psf (12 ft)} = 1230 \text{ kips} \\
L &= 20 \text{psf (12 ft)} = 410 \text{ kips}
\end{align*}
\]

Load Combinations

\[
W_0 = 0.75 W + 0.75 (0.6W) + 0.75 S
\]

\[
\begin{align*}
W_0 &= 254 \text{ kips} + 410 \text{ kips} + 0.75 (410 \text{ kips}) \\
&+ 0.75 (1230 \text{ kips}) \\
&= 1900 \text{ kips}
\end{align*}
\]

\[
W_0 = 0.75 (0.6)(5.6 \text{ kips}) = 2.52 \text{ kips}
\]

**FOA Hold Downs**

\[
\begin{align*}
\delta E T &= 0 = - (2.52 \text{ kips/ft})(11 \text{ ft}) - (1.904 \text{ kips})(8 \text{ ft})(8 \text{ ft}) / 2 + C (8 \text{ ft}) \\
C &= 88.52 \text{ kip-ft/ft}
\end{align*}
\]

\[
\begin{align*}
\delta E T &= 0 = (1.904 \text{ kips})(8 \text{ ft}) - 7 + 11.1 \text{ kips} \\
&= 4.1 \text{ kips (tension)}
\end{align*}
\]

Use Simpson HHDG11-SDS25.5

T = 11.8 kips

**FOA Shear Panel**

\[
U = 2W / E_T = 2(2.52 \text{ kips}) / 7.1 \text{ ft}
\]

\[
U = 710 \text{ plf}
\]

Use 15/8" structural

W 10d @ 6" O.C. (c=450 plf)
N-S ROOF DIAPHRAGM

275 pcf

23'-6"

8'

41'

DEMANDS:

Vkip

Vplf

Mkip

Mplf

CHAPD

DIAPHRAGM

(kips)

5.64

240

57.81

2.46

FOR DIAPHRAGM SWEEPING

CASE 1 + CASE 2

v = 705 pcf

USE 10d @ 6/6/12

W 1/2" SHEATHING

C = 910 pcf
SHEAR FLOW FOR TYPICAL SHORE WALL (N-S)

SIMPSON 1934 CLIP

→ DEMAND = 355 plf
→ CAPACITY = 695 plf
→ SPACING = 695/3.55 = 195
USE 2 FT SPACING

SIMPSON HDG11-5DS2.5
ANCHOR BOLT DESIGN FOR TENSION VIVACE

\[ V = \frac{W}{L_{\text{eff}}} = \frac{2.52 \text{ kips}}{7.1 \text{ ft}} = 355 \text{ psf} \]

* TAX \( \frac{1}{2} \) \# ANCHOR BOLTS

\[ E1 = 650 \text{ kips (1/6)} \]

\[ F_{\text{min}} = \frac{1040 \text{ kips}}{355 \text{ psf}} = 2.93 \text{ ft} \leq 9 \text{ ft} \]

USE \( \frac{1}{2} \) \# ANCHOR BOLTS @ 3 ft O.C.
19. CONCRETE MASONRY UNIT WALLS SHALL BE CONSTRUCTED OF GRAY N-4 TYPE UNITS, CONFORMING TO ASTM C 216.  UNITS SHALL BE LAY ED ON A RAMPS WITH MORTAR BEING TYPE "S" PER TABLE 210.7 OF THE INTERNATIONAL BUILDING CODE.  MORTAR WITH A MINIMUM COMPRESSIVE STRENGTH OF 2,000 PSI AT 28 DAYS ESSENTIAL.  3,000 PSI STRENGTH SHALL BE INSURED BY THE UNIT MANUFACTURER IN MEET OR EXCEED TABLE 210.5 FULL STRENGTHS AND REQUIREMENTS ALL MATERIALS SHOULD BE GROUTED SOLIDLY.

UNLESS NOTED OTHERWISE, PROVIDE THE FOLLOWING REINFORCEMENT:

- (2) #4 @ 48" O.C. HORIZ.
- (2) #5 @ 32" O.C. VERT.
- 2/3 SACKS OF CEMENT PER CUBIC YARD AND SHALL BE PROPORTIONED COMPATIBILITY AND SHALL NOTIFY ARCHITECT OF ANY DISCREPANCIES PRIOR TO CONSTRUCTION.

CONCRETE MASONRY UNITS TO BE FULLY GROUTED.

IN ADDITION PROVIDE (1) #4 @ 48" O.C. AND (2) 4" WALLS VERT. AT EACH SIDE OF OPENINGS. AT WALL CORNERS PROVIDE A ROW OF UNITS AND BASE apply the following Construction Details: Steel, Wood, Masonry, and Connections:

20. STRUCTURAL STEEL DESIGN, FABRICATION AND ERECTION SHALL BE BASED ON THE LATEST EDITION OF THE AISC SPECIFICATIONS AND [INSTITUTION].

21. ALL USE CONNECTIONS SHALL BE INSTALLED TO THE NAVY-Navy Connection Per A.I.C. (Including 6 X AND LARGER MEMBERS) INTERPRETATION OF CONSTRUCTION, AND ALL SAFETY PRECAUTIONS AND PROGRAMS INCIDENTAL, ACCEPTED STANDARDS OF PRACTICE. THE BUILDING OFFICIAL UNDERSTANDS THAT SUCH PROCEDURES PROVIDE A SLUMP OF 3" OR LESS.

22. GLUED LAMINATED MEMBERS SHALL BE FABRICATED IN CONFORMANCE WITH ASTM AND ATC SPECIFICATIONS.  THE MANUFACTURER SHALL PROVIDE AN IDENTIFICATION MARK AND BE ACCOMPANIED BY A CERTIFICATE OF CERTIFICATION WITH THE MANUFACTURER AND A SAMPLE OF MANUFACTURED MATERIAL.  A COPY OF THE MANUFACTURING SPECIFICATIONS AND CERTIFICATE OF MANUFACTURE SHALL BE PROVIDED TO THE CONTRACTOR PRIOR TO COVERING GLUED LAMINATED MEMBERS. ALL WASHINGTON STATE WALLS SHALL BE BUILT TO THE REQUIREMENTS OF WASHINGTON BUILDING CODE.  ALL CONTINUOUS GLUED LAMINATED MEMBERS SHALL BE DOUGLAS FIR COMBINATION 24F AND HS-150 AND ERECTION IN ACCORDANCE WITH INSTRUCTIONS PREPARED BY THE SUPPLIER.

23. WOOD PLATES IN DIRECT CONTACT WITH CONCRETE OR MASONRY SHALL BE PRESSURE TREATED WITH AN APPROVED PRESERVATIVE. PROVIDE 2 LAYERS OF APPLIED PRESSURIZED PAPER PAPER BETWEEN INTREATED LEDGERS, BLOCKS, ETC. AND CONCRETE OR MASONRY.
A. NAIL SIZES SPECIFIED ON DRAWINGS ARE BASED ON THE FOLLOWING SPECIFICATIONS:

<table>
<thead>
<tr>
<th>NAIL SIZE</th>
<th>DOCUMENT STAPLE</th>
<th>MINIMUM LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>6d</td>
<td>2 X 8</td>
<td>16d</td>
</tr>
<tr>
<td>10d</td>
<td>2 X 10</td>
<td>16d</td>
</tr>
<tr>
<td>13d</td>
<td>2 X 12</td>
<td>16d</td>
</tr>
<tr>
<td>16d</td>
<td>2 X 16</td>
<td>16d</td>
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<tr>
<td>20d</td>
<td>2 X 20</td>
<td>16d</td>
</tr>
<tr>
<td>25d</td>
<td>2 X 25</td>
<td>16d</td>
</tr>
</tbody>
</table>

IF CONTRACTOR PROPOSES THE USE OF ALTERNATE NAILS, THEY SHALL SUBMIT NAIL SPECIFICATIONS TO THE STRUCTURAL ENGINEER PRIOR TO CONSTRUCTION FOR REVIEW AND APPROVAL.

B. STUDS - THE FOLLOWING STAPLES MAY BE SUBSTITUTED FOR NAILING OF PLYWOOD (APA RATED SHEATHING):

<table>
<thead>
<tr>
<th>NAIL SIZE</th>
<th>DOCUMENT STAPLE</th>
<th>MINIMUM LENGTH</th>
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<tr>
<td>6d</td>
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<td>16d</td>
</tr>
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<td>16d</td>
</tr>
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<td>16d</td>
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<tr>
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<td>16d</td>
</tr>
<tr>
<td>20d</td>
<td>2 X 20</td>
<td>16d</td>
</tr>
<tr>
<td>25d</td>
<td>2 X 25</td>
<td>16d</td>
</tr>
</tbody>
</table>

IF CONTRACTOR PROPOSES THE USE OF ALTERNATE STUDS, THEY SHALL SUBMIT STUD SPECIFICATIONS TO THE STRUCTURAL ENGINEER PRIOR TO CONSTRUCTION FOR REVIEW AND APPROVAL.

C. STUDS AND BLOCKING - PLYWOOD (APA RATED SHEATHING) FASTENERS TO FRAME SHALL BE DRIVEN FLOOR TO TRUE OR TRUE NATURAL WITH NO COUNTERSINKING PERMITTED.

D. USE 5/8” DIAMETER ANCHOR BOLTS (WITH TRENTH PICHEL) FOR CONCRETE SUPPORTS.

E. PROVIDE SOLID BLOCKING BETWEEN STUDEs AT MID-HEIGHT OF ALL STUD WAllS OVER 10’ IN HEIGHT.

F. PROVIDE APPROVED PLYWOOD EDGE CLIPS CENTERED BETWEEN JOISTS/TRUSSES AT 28-1/2" O.C.

G. PROVIDE 1/2" SAFETY FINS AT JOINTS TO SUPPORTS WITH TWO 16d NAILS, END NAIL TO EACH STUD WITH TWO 16d NAILS AND STUD TO BOTTOM PLATE WITH TWO 16d NAILS.

H. PROVIDE SIX 16d NAILS AT 4" O.C. EACH SIDE OF JOINT.

I. PROVIDE SOLID BLOCKING AT ALL BEARING POINTS.

J. PROVIDE SADDLE BLOCKING AT FLOOR FRAMES TO SUPPORTS.

K. PROVIDE SOLID BLOCKING BETWEEN STUDS AT MID-HEIGHT OF ALL STUD WALLS OVER 10’ IN HEIGHT.

L. PROVIDE SOLID BLOCKING BETWEEN STUDS AT MID-HEIGHT OF ALL STUD WALLS OVER 10’ IN HEIGHT.

M. PROVIDE SOLID BLOCKING BETWEEN STUDS AT MID-HEIGHT OF ALL STUD WALLS OVER 10’ IN HEIGHT.

N. PROVIDE SOLID BLOCKING BETWEEN STUDS AT MID-HEIGHT OF ALL STUD WALLS OVER 10’ IN HEIGHT.

O. PROVIDE SOLID BLOCKING BETWEEN STUDS AT MID-HEIGHT OF ALL STUD WALLS OVER 10’ IN HEIGHT.

P. PROVIDE SOLID BLOCKING BETWEEN STUDS AT MID-HEIGHT OF ALL STUD WALLS OVER 10’ IN HEIGHT.

Q. PROVIDE SOLID BLOCKING BETWEEN STUDS AT MID-HEIGHT OF ALL STUD WALLS OVER 10’ IN HEIGHT.

R. PROVIDE SOLID BLOCKING BETWEEN STUDS AT MID-HEIGHT OF ALL STUD WALLS OVER 10’ IN HEIGHT.

S. PROVIDE SOLID BLOCKING BETWEEN STUDS AT MID-HEIGHT OF ALL STUD WALLS OVER 10’ IN HEIGHT.
1. It is the contractor's responsibility to verify all dimensions with the architectural floor plan and notify the architect and engineer of any discrepancies prior to starting work.

2. The general conditions, specifications, general notes on sheet S1.0, general structural details and the following apply to the work of the foundation:

3. Sub-grade preparations will conform to the requirements of the soils report and will be performed under the supervision of the soils engineer.

4. Footings are to be examined and certified in writing by the project soils engineer prior to placement of concrete.

5. All slab reinforcement should be supported on chairs to provide placement at mid-depth of slab.

6. Foundation system will be based upon the requirements of the soils report. The engineer of record must be notified of any discrepancies or updates of the soils information.

7. An approved water and vapor proof barrier must be installed under the concrete foundation system so that water and vapor cannot enter into the structure. Refer to the architect or owner's document and geotechnical engineer's recommendation for detailed requirements.

LEGEND

- SHEAR WALL
- HIDDEN LINE
- GRID LINE

P.T.D.F.: PRESSURE TREATED DOUGLAS FIR

TYP.: TYPICAL MEMBER
E.W.: EACH WAY
S.O.G.: SLAB ON GRADE
O.C.: ON CENTER
1. THE GENERAL CONDITIONS, SPECIFICATIONS, GENERAL NOTES ON SHEET S1.0, GENERAL STRUCTURAL DETAILS AND THE FOLLOWING APPLY TO THE WORK OF THE FLOOR FRAMING NOTES.

2. THE CONTRACTOR WILL CHECK FLOOR FRAMING DIMENSIONS AGAINST THE ARCHITECTURAL PLAN AND NOTIFY THE ARCHITECT AND ENGINEER OF RECORD OF ANY OMISSIONS AND DISCREPANCIES BEFORE STARTING WORK.

3. ALL WALLS AT THE FLOOR FRAMING LEVEL ARE TO BE 2X6 STUDS @ 16" O.C. AND 2X10 STUDS @ 24" O.C. FOR INSIDE AND OUTSIDE WALLS, RESPECTIVELY.

4. SEE ARCHITECTURAL PLANS FOR LOCATIONS OF PLUMBING WALLS.

5. BEARING HEADERS SPANNING 6'-0" OR MORE SHALL HAVE AT LEAST (2) 2X TRIMMER CONTINUOUS TO THE SILL PLATE, UNLESS NOTED OTHERWISE.

6. ALL SHEAR CONNECTORS AND BLOCKING MUST BE INSTALLED PRIOR TO THE INSTALLATION OF FLOOR SHEATHING.

7. USE SIMPSON HANGERS FOR FLOOR JOIST TO FLUSH BEAM CONNECTIONS, UNLESS OTHERWISE NOTED.

8. CARRY ALL MULTIPLE STUDS OR POSTS FROM SECOND FLOOR DOWN TO FIRST FLOOR OR BEAM BELOW. PROVIDE 4X SOLID BLOCKING @ FLOOR LEVEL.

9. SHEAR PANELS MAY BE INSTALL ON EITHER SIDE OF THE WALL.

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LEGEND

- P.T.D.F: PRESSURE TREATED DOUGLAS FIR
- TYP: TYPICAL MEMBER
- E.W: EACH WAY
- S.O.G: SLAB ON GRADE
- O.C: ON CENTER

S2.1 FLOOR FRAMING PLAN

GREAT NORTHERN SERVICES 310 Boles St, Weed, CA 96094
WEED HOUSING DEVELOPMENT

FRANZISKA BECK - ARCHITECTURAL DESIGNER
BRAIN LEE - ARCHITECTURAL DESIGNER
MEGAN LUNDHAL - ARCHITECTURAL DESIGNER
TRENT PICHEL - STRUCTURAL DESIGNER
SERGIO VERGARA - CONSTRUCTABILITY

As indicated
CEILING FRAMING NOTES

1. THE GENERAL CONDITIONS, SPECIFICATIONS, GENERAL NOTES ON SHEET S1.0, GENERAL STRUCTURAL DETAILS AND THE FOLLOWING APPLY TO THE WORK OF THE FLOOR FRAMING NOTES.

2. THE CONTRACTOR WILL CHECK FLOOR FRAMING DIMENSIONS AGAINST THE ARCHITECTURAL PLAN AND NOTIFY THE ARCHITECT AND ENGINEER OF RECORD OF ANY OMISSIONS AND DISCREPANCIES BEFORE STARTING WORK.

3. ALL WALLS AT THE FLOOR FRAMING LEVEL ARE TO BE 2X6 STUDS @ 16" O.C. AND 2X10 STUDS @ 24" O.C. FOR INSIDE AND OUTSIDE WALLS, RESPECTIVELY.

4. SEE ARCHITECTURAL PLANS FOR LOCATIONS OF PLUMBING WALLS.

5. BEARING HEADERS SPANNING 6'-0" OR MORE SHALL HAVE AT LEAST (2) 2X TRIMMER CONTINUOUS TO THE SILL PLATE, UNLESS NOTED OTHERWISE.

6. ALL SHEAR CONNECTORS AND BLOCKING MUST BE INSTALLED PRIOR TO THE INSTALLATION OF FLOOR SHEATHING.

7. USE SIMPSON HANGERS FOR FLOOR JOIST TO FLUSH BEAM CONNECTIONS, UNLESS OTHERWISE NOTED.

8. CARRY ALL MULTIPLE STUDS OR POSTS FROM SECOND FLOOR DOWN TO FIRST FLOOR OR BEAM BELOW. PROVIDE 4X SOLID BLOCKING @ FLOOR LEVEL.

9. SHEAR PANELS MAY BE INSTALL ON EITHER SIDE OF THE WALL.

LEGEND

- SHEAR WALL
- HIDDEN LINE
- GRID LINE
- P.T.D.F.: PRESSURE TREATED DOUGLAS FIR
- TYP: TYPICAL MEMBER
- E.W: EACH WAY
- S.O.G: SLAB ON GRADE
- O.C: ON CENTER
1. The general conditions, specifications, general notes on sheet S1.0, structural details, and the following apply to the work of the roof framing notes.

2. The contractor will check roof framing dimensions against the architectural plan and notify the architect and engineer of record of any omissions and discrepancies before starting work.

3. All walls are to be 2x6 studs @ 16" o.c. and 2x10 studs @ 24" o.c. for inside and outside walls, respectively.

4. Headers supporting roof loads shall have at least one 2x trimmer continuous to the sill plate, unless otherwise noted.

5. Headers spanning 12' 0" or more shall have at least (2) 2x trimmers continuous to the sill plate and (2) 2x king studs, unless otherwise noted.

6. All shear connectors and blocking must be installed prior to the installation of roof sheathing.

7. Interior non-bearing wall top plate may be 1x4 over 2x4 members.

8. See detail on sheet S4.1 for California framing requirements.

9. Shear panels may be installed on either side of the wall.

LEGEND

- SHEAR WALL
- GRID LINE
- HIDDEN LINE
- PRESSURE TREATED DOUGLAS FIR
- TYPICAL MEMBER
- EACH WAY
- SLAB ON GRADE
- ON CENTER

S2.3 ROOF FRAMING PLAN

GREAT NORTHERN SERVICES
310 Boles St, Weed, CA 96094

WEED HOUSING DEVELOPMENT

As indicated
FOOTING

PROVIDE CORNER BARS SAME SIZE AND AMOUNT AS FOOTING REINFORCEMENT

ALTERNATE BENDS WHERE POSSIBLE

FASTER @ MAIN-ROOF PER PLAN

FASTER @ CA. ROOF PER PLAN

2X STUD @ 16" O.C.

2X STUD @ 24" O.C.

2X DOUBLE TOP PLATE

CALIFORNIA ROOF SECTION

LAP 48d U.N.O (2'-0" - 6" MIN.)

FOOTING REINFORCING AT INTERSECTION

CONTINUE SHEAR PANEL TO HOLD DOWNS AS SHOWN

PROVIDE REQUIRED DOUBLE STUDS OR POSTS WHERE HOLD-DOWNS OCCUR

SHEATHING PER PLAN

BATTER PER PLAN

2X STUD PER PLAN

RIDGE BEAM PER PLAN

CALIFORNIA ROOF FRAMING

STUD WALL INTERSECTIONS

PROVIDE STUD BELOW SPLICES

MINIMUM PLATE SPLICE

STUD WALL INTERSECTIONS

RIDGE BEAM PER PLAN

2X STUD PER PLAN

RIDGE BEAM PER PLAN

CALIFORNIA ROOF RIDGE FRAMING

MINIMUM PLATE SPLICE

TYPICAL DETAILS

WEED HOUSING DEVELOPMENT

S4.0