GNS Weed Housing

A Senior Project

presented to

the Faculty of Architectural Engineering

California Polytechnic State University, San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Bachelor of Science

by

Galen Amick
&
Sarah Pascual

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Sarah Pascual
GNS - WEED HOUSING PROJECT (ARCE 415)

for

GREAT NORTHERN SERVICES

Architectural Engineering
California Polytechnic State University, San Luis Obispo, CA

Galen Amick
Sarah Pascual

Fall 2017
**Background**
In September 2014, the Boles Fire destroyed 150 homes as well as many local commercial buildings throughout Siskiyou County. Unfortunately, Federal Emergency Management Agency (FEMA) requires 500 or more homes to be damaged before providing assistance, even though the fire demolished about one third of the town. Thus, the local municipalities were left to deal with the aftermath. One of the victims of the fire was Great Northern Services (GNS), a non-profit organization dedicated to improving communities. Their office as well as adjacent residential living spaces were destroyed.

**Project Description**
Weed is a tight-knit community near Mount Shasta with a population of about 3000 people. The site is located at 780 South Davis St. in Weed, CA and consists of seven parcels on 1.3 acres of land. Of the seven parcels, two are intended to be designed as duplexes and five are intended for single-family homes (i.e. three bedrooms and two bathrooms). This particular project focused on one of the single-family homes. The habitable area should range between 1200 ft² - 1400 ft². It was also very important that the design would be budget-conscious and environmentally resilient. Weed is a small town, where the average income is roughly minimum wage. However, this should not impede a family or resident from owning a standard home. GNS also wanted to incorporate concepts of passive energy, prefabrication, and constructability into the design.

**Project Team**
GNS requested assistance from Cal Poly’s College of Architecture and Environmental Design to design a new housing complex for the site. In response, Cal Poly formulated an interdisciplinary course comprised of architecture, construction management, and architectural engineering students. The class is based around the concept of Interdisciplinary Product Delivery (IPD), which allows for a cohesive melding of disciplines that fosters a holistic and efficient design process. Our team consisted of two architectural engineering students, two architecture students, and one construction management students. Before the design began, our team put together a list of goals and objectives for the project, which we have reflected in our design. This package not only consists of structural drawings and calculations, but also includes constructibility diagrams and architectural features.

[Image]

ARCE: Galen Amick | Sarah Pascual
ARCH: Jackie Budidharma | Evan Royer
CM: Brock Armstrong
Proposition #1: SUSTAINABILITY

Goal #1: CREATE A SITE RESPONSIVE AND CLIMATE AWARE PROJECT

- Objective #1: Find a way to fit R25 insulation into our wall assembly and minimize thermal bridging
- Objective #2: Create a fire-resistant site using native fire-resistant plants and fire-resistant materials
- Objective #3: Orient building to optimize passive heating strategies and connect to eastern views in the shared family spaces
Proposition #2: LIVABILITY

Goal #2: CREATE AN INTERIOR EXPERIENCE THAT CATERS TO OCCUPANT COMFORT AND WELFARE

- Objective #1: Locate heat sources to maximize efficiency and ensure comfortable internal temperature
- Objective #2: For natural daylighting, make sure window area is 16-20% of the floor area
- Objective #3: Create a program layout that focuses on occupant convenience
Proposition #3: EFFICIENCY

Goal #3: UTILIZE A SIMPLIFIED METHOD OF CONSTRUCTION

- Objective #1: Use a uniform panelized system for the exterior walls of the house
- Objective #2: Integrate simplified connections for ease of constructability
EW1 SECTION
SCALE: 1/4" = 1'-0"

NS SECTION
SCALE: 1/4" = 1'-0"

EW2 SECTION
SCALE: 1/4" = 1'-0"

DETAIL WALL SECTION
SCALE: 1" = 1'-0"

- Metal Roofing
- Vapor permeable Barrier
- 2"x6" Rafter
- Batt Insulation / R-30
- Rigid Insulation / R-13.1
- 2"x4" Ceiling Rafter
- Blow-in Insulation / R-11.3
- Gutter
- 1"x4" Fascia board
- 3" Soffit Screened Vent
- 6'-16" Header

- Double Pane Window / U-012
- sill Extension
- Cement Fiber Board Siding
- 1"x2" Furring Strips
- Rigid Insulation / R-13.1
- Tyvek Homerep
- 1/2" Plywood Sheathing
- Batt Insulation R-23
- 5/8" Gypsum Board
- 1/2" Plywood sub-floor
- 2"x12" Floor Joist
- 2"x12" Rim Joist
- Batt Insulation / R-30
- Flashing
- Anchor Bolt

- Finished Grade
- Vapor permeable Barrier
- Rigid Insulation / R-5
- 4" Rebar
- CNU Stem Wall
- Frost Line / 2' Below Grade
- Geo-fabric Wrap
- 4" Drainage pipe
- 1'-6" Concrete footing
### Condensed Budget Cost Breakdown

<table>
<thead>
<tr>
<th>Item</th>
<th>Total</th>
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<tbody>
<tr>
<td>Foundation</td>
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<tr>
<td>Exterior Walls</td>
<td>$27,119</td>
</tr>
<tr>
<td>Roof</td>
<td>$12,205</td>
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<tr>
<td>Interior Walls</td>
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<td>Plumbing</td>
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<td>Fasteners</td>
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<tr>
<td>Shipping</td>
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### Construction Diagram

- **Phase 1**: Prefabricated wall panels constructed at Cal Poly arrive at Weed and are erected to form the perimeter of the house.
- **Phase 2**: Interior partition walls and garage framing constructed on site.
- **Phase 3**: Additional Framing added on top of the pre-fab panels and interior walls to support the roof.
- **Phase 4**: Roof Framing completed. Interior finishes and exterior cladding applied.

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### Panelization

<table>
<thead>
<tr>
<th>Callout</th>
<th>Type</th>
<th># of Panels</th>
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<tbody>
<tr>
<td>8A</td>
<td>Standard 8'x8' panel.</td>
<td>4</td>
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<tr>
<td>8B</td>
<td>8'x8' panel with vertical window.</td>
<td>6</td>
</tr>
<tr>
<td>8C</td>
<td>8'x8' panel with bathroom window.</td>
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<tr>
<td>8D</td>
<td>8'x8' panel with horizontal window.</td>
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<tr>
<td>8E</td>
<td>8'x8' panel with sliding glass door.</td>
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<td>6A</td>
<td>Standard 6'x8' panel.</td>
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<tr>
<td>6B</td>
<td>6'x8' panel with entry door.</td>
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</tr>
<tr>
<td>4A</td>
<td>Standard 4'x8' panel.</td>
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### EXPLODED WALL ASSEMBLY

- **PANELIZATION**
- **CONSTRUCTION DIAGRAM**
- **CONSTRUCTION DIAGRAM**
## Budget Cost Breakdown

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Material</th>
<th>Cost/SF</th>
<th>Total</th>
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<tbody>
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<td><strong>Concrete</strong></td>
<td>Slab On Grade (4&quot; Thick)</td>
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<td>Reinforcing Mesh</td>
<td>1 Roll</td>
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<td>$100</td>
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<td></td>
<td>Entry Door</td>
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<td>$418</td>
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<tr>
<td></td>
<td>Sliding Glass Door</td>
<td>1 EA</td>
<td>$267</td>
<td>$48</td>
<td>$315</td>
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<td><strong>Wood Container</strong></td>
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<td>Rigid R-5</td>
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<td><strong>Wood</strong></td>
<td>Rim Joists (2x12)</td>
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<td>Floor Joists (2x12, 16&quot; O.C.)</td>
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<td>1220 SF</td>
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<td>Batt R-30</td>
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<td>Carpet</td>
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<td>Base</td>
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<td>Vapor Barrier</td>
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<td>Bottom Plate</td>
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<td>Insulation</td>
<td>Ralou (R-23) + Rmax Thermachec (R-13) = R-36</td>
<td>1830 SF</td>
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<td>Siding</td>
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<td><strong>Windows</strong></td>
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<td>Vertical - 2600 Tilt Turn</td>
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<td>Exterior Paint</td>
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<td>$216</td>
<td>$328</td>
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<td><strong>Roof</strong></td>
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<tr>
<td><strong>Wood</strong></td>
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<td>Downspouts</td>
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<td>Bottom Plate (2x4)</td>
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<td>$232</td>
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<td>Ceiling Joists (2x4)</td>
<td>375 BF</td>
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<td>288 SF</td>
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<td></td>
<td>Drywall</td>
<td>Open Ceiling Plywood (3/8&quot;)</td>
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<td>Ceiling, Blown, Greenfiber (R-10.5)</td>
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## Budget Cost Breakdown

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<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Material</th>
<th>Labor</th>
<th>Equipment</th>
<th>Total</th>
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<tbody>
<tr>
<td>Corner Beads</td>
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<td>Tape, Sand, Prime, and Paint</td>
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<td>Exposed Ceiling</td>
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<td>Doors</td>
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<td>Closet Doors</td>
<td>Sliding Glass Doors</td>
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**Total Costs:** $149,601

**Total Cost (SF):** $104
### Senior Project
780 South Davis Street
Weed, CA, 96094

**Cost**: $149,601  
**Cost/SF**: $104  

#### Budget Cost Breakdown

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<th>Material</th>
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SHEARWALL WHERE OCCURS
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E.N.
0' - 7"
FRAMING PER S.102
SHEATHING PER S.102
HANGER PER S.102
16d @ 12" O.C.
A.B. PER S.101
8" CMU STEM WALL
(2) #4 (B)
SHEATHING PER S.101
SHEARWALL WHERE OCCURS
2X6 PT SOLE PLATE
FRAMING PER PLAN
0' - 7"
A.B. PER PLAN
HANGER PER S.102
16d @ 12" O.C.
18" MIN.
(2) #4 (B)
SEE PLAN
12" TYP.
18" MIN.
4" S.O.G.
8" CMU STEM WALL
A.B. PER PLAN
12" TYP.
2X6 PT SOLE PLATE
#4 @ 24" O.C.
SEE PLAN
12" TYP.
18" MIN.
4" S.O.G.
8" CMU STEM WALL
A.B. PER PLAN
12" TYP.
2X6 PT SOLE PLATE
#4 @ 24" O.C.
INTERIOR BEARING WALL
1/2" DIAM.
A.B. @ 4' O.C.
PT 2X LEDGER
8" CMU STEM WALL
(2) #4 (B)
SHEATHING PER S.102
SHEARWALL WHERE OCCURS
SEE S.102 FOR SHEATHING
E.N.
0' - 7"
FRAMING PER S.102
SHEATHING PER S.102
HANGER PER S.102
16d @ 12" O.C.
A.B. PER S.101
8" CMU STEM WALL
(2) #4 (B)
SHEATHING PER S.101
SHEARWALL WHERE OCCURS
2X6 PT SOLE PLATE
FRAMING PER PLAN
0' - 7"
A.B. PER PLAN
HANGER PER S.102
16d @ 12" O.C.
18" MIN.
(2) #4 (B)
SEE PLAN
12" TYP.
18" MIN.
4" S.O.G.
8" CMU STEM WALL
A.B. PER PLAN
12" TYP.
2X6 PT SOLE PLATE
#4 @ 24" O.C.
INTERIOR BEARING WALL
1/2" DIAM.
A.B. @ 4' O.C.
PT 2X LEDGER
8" CMU STEM WALL
(2) #4 (B)
SHEATHING PER S.102
SHEARWALL WHERE OCCURS
SEE S.102 FOR SHEATHING
E.N.
0' - 7"
FRAMING PER S.102
SHEATHING PER S.102
HANGER PER S.102
16d @ 12" O.C.
A.B. PER S.101
8" CMU STEM WALL
(2) #4 (B)
SHEATHING PER S.101
SHEARWALL WHERE OCCURS
2X6 PT SOLE PLATE
FRAMING PER PLAN
0' - 7"
A.B. PER PLAN
HANGER PER S.102
16d @ 12" O.C.
18" MIN.
(2) #4 (B)
SEE PLAN
12" TYP.
18" MIN.
4" S.O.G.
8" CMU STEM WALL
A.B. PER PLAN
12" TYP.
2X6 PT SOLE PLATE
#4 @ 24" O.C.
INTERIOR BEARING WALL
1/2" DIAM.
A.B. @ 4' O.C.
PT 2X LEDGER
8" CMU STEM WALL
(2) #4 (B)
SHEATHING PER S.102
SHEARWALL WHERE OCCURS
SEE S.102 FOR SHEATHING
E.N.
0' - 7"
FRAMING PER S.102
SHEATHING PER S.102
HANGER PER S.102
16d @ 12" O.C.
A.B. PER S.101
8" CMU STEM WALL
(2) #4 (B)
SHEATHING PER S.101
SHEARWALL WHERE OCCURS
2X6 PT SOLE PLATE
FRAMING PER PLAN
0' - 7"
A.B. PER PLAN
HANGER PER S.102
16d @ 12" O.C.
18" MIN.
(2) #4 (B)
SEE PLAN
12" TYP.
18" MIN.
4" S.O.G.
8" CMU STEM WALL
A.B. PER PLAN
12" TYP.
2X6 PT SOLE PLATE
#4 @ 24" O.C.
FOUNDATION PLAN NOTES:

1. SEE GENERAL NOTES FOR SPECIFICATIONS.
2. FOR FOUNDATION DETAILS NOT REFERENCED SEE S.302
3. GARAGE SLAB TO BE REINFORCED WITH #4 BARS @ 24" O.C.
4. VERIFY ALL UTILITY LOCATIONS IN FIELD
5. SOIL AT BEARING SHALL BE MINIMUM 100 PSF CAPACITY ON UNDISTURBED SOIL (OR COMPACTED STRUCTUAL FILL) AND SHALL BE VERIFIED & APPROVED BY LICENSED GEO-TECHNICAL ENGINEER
6. LEGEND:
   - DENOTES 8" CMU STEM WALL
   - DENOTES SHEAR WALL LOCATION
   - DENOTES SIMPSON STRONGWALL LENGTH L & HEIGHT h WITH SIMPSON STRONWALL ANCHOR BOLT
   - MARK
   - SW
   - MARK
   - APA SHEATHING TYPE
   - NAILING
   - (BOUNDARY, EDGE, FIELD)
   - SHEARWALL SCHEDULE

HOLDOWN/STRAP SCHEDULE

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NOTES:

1. ALL PANEL EDGES SHALL BE BACKED WITH MINIMUM FULL STUD DEPTH HORIZONTAL BLOCKING PER SCHEDULE.
2. EDGE NAILING SHALL BE PROVIDED AT ALL PANEL EDGES, THE TOP MEMBER OF DOUBLE TOP PLATES, SOIL PLATES, SOLE PLATES, AND AT ALL END POSTS OR STUDS WHICH COMPRISE THE SHEAR WALL BOUNDARY. FIELD NAILING SHALL BE PROVIDED AT ALL INTERMEDIATE FRAMING MEMBERS.
3. STAGGER NAILS AT ABUTTING PANELS
4. SCREW LENGTH SHALL BE MIN 1-1/2" PENETRATION IN CONNECTING MEMBER
5. INSTALL SIMPSON "STRONG-WALL" IN ACCORDANCE WITH SIMPSON STRONGTIE MANUFACTURER INSTRUCTIONS
6. PROVIDE A MINIMUM OF TWO ANCHOR/BOLT BOLTS AT EACH SHEAR WALL SECTION OR SHEARWALL WITH ONE ANCHOR BOLT A MINIMUM OF 3" AND A MAXIMUM OF 6" FROM EACH END OF EACH MEMBER OR SHEARWALL
7. SILL PLATES IN CONTACT WITH CONCRETE SHALL BE PRESSURE TREATED. ALL NAILS, BOLTS AND WASHERS IN CONTACT WITH PRESSURE TREATED WOOD TO BE HOT DIP GALVANIZED
8. PROVIDE 2" x 2" x 0.229" MIN PLATE WASHERS AT EACH ANCHOR BOLT
9. SILL BOLT EMBEDMENT IN CONCRETE SHALL BE MIN 7"
FLOOR FRAMING PLAN NOTES:

1. SEE GENERAL NOTES FOR SPECIFICATIONS.
2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS WITH THE ARCHITECTURAL DRAWINGS. THE CONTRACTOR SHALL NOTIFY THE ARCHITECT AND ENGINEER OF ANY VARIANCES PRIOR TO STARTING WORK.
3. FLOOR SHEATHING SHALL BE 1/2” WOOD STRUCTURAL PANEL, INSTALLED WITH FACE OF GRAIN ┴ TO SUPPORTS WITH 10D COMMON NAILS @ 6” O.C. B.N. 6” O.C. E.N. AND 10” O.C. FIELD NAILING.
4. PANEL BOUNDARY NAILING B.N. AT ALL BEAMS, JOISTS, BLOCKING, ECT.
5. ALL STRUCTURAL WALLS ARE TO BE 2X6 LF; 9 STUDS @ 16” O.C. UNO.
6. SEE ARCHITECTURAL DRAWINGS FOR INTERIOR WALLS AND PLUMBING WALL LOCATIONS.
7. LEGEND:

- **Denotes Shear Wall**
- **Denotes 2X6 Wall W/ Studs @ 16” O.C.**
- **Denotes 6X8 P.T. DF-L #1 Post**

HANGER SCHEDULE

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<th>HANGERS</th>
<th>CAPACITY (LBS)</th>
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<tr>
<td>C1</td>
<td>SIMPSON LRU267</td>
<td>980</td>
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<tr>
<td>C2</td>
<td>SIMPSON LSSU210</td>
<td>1145</td>
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<td>C3</td>
<td>SIMPSON LV210</td>
<td>1000</td>
</tr>
<tr>
<td>C4</td>
<td>SIMPSON MSCS W/ H=12”</td>
<td>8200</td>
</tr>
<tr>
<td>C5</td>
<td>SIMPSON L210</td>
<td>850</td>
</tr>
<tr>
<td>C6</td>
<td>SIMPSON HUC412</td>
<td>2300</td>
</tr>
<tr>
<td>C7</td>
<td>SIMPSON HUS410</td>
<td>2000</td>
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NOTE: ALL CONNECTORS TO BE INSTALLED PER MANUFACTURER REQUIREMENTS.

SHARROW WALL SCHEDULE

<table>
<thead>
<tr>
<th>MARK</th>
<th>APA SHEATHING TYPE</th>
<th>NAILING (BOUNDARY, EDGE, FIELD)</th>
<th>SOLE PLATE</th>
<th>WALL STUD &amp; BLOCKING CONNECTION</th>
<th>REIMBULKING CONNECTION</th>
<th>ANCHOR SPACING</th>
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</thead>
<tbody>
<tr>
<td>SW</td>
<td>HSS2 STRUC. 1</td>
<td>16d @ 12” O.C.</td>
<td>2x</td>
<td>2x</td>
<td>1/2” Diam. @ 4” O.C.</td>
<td></td>
</tr>
</tbody>
</table>

NOTES:

1. ALL PANEL EDGES SHALL BE BACKED WITH MINIMUM FULL STUD DEPTH HORIZONTAL BLOCKING PER SCHEDULE.
2. EDGE NAILING SHALL BE PROVIDED AT ALL PANEL EDGES. THE TOP MEMBER OF DUPLICATE TOP PLATES, SILL PLATES, SOLE PLATES, AND AT ALL END POSTS OR STUDS WHICH COMPRIZE THE SHEAR WALL BOUNDARY. FIELD NAILING SHALL BE PROVIDED AT ALL INTERMEDIATE FRAMING MEMBERS.
3. STAGGER NAILS AT ABUTTING PANELS
4. SCREEN LENGTH SHALL BE MIN 1-1/2” PENETRATION IN CONNECTING MEMBER
5. INSTALL SIMPSON “STRONG-WALL” IN ACCORDANCE WITH SIMPSON STRONGTIE MANUFACTURER INSTRUCTIONS
6. PROVIDE A MINIMUM OF TWO ANCHOR/SILL BOLTS AT EACH SILL PLATE SECTION OR SHARROW WALL WITH ONE ANCHOR BOLT A MINIMUM OF 3” AND A MAXIMUM OF 6” FROM EACH END OF EACH MEMBER OR SHARROW WALL.
7. SILL PLATES IN CONTACT WITH CONCRETE SHALL BE PRESSURE TREATED. ALL NAILS, BOLTS AND WASHERS IN CONTACT WITH PRESSURE TREATED WOOD TO BE HOT DIP GALVANIZED
8. PROVIDE 3” x 3” x 0.229” MIN PLATE WASHERS AT EACH ANCHOR BOLT
9. SILL BOLT EMBEDMENT IN CONCRETE SHALL BE MIN 7”.

Scale: 1/4” = 1’-0”

License SE Seal:

Project Title: GNS - WEED HOUSING

Site: 780 S. DAVIS ST WEED, CA 96094

Revisions

No. Desc. Date

Author: Checker

Plot Date: 12/20/2017 12:11:58 AM

Sheet Name: Floor Framing Plan

Sheet Number: S.102
1. SEE GENERAL NOTES FOR SPECIFICATIONS
2. RAFTERS SHALL BE INSTALLED AT 16" O.C. U.N.O.
3. ROOF OVERHANG SHALL BE 12" U.N.O.
4. ROOF SLOPE SHALL BE 5:12 U.N.O.
5. SIMPLER CONNECTORS ARE BLOCKING AT THE DOUBLE TOP PLATE SHALL BE INSTALLED PRIOR TO INSTALLATION OF ROOF SHEATHING.
6. ROOF SHEATHING SHALL BE 1/2" WOOD STRUCTURAL PANEL INSTALLED WITH FACE OF GRAIN ┴ TO SUPPORTS WITH 10D COMMON NAILS @ 6" O.C. B.N. 6" O.C. E.N. AND 12" O.C. FIELD NAILING. SPAN RATING SITE STAGGER JOINTS.
7. PANEL BOUNDARY NAILING B.N. AT ALL BEAMS, JOISTS, BLOCKING, ETC.
8. DOUBLE TOP PLATES SHALL BE (2) 6X6 DF-L #2.
9. SEE HANGER SCHEDULE. ALL MANUFACTURED CONNECTORS SHALL BE INSTALLED PER MANUFACTURER REQUIREMENTS. USE SIMPSON PAGE HANGERS WHERE NOT INDICATED.
10. PSL - PARALLEL STRAND LUMBER
11. LEGEND:

**HANGER SCHEDULE**

<table>
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<tr>
<th>MARK</th>
<th>HANGER</th>
<th>CAPACITY (LBS)</th>
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<td>C1</td>
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<td>C2</td>
<td>SIMPSON LSSU210</td>
<td>1145</td>
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<tr>
<td>C3</td>
<td>SIMPSON HUS410</td>
<td>2056</td>
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<tr>
<td>C4</td>
<td>SIMPSON MSC5 (H=12&quot;)</td>
<td>2066</td>
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<td>C5</td>
<td>SIMPSON LSU10</td>
<td>850</td>
</tr>
<tr>
<td>C6</td>
<td>SIMPSON HUC412</td>
<td>2380</td>
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</table>

**NOTE:** ALL CONNECTORS TO BE INSTALLED PER MANUFACTURER REQUIREMENTS.
FRAMING AT MAIN ROOF

ROOF SHEATHING AT MAIN ROOF TO BE EXTENDED TO MAIN ROOF SUPPORT SHEARWALL WHERE OCCURS

2x6 EXTERIOR WALL W/ STUDS @ 16" O.C.

2x MAIN ROOF RAFTER

3" SHEATWALL WHERE OCCURS

2x CALIFORNIA FRAMING

2x BLOCKING

FRAMING AT MAIN ROOF

2x CONT. W/ 2-16d @ 24" O.C.

California Roof @ Shear Wall

California Ridge

California Roof to Main Roof

2x MAIN ROOF RAFTER

2x6 RIDGE BEAM W/ 2-16d TOENAIL, TYP EA. FACE AND EA. SIDE

2x6 RIDGE BOARDS W/ 2-16d TOENAIL, TYP EA. FACE AND EA. SIDE

ROOF SHEATHING AT CALIFORNIA FRAMING

EXTEND ROOF SHEATHING TO WALL

2x CONT. W/ 3-16@ 24" O.C.

2x CALIFORNIA FRAMING

ROOF SHEATHING PER PLAN

HANGER PER PLAN

FRAMING PER PLAN

POST PER PLAN

SIMPSON EEC 44

TOP BARS STEPPED AREA (2) #4 MIN BTM OF FTG

#4 MIN 1' - 6" MAX

FACE OF STEPS SHALL BE CAST AGAINST UNDISTURBED EARTH. IF EXCAVATION RAVELLS, BACKFILL W/ CONC WHEN FTG IS CAST.

2x STUDS FRAMING

2x TOP PLATE

STRAP & NAILING PER SCHEDULE

2x STUDS FRAMING

2x4 ROOF RAFTERS @ CALIFORNIA FRAMING @ 16" O.C. (U.N.O.) PROVIDE INTERMEDIATE SUPPORT @ 8'-0", MAX. PER DETAIL C

2x6 PURLIN & 2x4 KICKER @ 8'-0" O.C.

2x6 RIDGE (U.N.O)

2x6 FLA

T VALLEY

2x6 FLA

T VALLEY

2x MAIN ROOF RAFTER FRAMING (TYP.)
<table>
<thead>
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<th>Desc.</th>
<th>Date</th>
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<tr>
<td>1</td>
<td>Shear Wall Nailing</td>
<td>1/2&quot; = 1'-0&quot;</td>
</tr>
<tr>
<td>2</td>
<td>Typical Diaphragm Nailing</td>
<td>1/2&quot; = 1'-0&quot;</td>
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</tbody>
</table>

**Shear Wall Nailing**

- **2x CONT. TOP PLATE**
- **HOLDOWN POST PER PLAN 2x MIN**
- **HOLDOWN & ANCHOR PER PLAN**
- **2x PT SILL PLATE REQUIRED AT ALL SHEAR WALLS**
- **MIN 5/8" ANCHOR BOLTS w/ PLATE WASHERS, SPACED PER SHEARWALL SCHEDULE**
- **HOLDOWN & ANCHOR PER PLAN**
- **BOUNDARY NAILING IS ALONG ENTIRE OUTER PERIMETER OF SHEARWALL**
- **FIELD NAILING IS INSIDE PERIMETER OF PLYWOOD PANEL**

**Typical Diaphragm Nailing**

- **EDGE NAILING ALONG PERIMETER OF PLYWOOD PANEL (UNLESS A BOUNDARY EDGE)**
- **ALL PLYWOOD NAILING PER THE SHEARWALL SCHEDULE**
- **DIAPHRAGM BOUNDARY / NAILING**
- **FIELD NAILING IS INSIDE PERIMETER OF PLYWOOD PANEL**
- **FLOOR / ROOF JOISTS**
- **10D COMMON NAILS**
- **CONTINUOUS PANEL JOINT**
- **Continuous 2x Blocking at all adjoining panel edges**
- **2x Framing at all adjoining panel edges**

**License SE Seal:**

**Project Title:**

GNS - WEED HOUSING

**Site:**

38 S. DAVIS ST
WEED, CA 96094

**Revisions**

<table>
<thead>
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<td>1</td>
<td>GNS - WEED HOUSING</td>
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**Details**

- **Author:**
- **Checked by:**

**Plot Date:**

12/1/2017 12:11:59 AM

**Sheet Name:**

S.303

**Scale:**

1/2" = 1'-0"
ALL SHOP DRAWINGS (EXCEPT REINFORCING STEEL) SHALL AND/OR FOR ANY HAZARDS RESULTING FROM THE ACTIONS OF STRUCTURAL DRAWINGS. SHOP DRAWINGS SHALL INDICATE THE CONTRACTOR'S NAME AND ADDRESS, THE PROJECT'S LOCATION, THE CONTRACTOR'S STATE OF REGISTRATION, AND THE CONTRACTOR'S LICENSE NUMBER.

1. All materials, workmanship, design, and construction shall conform to the specifications, the 2010 California Building Code (CBC), and the California City of Weed Municipal Code. All shop drawings shall be executed by an architect and/or engineer of record and shall be submitted to the City of Weed, Department of Planning and Development. Shop drawings are intended to be guidelines only and must be specified.

2. The City of Weed reserves the right to approve any shop drawings or shop drawings may be subject to supplement with a letter of instruction or modification.

3. The City of Weed shall provide temporary bracing for the structure and structural components until all final connections have been completed in accordance with the plans and specifications.

4. The contractor shall be responsible for safety precautions and the methodology, techniques, sequences, or procedures required to perform his work. The contractor shall provide working conditions at the site, and for any hazards resulting from the actions of any trade contractor. The structural engineer has no duty to inspect, supervise, note, correct or report any health or safety deficiencies of the warnings, contracts, or other entities or personnel at the project site.

5. The contractor initiated shall be submitted in writing to the architect and structural engineer for approval prior to fabrication or installation.

6. Drawings indicate general and typical details of construction. Where conditions are not specifically indicated, but are of similar character to those shown on drawings, similar details of construction shall be used.

7. All structural systems which are to be composed of components to befield erected shall be supervised by the supplier during manufacturing.

General Notes:

- Sheet No. 1
- Checked by: S. PASCUAL
- Desc.
- Sheet Name: SN.101
- Revision: No.
- Date: 780 S. DAVIS ST
- San Luis Obispo, CA 93401
- License SE Seal:

Project Title: GNS - HOUSING

Site:

TRE S. DAVIS ST
WEED, CA

Revisions

No. Desc. Date

Author: Author

Checked by: Checked

Plot Date: 12/13/12 11:59 AM

Sheet Name: Sheet Number:

Scale:

General Notes:

- Mineral contents and cement and maximum amounts of water may be changed if a concrete performance mix is submitted to the structural engineer and accepted by the City of Weed. After the performance mix is approved by the City of Weed, the construction engineer shall issue the following:
- The maximum amounts of cement and fine and coarse aggregates, water and admixtures as well as the water-cement ratio, slump, slump changes, and other characteristics of the performance mix shall be established by the following:

- 15. Reinforcing steel shall conform to ASTM A 615, including supplements S 1, Grade 60, except Grade 50. Exceptions are made as per the engineering notes.

- 16. All concrete masonry units shall be fabricated, cured, and firmly adhered in accordance with NWC 24F-V4 or 24F-1.8E, frost-resistant concrete strength of 2,400 psi at 28 days, design f' = 1,350 psi. Standards shall be verified by the unit strength method in accordance with IBC Section 2105.2. Full stresses are required. All masonry shall be rebarred as specified.

- 17. The use of a performance mix requires both a mix design and an approved mixing plant. The cost of which shall be paid by the contractor.

- 18. The maximum number of all moisture shall be included in the structure and structural components until all final connections have been completed in accordance with the plans and specifications.

- 19. All foundation structural notes shall be reviewed and stamped by the engineer to indicate which materials, workmanship, design, and construction are necessary.

- 20. The structural engineer understands that such procedures may be subject to supplement with a letter of instruction or modification.

- 21. The building officials recognize that structural review is a technique employed to minimize the risk of problems arising during construction. Structural review does not constitute any inspection. In all cases, the contractor shall retain the responsibility for the quality of work and for adherence to the approved plans and specifications.

- 22. Subgrade preparation including drainage, excavation, compaction, and filling requirements shall conform strictly with regulatory requirements in the soils report or as specified by the engineer. Footings shall be built on solid undisturbed earth. Where no soils, soils, and fill of the structure shall be at least 18" below finished grade. Footings shall be designed in accordance with the following:

- 23. soils engineer. Soil profiles behind all retaining wall shall be designed and constructed with free-draining granular fill and provide for subsurface drainage as noted in the soils report.

- 24. soils engineers. Structural notes shall indicate the location of all levels of the structure and structural components until all final connections have been completed in accordance with the plans and specifications.

- 25. The building officials recognize that structural review is a technique employed to minimize the risk of problems arising during construction. Structural review does not constitute any inspection. In all cases, the contractor shall retain the responsibility for the quality of work and for adherence to the approved plans and specifications.

DESIGN SHOWN ON PLANS IS BASED ON LUMBER MANUFACTURED BY THE TRUE-JOIST CORPORATION. ALTERNATE MANUFACTURERS MAY BE USED SUBJECT TO REVIEW AND APPROVAL BY THE ARCHITECT AND STRUCTURAL ENGINEER. ALTERNATE JOIST HANGERS AND OTHER HARDWARE MAY BE SUBSTITUTED FOR ITEMS SHOWN PROVIDED THEY HAVE 120% APPROVAL FOR EQUAL OR GREATER LOAD CAPACITIES. ALL JOIST HANGERS AND OTHER HARDWARE SHALL BE COMPATIBLE IN SIZE WITH MEMBERS PROVIDED.

26. SUBMITTED DRILLING DETAILS ARE APPROVED AND FOUND SATISFACTORY TO THE ARCHITECT AND STRUCTURAL ENGINEER. ALTERNATE DRILLING DETAILS MAY BE SUBMITTED FOR ITEMS SHOWN PROVIDED THEY HAVE 120% APPROVAL FOR EQUAL OR GREATER LOAD CAPACITIES. ALL JOIST HANGERS AND OTHER HARDWARE SHALL BE COMPATIBLE IN SIZE WITH WOOD FRAMING WELDED JOIST WEB PROVIDED.

18. PROVIDE TONGUE AND GROOVE JOINTS FOR CLOSED-END SHEATHING. SHEATHING WITH NO COUNTERSINKING PERMITTED.

11. PROVIDE WOOD FRAMING DETAILS AS SHOWN ON THE DRAWINGS. USE DIRECT ATTACHMENTS. PROVIDE 3" X 3" X 1/4" TONGUE AND GROOVE JOINTS OR SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. WHERE CONNECTOR BOLTS CONFORM TO WNZ SERIES JOIST HANGERS.

27. PROVIDE APPLIED METAL CONNECTIONS IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

30. PROVIDE GRID WALLS OR SHEAR WALLS AS SHOWN. UNLESS NOTED ON THE PLANS, APA RATED ROOF AND FLOOR SHEATHING SHALL BE LAYED UP WITH STRETCHER JOINTS AT ALL PANEL EDGES AND END OF ALL ROOF AND FLOOR SHEATHING.

14. PROVIDE SHEATHING NAILING SPECIFICATIONS TO DISCUSS THE TECHNIQUES USED IN THEIR DRAWINGS IN ACCORDANCE WITH THE NORTHERN RESEARCH BOARD AND APA RATED SHEATHING (SPAN RATING 24/0) ON EXTERIOR SURFACES AND NO COUNTERSINKING PERMITTED.

10. PROVIDE INTERIOR SHEATHING WHEN SHEATHING IS PROVIDED OVER ALL OPENINGS NOT OTHERWISE NOTED. SOLID BLOCKING AT ALL BEARING POINTS.

22. PROVIDE WOOD PLATES IN DIRECT CONTACT WITH CONCRETE OR MASONRY. SHALL BE PRESSURE-TREATED WITH DOUBLE CEDAR WOOD EMBRACE. PROVIDE 2 LAYERS OF ASPHALT BUTTED SHEETS BETWEEN INTERIOR SUPPORTS, BLOCKING, STICKS, CONCRETE OR MASONRY.

19. PROVIDE TONGUE AND GROOVE JOINTS ON DRAWINGS AS SHOWN ON THE FOLLOWING SPECIFICATIONS.

<table>
<thead>
<tr>
<th>NAIL SIZE</th>
<th>LENGTH</th>
<th>DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>8d</td>
<td>2-3/4&quot;</td>
<td>0.131&quot;</td>
</tr>
<tr>
<td>10d</td>
<td>2-1/2&quot;</td>
<td>0.148&quot;</td>
</tr>
<tr>
<td>12d</td>
<td>2-1/2&quot;</td>
<td>0.162&quot;</td>
</tr>
</tbody>
</table>

23. PROVIDE WOOD FASADES AS SHOWN ON THE DRAWINGS. PROVIDE 2" x 2" JOIST SPACING AT ALL PANEL EDGES AND ENDS OF ALL ROOF AND FLOOR SHEATHING.

24. PROVIDE LAMINATED COMMERCIAL GRADE DOUGLAS FIR VENEER GLUED WITH A WATERPROOF ADHESIVE.

7. PROVIDE LAMINATED COMMERCIAL GRADE DOUGLAS FIR VENEER. WHERE NUMBERS OTHER THAN SHOWN ON THE PLANS ARE MANUFACTURED BY THE TRUS-JOIST CORPORATION. ALTERNATE MANUFACTURERS MAY BE USED SUBJECT TO REVIEW AND APPROVAL. PROVIDE 120% APPROVAL FOR EQUAL OR GREATER LOAD CAPACITIES. ALL JOIST HANGERS AND OTHER HARDWARE SHALL BE COMPATIBLE IN SIZE WITH MEMBERS PROVIDED.

26. PROVIDE WOOD PLATES IN DIRECT CONTACT WITH CONCRETE OR MASONRY. SHALL BE PRESSURE-TREATED WITH DOUBLE CEDAR WOOD EMBRACE. PROVIDE 2 LAYERS OF ASPHALT BUTTED SHEETS BETWEEN INTERIOR SUPPORTS, BLOCKING, STICKS, CONCRETE OR MASONRY.

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<td>12d</td>
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<td>0.162&quot;</td>
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<td>0.162&quot;</td>
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</table>

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26. PROVIDE WOOD PLATES IN DIRECT CONTACT WITH CONCRETE OR MASONRY. SHALL BE PRESSURE-TREATED WITH DOUBLE CEDAR WOOD EMBRACE. PROVIDE 2 LAYERS OF ASPHALT BUTTED SHEETS BETWEEN INTERIOR SUPPORTS, BLOCKING, STICKS, CONCRETE OR MASONRY.
STRUCTURAL CALCULATIONS

for

GNS - Weed Housing Project
(ARCE 415)

HARMONIOUS TECTONICS

ARCE: GALEN AMICK
SARAH PASCUAL

DATE: 12/1/2017
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- Load Takeoff \(^{T1}\)
- Wind Analysis \(^{W1-2}\)
- Seismic Analysis \(^{S1-2}\)

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- Floor Framing Design \(^{F1-4}\)
- Column Design \(^{C1}\)

**Lateral Design**
- Shear Wall Design \(^{L1-11}\)
- Diaphragm Design \(^{L12-15}\)
- Chord/Collector Design \(^{L16-28}\)

**Connection Design** \(^{CN1-3}\)

**Foundation Design** \(^{FN1}\)

**Miscellaneous** \(^{M1-2}\)
Load Takeoff

**Roof Dead Load**

<table>
<thead>
<tr>
<th>Material</th>
<th>Load (psf)</th>
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<tbody>
<tr>
<td>Single Ply</td>
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<td>Sheathing (1/2&quot;)</td>
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<td>Insulation</td>
<td>3.0</td>
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<td>Framing</td>
<td>2.5</td>
</tr>
<tr>
<td>MEP</td>
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<tr>
<td>Ceiling (Gyp)</td>
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<tr>
<td>Misc</td>
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Total Roof Dead Load: 13.0 psf

Load on Horiz. Plane:

\[
(5:12) \times 13 \times 1.08 = 14.0 \text{ psf}
\]

**Floor Dead Load**

<table>
<thead>
<tr>
<th>Material</th>
<th>Load (psf)</th>
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<tbody>
<tr>
<td>Flooring (Vinyl Tile)</td>
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<tr>
<td>Sheathing (3/4&quot;)</td>
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<tr>
<td>Framing (2x12 @ 16&quot; O.C.)</td>
<td>2.5</td>
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<tr>
<td>Insulation</td>
<td>3.0</td>
</tr>
<tr>
<td>MEP</td>
<td>1.0</td>
</tr>
<tr>
<td>Misc</td>
<td>1.5</td>
</tr>
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Total Floor Dead Load: 11.7 psf

**Floor Live Loads**

<table>
<thead>
<tr>
<th>Type</th>
<th>Load (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Residential</td>
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</tr>
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</table>

**Roof Live Load: (LRF1)**

\[
L_0 = 20 \text{ psf} \\
L_R = L_0 \times R_1 \times R_2 = 19 \text{ psf} \\
R_2 = 0.95 \ (5:12) \\
R_1 = 1 \text{ At } < 200 \text{ ft}^2 \\
R_1 = 1.2 \times 0.01 \text{ At } 200 \text{ ft}^2 < A < 600 \text{ ft}^2 \\
R_1 = 0.6 \text{ At } > 600 \text{ ft}^2 \\
R_2 = 1.2 \times 0.05 \times F = 1
\]

**Misc. Dead Loads**

<table>
<thead>
<tr>
<th>Material</th>
<th>Load (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior Walls</td>
<td>10.0</td>
</tr>
<tr>
<td>Exterior Walls</td>
<td>23.0</td>
</tr>
</tbody>
</table>

**Ceiling Load**

10 psf

\[
DL = 14.0 \text{ psf}
\]
# WIND DESIGN

- ENCLOSED, SIMPLE DIAPHRAGM, LOW RISE

## Step 1: Risk Category

<table>
<thead>
<tr>
<th>Step 2: Basic Wind Speed, V</th>
</tr>
</thead>
<tbody>
<tr>
<td>110 mph</td>
</tr>
</tbody>
</table>

## Step 3: Wind Load Parameters

<table>
<thead>
<tr>
<th>Exposure:</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>K_{x,y},</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
</tr>
</tbody>
</table>

## Step 4: Wind Pressure, p_{330}

- Horizontal (A, B, C, D): 24.4 / 7.2 / 17.7 / 33.9
- Vertical (E, F, G, H): -23.1 / -16.0 / -16.0 / 19.0
- Overhangs (E, I, G, J): -32.3 / -25.3

<table>
<thead>
<tr>
<th>Fig. 28.6-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEP 5: Adjustment Factor, A</td>
</tr>
<tr>
<td>1.21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eq. 28.4-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEP 6: Determine p_{x}</td>
</tr>
</tbody>
</table>

\[
p_{x} = \lambda K_{x,y} P_{330}
\]

- \( A = (1.21)(1.0)(24.4) = 22.4 \text{ psi} \)
- \( B = (1.21)(1.0)(7.2) = 14.7 \text{ psi} \)
- \( C = (1.21)(1.0)(17.7) = 21.4 \text{ psi} \)
- \( D = (1.21)(1.0)(3.9) = 4.72 \text{ psi} \)

## Diagram:

- \( a = 46' \)
- \( h = 15' \)
- Not less than: \( \frac{0.04(34')}{0.4(17')} = 1.36 < 3.4' \)
- \( 3' < 3.4' \)
- \( a = 3.4' \)
- \( h = 15' \)
<table>
<thead>
<tr>
<th>CASE A</th>
<th>CALCULATIONS</th>
<th>ANSWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = 32.2 psf \cdot \frac{2}{3} \cdot (2.34') = 876 #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B = 8.45 psf \cdot 8' \cdot (2.34') = 461 #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C = 21.4 psf \cdot \frac{6}{2} \cdot (18'-6.8') = 959 #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D = 4.72 psf \cdot 8' \cdot (18'-6.8') = 423 #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>\Sigma = 2719 #</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CASE B</th>
<th>CALCULATIONS</th>
<th>ANSWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = 32.2 psf \cdot 8' \cdot 3.14' = 876 #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C = 21.4 psf \cdot 8' \cdot (16'-16'-3.14') = 5924 #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>\Sigma = 6800 # (LRFD)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL Wind = 4553 # + 5086 # = 7639 # (LRFD)

0.6W = 4684 # (ASD) #

E-W WIND (WORST CASE)

N-S WIND DEMAND

<table>
<thead>
<tr>
<th>CASE B</th>
<th>CALCULATIONS</th>
<th>ANSWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = 32.2 psf \cdot 8' \cdot 3.14' = 876 #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C = 21.4 psf \cdot 8' \cdot (38'- 3.14') = 5924 #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>\Sigma = 6800 # (LRFD)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

0.6W = 4680 # (ASD) #

N-S WIND (WORST CASE)
### SEISMIC BASE SHEAR

*Roof DL Adjusted for slope = 14 psf Snow Load Contribution (S)*

- **Interior Wall DL = 10 psf**
- **Exterior Wall DL = 28 psf**
- **Floor DL = 12 psf**

\[
P_f = 60 \text{ psf} \quad \text{60 psf > 30 psf}
\]

\[
P_f = 60 \text{ psf}
\]

\[
S = 0.20 \text{ psf} \quad \text{0.20(47 psf) = 9.4 psf}
\]

### SEISMIC WEIGHT

- **Roof = Area x Weight = 1955 \# x 14 psf = 27,370 \#**
- **Sloped Roof Wall A = 69 \# x 23 psf = 1,587 \#**
- **Garage Back Wall @ = 208 \# x 10 psf = 2,080 \#**
- **South Wall (1) = 148 \# x 23 psf = 3,404 \#**
- **West Wall @ = 80 \# x 23 psf = 1,840 \#**
- **Clear Story = 82 \# x 23 psf = 1,886 \#**
- **Int Sloped Wall @ = 80 \# x 10 psf = 800 \#**
- **Master Raised Wall = 60 \# x 10 psf = 600 \#**

\[
\text{Int. Panel Wall} = \text{L x } \frac{3}{2} \text{ x Wt.} = 120 \text{ ft x } \frac{3}{2} \text{ x 10 psf} = 4,800 \#
\]

\[
\text{Ext. Panel Wall} = \text{L x } \frac{3}{2} \text{ x Wt.} = 142 \text{ ft x } \frac{3}{2} \text{ x 23 psf} = 13,432 \#
\]

\[
\text{Snow Load} = \text{Area x 0.2} \quad P_s = 1955 \# x 0.2(47 psf) = 18,377 \#
\]

\[
\begin{align*}
W &= 76,167 \# \quad W = 76,167 \#
\end{align*}
\]

### SEISMIC DESIGN CRITERIA

- **Risk Category = II**
- **Ie = 1.0**
- **Design Category = D**
- **SDS = 0.594**
- **SD1 = 0.384**
- **T = 0.086 CTL 6**

### STRUCTURAL SYSTEM

**Bearing Wall (Light Frame w/ Wood Str. Panels)**

- **Response Mod. Factor R = 6.5**
- **Over Strength Factor \( \Omega_o = 2 \)**
- **\( C_s = \frac{R}{\Omega_o} = 0.091 \)**
Design Maps Summary Report

User-Specified Input

(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

\[ S_s = 0.736 \text{ g} \quad S_{M5} = 0.891 \text{ g} \quad S_{DS} = 0.594 \text{ g} \]
\[ S_1 = 0.328 \text{ g} \quad S_{M1} = 0.572 \text{ g} \quad S_{D1} = 0.381 \text{ g} \]

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.

MCE\textsubscript{R} Response Spectrum

Design Response Spectrum

While this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.
**Roof Framing Design**

**Load Combos:**

\[
D_{\text{os}} = \frac{(14.0 \text{ psf} + 46.6 \text{ psf})}{1.15} = 52.9 \text{ psf}
\]

\[
D_{\text{os}} = \frac{(14.0 \text{ psf} + 0.75(46.6 \text{ psf})}{1.15} = 42.7 \text{ psf}
\]

\[
\therefore D_{\text{os}} \text{ governs} = 60.8 \text{ psf}
\]

**Typical Roof Joist** (RJ-1)

- \( L = 19' \)
- \( w = 60.8 \text{ psf} \times \frac{12''}{12} = 814.07 \text{ psf} \)
- \( V_u = \frac{814.07 \text{ psf} \times 19'}{19'} = 770 \text{ #} \)
- \( M_u = \frac{814.07 \text{ psf} \times (19')^2}{6} = 36568 \text{ ft-lb} \)

**NDS Table 1a**

**Table 1b**

**NDS Table 4.3.1**

**Try 2x12 DF-L #1 or BTR:**

\[
f_b = \frac{M_u}{S} = \frac{3656.8 \text{ ft-lb} \times 12''}{31.64 \text{ in}^2} = 1387.7 \text{ psi}
\]

\[
F_b = F_b (C_0 \cdot C_{01} \cdot C_{f} \cdot C_{0} \cdot C_{0} \cdot C_{0})
\]

- \( F_b = 1200 \text{ psi} \times (1.15)(1.0)(1.15) \)
- \( = 1587 \text{ psi} \) > \( f_b \)

\[
\therefore \text{OK for Flexure}
\]

\[
f_v = \frac{1.5V}{A} = \frac{1.5(770 \text{ #})}{16.68 \text{ in}^2} = 66.4 \text{ psi}
\]

\[
F_v = F_v (C_0 \cdot C_{01} \cdot C_{f} \cdot C_{0})
\]

- \( F_v = 180 \text{ psi} \times (1.15) \)
- \( = 207 \text{ psi} \) > \( f_v \)

\[
\therefore \text{OK for Shear}
\]
### Reference Calculations

<table>
<thead>
<tr>
<th>Reference</th>
<th>Calculations</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta_{l,8} = \frac{5 \text{vol}^4}{384EI} )</td>
<td></td>
</tr>
<tr>
<td>( \text{Answer} )</td>
<td></td>
</tr>
</tbody>
</table>

\[ \frac{5(18.67 \text{ plf})(19)^4(2)^3}{384(1.86 \text{ kips})(178 \text{ in}^3)} = 0.742'' \]

\[ \frac{16 \times 12''}{180} = 1.2'' < \Delta_{l,6} \checkmark \]

\[ \Delta_{l} = \frac{5wL^4}{384EI} = \frac{5(19 \text{ plf})(12)^4(12)}{384(1.86 \text{ kips})(178 \text{ in}^3)} = 0.232'' \]

\[ \frac{16 \times 12''}{240} = 0.9'' > \Delta_{l} \checkmark \]

\[ \therefore \text{OK for deflection} \]

**USE 2X12 DF-L #1 OR BTR @ 16'' O.C.**

---

### Typical Valley Joist (RJ-2)

- **L = 18'**
- **w = 60.8 plf \cdot \frac{L}{12} = 81.07 plf**

\[ \therefore \text{same loading and less length than RJ-1} \]

**USE 2X12 DF-L #10 OR BTR @ 16'' O.C.**

---

### Typical Valley Beam (RB-1)

- **L = 26'**
- **w = 60.8 plf \cdot 12' = 730 plf**
- **W = \frac{2(6.5 \cdot 730 \text{ plf} \cdot 26')}{3} = 6323 \text{ lb}**
- **M_{w} = 0.128 \times 6.5 \times 730 \text{ plf} \cdot 26' = 31,505 \text{ lb-ft}**
<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>CALCULATIONS</th>
<th>ANSWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIEDEMUSGER CATALOG</td>
<td>TRY PSL 5 7/8&quot; x 14&quot; (E = 2.2E6 psi, I = 120 in^4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M = 40,740 # ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V = 14,210 #</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ΔDLS = 0.013WL^3 / EI = 0.013(0.5 · 730 plf · 26')(26'·12')^3 / (2.2E6 psi)(1201 in^4) = 0.95&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Δallow _DLS = L / 180 = 26' · 12' / 180 = 1.73&quot; &gt; ΔDLS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ΔL = 0.013WL^3 / EI = 0.013(0.5 · 730 plf · 11')(11'·12')^3 / (2.2E6 psi)(1201 in^4) = 0.50&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Δallow _L = L / 240 = 26' · 12' / 240 = 1.36&quot; &gt; ΔL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>:: OK FOR DEFLECTION</td>
<td>USE PSL 5 7/8&quot; x 14&quot;</td>
</tr>
</tbody>
</table>

| RIDGE BEAM (RB-2) | | |
| L = 11' | | |
| W = 60.8 psf · 12' = 730 plf | | |
| V = 2(0.5 · 730 plf · 11') / 3 = 2675 # | | |
| M = 0.125(0.5 · 730 plf · 11')(11') = 5675 # ft | | |
| TRY 4X12 DF-L #2 | | |
| f_b = M / S = 5675 # ft · 12' / 73.83 in^3 = 116.3 psi | | |
| F_b' = F_b (C_a · C_d · C_l · C_f · C_e · C_r · C_t) = 900 psi (1.15)(1.1) = 1139 psi > f_b | | |
| :: OK FOR FLEXURE | USE 4X12 DF-L #2 | |
| f_V = 1.5V / A = 1.5(2675 #) / 31.38 in^2 = 101.9 psi | | |
| F_V = F_V (C_a · C_d · C_l · C_f · C_e · C_r · C_t) = 180 psi (1.15) = 207 psi > f_V | | |
| :: OK FOR SHEAR | | |
| ΔDLS = 0.013WL^3 / EI = 0.013(0.5 · 730 plf · 11')(11'·12')^3 / (1.4E6 psi)(115.3 in^4) = 0.181" | | |
| Δallow _DLS = L / 180 = 11' · 12' / 180 = 0.73" > ΔDLS | | |
| :: OK FOR DEFLECTION | USE 4X12 DF-L #2 | |
**RB3 DESIGN**

*THIS BEAM DESIGN WILL BE USED FOR ALL 3 BEAMS SUPPORTING*

**PS**

*REACTION FROM RIDGE BEAM*

- **W** = Sub-Beam Loading
- **W** = Rain from Valley Beam
  - Tributary Area

\[
P = \frac{1}{2} \times 11.5 \times (D+5)
\]

\[
P = 126.5 \times (13+47) = 3.8 K
\]

- **W** = Tuile x (D+5) = 4.5 x 60
  - psf

\[
W = 405 \text{ psf} = 0.41 \text{ kN/m}
\]

\[
W_2 = 0.843(k) \times (D+5)
\]

\[
P_{W2} = \frac{0.843(3.75)^2}{2} \times (D+5)
\]

\[
P_{W2} = 0.36 K
\]

\[
R_1 = R_2 = 3.8 K
\]

\[
\Delta_{\text{MAX}} = \frac{Pd^3}{48EI} = \frac{12650(47000)(800000)}{4\times 1.1 \times 1600 \times 100 \times 100}
\]

\[
\Delta_{\text{MAX}} = 1.26
\]

\[
I_{\text{REA}} = 57 \text{ in}^4
\]

- **V** = 3.8 K

**NPS 2015**

**SHAPE OVERVIEW**

- **M** = 6,800 # ft = 900 # ft

\[
\Delta_{\text{MAX}} = 0.25\text{ in}
\]

\[
V_{\text{REA}} = \frac{M}{F} = 30.1 \text{ in}^2
\]

\[
S_{\text{REA}} = \frac{M}{F} = \frac{6800 \times 12}{1350 \times 1.13} = 52.56 \text{ in}^3
\]

\[
I_{\text{REA}} = 57 \text{ in}^4
\]

**TRY 6x12 DE-L NO. 1**
RB3 DESIGN CONT.

6x12 DF-L No. 1

\[ F_U = \frac{2}{3} \frac{V}{A} = 1.5 \times \left( \frac{3800}{63.25 \text{ in}^2} \right) \]

\[ F_U = 90.12 \text{ psi} \]

\[ F_V = F_U \times 60 = 170 \times 115 = 19,630 \text{ psi} > 90 \]

\[ f_b = \frac{N_b}{S} = \frac{6800 \times 12}{121.2 \text{ in}^2} = 52.7 \text{ psi} \]

\[ f_L = f_b \times 60 \times 6 = 3150 \times 1.15 \times 1.0 = 1553 \text{ psi} \]

\[ f_b > f_L \]

\[ \Delta_{max} = \frac{P L^2}{48 E I} + \frac{was \times L}{681 E I} \]

\[ P_D = \left( \frac{126.5 \times \phi \times 47 \text{ psi}}{3} \right) \]

\[ W_a = 1212 \text{ kbf} \]

\[ \text{Use } 6 \times 12 \text{ DF-L No. 1} \]
HarT

Roof Framing (RJ+3)

\[ W = 0 + S = (14 + 47) \text{ psf} = \frac{16}{12} = 81 \text{ psf} \]

\[ R_1 = \frac{W}{(12\text{ ft})^2} = 431 \text{ #} \]

\[ R_2 = \frac{W}{(20\text{ ft})} = 6.22 \text{ #} \]

\[ \text{Try } 2 \times 2 \text{ DF-L #2 - BTR} \]

\[ F_b = F_o \left( \frac{6.45}{1.15} \times \frac{1.2}{1.15} \right) = 1428 \text{ psf} \]

\[ V = F \times t = 180 \text{ psf} \times 1.15 = 207 \text{ psf} \]

\[ V = \frac{3}{4} l^2 = 15 (460 \text{ in})^2 = 63 \text{ psi} < 207 \text{ psi, } \checkmark \]

\[ S_L = \frac{240}{260} = 0.67 \text{ Snow Load Governs } \]

\[ L = 12'' \times 240 = 132''/240 = 0.55'' \]

\[ \Delta_{max} = \frac{wL^3}{24EI} \left( \frac{h'' - 2h'^2}{h'^2} x + \frac{h'' - 2h'^2}{h^2} x^2 + \frac{h'' - 2h'^2}{h^2} x^3 + \frac{h'' - 2h'^2}{h^2} x^4 + \frac{h'' - 2h'^2}{h^2} x^5 \right) = 0.15'' < 0.55'' \text{, } \checkmark \]

\[ w = 47 \text{ psf} = 564 \text{ lb/ft}^2 \]

\[ T = 41.63 \text{ in} \]

\[ E = 1,600,000 \text{ psi} \]

USE 2x4 DF-L No. 2 BTR
**Reference**

<table>
<thead>
<tr>
<th>GARAGE BEAM (GB-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( w = 60.8 \text{ psf} \times 10' = 608 \text{ plf} )</td>
</tr>
<tr>
<td>( V_d = \frac{608 \text{ plf} \times 16'}{2} = 4864 \text{ #} )</td>
</tr>
<tr>
<td>( M_d = \frac{608 \text{ plf} \times 16'^2}{8} = 19456 \text{ # ft} )</td>
</tr>
</tbody>
</table>

**TRY 6X16 DF-L SEL. STR.**

| \( f_b = \frac{19456 \text{ # ft}}{220.2 \text{ in}^2} = 1060 \text{ psi} \) |
| \( f_b' = 1600 \text{ psi} \times (1.13)(0.97) = 1782 \text{ psi} > f_b \checkmark \) |
| \( C_f = \left( \frac{f_b'}{f_b} \right)^4 = \left( \frac{1782}{1060} \right)^4 = 0.71 \) |
| OK FOR FLEXURE |
| \( f_v = 1.5 \left( \frac{4864 \text{ #}}{85.25 \text{ in}^2} \right) = 85.6 \text{ psi} \) |
| \( f_v' = 170 \text{ psi} \times (1.15) = 195.5 \text{ psi} > f_v \checkmark \) |
| OK FOR SHEAR |
| \( \Delta_{pl} = \frac{5(608 \text{ plf} \times 16' \times 12')^2}{984(1626 \text{ psi})(1767 \text{ in}^2)} = 0.33'' \) |
| \( \Delta_{dff} = \frac{16' \times 12'}{180} = 1.07'' > \Delta_{pl} \checkmark \) |
| OK FOR DEFLECTION |

**Use 6X16 DF-L SEL. STR**

GB-1
CEILING JOISTS

\[ w = 34 \text{ psf} \cdot 2' = 68 \text{ psf} \]

\[ V_u = \frac{68 \text{ psf} \cdot 20'}{2} = 680 \text{#} \]

\[ M_u = \frac{68 \text{ psf} \cdot (20')^2}{8} = 3400 \text{#} \cdot \text{ft} \]

\[ D = 14 \text{ psf} \]

\[ L_f = 20 \text{ psf} \]

\[ D + L_f = 34 \text{ psf} \]

TRY 2\times12 DF L #1

\[ f_b = \frac{3400 \#}{31.04 \text{ in}^2} = 129.6 \text{ psi} \]

\[ f_b = 1000 \text{ psi} (1.25)(1.01)(1.15) = 1433 \text{ psi} > f_b \checkmark \]

\[ f_b \text{ OK FOR FLEXURE} \]

\[ f_v = \frac{157680 \#}{14.85 \text{ in}^2} = 1043 \text{ psi} > f_v \checkmark \]

\[ f_v \text{ OK FOR SHEAR} \]

\[ \Delta_{DL} = \frac{5(68 \text{ psf})(20')(12')^2}{384(1.7)(60 \text{ psi})(176 \text{ in}^2)} = 0.81'' \]

\[ \Delta_{DL, (emin)} = \frac{20 \cdot 12}{1160} = 1.33'' < \Delta_{DL} \checkmark \]

\[ \Delta_L = \frac{5(20 \text{ psf})(2')(20')(12')^2}{384(1.7)(60 \text{ psi})(176 \text{ in}^2)} = 0.48'' \]

\[ \Delta_L, (emin) = \frac{20 \cdot 12}{240} = 1'' > \Delta_L \checkmark \]

\[ \Delta \text{ OK FOR DEFLECTION} \]

\[ \Rightarrow \text{ USE 2\times12 DF L #1 0.2' O.C. For CJ1} = \]
**REFERENCE**

CJ2 (L = 8.83')

\[ w = 34 \text{ psf} \cdot 2' = 68 \text{ plf} \]

\[ V_e = \frac{68 \text{ plf} \cdot 8.83'}{2} = 300.3 \text{ #} \]

\[ M_u = \frac{68 \text{ plf} \cdot (8.83')^2}{8} = 663 \text{ #} \cdot \text{f} \]

**TRY 2 x 6 DF-L #2**

\[ f_b = \frac{663 \text{ #} \cdot 12}{7.5 \text{ in}^2} = 1053 \text{ psi} \]

\[ f_b' = 900 \text{ psi} \cdot (1.25) \cdot (1.3) \cdot (1.15) = 1652 \text{ psi} > f_b \]

\[ f_b' > f_b \text{ OK FOR FLEXURE} \]

\[ f_v = \frac{1.5 \cdot (300.3 \text{ #})}{8.25 \text{ in}^2} = 54.6 \text{ psi} \]

\[ F_v' = 180 \text{ psi} \cdot (0.25) = 45 \text{ psi} > f_v \]

\[ f_v' > f_v \text{ OK FOR SHEAR} \]

\[ \Delta_p = \frac{5(68 \text{ plf} \cdot 8.83')^2}{384(1.6 \text{ in} \cdot 6 \text{ psi}) (20.8 \text{ in}^3)} = 0.29' \]

\[ \Delta_p' = \frac{8.3 \cdot 12}{16.0} = 5.19' > \Delta_p \]

\[ \Delta_L = \frac{5(20 \text{ psf} \cdot 2) (8.83')^2}{384(1.6 \text{ in} \cdot 6 \text{ psi}) (20.8 \text{ in}^3)} = 0.44' \]

\[ \Delta_L' = \frac{8.3 \cdot 12}{24.0} = 0.44' > \Delta_L \]

\[ \Delta_L' > \Delta_L \text{ OK FOR DEFLECTION} \]

**USE 2 x 6 DF-L #2 @ 2' OC FOR CJ2**
FLOOR FRAMING DESIGN

LOAD COMBOS:
\[
D+L = \frac{(12 \text{ psf} + 40 \text{ psf})}{1.0} = 52 \text{ psf}
\]
\[
D + 0.75L = \frac{(12 \text{ psf} + 0.75 	imes 40 \text{ psf})}{1.0} = 42 \text{ psf}
\]
\[
\therefore D+L \text{ GOVERNS} = 52 \text{ psf}
\]

TYPICAL FLOOR JOIST (FJ-1)

\[
L = 18'
\]
\[
\omega = 52 \text{ psf} \times \frac{18^2}{12} = 69.33 \text{ plf}
\]
\[
V_u = \frac{69.33 \text{ plf} \times 18'}{8} = 624 \#
\]
\[
M_u = \frac{69.33 \text{ plf} \times (18')^2}{8} = 2508 \# \text{ft}
\]

TRY 2X12 DF-L #1

\[
f_b = \frac{M_u}{S} = \frac{2508 \# \text{ft} \times 12}{31.64 \text{ in}^2} = 1065 \text{ psi}
\]

\[
F_b' = F_b \left( \frac{C_b \cdot C_d \cdot C_r \cdot C_l \cdot C_w \cdot C_i}{C_r} \right)
\]
\[
= 1000 \text{ psi} \times (1.0)(1.0)(1.15)
\]
\[
= 1150 \text{ psi} > f_b \checkmark
\]

\[
\therefore \text{OK FOR DEFLECTION}
\]

\[
f_v = \frac{1.5V}{A} = \frac{1.5(624 \#)}{16.88 \text{ in}^2} = 55.5 \text{ psi}
\]

\[
F_v' = F_v \left( \frac{C_b \cdot C_d \cdot C_r \cdot C_l}{C_l} \right)
\]
\[
= 180 \text{ psi} \times (1.0)
\]
\[
= 180 \text{ psi} > f_v \checkmark
\]

\[
\therefore \text{OK FOR SHEAR}
\]

\[
\Delta_{pl} = \frac{5wL^4}{384EI} = \frac{5(69.33 \text{ plf})(18')^4(12)^3}{384(11.76 \text{ psf})(178 \text{ in}^4)} = 0.54''
\]

\[
\Delta_{allow} = \frac{L}{180} = \frac{18' \times 12''}{180} = 1.20''
\]

\[
\therefore \text{OK FOR DEFLECTION}
\]

USE 2X12 DF-L #1
**FB.1 \( (l = 11.17') \)**

\[
\begin{align*}
\text{w} &= 52 \text{ psf} \cdot 10' = 520 \text{ psf} \\
\text{V_a} &= \frac{520 \text{ psf} \cdot 11.17'}{2} = 2904 \# \\
M_u &= \frac{(520 \text{ psf})(11.17')^2}{8} = 8110 \#' \\
\text{TRY 4x12 DF L #1 OR BTR} \\
\text{f_b} &= \frac{8110 \#' \cdot 12}{73.83 \text{ in}^2} = 1316 \text{ psi} \\
F_b' &= 1200 \text{ psi} (1.6) (1.7) = 1320 \text{ psi} > f_b, \checkmark \\
\text{OK FOR FLEXURE} \\
\text{f_v} &= \frac{1.5(2904 \#)}{39.38 \text{ in}^2} = 111 \text{ psi} \\
F_v' &= 180 \text{ psi} (1.6) = 160 \text{ psi} > f_v, \checkmark \\
\text{OK FOR SHEAR} \\
\Delta_{pL} &= \frac{5(520 \text{ psf})(11.17')^2 (12')^2}{384 \cdot (1.3 \text{ E6 psi})(415.3 \text{ in}^2)} = 0.24^\circ \\
\Delta_{sh} &= \frac{11.17' \cdot 12}{180} = 0.74' > \Delta_{pL}, \checkmark \\
\Delta_L &= \frac{5(910 \text{ psf} \cdot 10')(11.17')(12')^2}{384 \cdot (1.8 \text{ E6 psi})(415.3 \text{ in}^2)} = 0.187' \\
\Delta_{def} &= \frac{11.17' \cdot 12}{240} = 0.51' > \Delta_L, \checkmark \\
\text{OK FOR DEFLECTION} \\
\text{USE 4x12 DF L #1 OR BTR} & \checkmark
\end{align*}
\]
\( w = 52 \text{ psf} \times \left( \frac{\text{pcf}}{24} \right) = 34.67 \text{ pcf} \)

\( P = 52 \text{ psf} \times 10^{-11} \text{ ft} = 29.64 \text{ kip} \)

\( V_0 = \frac{(34.67 \text{ pcf} \times 18)}{2} = 1704 \text{ kip ft} \)

\( V_x = 1704 \text{ kip ft} - (34.67 \text{ pcf} \times 9) \)

\( V_x = 1452 \text{ kip ft} \)

\( M_y = \frac{1}{2} (1704 + 1452)(9) \)

\( M_y = 14,472 \text{ kip ft} \)

**TRY PSL \( 3\frac{1}{2} \times 11\frac{1}{4} \)**

\( M = 17970 \text{ kip ft} \)

\( V = 8035 \text{ kip} \)

\( \Delta_{PHL} = \frac{5(34.67 \text{ pcf})(18)(\frac{1}{4})(12)}{384(2.2 \text{ kips/ft})(415 \text{ in}^3)} + \frac{(29.64 \text{ kip})(16)(12)}{48(2.2 \text{ kips/ft})(415 \text{ in}^3)} = 0.76" \)

\( \Delta_{PL} = \frac{16 \times 12}{180} = 1.2 > \Delta_{PHL} \)

\( \Delta_L = \frac{5(40 \text{ psf} \times \frac{16}{24})(18)^2(12)}{384(2.2 \text{ kips/ft})(415 \text{ in}^3)} + \frac{(40 \text{ psf} \times \frac{16}{24})(16^2)(12)}{48(2.2 \text{ kips/ft})(415 \text{ in}^3)} = 0.58" \)

\( \Delta_{FRC} = \frac{16 \times 12}{240} = 0.9" > \Delta_L \)

\[ \therefore \text{USE PSL} \ 3\frac{1}{2} \times 11\frac{1}{4} \]
CLEAR SPAN COLUMN 1

P = 8.1k + 11.29k = 19.39k  \text{ Governing Load: 0.15}

Kc = 0.8  \text{ (Fixed-Pinned) Assumption}

A = 4in^2  
I = 51.56in^4  
S = 143.1in^3

\[ \frac{d}{d} = \left( \frac{14}{4} \right) \left( \frac{14}{4} \right) = 24.44 \]

\[ E_{m} = E_{m} / \left( 1 + \frac{E_{m}}{E_{b}} \cdot \frac{f}{f} \right) \]

\[ E_{m} = 580,000 \text{ psi} \]

\[ f_{e} = 0.822 \left( \frac{E_{m}}{d^2} \right) = 0.822 \left( \frac{580,000}{24.44^2} \right) = 798.17 \text{ psi} \]

\[ f_{c} = \frac{E_{m}}{1 + \frac{2}{2} \cdot \frac{f_{e}}{f_{c}}} \]

\[ C_{p} = \frac{4f_{e}E_{m}f_{c}c}{2c} = \frac{798.17 \cdot 580}{24.44} = 0.555 \]

\[ f_{c} = \frac{E_{m}}{1 + \frac{2}{2} \cdot \frac{f_{e}}{f_{c}}} \]

\[ \text{ Allowable Force} = 26,333 \text{ kips} > 19.39 \text{ kips} \]

G-1 USE 6x8x14' DF-L No. 1 Post
Shear Wall Design (E-W)

**V** = 6131# (LRFD)
- = 4852# (ASD)

\[ w = \frac{4852 \#}{86} = 106 \text{ plf} \]

\[ R_1 = \frac{106 \text{ plf} \times 8 \text{ ft}}{2} = 420 \# \]

\[ R_2 = \frac{106 \text{ plf} \times 36 \text{ ft}}{2} = 1890 \# \]

\[ M_1 = \frac{106 \text{ plf} \times (61)^2}{8} = 840 \# \text{ ft}^2 \]

\[ M_2 = \frac{106 \text{ plf} \times (36)^2}{8} = 17010 \# \text{ ft}^2 \]

**Forces @ SW:**
- SW1 = 1890#
- SW3 = 420#
- SW5/6 = 2310#
Table 4.3A

<table>
<thead>
<tr>
<th>h</th>
<th>v</th>
<th>DEMAND</th>
<th>CAPACITY</th>
<th>NAILING</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{h}{10} )</td>
<td>( \frac{v}{10} )</td>
<td>( 2h = 378 \text{ lb} )</td>
<td>( 520 \text{ lb} )</td>
<td>( 6^\circ, 6^\circ, 6^\circ )</td>
</tr>
</tbody>
</table>

\( h = \frac{8}{10} = 0.8 \) \( \leq 2 \) \( \text{NO REDUCTION FOR LEFT} \)

\( v = \frac{h}{10} = 1890\# \times 10' = 189 \text{ lb} \)

\( \text{DEMAND} = 2h = 378 \text{ lb} \)

\( \text{CAPACITY} = 520 \text{ lb} \)

\( \text{NAILING} = 6^\circ, 6^\circ, 6^\circ \)

- USE \( 1/2^\circ \) SHEATHING
- \#8A COMMON NAILS @ 6^\circ, 6^\circ, 6^\circ

\( \text{DEFLECTION CHECK NOT REQUIRED FOR ARCH W5} \)

Determine Max C/T Forces

<table>
<thead>
<tr>
<th>WALL WEIGHT</th>
<th>6' = 24 \text{ psf/piece}</th>
<th>160 \text{ psf}</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROOF WEIGHT</td>
<td>16' = 11 \text{ psf}</td>
<td>171 \text{ psf}</td>
</tr>
</tbody>
</table>

\( D = 0.7E = (1.0 - 0.14 \frac{5h}{v})D + 0.2PC_E \)

\( 0.7E = 0.92D + 0.7G_E \) \( \text{MAX COMB} \)

\( 0.6D + 0.7E = (0.6 - 0.2 \frac{5h}{v})D + 0.7G_E \)

\( 0.46D + 0.7G_E \) \( \text{MAX TENS} \)

\( 2M_{ax} = 0 = (1890\# 	imes 0.7)(8') + (1740\# 	imes 0.92)(5') + (126\# 	imes 0.92)(10') + C_{\text{MAX}}(10') \)

\( C_{\text{MAX}} = 2.5' \)

\( 2M_{ax} = 0 = (1890\# 	imes 0.7)(8') + (1740\# 	imes 0.46)(5') + T_{\text{MAX}}(10') \)

\( T_{\text{MAX}} = 1.5' \)
HARMONIOUS Tectonics Har T

PROJECT: 2017 IPD WEED RESIDENTIAL
NAME
DATE
SCOPE

REFERENCE

CHECK END POSTS (CHORDS FOR COMPRESSION)

DEMAND:
\[ C_{max} = 2.5k \]
\[ T_{max} = 1.18k \]

TRY (2) 2x6 DF-L #2

\[ f_C = \frac{F}{A} = \frac{2560\#}{2(6.25in)^2} = \frac{152psi}{1} \]

\[ f_C' = f_C \cdot C_P \cdot C_t \cdot C_f \cdot C_e \]
\[ C_P = 1.4, C_t = 1.1 \]

\[ C_f = \frac{1 + \frac{F_{eq}}{F}}{2c} \sqrt{\left(1 + \frac{F_{eq}}{F_C}ight)^2 - \left(\frac{F_{eq}}{F_C}\right)} \]
\[ C_e = \frac{f_{Ceb}}{F_{eq}} \]

\[ F_{eq} = 0.822 \cdot F_{emb} = 0.822 \cdot 568 = 350 \cdot \frac{1}{1.6} \]
\[ F_{eq} = 237k \psi \]
\[ F_{c} = 1.6 \cdot 725 = 2006 \psi \]

\[ f_C' = \frac{1}{2(6.25in)^2} \cdot \sqrt{\left(2006\psi \right) - \left(237k \psi \right)} = 0.725 \]

\[ F_{c} = 237k \psi \cdot 0.572 = 135k \psi \]

OK FOR COMPRESSION II TO GRAIN

CHECK COMPRESSION II TO GRAIN

\[ F_{c} = F_{c} \cdot C \cdot C_t \cdot C_f \cdot C_e \]
\[ C_P = 1.4 \cdot 0.375 = 1.5 \]

\[ F_{eq} = 701.25 \psi \cdot 1.25 = 876.56 \psi \]

\[ f_C' > F_{eq} \]

SIZE HOLDOWNS

USE: SIMPSON HD3B W/CAPACITY = 1865 #
\[ T_{max} = 1140 \# \]
**REFERENCE**

**ANSWER**

**SW5 & SW6 - SHEATHING DESIGN**

\[ b = \frac{12}{6} - 2 \{ < 2 \text{ NO REDUCTION FOR LIFT} \}
\]

\[ b_{eff} = 12' \]

\[ V = \frac{2310 \text{#}}{12'} = 193 \text{plf} \]

**DEMAND** = 2V = 386 plf

**CAPACITY** = 320 plf

**NAILING** = 8d @ 6, 6, 6

"USE \( \frac{1}{2}'' \) SHEATHING W/ 8d COMMON NAILS @ 6, 6, 6"

**DEFLECTION CHECK NOT REQ'D**

**DETERMINE MAX T/G FORCES**

**WALL WT:**

12' x 20 psf / face = 240 psf

**CLERESTORY:**

14' x 20 psf / face = 280 psf

**ROOF WT:**

14' x 19 psf / face = 266 psf

\[ \Sigma = 376 \text{psf} \]

**BEAM 1:** 180 psf

**BEAM 2:** 180 psf

**SEATEAR**

**DESIGN FOR**

**GREATER BEAM**

\[ D + 0.7E = 0.92D + 0.7E \]

\[ 2M_e = 0 = (376 x 0.92)(3') + (746 x 0.92)(6') + (2310 x 0.7)(12') - C_{\text{end}}(E) \]

\[ C_{\text{max}} = 4.1K \]

\[ 0.6D + 0.7E = 0.46D + 0.7E \]

\[ 2M_e = 0 = (376 x 0.46)(3') + (746 x 0.46)(6') + (2310 x 0.7)(12') - T_{\text{max}}(E) \]

\[ T_{\text{max}} = 2.8K \]
# Reference

## Check End Posts (Chords for Compression)

**Demand**
- $C_{max} = 4.1 \text{kN}$
- $T_{max} = 2.2 \text{kN}$

**Try (2) PLY DF-1 #2**

\[ f_c = \frac{P}{A} = \frac{41000 \#}{214.25 \text{ in}^2} = 194.5 \text{ psi} \]

\[ F_c' = F_c (C_a \cdot C_m \cdot C_s \cdot C_f) \]
- $C_a = 1.25$ (Corrosion)
- $C_m = 1.0$ (Material)
- $C_s = 1.0$ (Size)
- $C_f = 1.1$ (Flexure)

\[ I = \frac{12.5 \times 12}{12} = 125 \text{ in}^4 \]

\[ f_{Ed} = 0.822 \times (0.80 \times E) \]
- $E = 29,000 \text{ ksi}$

\[ F_{Ed} = 11350 (psi) \times (1.1) = 2576 (psi) \]

\[ C_f = \frac{110.812}{205.1} \times \frac{180.625}{205.1} = 0.82 \text{ ksi} \]

\[ f_{Ed} = 2576 \text{ psi} \times 0.82 = 212 \text{ psi} > f_c \]

**OK for Compression II to Grain**

## Check Comp. 1 to Grain

\[ F_{cd} = F_{cd} (C_d \cdot C_k \cdot C_s \cdot C_h) \]
- $C_d = 1.25 \times 0.375 = 1.25$

\[ F_{cd} = 2576 \text{ psi} \times 1.25 = 3220 \text{ psi} > f_c \]

\[ \text{(2) 2x6 DF-1 #2 OK for End Posts} \]

## Size Holdowns

- Use Simpson HD7B W/Capacity = 6445 #
- $T_{min} = 2.2 \text{kN}$
**Shear Transfer C Line 2 (SW 5x6)**

1. **Try Simpson A34 Clip (815#)**
   - \( V_h = \frac{2310\#}{12\text{"}} = 192.5 \text{ lbf} \)
   - **Shear Transfer C Blocking**
   - \( S = \frac{5\text{"}}{142.5 \text{ lbf}} = 2.57\text{"} > 1\text{"} \text{ Leave Spacing} \)
   - **Use Simpson A34 V516#1 @ 16\" O.C**

2. **Try 1/4" (d=0.162")**
   - \( P = 3.5\" + 0.5\" - 3/4\" = 2.25\" \)
   - \( 60 = 0.172 \times 60 = 1.072 \times P \)
   - \( Z = (141\#)(1.6) = 225.6\# \)
   - **S = 225.6\# / 142.5 \text{ lbf} = 1.6\"**
   - **Use 1/4" Common Nail @ 12\" O.C**

3. **Try 1/4" (d=0.162")**
   - \( P = 3.5\" - 1.5\" - 3/4\" = 1.25\" \)
   - \( 60 = 0.178 \times 60 = 1.28 \times P \)
   - \( Z = (141\#)(1.6) = 225.6\# \)
   - **S = 225.6\# / 142.5 \text{ lbf} = 1.6\"**
   - **Use 1/4" Common Nail @ 12\" O.C**
SW 3 - SHEATHING DESIGN

420#  

A  4'  2'  
B  6'  1'  
C  8'  1.53'  
D  8'  2'  

\( h = \frac{V}{222} \)

DEMAND = 2\( \sqrt{h} \) = 38.2 plf

DEMAND LESS THAN THAT OF SW1, SW2, SW4

USE 1 5/32" STRUCTURAL 1

USE COMMON NAILS & 8, 6, 6

DEFLECTION NOT REQ'D

DETERMINE MAX T & C FORCES

WALL WT: \( 8' \times 80\text{psf} / \text{acc} = 160 \text{ plf} \)

HEADER: \( 63 \text{ plf} \times 2' = 126 \text{ plf} \)

\( \Sigma = 223 \text{ plf} \)

\( 420# \)  

\( \frac{222 \text{ plf}}{12} \)  

\( \frac{12L}{d} = 0.7E = 0.92D \times 0.7E \) (MAX COMP)

\( \Sigma M_e = 6 = (223 \text{ plf} \times 0.92) 12 + (120 \text{ plf} \times 0.7) (8) + (120 \text{ plf} \times 0.7) (8) \)

MAX TENS

\( \Sigma M_c = 0 = (223 \text{ plf} \times 0.92) 12 + (120 \text{ plf} \times 0.7) (8) + 120 \text{ plf} \times 0.7 (8) \)

\( T_{max} = 783 \text{ plf} \)

SIZE HOLDOWN

USE D17 2" W/ \( T_{max} = 1825 \text{ plf} \)
### Project Scope

**2017 IPD Weed Residential**

**Date**

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<tr>
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<th>ANSWER</th>
</tr>
</thead>
</table>

**N-S Dir. Shear Wall Design (A)**

- **V@ line A:** 2718#
- **V tributory to garage:** 1360#
- **Simpson WSW 24x8:**
  - **Allow P:** 7300#
  - **Vallow:** 9785#
  - **Hold down for Simpson WSW**

**Demand (T):**

\[
\text{Demand (T)} = \frac{1360\# \times 8\,ft}{2(24\,in - 4\,in)} = 2856\#
\]

- **WSW AB 7/8" T allow:** 11,300#
  - **11,300# > 2,856#**

**Use (2) Simpson WSW 24x8 W/ 7/8" in WSW AB for garage.**

- **SW @ carport**
**Assumptions**
- Segmented design
- ASD
- Aspect ratio < 2:1 unblocked

**Shear Wall Design: N-S Line**

**V**:
\[ V = 1770\frac{\text{lb}}{\text{ft}} + 360\frac{\text{lb}}{\text{ft}} + 59\frac{\text{plf}}{\text{ft}}(10') = 2720\frac{\text{lb}}{\text{ft}} \]

**Vsw**:
\[ Vsw = \frac{V}{8} = \frac{2720}{10'} = 272\frac{\text{plf}}{\text{ft}} \]

**Aspect Ratio**:
\[ 8'10'' / 10'' = 0.8 < 2 \checkmark \]

- Wood STR Panels 15/32 in thickness
- 10d common nails w/min. fastener penetration 1 1/2 in
- 6d edge nailing 112 in field

**Uplift**
\[ T_{mc} = 0 = 1770\frac{\text{lb}}{\text{ft}}(8') + 360\frac{\text{lb}}{\text{ft}}(8') - (59\frac{\text{plf}}{\text{ft}})(10')(8') + T(10') \]
\[ T = 2176\frac{\text{lb}}{\text{ft}} \]

**HOLD DOWN**
- Use HDU2-505.25 Tallow = 3075\# > 2176\# \checkmark
SHEAR WALL DESIGN N-S LINE(

Assumptions:
- Segmented Design
- ASD
- Aspect Ratio 2:1 Unblocked

\[ V_0 = 47 \text{ plf} \]

\[ \ell_b = 34' \]

\[ V = \frac{1}{1.5} \ell_b \approx \frac{1}{1.5} \times 34' = 22.66' = 63.6 \text{ plf} \]

\[ V_{design} = 135.2 \text{ plf} \]

Aspect Ratio Worst Case = \( \frac{5}{6} \times 0.625 < 2\) UNBLOCKED

- 15/32" wood stirr panels (MIN GRAVITY)
- 6" w/1/4" 1X4 penetration USE 10d 3/4" penetration
- 6" edge nailing 12 in field nailing

\[ V_{sw} = 310 \text{ plf} \times 63.6 \text{ plf} \checkmark \]

UP LIFT

\[ S_a = (14 + 14 + 1) \times (9.5) \]

\[ T = 554 \# \]

\[ T_{max} = 554 \# \]

TENSION BUDDING

WORST CASE

HOLD DOWN

USE SIMPSON DIT 12 TAILORED = 910# W/ 108 COMMON > 554# X

WOOD GOWN

2017-2018
**DIAPHRAGM DESIGN**

\[ v_{\text{max}} = \frac{(105 \text{ psi})(53')}{2} = 114.3 \text{ psi} \]

\[ v_{\text{max}} = \frac{114.3 \text{ psi}}{3'} = 38 \text{ psi} \]

\[ P_{\text{max}} = \frac{(105 \text{ psi})(57')}{5} = 1777 \text{ lb/ft} \]

\[ P_{\text{max}} = \frac{1777 \text{ lb/ft}}{3'} = 592 \text{ lb/ft} \]

4. **ASPECT RATIOS**

\[ \frac{36}{9} = 4 \]  \( \Rightarrow \)  \( \text{MAX. RATIO } \sqrt{ } \) (BLOCKED)

- **DEMAND** = 23 = 108 lb
- **CAPACITY** = 540 lb
- **NAILING** = 8d @ 6, 6, 12 (CASE 3)

5. **USE 1/2" SHEATHING w/6d COMMON NAILS @ 6, 6, 12 BLOCKED**

6. **ASPECT RATIOS**

\[ \frac{36}{9} = 0.97 < 3.1 \]  \( \Rightarrow \)  \( \text{UNBLOCKED } \sqrt{ } \)

- **DEMAND** = 108 lb
- **CAPACITY** = 460 lb
- **NAILING** = 8d @ 6, 6, 12 (CASE 4)

7. **USE 1/2 SHEATHING w/6d COMMON NAILS @ 6, 6, 12 UNBLOCKED**
### Diaphragm Design - Gravity

**Assumptions**
- Roof DL = 14 psf  
- Roof Live = 19 psf  
- Sheathing, edges supported  
- Joists @ 16" O.C.

**Panel Span Rating (Roof / Floor)**
- IBC 2304.11.8(5)
- 16'/0' → 3/8" panel thickness req'd
- Max Total Load = 40 psf > 33 psf ✓
- Max Live Load = 30 psf > 19 psf ✓

**15/32" Min Panel Thickness for Diaphragm / Serviceability**

**Panel Thickness**
**PROJECT**  
2017 IPD WEED RESIDENTIAL

**NAME**  

**DATE**  

**SCOPE**  

### Reference: NDS 2015 SDPWS T4.2.4

### Calculations

**Diaphragm Design N-S Seismic**

**Design Assumptions**

- Flexible Diaphragm
- Unblocked
- ASD

**Deflection**

As aspect ratio: L/W = 38'/46' = 0.832 < 3

Un-Blocked OK

### Shear Demand

\[ V_{max} = 2,206\text{#} \rightarrow V = V/L = 2718\text{#} / 46' = 60 \text{ plf} \]

### Diaphragm Design

- Sheathing Grade: Sheathing, 3 Single Floor
- Common Nail Size: 0.1/6" Edge/12" Field
- Minimum Fastener Penetration: 1-3/8"
- Minimum Panel Thickness: 15/32" (due to availability)
- Minimum of Nominal Width of Nailed Face @ Support Edge: 2.25"
- Assume Case 2(3,4,5,6)

\[ V_3 = 480 \text{ plf} \quad 480/2 = 240 \quad 240 \text{ plf} > 60 \text{ plf} \]

**Answer**
DIAPHRAGM DESIGN N-S SEISMIC

\[ W = 76,167 \text{#} \]
\[ V = C_s W = 0.091(76,167) = 6,931 \text{#} \]
\[ 0.7V = 0.7(6,931) = 4,852 \text{#} \]

LOADING W/ WEIGHT OF WALLS IN DIAPHRAGM WEIGHT.

\[ W = 0.7V + \frac{4,852}{174.8 \text{sl}^2} = 46 \text{#} \]
\[ W_i = 128 \text{plf} \]

RA: \[ \frac{W_i}{2(3.5)} \times (3.8)^2 = 2,718 \text{#} \]

\[ RC = \frac{W_i}{2(3.5)} \times (3.5^2 - 0.5^2) = 2,146 \text{#} \]

\[ V: \]
\[ M: \]
\[ CF: \]
\[ M(x) = \frac{-128x^2}{2} \quad \text{for} \quad 0 < x < 4 \]

\[ M(x) = \frac{-128(x-4)^2 + 2206(x-4) - 1024}{2} \quad \text{for} \quad 4 < x < 38 \]
HARMONIOUS TECTONICS HarT

PROJECT: 2017 IPD WEED RESIDENTIAL
NAME
DATE
SCOPE

CHORD FORCES (E-W)

For $0 < x < 9$

$M(x) = -\frac{105}{2}x^2 + 172.5x$

$H5: M_{max} (x=5') = 1050 \text{ #} \cdot \text{ft}$
$P_{chord} = 27.6\text{#}$

$H6: M_{max} (x=15') = 9765 \text{ #} \cdot \text{ft}$
$P_{chord} = 257\text{#}$

$H7: M_{max} (x=27.5') = 17970 \text{ #} \cdot \text{ft}$
$P_{chord} = 473\text{#}$

$H8: M_{max} (x=37') = 13230 \text{ #} \cdot \text{ft}$
$P_{chord} = 348.2\text{#}$

$H9: M_{max} \approx 17970 \text{ #} \cdot \text{ft}$
$P_{chord} \approx 473\text{#}$
Collector Force & Line 1 (h1)

H1 : F_{collect} = 106.2 \text{ ft lb}

\[ \text{F}_{\text{well}} = \frac{1943 \text{ ft}}{24} = 80.9 \text{ ft lb} \]
HARMONIOUS TECTONICS Hart

REFERENCE

NS COLLECTOR DESIGN

LOAD COMBINATION

(1 + 0.14S0.5) D + 0.7 PGE

COLLECTOR (A)

V = 2718#

V0 = UNIT SHEAR = V/L = 2718#/10'

V0 SW DEMAND = 2718#/10'

W SW = 272 pcf

STRUCT FORCE (A)

T/C MM (A) = 1770#

PLAN (A)
**HARMONIOUS TECTONICS HarT**

**PROJECT** 2017 IFD WEED RESIDENTIAL

**REFERENCE**

**CHORD/COLLAR DESIGN (E-W)**

**DESIGN WORST CASE C LINE 2 (w/6x12 DF-L No.1)**

- \( T_{\text{max}} = 482 \) #, \( T_{\text{min}} = 6800 \) #:

- \( \frac{T_{f_1}}{T_{\text{max}}} + \frac{T_{f_2}}{T_{\text{max}}} \leq 1.0 \) \( \land \) \( \frac{T_{f_1} - T_{f_2}}{T_{\text{max}}} \leq 1.0 \)

- \( f_i = \frac{P}{A_i} = \frac{482 \text{#}}{1325 \text{ ft}^2} = 0.37 \text{ psi} \)

- \( f_i = f_i (C_p + C_{G_c} \cdot C_{f_c} \cdot C_{f_c}) \)
  - 675 psi \((1.15)(1.0)\)
  - 774.25 psi

- \( f_{1} = 673.26 \text{ psi} \)

- \( f_{1} = f_{1} (C_p + C_{G_c} \cdot C_{f_c} \cdot C_{f_c} \cdot C_{f_c}) \)
  - 1350 psi \((1.15)(1.0)\)
  - 1553 psi

- \( f_{1}^{**} = 1553 \text{ psi} \)

- \( \frac{734}{774.25} = 0.94 < 1.0 \checkmark \)

- \( \frac{673.26 - 734}{1553} = 0.03 < 1.0 \checkmark \)

\( \therefore 6x12 \text{ DF-L No.1 OK FOR COMBINED LOADING} \)

**ANSWER**

H10, H11, H12
CHORD/COLLECTOR DESIGN (E-W)

DESIGN FOR WORST CASE B LINE C (N/1(3) 2X6 DF-L No. 2)

\[ T_{\text{max}} = 473 \text{#} \]

\[ w = (\text{14 psf} + \text{6.8 psf}) \times \left( \frac{15}{2} \right) = 456 \text{psf} \]

\[ V_e = \frac{156 \text{ psf} \times L}{2} = 1368 \text{#} \]

\[ M_e = \frac{456 \text{ psf} \times L^2}{8} = 2052 \text{ ft-lb} \]

\[ f_a = \frac{2052 \text{ ft-lb} \times 12"}{27.75 \text{ in}^2} = 1085.7 \text{ psi} \]

\[ f_k^\prime = 100 \text{ psi} \times 1.15 \times 1.3 = 1345.5 \text{ psi} > f_a \checkmark \]

\[ f_N = 1.5 \left( \frac{1368 \text{#}}{3(8.25 \text{ in}^2)} \right) = 82.91 \text{ psi} \]

\[ f_{v^\prime} = 207 \text{ psi} \times 1.15 = 237 \text{ psi} > f_N \checkmark \]

\[ \Delta_{\text{min}} = \frac{1.15}{160} = 0.007 > \Delta_{\text{dis}} \checkmark \]

\[ \Delta_{\text{dis}} = -\frac{5(456 \text{ psf}) \times L^4}{3(416 \text{ psf}) \times (0.25 \text{ in}^2)} = 0.11" \]

\[ C_{\text{max}} = 473 \text{#} = 19.11 \text{ psi} \]

\[ f_t^\prime = 575 \text{ psi} \times 1.15 \times 1.3 = 1194 \text{ psi} > f_t \checkmark \]

COMBINED LOADING:

\[ 19.11 + 1085.7 = 0.82 < 1.0 \checkmark \]

\[ 1190 + 1345.5 = 0.79 < 1.0 \checkmark \]

\[ 1085.7 + 19.11 = 0.79 < 1.0 \checkmark \]

\[ 1345 \checkmark \]

\[ :: \text{OK FOR COMBINED TENSION \& BENDING} \]

\[ :: \text{USE (3) 2X6 DF-L No. 2 FOR HEADERS @ LINE C} \]
COLLECTOR DESIGN A

Load Combination

\( W = D_{\text{roof}} + S_{\text{wlu}} + 13 \text{ psf} + 47 \text{ psf} \times 1.60 \text{ psf} \)

\( 0.7 \cdot f_{\text{ge}} = 0.7 \times (1.10) \frac{1770 \#}{0.7} = 1770 \# \)

\( W = (1 + 0.14 \times 50\%) \cdot D\cdot C_{\text{tribu} + \text{ps}} = 1 + 0.14 \times (0.09) \times (60 \text{ psf}) \times (12 \text{ ft}) \)

\( W = 730 \text{ psf} \)

Collector from Garage Header to SW in Line A

**REINFORCEMENT LENGTH ABOVE GARAGE**

\( 0.790 \text{ ft} \)

**TRY 6\\times6**

**DFL Sel Str**

\( A = 85.25 \text{ in}^2 \)

\( \sigma_{cr} = 20.2 \text{ ksi} \)

\( P = 1770 \text{ lb} \)

\( F_e = \frac{P}{A} = \frac{1770}{85.25} \text{ psi} = 21 \text{ psi} \)

\( F_{\text{cr}} = F_{d} \times A \times C_{r} = 950 \text{ psi} \times 1.6 \times 1.0 = 1520 \text{ psi} \geq 21 \text{ psi} \) \checkmark

\( f = C/A = 1770/85.25 = 21 \text{ psi} \)

\( F = F_{d} \times C \times L = 1000 \text{ psi} \times 1.6 \times 1.0 \times 1.0 = 1600 > 21 \text{ psi} \) \checkmark
COLLECTOR DESIGN @

6x16 COLLECTOR/HEADER COMBINED LOADING: CHECK CONT.

\[ F_b = \frac{M}{S_x} = \frac{730^{2} \cdot 10}{8} \times \frac{1}{S_1} = \frac{730^{2} \cdot 10}{8 \times 220.2 \text{ in}^2} = 1611 \text{ lb-in} \]

\[ F_b = F_b \times C_0 \times C_L \times C_F = 1600 \text{ psi} \times 1.25 \times 0.97 = 1940 \text{ psi} \times 0.97 > 1611 \sqrt{X} \]

COMBINED COMPRESSION & BENDING

\[ \frac{F_b}{F_{OC}} + \frac{F_b}{(1 - (C_F \cdot C_0 \cdot C_L))^2} \leq 1.0 \]

\[ \frac{F_b}{1600 \text{ psi}} + \frac{1611}{9700 \text{ psi} \times (1 \times (0.97 \times 1.25)^2) \leq 1.0 \]

\[ F_{CE} = 0.822 \text{ ksi} \]

\[ F_{CE} = 578 \text{ ksi} \]

\[ \frac{1611}{9700 \text{ psi} \times (0.97 \times 1.25)^2} \leq 1.0 \]

\[ F_{CE} = 578 \text{ ksi} \]

Emin = 580,000 psi

0.86 \leq 1.0 \sqrt{X}

\[ \text{AXIAL LOAD HAS LITTLE IMPACT ON GARAGE HEADER} \]

USE 6x16 DF-L SEL STR

* COLLECTOR ALONG LINE @ WILL BE SAME AS COLLECTOR ALONG LINE @.

DESIGN OF COLLECTOR HEADER ABOVE GARAGE (1H9)
COLLECTOR DESIGN N-S ALONG A

COLLECTOR DESIGNED WORST CASE FOR TRANSVERSE LONGITUDINAL LOADING

\[ W_T = 0.7 \left( 6.931 \right) / 46^\circ = 106 \text{ plf} \]

\[ V_{\text{MAX}} = 1770^{\circ} \]

\[ M = \frac{W_T L^2}{\theta} = \frac{106 \text{ plf} \left( 46^\circ \right)^2}{\frac{\pi}{180}} = 281037 \text{ k-ft} \]

CHORD FORCE: \[ M/L = 281037 \text{ k-ft/5 in} = 56215 \text{ k} \]

AXIAL FORCE: \[ A \times 6 \text{ DF-L No.2 TYPICAL PBL TOP R} \]

\[ V_{\text{MAX}} \text{ GOVERNS} \]

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

\[ S = 7.56 \text{ in}^2 \]

\[ L = 20.8 \text{ in} \]

\[ F_t \]

\[ F_t = V/A = 1770^{\circ} / 8.25 \text{ in}^2 = 215 \text{ psi} \]

NDS 2015

\[ F_t = 6 \times 6 \times 6 \times CF = 575 \text{ psi} \times 1.6 \times 1.1 = 1012 \text{ psi} > 215 \text{ psi} \]

\[ F_c = V/A = 215 \text{ psi} \]

\[ F_r = F_r \times 6 \times 6 \times CF = 1350 \text{ psi} \times 1.6 \times 1.1 = 2376 \text{ psi} > 215 \text{ psi} \]

USE 2 x 6 DF-L NO.2 TYP COLLECTOR UNO.

\[ H1, H2, H3, H4, H5 \]

* 1770^{\circ} IS THE HIGHEST STRUT FORCE IN THE N-S LOADING DIR. * UNO. ALL COLLECTORS WILL BE 2 x 6 DF-L NO.2
**N-S Collector Design**

**Collector C**

\[ V = 2,146 \text{ ft}^3 \]

\[ V_0 = \sqrt{18} = 2,146 / 146 = 47 \text{ ft}^3 / \text{ft} \]

\[ V_0 SW = 2,146 / 34 = 63.6 \text{ ft}^3 / \text{ft} \]

---

**T/C Max = 190 ft**

**170 H < 1770**

[Use Line A Collector Design]

2 x 6 DF-L No. 2 OKAY
<table>
<thead>
<tr>
<th>MEMBER</th>
<th>CHORD (#)</th>
<th>COLLECTOR (#)</th>
<th>DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>391</td>
<td>106.2</td>
<td>2X6 DBL TDP R</td>
</tr>
<tr>
<td>H2</td>
<td>104.1</td>
<td>30.4</td>
<td>2X6 DBL TDP R</td>
</tr>
<tr>
<td>H3</td>
<td>391</td>
<td>35.6</td>
<td>2X6 DBL TDP R</td>
</tr>
<tr>
<td>H4</td>
<td>258.3</td>
<td>30</td>
<td>2X6 DBL TDP R</td>
</tr>
<tr>
<td>H5</td>
<td>27.6</td>
<td>83.6</td>
<td>2X6 DBL TDP R</td>
</tr>
<tr>
<td>H6</td>
<td>25.7</td>
<td>189.7</td>
<td>(3) 2X6 DF-L1 H2</td>
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<tr>
<td>H7</td>
<td>147.3</td>
<td>168.2</td>
<td>(3) 2X6 DF-L#2</td>
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<tr>
<td>H8</td>
<td>348.2</td>
<td>116.2</td>
<td>(3) 2X6 DF-L#2</td>
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<tr>
<td>H9</td>
<td>427.3</td>
<td>1770</td>
<td>6X16 DF-L SD1 STRE</td>
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<tr>
<td>H10</td>
<td></td>
<td>464.1</td>
<td>6X12 DF-L#1</td>
</tr>
<tr>
<td>H11</td>
<td></td>
<td>353</td>
<td>6X12 DF-L#1</td>
</tr>
<tr>
<td>H12</td>
<td></td>
<td>483</td>
<td>6X12 DF-L#1</td>
</tr>
</tbody>
</table>
**GRAVITY CONNECTIONS**

1. **RAFTER TO RIDGE BEAM**
   - $V_u = 770\#$
   - USE: SIMPSON RRU267 W/CAPACITY = 980\#

2. **RAFTER TO INTERIOR WALL**
   - $V_u = 770\#$
   - USE: SIMPSON VPA2 W/CAPACITY = 1050\#

3. **RAFTER TO VALLEY BEAM**
   - $V_u = 770\#$
   - USE: SIMPSON ISSU210 W/CAPACITY = 1145\#

4. **VALLEY BEAMS & RIDGE BEAN TO 6X12 BEAM**
   - $V_u = \begin{cases} 3223\# (VALLEY) \\ 2075\# (RIDGE) \end{cases}$
   - USE: SIMPSON MSC5 W/H = 12, W/CAPACITY = 6450\# (VALLEY) = 3220\# (RIDGE)

5. **LOWER ROOF RAFTER TO BEAM/WALL**
   - $V_u = 431\#$
   - USE: SIMPSON J626 W/CAPACITY = 1050\#

6. **COLUMN TO FOUNDATION**
   - $V_u = 9.89\#$
   - USE: SIMPSON CBSG 6L-SDS2 W/CAPACITY = 20715\#
**Panel to Panel Nailing Required**

- **V = 59 plf**
- **V_x = V x h = 1770#**
- **V_1 = 59 plf x 8" = 472#**
- **V_2 = 59 x 8" = 236#**
- **V_3 = 59 x 8" = 472#**

**Design is for the worst case lateral loading from Diaphragm seismic force. 1770# is the force from the collector connecting the shear wall along line 8'. This panel nailing will be typical unless noted in plan.**

**Uplift:**

\[ U_p = \frac{(1770# + 472# + 236# + 472#) 8"}{3} = 2,950\# \]

**Nail Capacity:**

\[ N_{p} = Z x G_0 x C_x G_x x C_x B_x x C_x a = 118\# x 1.6 x 0.7 = 132.16\# \]

- **G_0 = 1.6 Eq.**
- **C_x 0.7 x 0.7 x 0.7 = 0.7**
- **G_x = 1.0 < 100°F**
- **B_x = 1.0 < 100°F**
- **a = 1.0 < 100°F**

**Min - (23) 10d common nails full penetration, Req per panel connection. Space evenly along height & stagger.**
GEOMETRY CONNECTIONS

A) RAFTER TO RIDGE BEAM
   \[ V_u = 770 \# \]
   - USE SIMPSON LRU267 W/CAPACITY = 1050#.

B) RAFTER TO INTERIOR WALL
   \[ V_u = 770 \# \]
   - USE SIMPSON VPA2 W/CAPACITY = 1050#.

C) RAFTER TO VALLEY BEAM
   \[ V_u = 770 \# \]
   - USE SIMPSON LSSU210 W/CAPACITY = 1145#.

D) VALLEY BEAMS & RIDGE BEAM TO 6X12 BEAM
   \[ V_u = \begin{cases} 
   4323 \# \text{(VALLEY)} \\
   2075 \# \text{(RIDGE)} 
\end{cases} \]
   - USE SIMPSON MSC5 W/ 1 = 12\" W/CAPACITY = 6450# (VALLEY)
     + 3220# (RIDGE).

E) LOWER ROOF RAFTER TO BEAM/WALL
   \[ V_u = 431 \# \]
   - USE SIMPSON JB828 W/CAPACITY = 1050#.

F) COLUMN TO FOUNDATION
   \[ P_u = 19,375 \# \]
   - USE SIMPSON CBS585L-SDS2 W/CAPACITY = 20915#.
**Reference**

Panel to panel nailing required.

\[ V = 59 \text{ plf} \]
\[ V_1 = V \times \frac{1}{8} = 472 \text{ plf} \]
\[ V_2 = 59 \times 14 = 236 \text{ plf} \]
\[ V_3 = 59 \times 8 = 472 \text{ plf} \]

The shear wall, along line 4, this panel nailing will be typical unless noted in plan.

\[ E = 0 = (1770 \text{ plf} + 472 \text{ plf} + 236 \text{ plf} + 472 \text{ plf}) \times 8' = \text{Uplift (8')} \]

\[ \text{Uplift} = 2.1950 \text{ plf} \]

\[ V_s = \text{Uplift} / H = 3.70 \text{ plf} \]

**NDS 2015**

\[ Z' = Z \times C_0 \times C_m \times C_e \times C_a \times C_k \times C_x = 118 \text{ plf} \times 1.6 \times 0.7 = 132.16 \text{ plf} \]

**Nails per Panel**

- **Nails per Foot**
  \[ V_s / Z' = 2.1950 / 132.16 = 0.0163 \text{ Nails/ft} \]
- **Nails per Panel**
  \[ 2.8 \text{ Nails/ft} \times 1 = 23 \text{ Nails/Panel} \]

**Nail Common**

- **Common**
  \[ Z = 118 \text{ plf} \]

**Min.**

- **(23)** 10C Common Nails Full Penetration

**Req. Per Panel Connection**

- Space evenly along height 3 stagger
NS LAP SPlice DESIGN

\[ V_{\text{MAX}} = 1770 \text{ #} \]

\[ C_{\text{MAX}} = 8.25 \text{ #} \]

\[ \text{MIN TOP PLATE SPlice LENGTH} = 24' \text{"} \]

\[ D = 0.148 \text{ in} \quad \Omega = 10 \text{d comonov} \]
\[ k = 3 \text{in} \quad L = 1.5 \text{in} \]
\[ f_{\text{m}} = 90 \text{ ksi} \quad f_{\text{c}} = 10,000 \text{ psi} \]
\[ C = 0.50 \]
\[ f_{\text{c}} = 116.50 \text{ psi} \]

\[ Z = Z_{\text{c}} \times C_{\text{c}} = 118 \text{ psi} \times 1.6 \times 1.0 = 189 \text{#/inch} \]

\[ N = \frac{V}{Z'} = \frac{1770 \text{ #}}{189} = 9.36 \text{ USE 10 NAILS} \]

\[ \text{MIN DESIGN LAP SPlice} \]

[USE 2' SPlice WITH (6) 10D common]

[ NAILS 3in long staggered]
**NS LAP SPLICE DESIGN**

\[ V_{\text{max}} = 1770 \, \# \]
\[ C_{\text{max}} = 875 \, \# \]

**CBC R602.3.2**

**MIN TOP PLATE SPLICE LENGTH = 24'**

\[ \begin{array}{c}
\text{\textbullet} \\
\text{\textbullet} \\
\text{\textbullet} \\
\text{\textbullet} \\
\text{\textbullet} \\
\text{\textbullet} \\
\text{\textbullet} \\
\end{array} \]

\[ \text{\textbullet} \quad 2'-0'' \quad \text{\textbullet} \]

\[ \rightarrow 1770 \, \# \]

**NDS 2015**

\[ D = 0.148 \, \text{in} \times \phi \, \text{10d common} \]
\[ L = 3 \text{in}, \quad L_2 = 2.5 \text{in}, \quad L_3 = 1.5 \text{in} \]
\[ f_y = 90 \, \text{ksi}, \quad f_y = 90 \, \text{ksi} \]
\[ G = 0.50 \]
\[ f_c = 46.50 \, \text{psi} \]
\[ Z = Z \times C_0 \times C_0 = 118 \text{psi} \times 1.6 \times 1.0 = 189 \text{lb/lin. ft} \]

\[ N = \frac{V}{Z'} = \frac{1770 \, \#}{189} = 9.36 \quad \text{USE 10 NAILS} \]

**MIN DESIGN LAP SPLICE**

[CUSE 2° SPLICE WITH (6) 10D COMMON
NAILS 3in. LONG STAGGERED]
**PROJECT**
2017 IPD WEED RESIDENTIAL

**NAME**

**DATE**

**SCOPE**

---

<table>
<thead>
<tr>
<th><strong>REFERENCE</strong></th>
<th><strong>ANSWER</strong></th>
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<tbody>
<tr>
<td><strong>FOUNDATION DESIGN</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SOILS CRITERIA:</strong></td>
<td></td>
</tr>
<tr>
<td>- SITE CLASS: D</td>
<td></td>
</tr>
<tr>
<td>- VERTICAL FOUNDATION PRESSURE = 2000 psf</td>
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</tr>
<tr>
<td>- LATERAL BEARING PRESSURE = 150 psf/ft BELOW NATURAL GRADE</td>
<td></td>
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<tr>
<td>- COEFFICIENT OF FRICTION = 0.25</td>
<td></td>
</tr>
<tr>
<td>- FROST LINE = 12' BELOW GRADE</td>
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[Diagram of foundation design]

---
RIGID INSULATION OPTION ANALYSIS

\[
R \text{ Value Assembly} = \tau (\%)(R \text{- Component})
\]

<table>
<thead>
<tr>
<th>WALL COMPONENT</th>
<th>R VALUE</th>
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<tbody>
<tr>
<td>FBC</td>
<td>0.500</td>
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<tr>
<td>AIR</td>
<td>0.286</td>
</tr>
<tr>
<td>SHEATHING</td>
<td>0.500</td>
</tr>
<tr>
<td>ROCK WOOL</td>
<td>23.000</td>
</tr>
<tr>
<td>DRY WALL</td>
<td>0.560</td>
</tr>
</tbody>
</table>

\[
\text{W/ Bat + R13)} \quad \text{(W/ No Bat + 2x R13 Ridge)}
\]

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>R VALUE</th>
</tr>
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<tbody>
<tr>
<td>FBC</td>
<td>0.500</td>
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<tr>
<td>AIR</td>
<td>0.286</td>
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<tr>
<td>SHEATHING</td>
<td>0.500</td>
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<tr>
<td>DRY WALL</td>
<td>0.560</td>
</tr>
<tr>
<td>STUD</td>
<td>6.880</td>
</tr>
</tbody>
</table>

\[
\text{W/ R13 Thermal Gap) \quad 8.726}
\]

\[
\text{Without Any Rigid Insulation}
\]

\[
R = (0.8361)(24.846) + (0.1639)(8.726) = 22.20 \text{ NO RIG. INS. + 0 COST (0}2500)
\]

\[
U = \frac{1}{R} = 0.045
\]

\[
\text{With One Sheet R13 Rigid Insulation}
\]

\[
R = (0.8361)(37.846) + (0.1639)(31.726) = 35.70 \text{Bat + (1)Sheets R13 + } \$2500
\]

\[
U = 0.028
\]

\[
\text{With Two Sheets R13 Rigid Insulation + No Bat}
\]

\[
R = (0.8361)(27.846) + (0.1639)(21.726) = 26.84 \text{ NO BAT + (2) SHEETS R13 + } \$4100
\]

\[
U = 0.037
\]
Framing to Insulated Panel Wall Ratio

Exterior Wall Area = 122' x 8' = 976 $\text{ft}^2$

Double T 12½" x 3" Sill Area = 122' x (4½/12) = 46 $\text{ft}^2$


Surface Area of Studs in Total Panel Wall Face = \text{Length of Stud} \times h = 11.44' \times 8' = 91.52 $\text{ft}^2$

Panel Wall Connections = 24 Panels = 23 Connections

Additional 2x Stud Surface to Additional Connections = 23 Connections \times 6 Board x h

= 23 \times \frac{1.5}{12} \times 8' = 23 $\text{ft}^2$

Total Wall Area Made Up of Studs = (46 + 91.52 + 23) = 160.52 $\text{ft}^2$

Percent of Wall (Studs) = \frac{160}{976} \times 100 = 16.39\%