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

December 2017

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 ft^2 - 1400 ft^2. 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.

HARMONIOUS TECTONICS

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

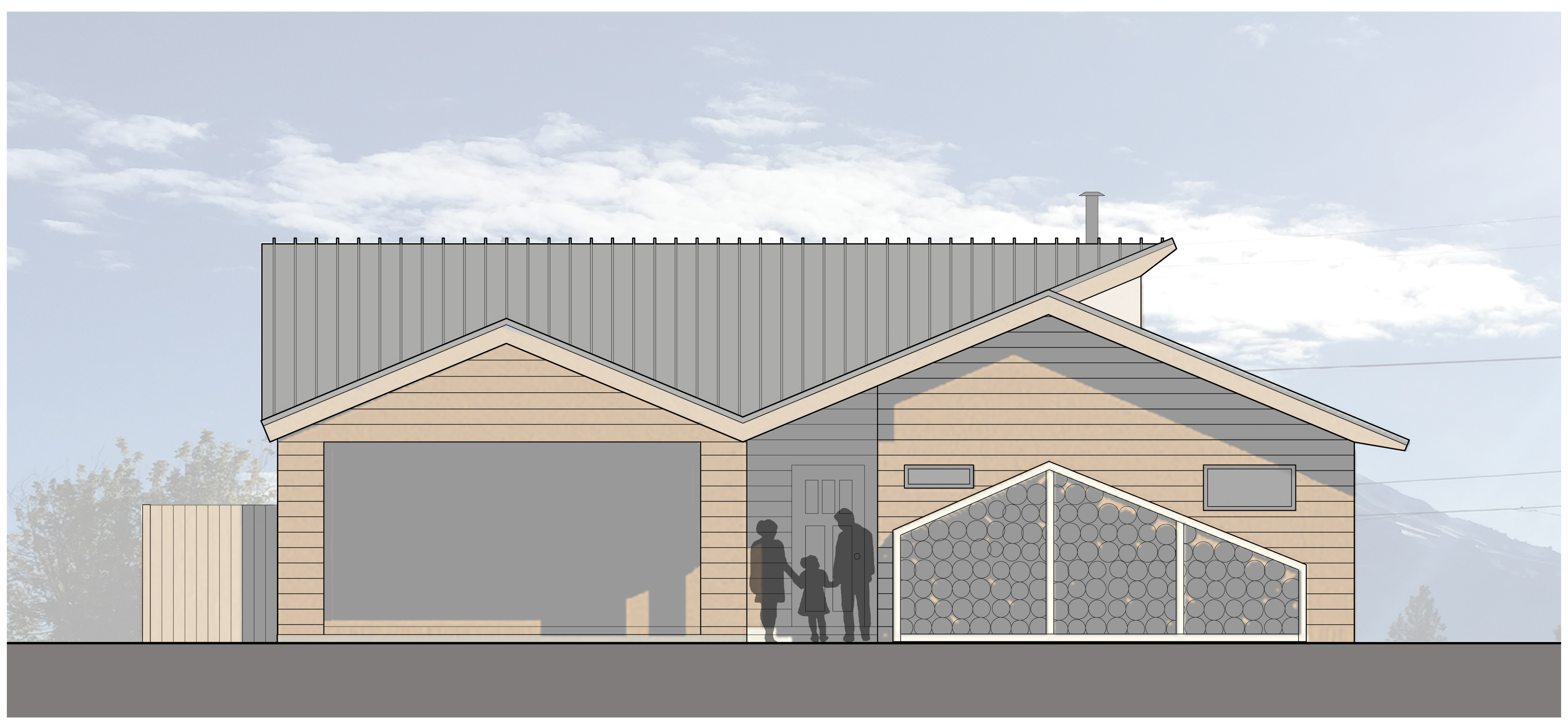
Goal #3: UTILIZE A SIMPLIFIED METHOD OF CONSTRUCTION

- Objective #1: Use a uniform panelized system for the exterior walls of the house
- Objective #2: Integrate simplified connections for ease of constructability

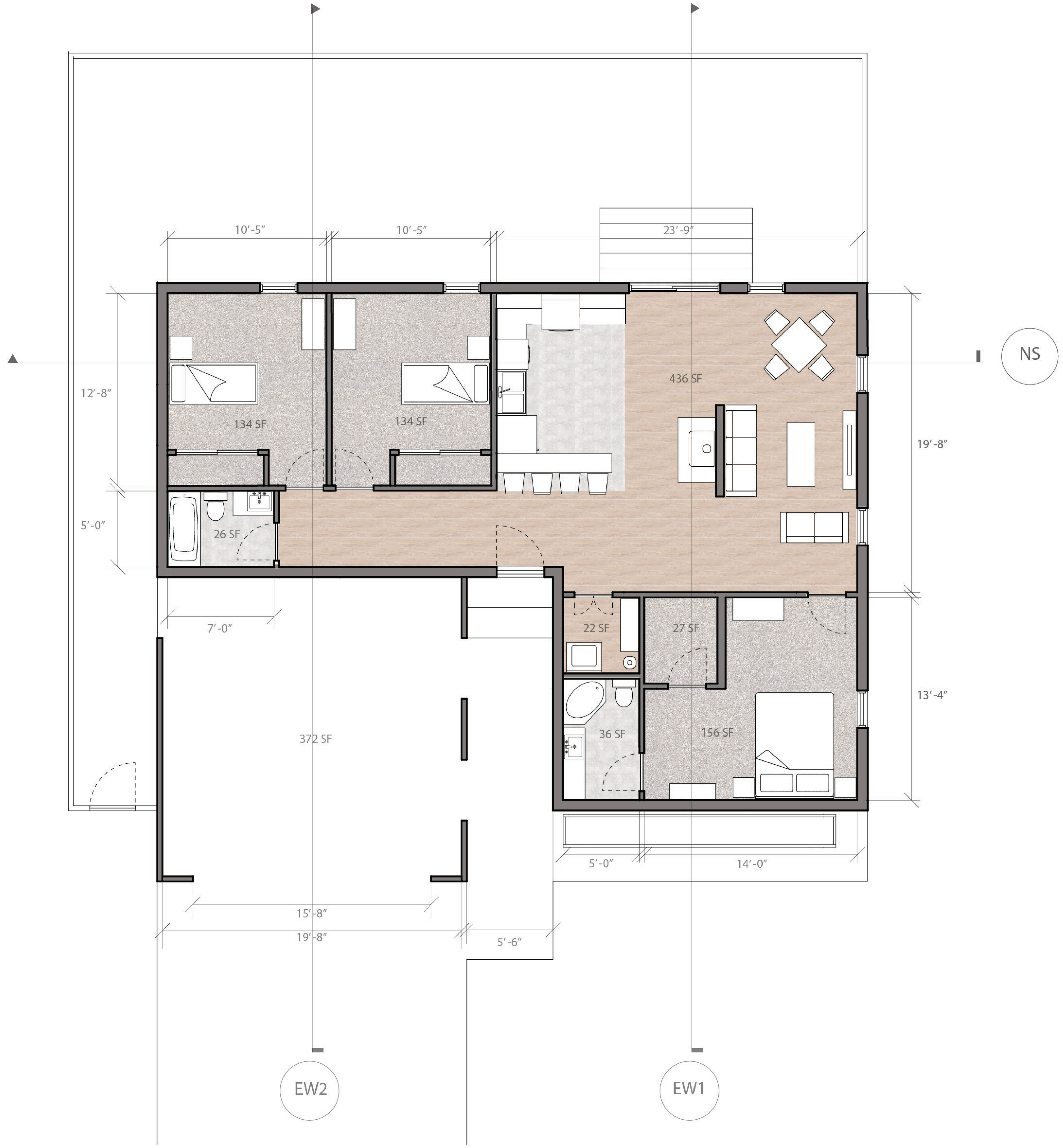
HarT

Harmonious Tectonics

Galen Amick - Brock Armstrong - Jackie Budidharma - Sarah Pascual - Evan Royer

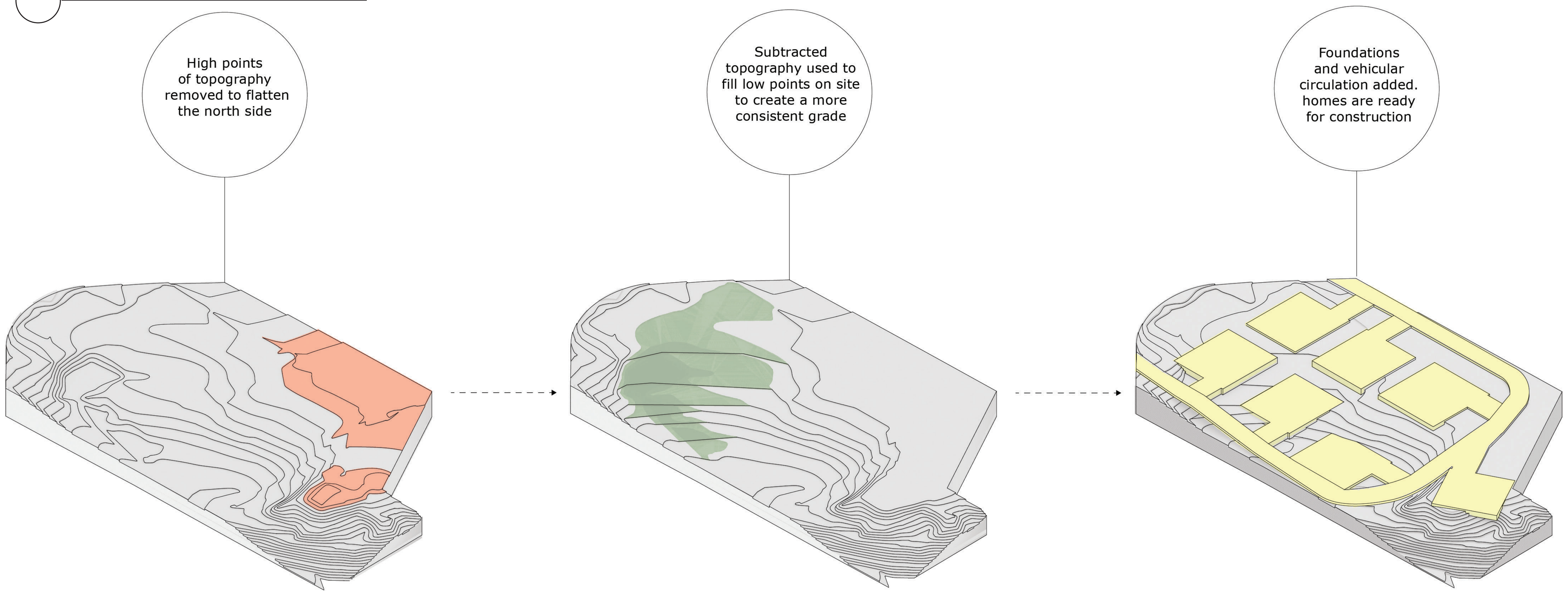


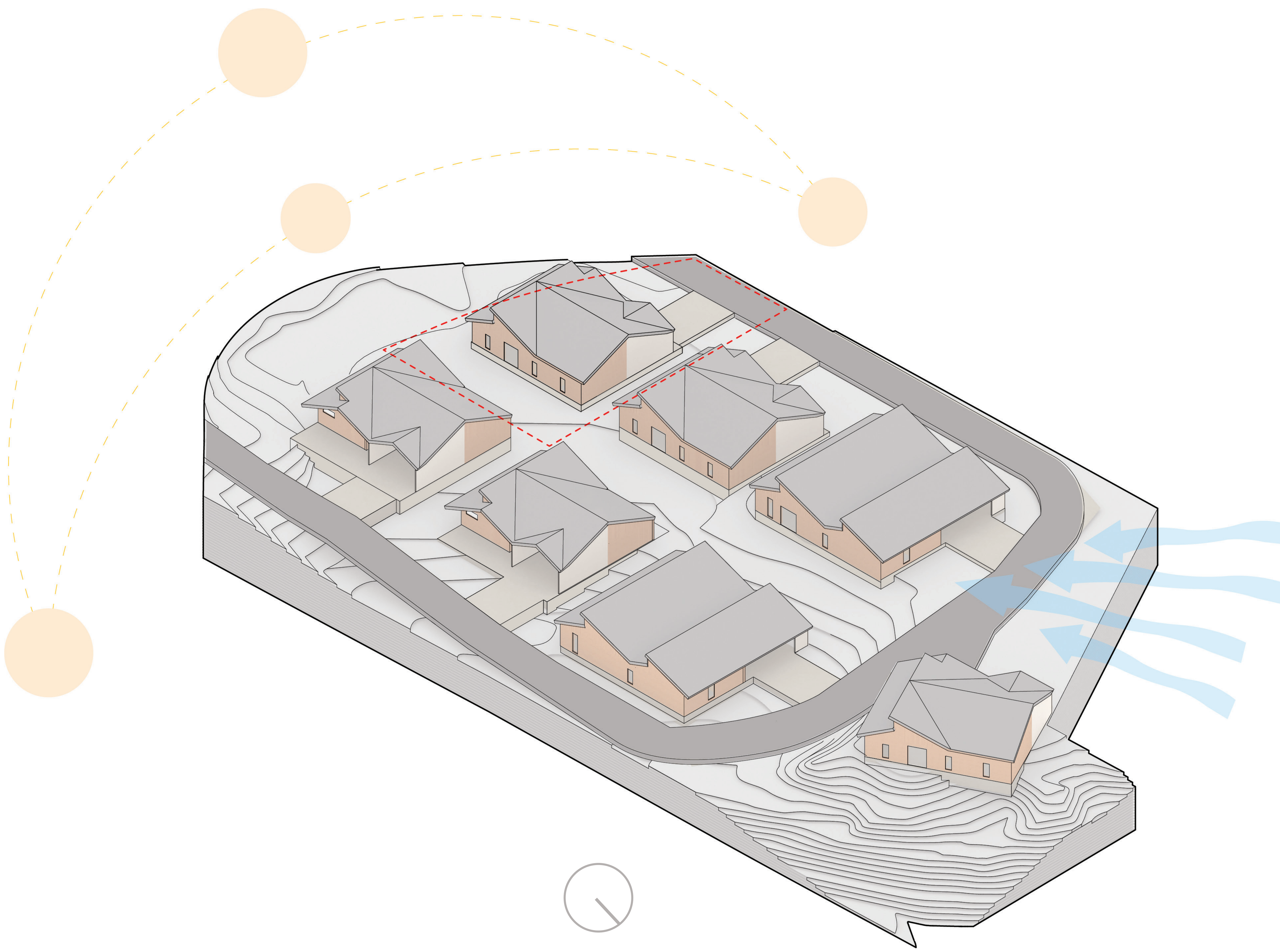
WEST ELEVATION
SCALE: 1/4" = 1'-0"



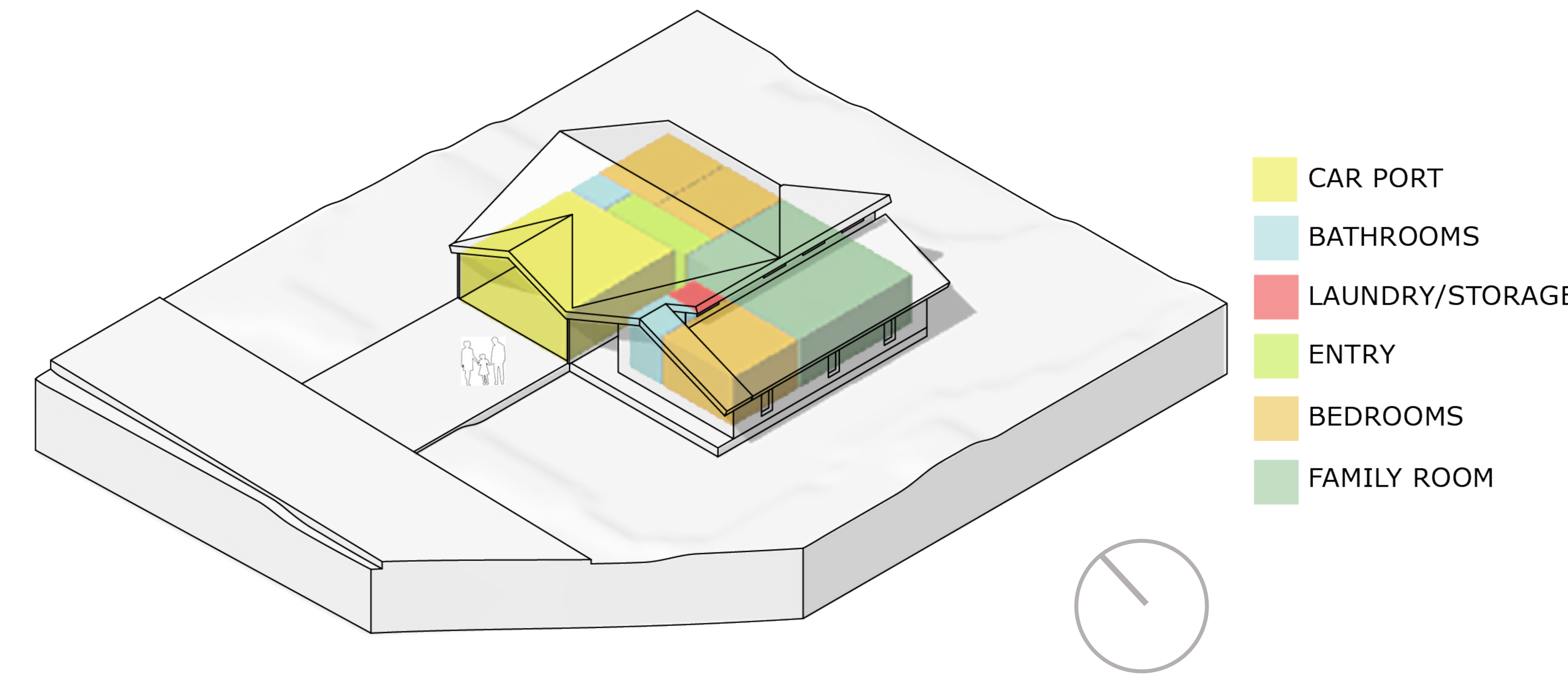
FLOOR PLAN
SCALE: 1/4" = 1'-0"

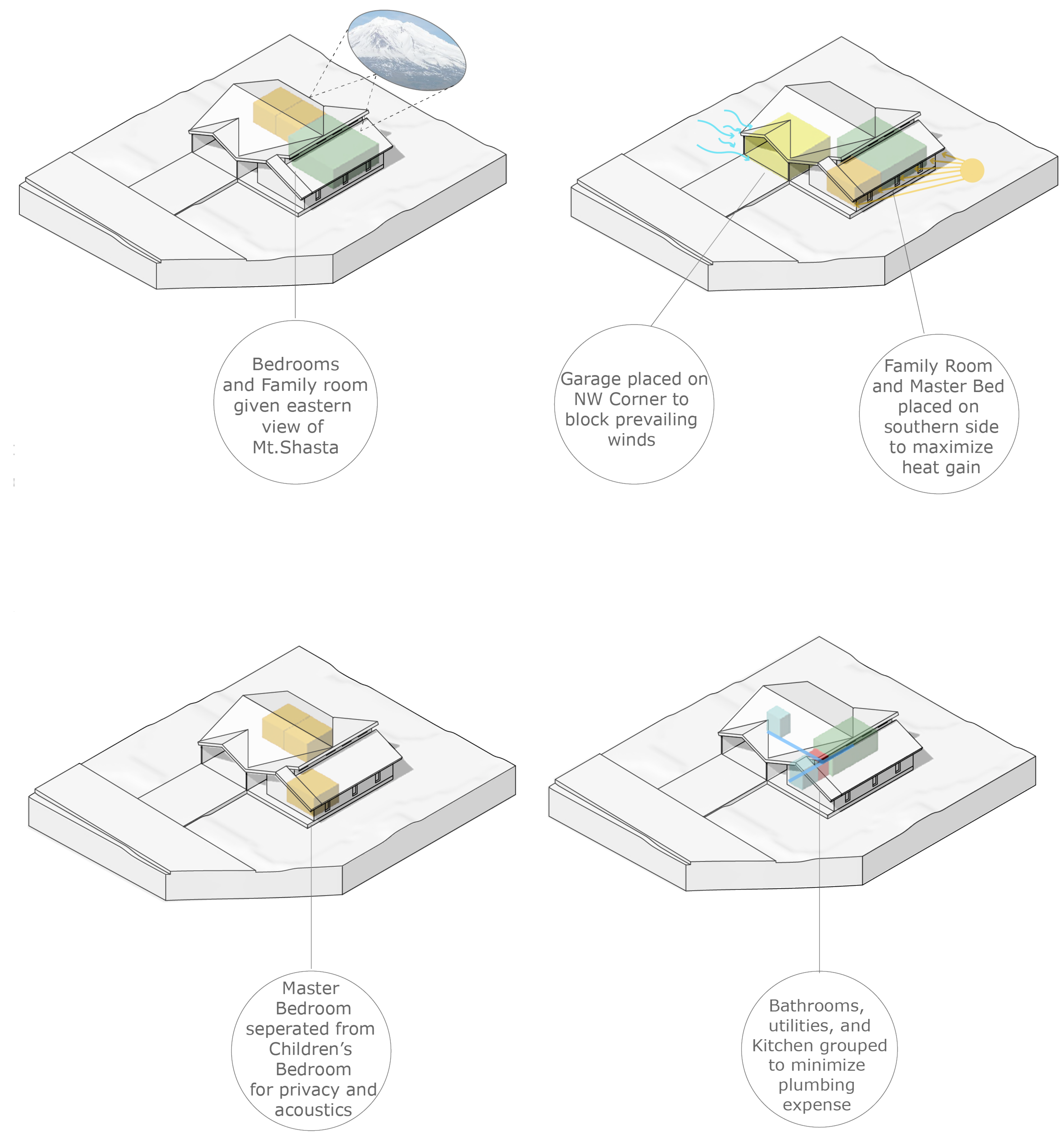
SITEWORK DIAGRAM



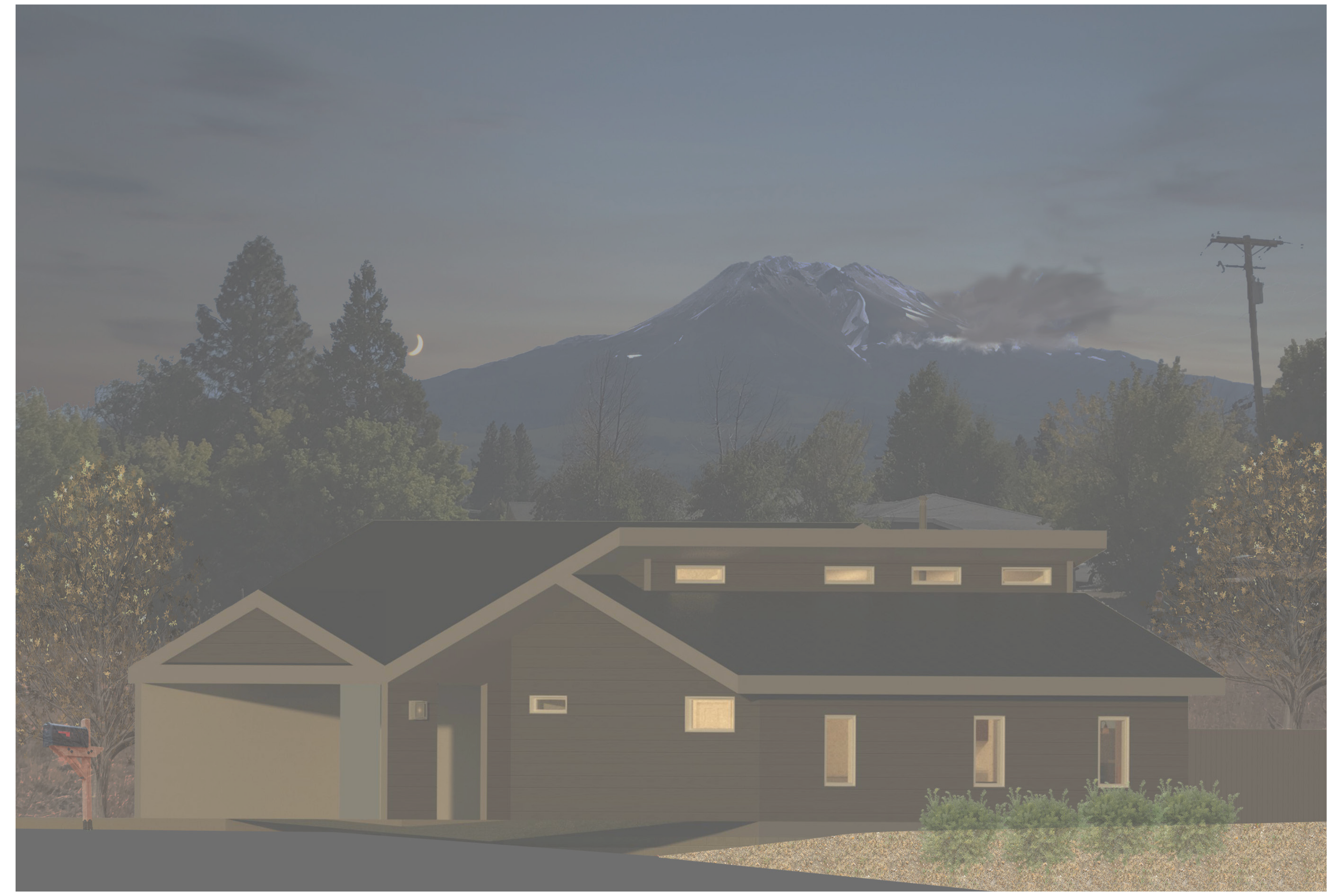


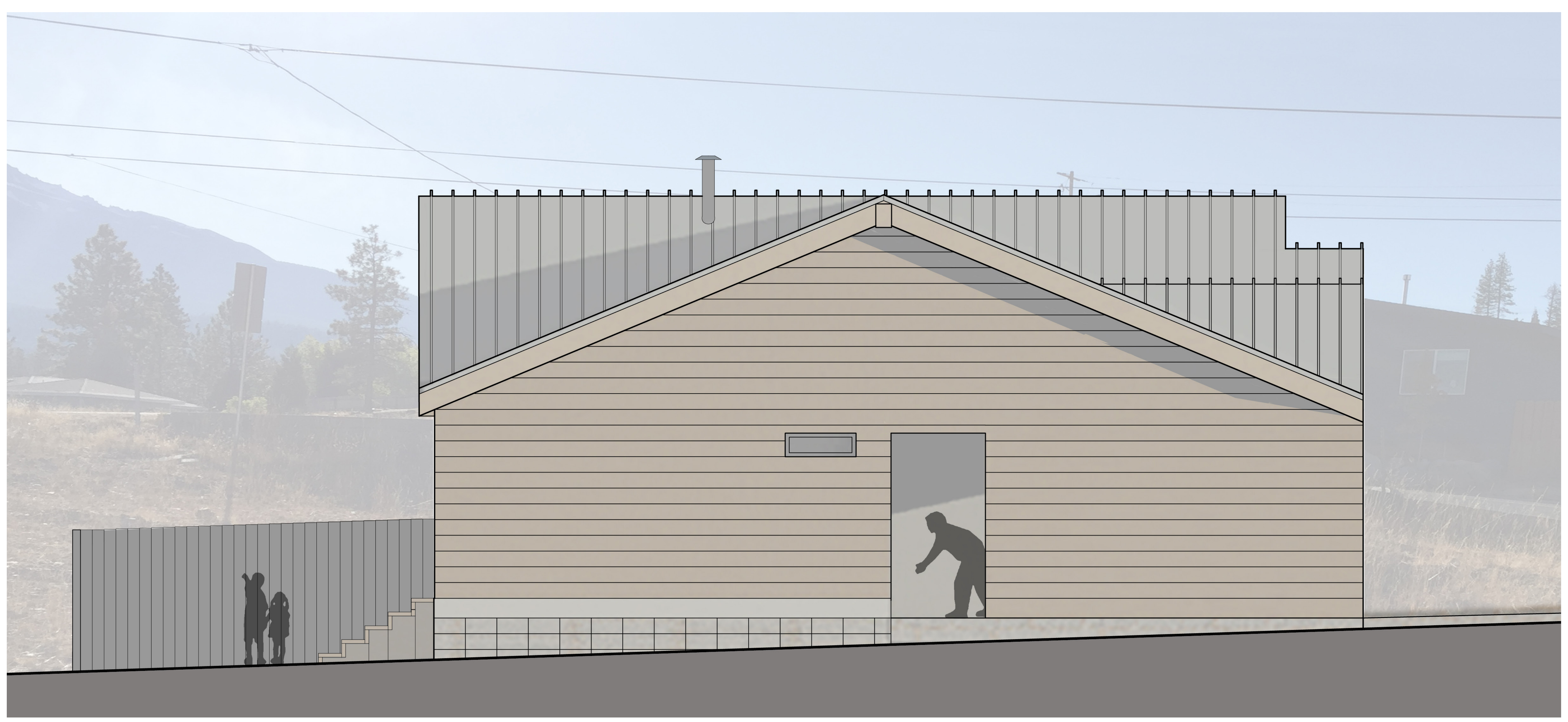
PROGRAM DIAGRAM



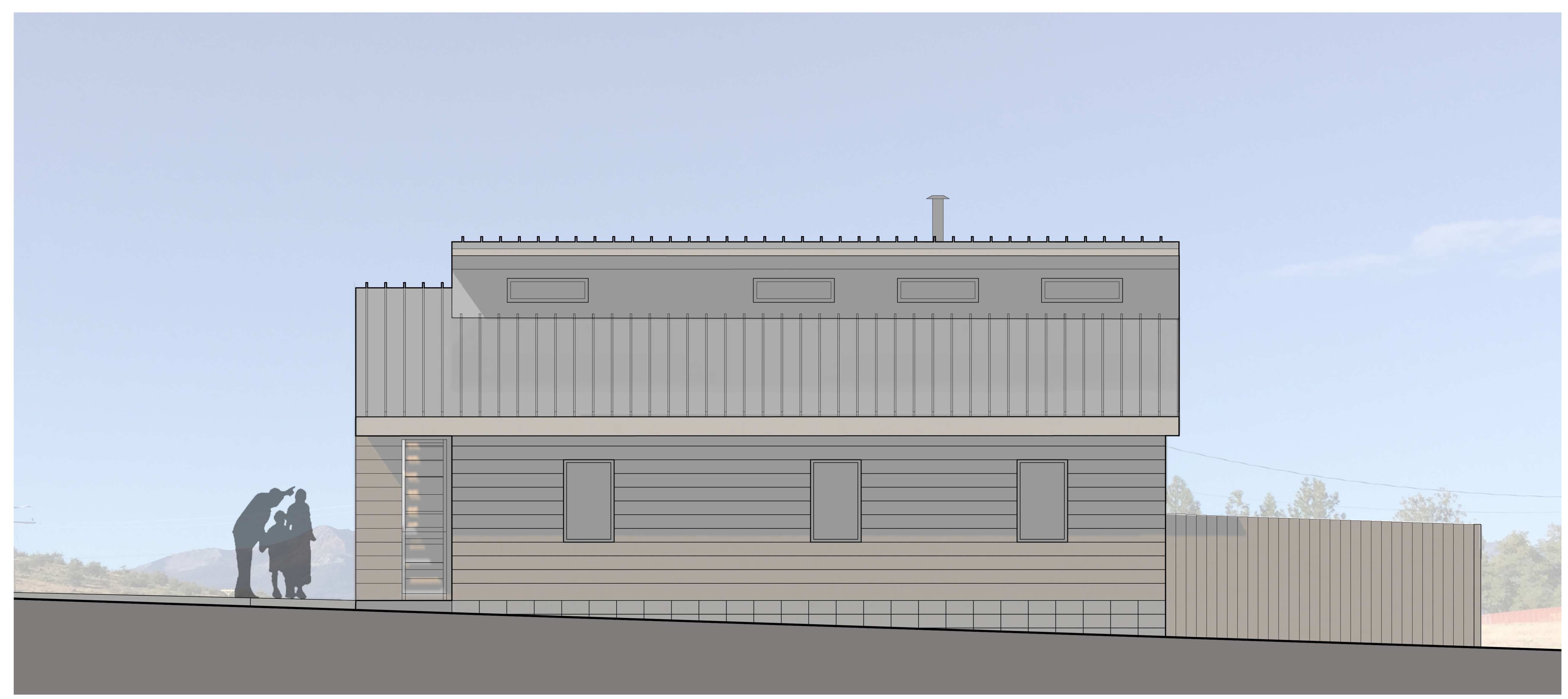


CEILING PLAN
SCALE:1/4″ = 1′-0″



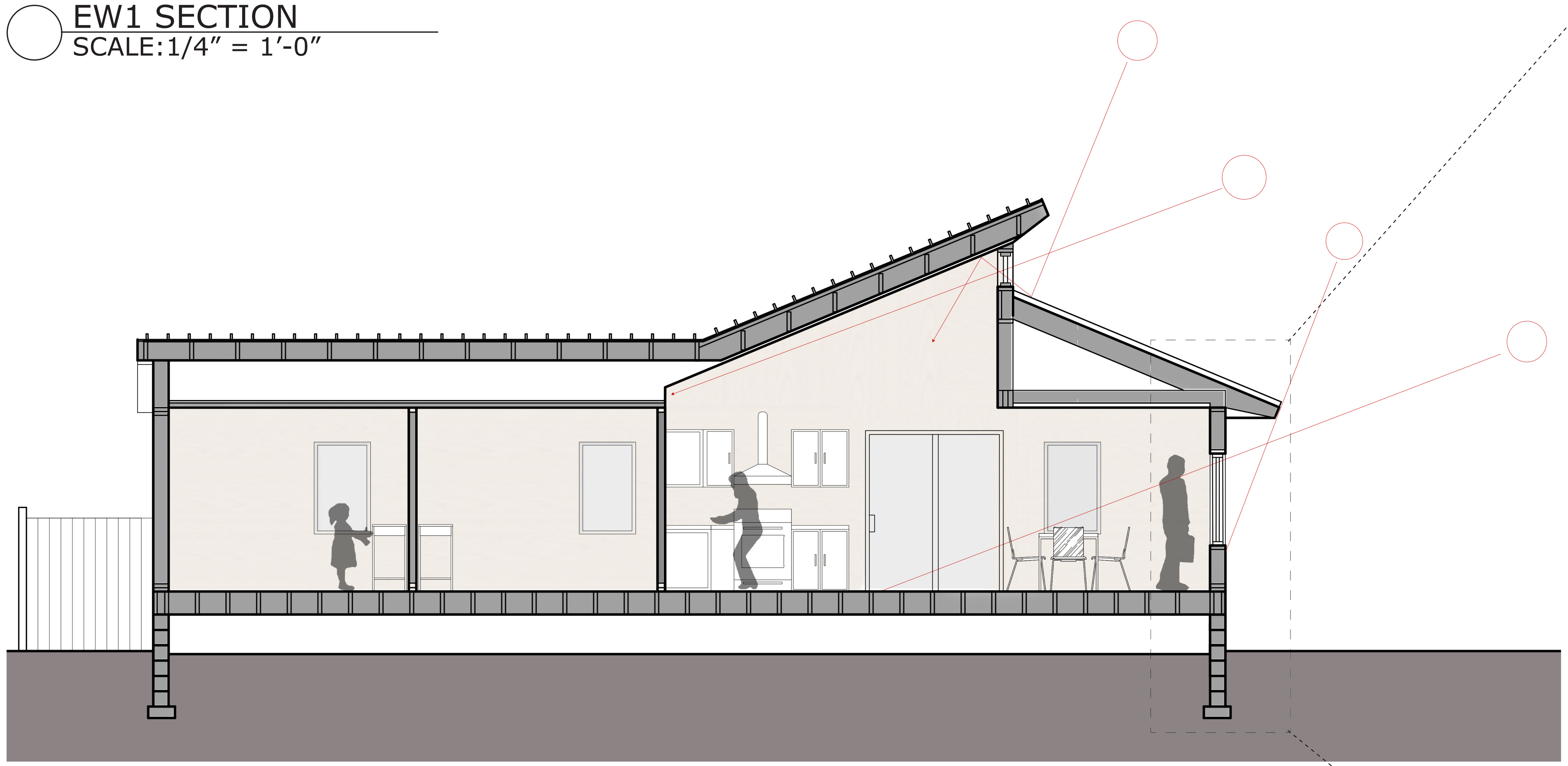


NORTH ELEVATION
SCALE:1/4″ = 1′-0″

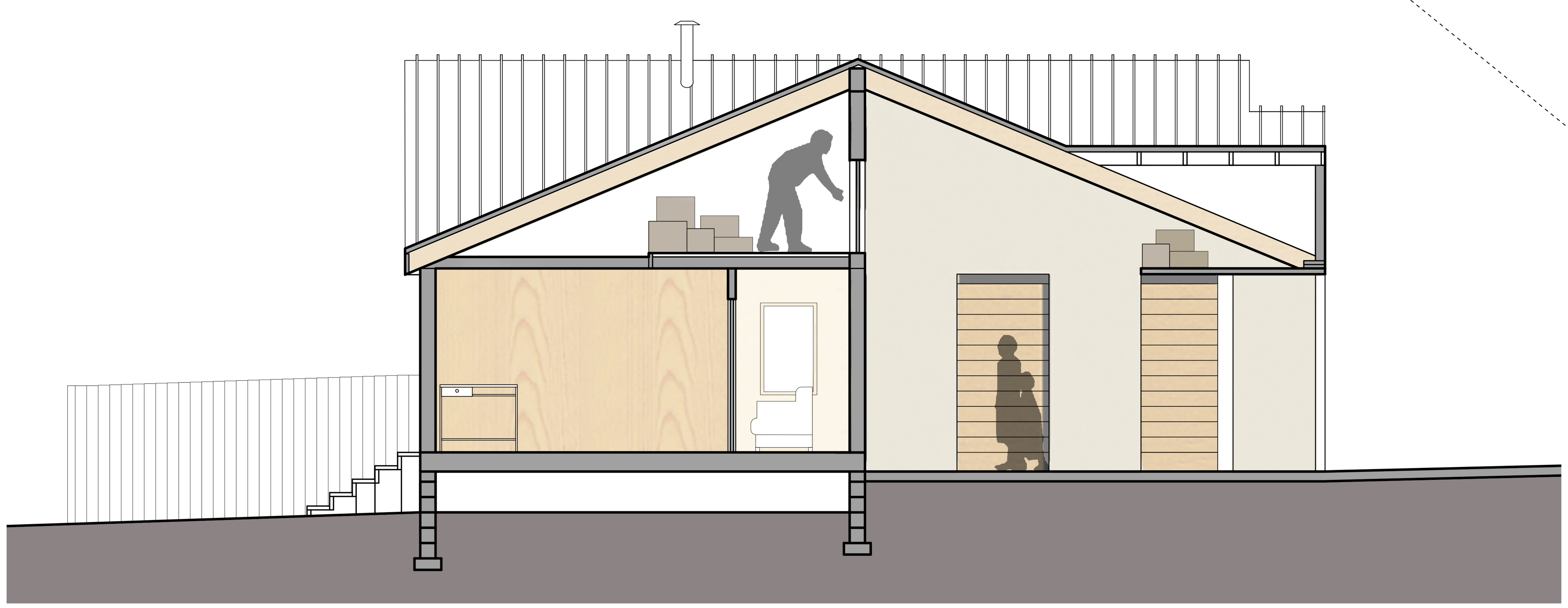


SOUTH ELEVATION
SCALE:1/4″ = 1′-0″

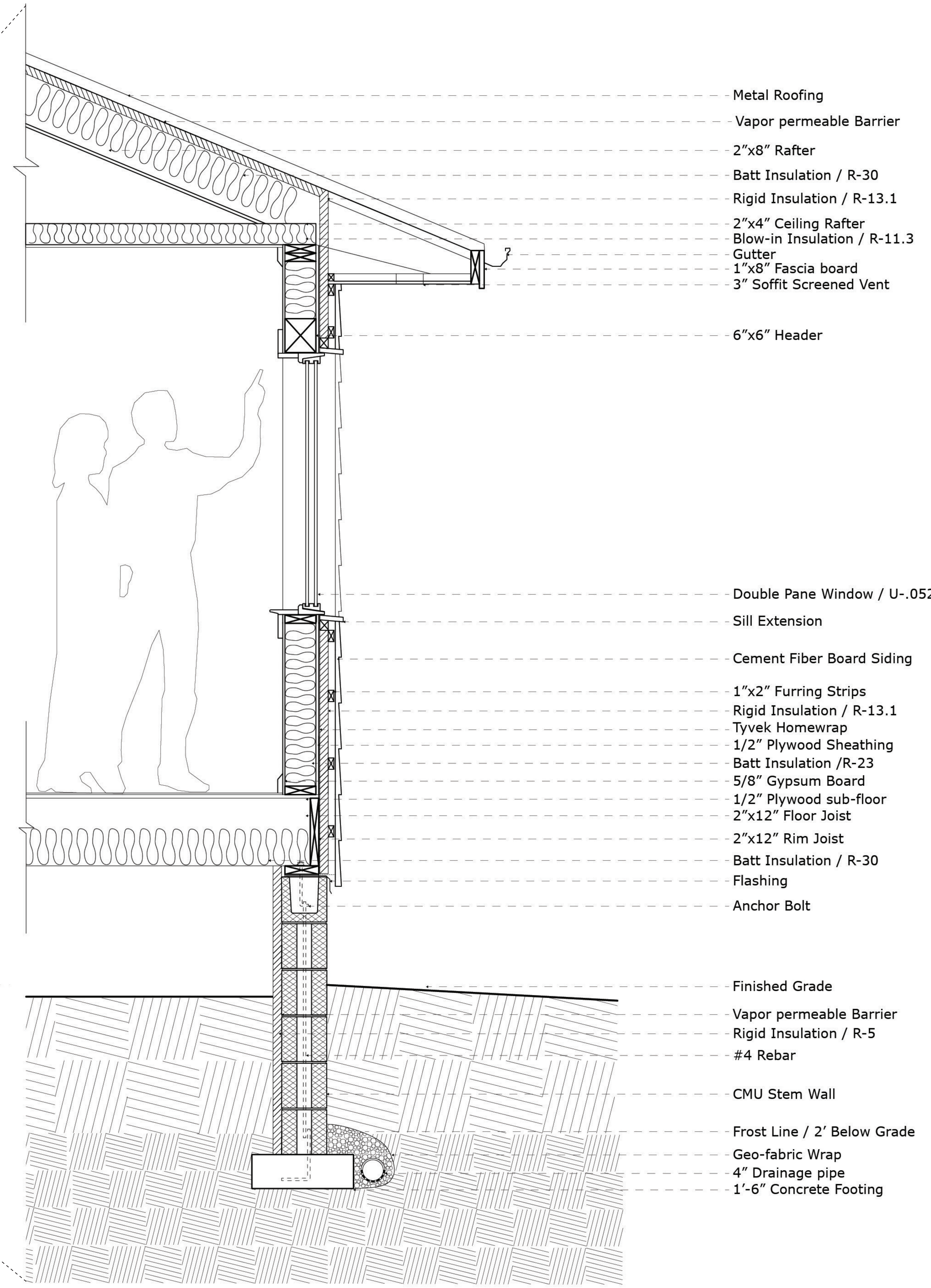
EW1 SECTION
SCALE:1/4" = 1'-0"



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

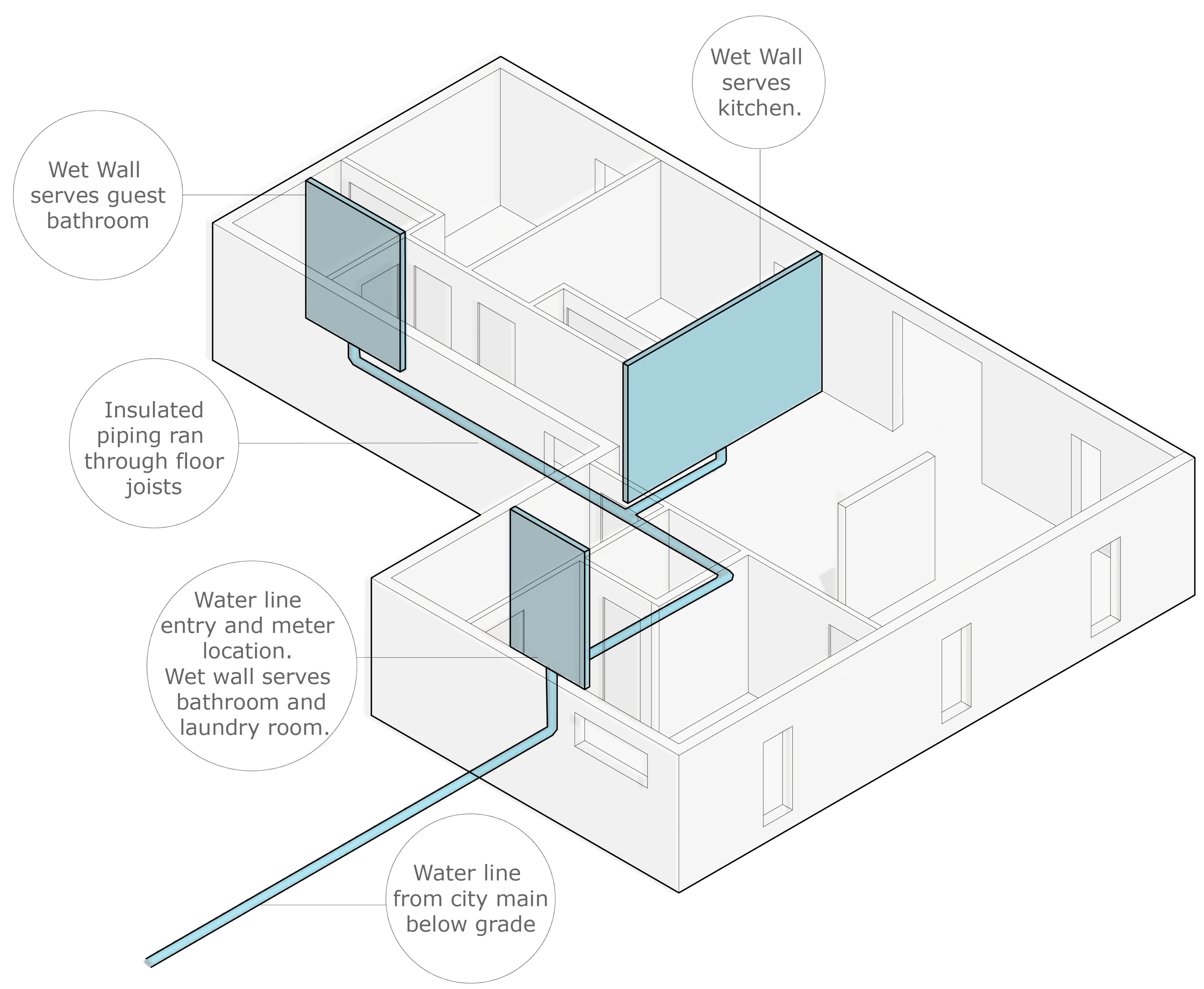


EW2 SECTION
SCALE:1/4" = 1'-0"

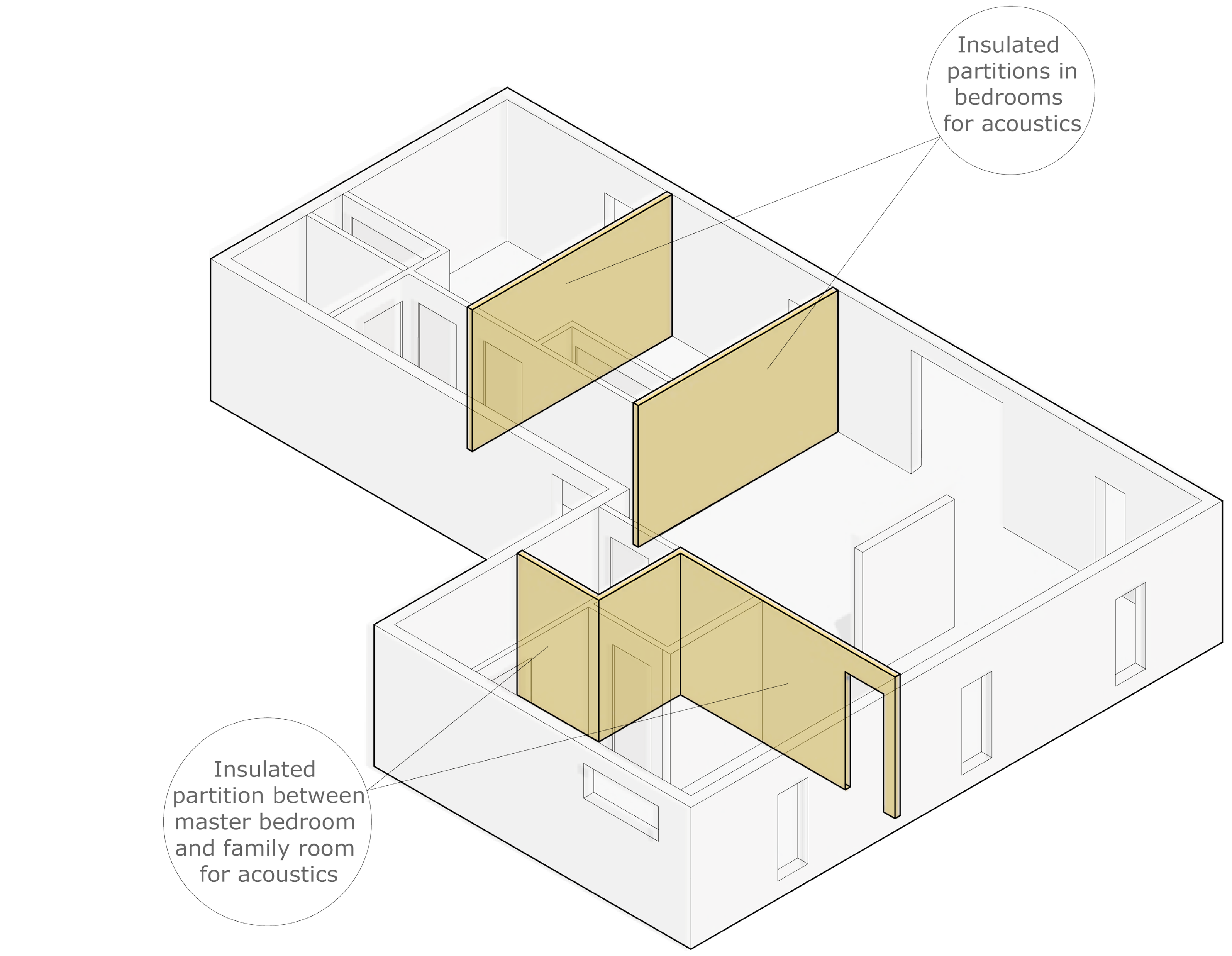


DETAIL WALL SECTION
SCALE:1" = 1'-0"

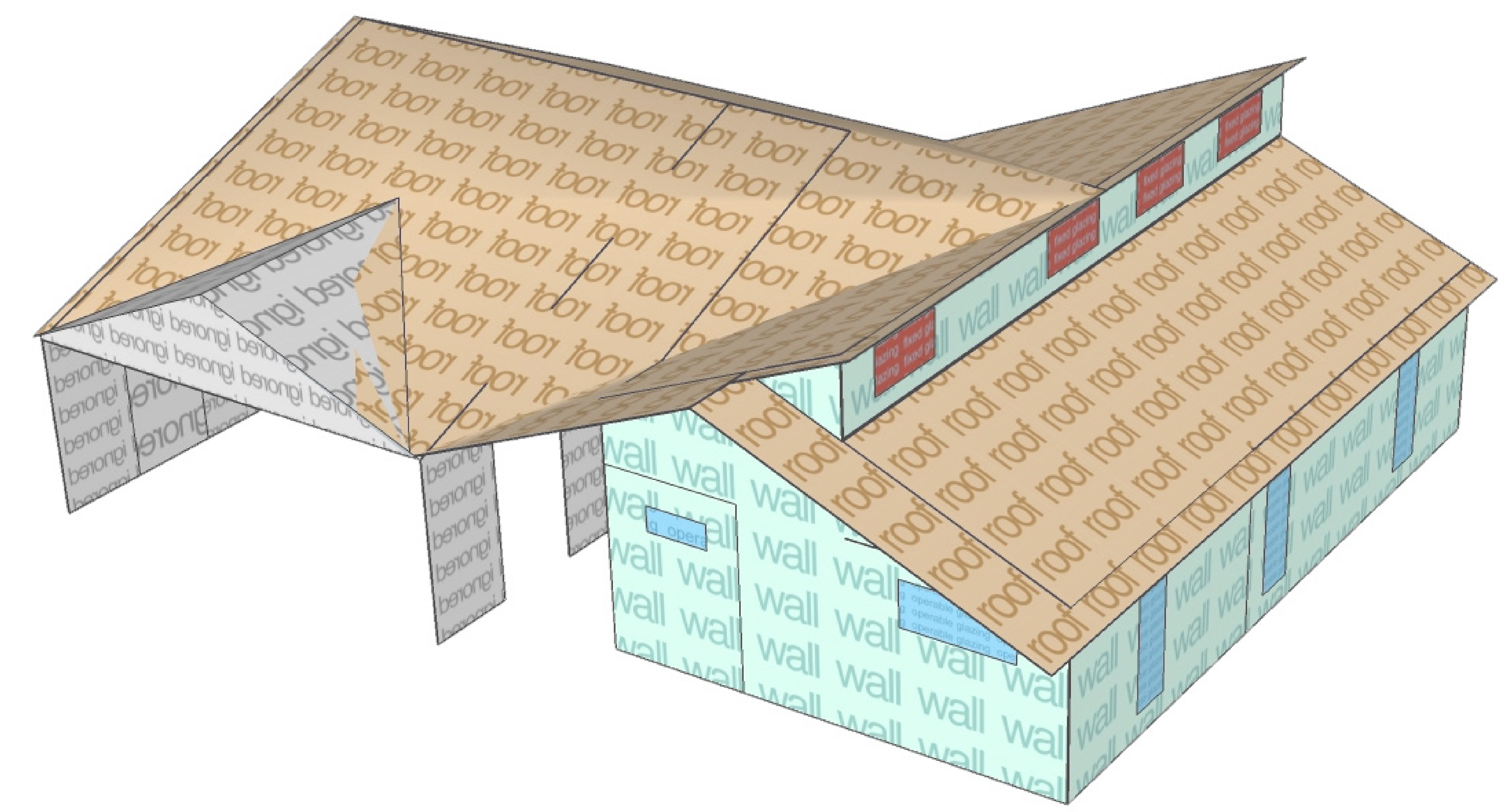
PLUMBING DIAGRAM



ACOUSTIC DIAGRAM



ENERGY TESTING

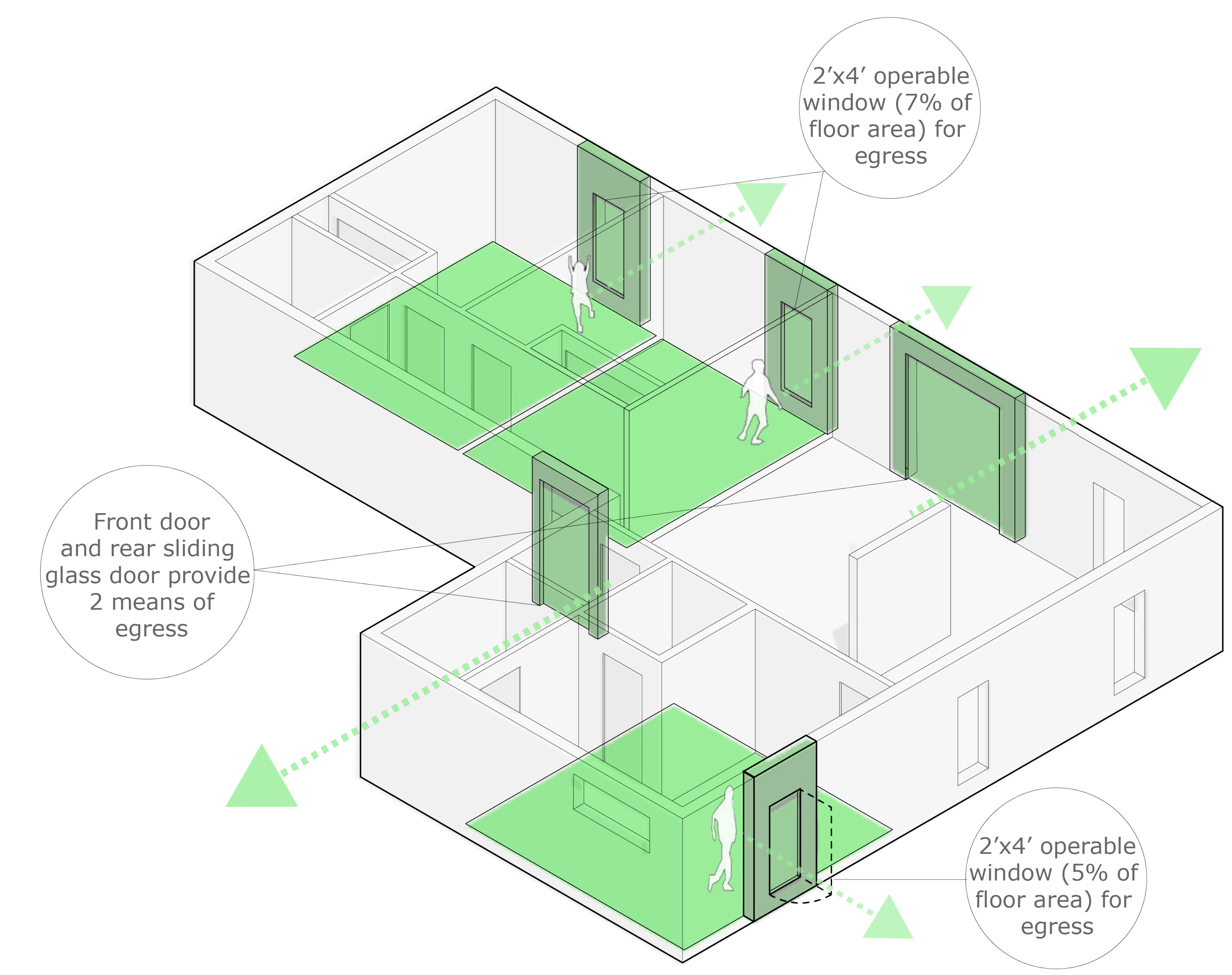


Total Floor Area 1,130 ft²

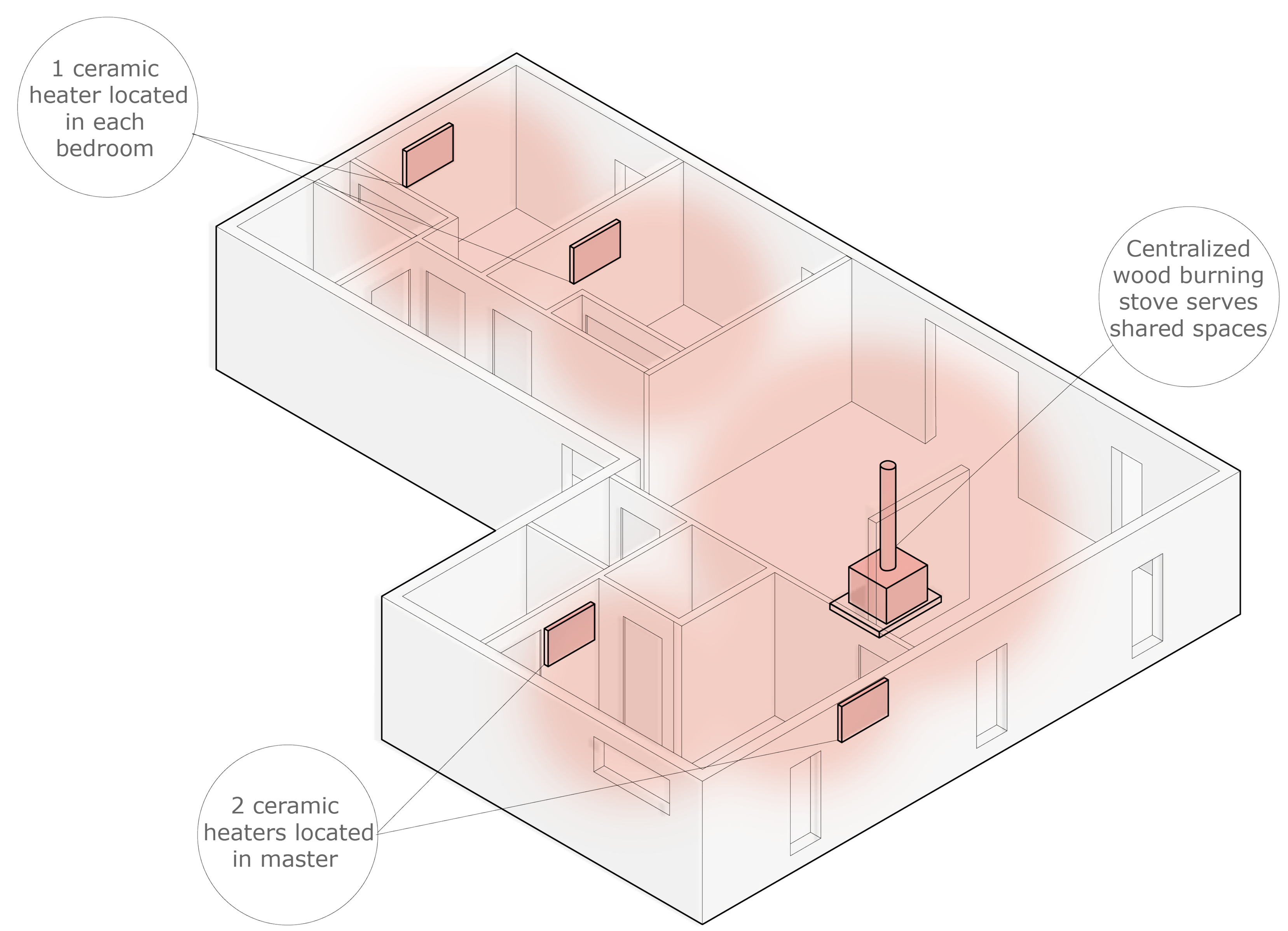
Daylighting % of floor area (annual)	
Underlit:	0
Well Lit:	31
Overlit:	69

Energy Use Intensity kBTU/ft²/yr	
2030 Challenge:	12
Actual:	11

EGRESS DIAGRAM



HEATING DIAGRAM



Master Bedroom Render

Kitchen Render

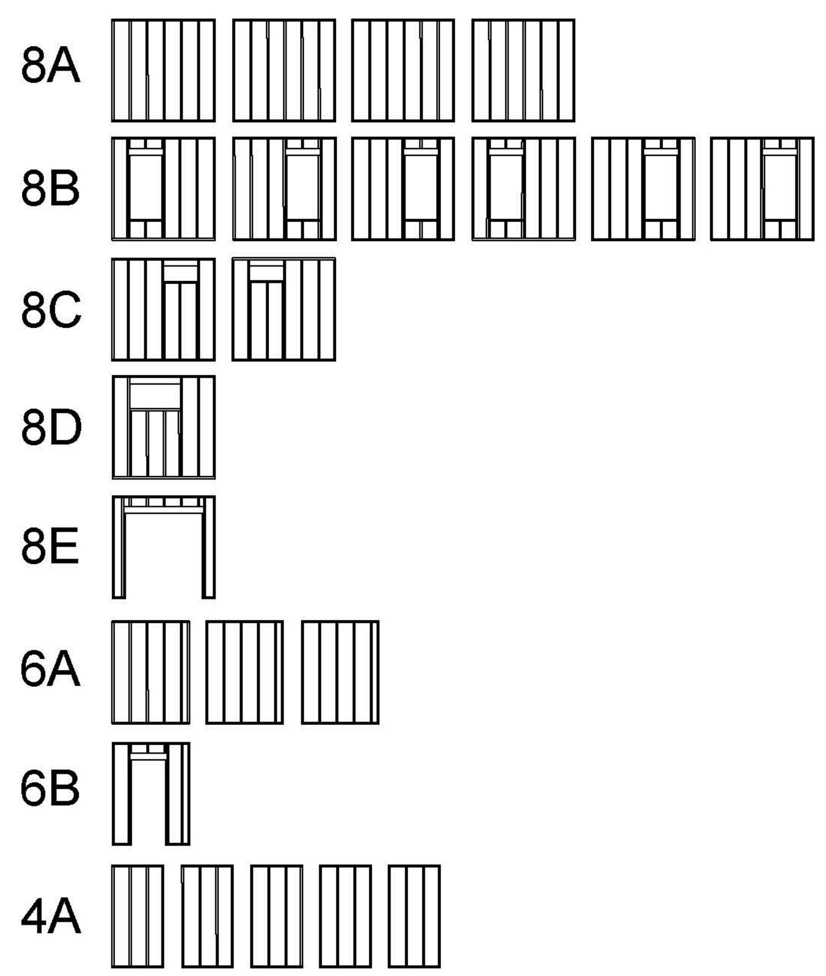
Master Bedroom Render 2

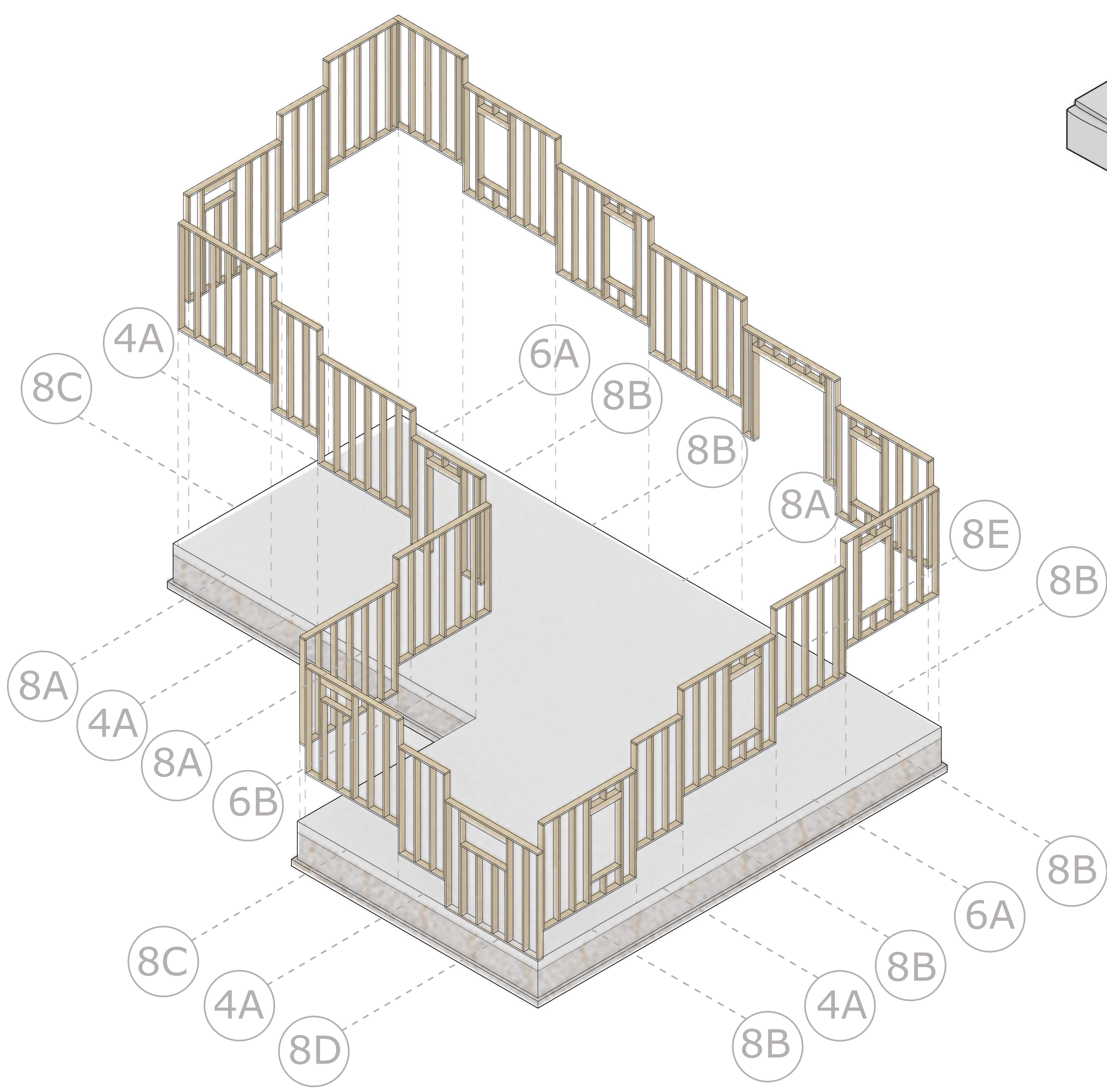
Family Room Render

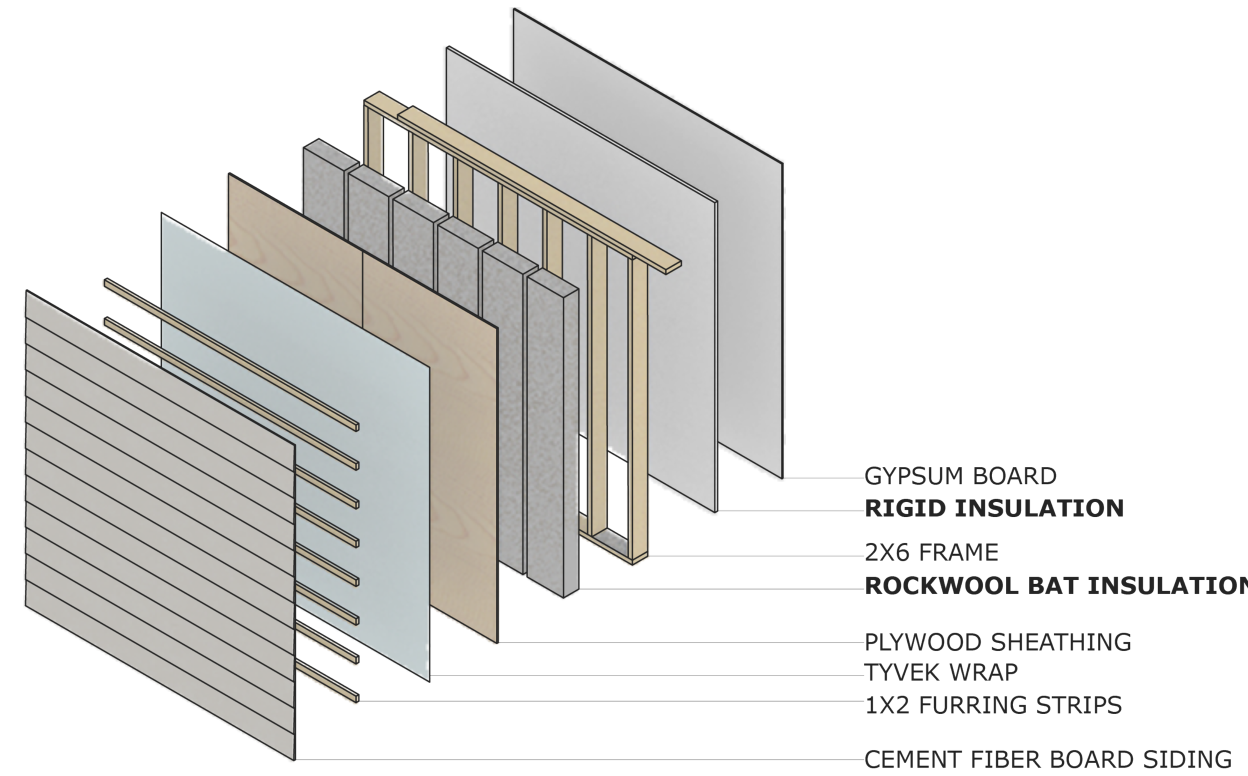
Bedroom Render

PANELIZATION

Callout	Type	# of Panels
8A	Standard 8'x8' panel.	4
8B	8'x8' panel with vertical window.	6
8C	8'x8' panel with bathroom window.	2
8D	8'x8' panel with horizontal window.	1
8E	8'x8' panel with sliding glass door.	1
6A	Standard 6'x8' panel.	3
6B	6'x8' panel with entry door.	1
4A	Standard 4'x8' panel.	5



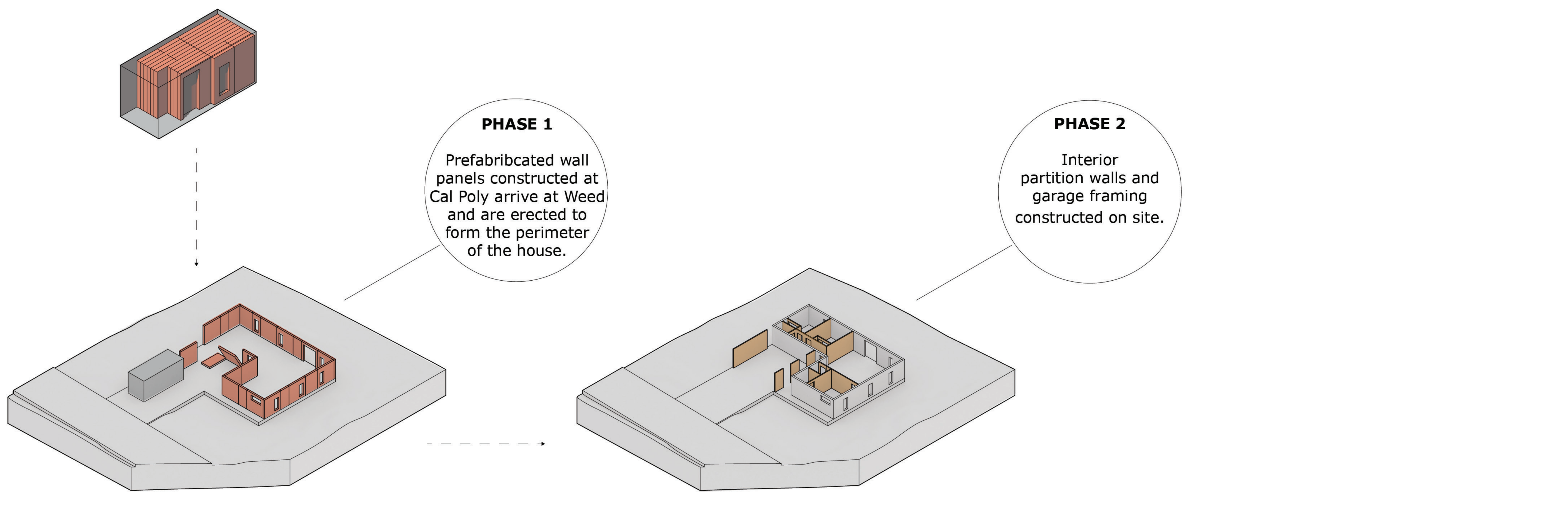




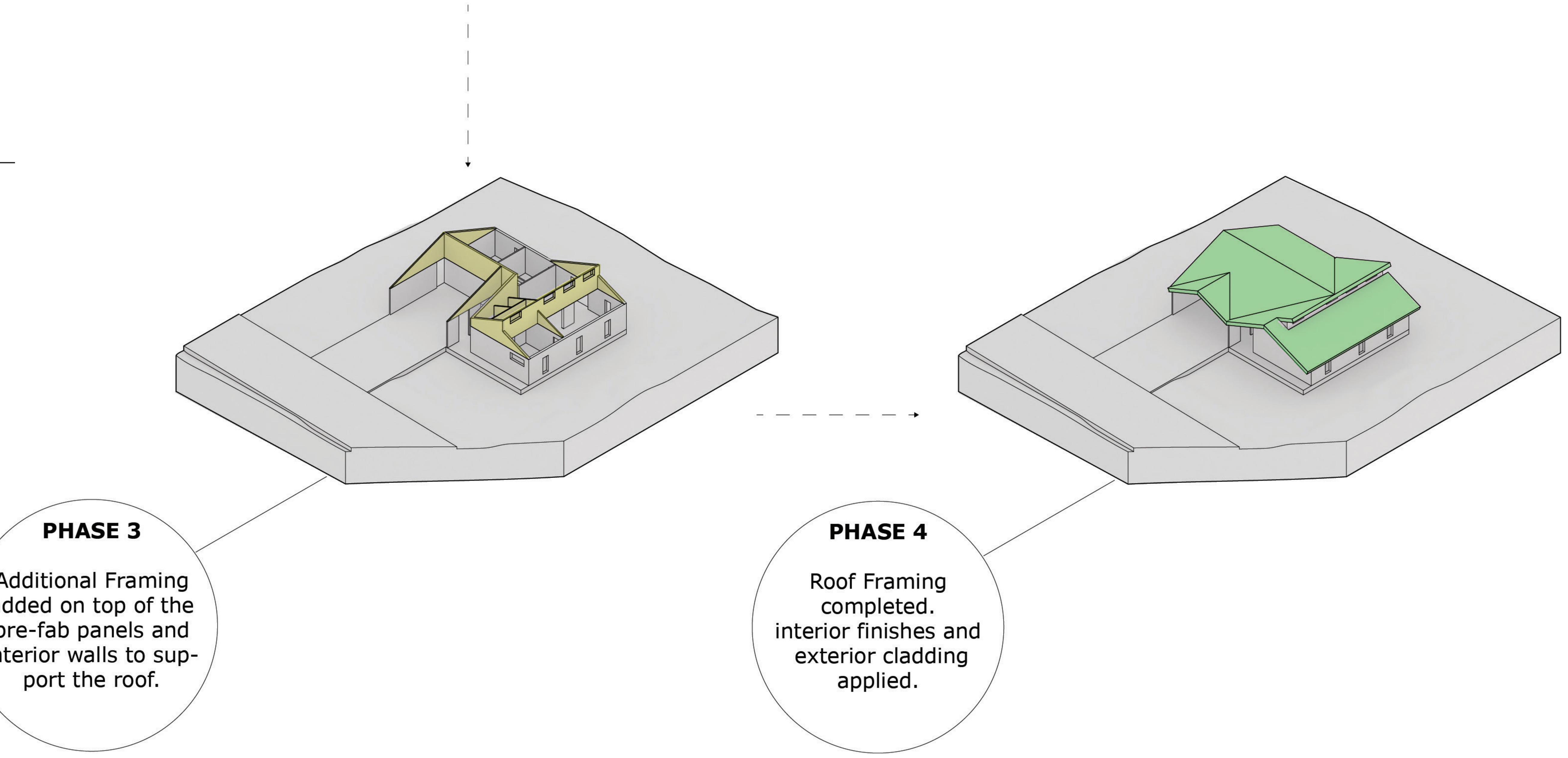
EXPLODED WALL ASSEMBLY

Condensed Budget Cost Breakdown

Item		Total
Foundation	$	17,746
Floor	$	13,528
Exterior Walls	$	27,119
Roof	$	32,205
Interior Walls	$	19,530
Electrical	$	7,215
Plumbing	$	10,218
Heating	$	1,926
Fire Sprinklers	$	3,043
Millwork	$	9,918
Appliances	$	1,774
Car Port	$	2,214
Fasteners	$	2,500
Shipping	$	665



CONSTRUCTION DIAGRAM



ID	Task Name	Duration	Start	Finish
1	**HarT Housing Project**	**226 days**	**Mon 9/18/17**	**Mon 7/30/18**
2	**Precon Activities**	**192 days**	**Mon 9/18/17**	**Tue 6/12/18**
3	Design	55 days	Mon 9/18/17	Fri 12/1/17
4	GNS Project Decision	0 days	Fri 12/1/17	Fri 12/1/17
5	**Subcontractor Pricing**	**40 days**	**Mon 1/29/18**	**Fri 3/23/18**
6	Sub Contractor Bid Period	20 days	Mon 1/29/18	Fri 2/23/18
7	GNS Review of Sub Bids	10 days	Mon 2/26/18	Fri 3/9/18
8	Award Subcontractors	5 days	Mon 3/12/18	Fri 3/16/18
9	Complete Subcontractor Agreements	5 days	Mon 3/19/18	Fri 3/23/18
10	**Submittals**	**10 days**	**Mon 3/26/18**	**Fri 4/6/18**
11	Electrical Submittals	10 days	Mon 3/26/18	Fri 4/6/18
12	Heating Submittals	10 days	Mon 3/26/18	Fri 4/6/18
13	Flooring Submittals	10 days	Mon 3/26/18	Fri 4/6/18
14	Plumbing Submittals	10 days	Mon 3/26/18	Fri 4/6/18
15	D/F/H Submittals	10 days	Mon 3/26/18	Fri 4/6/18
16	Glass Submittals	10 days	Mon 3/26/18	Fri 4/6/18
17	Paint Submittals	10 days	Mon 3/26/18	Fri 4/6/18
18	Millwork Shop Drawings	10 days	Mon 3/26/18	Fri 4/6/18
19	Fire Sprinkler Shop Drawings	10 days	Mon 3/26/18	Fri 4/6/18
20	Metal Roofing Submittals	10 days	Mon 3/26/18	Fri 4/6/18
21	Exterior Siding Submittals	10 days	Mon 3/26/18	Fri 4/6/18
22	Appliance Submittals	10 days	Mon 3/26/18	Fri 4/6/18
23	**Submittal Review and Approval**	**5 days**	**Mon 4/9/18**	**Fri 4/13/18**
24	Review and Approve Concrete Mix	5 days	Mon 4/9/18	Fri 4/13/18
25	Review and Approve Electrical Submittals	5 days	Mon 4/9/18	Fri 4/13/18
26	Review and Approve Heating Submittals	5 days	Mon 4/9/18	Fri 4/13/18
27	Review and Approve Flooring Submittals	5 days	Mon 4/9/18	Fri 4/13/18
28	Review and Approve Plumbing Submittals	5 days	Mon 4/9/18	Fri 4/13/18
29	Review And Approve D/F/H Submittals	5 days	Mon 4/9/18	Fri 4/13/18
30	Review and Approve Glass Submittals	5 days	Mon 4/9/18	Fri 4/13/18
31	Review and Approve Paint Submittals	5 days	Mon 4/9/18	Fri 4/13/18
32	Review and Approve Millwork Shop Drawigns	5 days	Mon 4/9/18	Fri 4/13/18
33	Review and Approve Fire Sprinkler Shop Drawings	5 days	Mon 4/9/18	Fri 4/13/18
34	Review and Approve Metal Roofing Submittals	5 days	Mon 4/9/18	Fri 4/13/18
35	Review and Approve Exterior Siding Submittals	5 days	Mon 4/9/18	Fri 4/13/18
36	Review and Approve Appliance Submittals	5 days	Mon 4/9/18	Fri 4/13/18
37	**Fabrication and Procurement**	**112 days**	**Mon 1/8/18**	**Tue 6/12/18**
38	Quarter 1 of Building Panels	50 days	Mon 1/8/18	Fri 3/16/18
39	Quarter 2 of Building Panels	50 days	Mon 4/2/18	Fri 6/8/18
40	Ship Panels to Weed	2 days	Mon 6/11/18	Tue 6/12/18
41	Procure Exterior Siding	20 days	Mon 4/16/18	Fri 5/11/18
42	Procure Electrical Fixtures	30 days	Mon 4/16/18	Fri 5/25/18
43	Procure Heating Equipment	15 days	Mon 4/16/18	Fri 5/4/18
44	Procure Flooring	25 days	Mon 4/16/18	Fri 5/18/18
45	Procure Plumbing Fixtures	20 days	Mon 4/16/18	Fri 5/11/18
46	Procure and Fabricate D/F/H	25 days	Mon 4/16/18	Fri 5/18/18
47	Procure Roofing	25 days	Mon 4/16/18	Fri 5/18/18
48	Procure Glass	20 days	Mon 4/16/18	Fri 5/11/18
49	Procure Paint	5 days	Mon 4/16/18	Fri 4/20/18
50	Fabricate Millwork	25 days	Mon 4/16/18	Fri 5/18/18
51	Procure Fire Sprinklers	15 days	Mon 4/16/18	Fri 5/4/18
52	Procure Appliances	15 days	Mon 4/16/18	Fri 5/4/18
53	**Construction Activities**	**53 days**	**Thu 5/17/18**	**Mon 7/30/18**
54	Grade Lots	5 days	Thu 5/17/18	Wed 5/23/18
55	Dig Footings	3 days	Tue 5/22/18	Thu 5/24/18
56	Utility Trenching	1 day	Thu 5/24/18	Thu 5/24/18
57	Tie Rebar	1 day	Fri 5/25/18	Fri 5/25/18
58	Pour Footings	1 day	Mon 5/28/18	Mon 5/28/18
59	Pour Slab	1 day	Mon 5/28/18	Mon 5/28/18
60	Build Stem Wall	2 days	Tue 5/29/18	Wed 5/30/18
61	Concrete Curing	7 days	Thu 5/31/18	Fri 6/8/18
62	Foundation Inspection	0 days	Fri 6/8/18	Fri 6/8/18
63	Frame/Sheath Floor	3 days	Fri 6/8/18	Tue 6/12/18
64	Floor Framing Inspection	0 days	Tue 6/12/18	Tue 6/12/18
65	Insulate Floors/Crawl Space	1 day	Mon 6/11/18	Mon 6/11/18
66	Panels Arrive	0 days	Tue 6/12/18	Tue 6/12/18
67	Place Panels	2 days	Tue 6/12/18	Wed 6/13/18
68	Frame Remaining Exterior Walls	3 days	Wed 6/13/18	Fri 6/15/18
69	Sheath Exterior Walls	1 day	Fri 6/15/18	Fri 6/15/18
70	Exterior Framing Inspection	0 days	Fri 6/15/18	Fri 6/15/18
71	Insulate Exterior Walls	1 day	Fri 6/15/18	Fri 6/15/18
72	Install Building Paper on Exterior Walls	2 days	Fri 6/15/18	Mon 6/18/18
73	Install Exterior Siding	3 days	Mon 6/18/18	Wed 6/20/18
74	Install Exterior Doors	1 day	Mon 6/18/18	Mon 6/18/18
75	Install Windows	2 days	Mon 6/18/18	Tue 6/19/18
76	Frame Roof	4 days	Fri 6/15/18	Wed 6/20/18
77	Sheath Roof	2 days	Wed 6/20/18	Thu 6/21/18
78	Roof Framing Inspection	0 days	Thu 6/21/18	Thu 6/21/18
79	Install Rigid Insulation on Roof	2 days	Thu 6/21/18	Fri 6/22/18
80	Install Vapor Barrier on Roof	1 day	Mon 6/25/18	Mon 6/25/18
81	Frame Interior Ceiling	3 days	Tue 6/26/18	Thu 6/28/18
82	Install Metal Roofing	5 days	Tue 6/26/18	Mon 7/2/18
83	Frame Interior Partitions	3 days	Mon 6/25/18	Wed 6/27/18
84	Drywall 1 Side of Interior Partitions	2 days	Wed 6/27/18	Thu 6/28/18
85	Interior Framing Inspection	0 days	Thu 6/28/18	Thu 6/28/18
86	Rough Electrical	2 days	Fri 6/29/18	Mon 7/2/18
87	Rough Fire Sprinklers	2 days	Fri 6/29/18	Mon 7/2/18
88	Rough Electrical Inspection	0 days	Mon 7/2/18	Mon 7/2/18
89	Rough Fire Sprinkler Inspection	0 days	Mon 7/2/18	Mon 7/2/18
90	Rough Plumbing	2 days	Fri 6/29/18	Mon 7/2/18
91	Rough Plumbing Inspection	0 days	Mon 7/2/18	Mon 7/2/18
92	Drywall Remaining Walls/Ceiling	2 days	Mon 7/2/18	Tue 7/3/18
93	Insulate Attic Space	1 day	Wed 7/4/18	Wed 7/4/18
94	Install Interior Doors	1 day	Wed 7/4/18	Wed 7/4/18
95	Tape/Sand/Prime Interior Partitions and Ceiling	5 days	Tue 7/3/18	Mon 7/9/18
96	Rough Heating	2 days	Mon 7/9/18	Tue 7/10/18
97	Rough Heating Inspection	0 days	Tue 7/10/18	Tue 7/10/18
98	Paint /Stain	5 days	Tue 7/10/18	Mon 7/16/18
99	Install Flooring	5 days	Fri 7/13/18	Thu 7/19/18
100	Install Millwork	3 days	Wed 7/18/18	Fri 7/20/18
101	Finish Electrical	3 days	Thu 7/19/18	Mon 7/23/18
102	Finish Plumbing	3 days	Thu 7/19/18	Mon 7/23/18
103	Finish Fire Sprinklers	1 day	Tue 7/17/18	Tue 7/17/18
104	Finish Heating	1 day	Fri 7/20/18	Fri 7/20/18
105	Finish Electrical Inspection	0 days	Mon 7/23/18	Mon 7/23/18
106	Finish Plumbing Inspection	0 days	Mon 7/23/18	Mon 7/23/18
107	Finish Fire Sprinkler Inspection	0 days	Mon 7/23/18	Mon 7/23/18
108	Finish Heating Inspection	0 days	Mon 7/23/18	Mon 7/23/18
109	Building Final Inspecion	0 days	Mon 7/23/18	Mon 7/23/18
110	Punch Walk	0 days	Mon 7/23/18	Mon 7/23/18
111	Punch Work	5 days	Tue 7/24/18	Mon 7/30/18
112	Final Walk	0 days	Mon 7/30/18	Mon 7/30/18
113	Substantial Completion	0 days	Mon 7/30/18	Mon 7/30/18

ARCE: Galen Amick
ARCE: Sarah Pascual
ARCH: Jackie Budidharma
ARCH: Evan Royer
CM: Brock Armstrong

HarT Harmonious Tectonics

Senior Project
780 South Davis Street
Weed, CA, 96094

SF (Livable):	1062
SF (Garage):	1434
Cost:	$ 149,601
Cost/SF:	$ 104

Budget Cost Breakdown

Item	Description	Estimate	Unit	Material	Labor	Equipment	Total
Foundation							$ 17,746
Concrete	Slab On Grade (4" Thick)	1053	SF	$ 2,106	$ 1,053	$ -	$ 3,159
	Slab Footing (12"x12")	157	LF	$ 1,468	$ 355	$ -	$ 1,823
	Footing (12"x24")	163	LF	$ 815	$ 1,141	$ -	$ 1,956
CMU	Stem Wall	326	SF	$ 2,367	$ 1,395	$ -	$ 3,762
Rebar	#4	51	EA	$ 215	$ 2,040	$ -	$ 2,255
Reinforcing Mesh		1	Roll	$ 95	$ 100	$ -	$ 195
Stairs	Entry Door	1	EA	$ 194	$ 418	$ -	$ 613
	Sliding Glass Door	1	EA	$ 267	$ 48		$ 315
Wood Container		1	EA	$ 120	$ 233	$ -	$ 353
Trenching		1	EA	$ -	$ 1,752	$ 546	$ 2,298
Sand		8	CY	$ 274	$ 160	$ -	$ 434
Visqueen		1800	SF	$ 54	$ 198	$ -	$ 252
Insulation (stem wall)	Rigid R-5	352	SF	$ 187	$ 144	$ -	$ 331
Floor							$ 13,528
Wood	Rim Joists (2x12)	187	BF	$ 146	$ 378	$ -	$ 524
	Floor Joists (2x12, 16" O.C.)	2152	BF	$ 1,679	$ 4,347	$ -	$ 6,026
	Sheathing (5/8")	1220	SF	$ 342	$ 830	$ -	$ 1,171
Insulation	Batt R-30	1112	SF	$ 1,557	$ 356	$ -	$ 1,913
LVT	Everywhere except bedrooms and bathrooms.	596	SF	$ 1,067	$ 1,192	$ -	$ 2,259
Travertine	Bathrooms	100	SF	$ 118	$ 200	$ -	$ 318
Carpet	Bedrooms	450	SF	$ 252	$ 225	$ -	$ 477
Base		280	LF	$ 120	$ 498	$ -	$ 619
Vapor Barrier		1112	SF	$ 122	$ 100	$ -	$ 222
Exterior Walls							$ 27,119
Wood	Panels (2x6, 16" O.C.)	1673	BF	$ 1,459	$ 1,364	$ -	$ 2,824
	Remaining Framing (2x6, 16" O.C.)	326	BF	$ 277	$ 359	$ -	$ 636
	Top Plate	263	LF	$ 224	$ 463	$ -	$ 686
	Bottom Plate	163	LF	$ 139	$ 287	$ -	$ 425
	Header	75	LF	$ 47	$ 183	$ -	$ 230
	Sheathing (5/8")	1568	SF	$ 439	$ 1,066	$ -	$ 1,505
Insulation	Roxul (R-23) + Rmax Thermasheath (R-13) = R-36	1830	SF	$ 3,697	$ 1,263	$ -	$ 4,959
Siding	Fiber Cement Panels; Color = Timber Bark	1920	SF	$ 2,227	$ 1,581		$ 3,808
Windows	Clearstory - 4010 Fixed	4	EA	$ 713	$ 409	$ -	$ 1,122
	Vertical - 2650 Tilt-Turn	6	EA	$ 1,914	$ 614	$ -	$ 2,528
	Horizontal - 4020 Awning	1	EA	$ 103	$ 102	$ -	$ 205
	Bathroom - 2812 Awning	2	EA	$ 628	$ 205	$ -	$ 833
Tyvek Homewrap		2	Rolls	$ 318	$ 600	$ -	$ 918
Tyvek Tape		3	Rolls	$ 42	$ 60	$ -	$ 102
Tyvek Flashing Tape		1	Box	$ 270	$ 50	$ -	$ 320
Dupont RainVent Batten		196	EA	$ 1,094	$ 784	$ -	$ 1,878
Base Flashing		170	LF	$ 68	$ 9	$ -	$ 77
Window/Door Flashing		50	LF	$ 20	$ 3	$ -	$ 23
Exterior Paint		400	SF	$ 92	$ 448	$ -	$ 540
Wood Fence		115	LF	$ 1,929	$ 1,244	$ -	$ 3,173
Wood Gate		1	EA	$ 112	$ 216	$ -	$ 328
Roof							$ 32,205
Wood	Rafters (2x12, 16" O.C.)	4028	BF	$ 3,142	$ 7,049	$ -	$ 10,191
	Rafters (2x8, 16" O.C.)	224	BF	$ 175	$ 392	$ -	$ 567
	Ridge (4x12)	51	LF	$ 187	$ 520	$ -	$ 707
	Valley Beam (PSL 5-1/4" x 14" 28')	56	LF	$ 1,292	$ 280	$ -	$ 1,572
	Fascia (2x12)	324	BF	$ 253	$ 891	$ -	$ 1,144
	Air Gap (1x4)	452	BF	$ 832	$ 122	$ -	$ 954
	Sheathing (5/8")	2304	SF	$ 645	$ 1,705	$ -	$ 2,350
Insulation	Rmax Thermasheath (1 Layer, R-13)	2304	SF	$ 2,120	$ 507	$ -	$ 2,627
	Roxul (R-23)	536	SF	$ 590	$ 204	$ -	$ 793
	Roxul (R-15)	536	SF	455.6	$ 204	$ -	$ 659
Metal Roof Panels	Color = Charcoal	2304	SF	$ 2,327	$ 3,525	$ -	$ 5,852
Roof Underlayment		10	Rolls	$ 1,902	$ 150	$ -	$ 2,052
Snow Stop		35	EA	$ 53	$ 88	$ -	$ 140
Drip Edge		230	LF	$ 92	$ 12	$ -	$ 104
Gutters		60	LF	$ 254	$ 203	$ -	$ 458
Downspouts		2	EA	$ 179	$ 13	$ -	$ 192
Stacks		98	LF	$ 805	$ 1,039	$ -	$ 1,843
Interior Walls							$ 19,530
Wood	Studs (2x4)	720	BF	$ 533	$ 720	$ -	$ 1,253
	Top Plate (2x4)	132	LF	$ 112	$ 232	$ -	$ 345
	Bottom Plate (2x4)	132	LF	$ 112	$ 232	$ -	$ 345
	Ceiling Joists (2x4)	375	BF	$ 278	$ 450	$ -	$ 728
	Sheathing (5/8")	288	SF	$ 81	$ 196	$ -	$ 276
	Open Ceiling Plywood (3/8")	1312	SF	$ 722	$ 984	$ -	$ 1,706
Drywall	Wall	3264	SF	$ 881	$ 1,926	$ -	$ 2,807
	Ceiling	544	SF	$ 147	$ 408	$ -	$ 555
	Green Board	512	SF	$ 225	$ 302	$ -	$ 527
	Type X	320	SF	$ 179	$ 189	$ -	$ 368
Insulation	Ceiling, Blown, GreenFiber (R-10.5)	574	SF	$ 161	$ 276	$ 115	$ 551

ARCE: Galen Amick
ARCE: Sarah Pascual
ARCH: Jackie Budidharma
ARCH: Evan Royer
CM: Brock Armstrong

HarT Harmonious Tectonics

Senior Project
780 South Davis Street
Weed, CA, 96094

SF (Livable): 1062
SF (Garage): 1434
Cost: $ 149,601
Cost/SF: $ 104

Budget Cost Breakdown

Item	Description	Estimate	Unit	Material	Labor	Equipment	Total
	Roxul Safe 'n Sound	600	SF	$ 456	$ 168	$ -	$ 624
Corner Beads		500	LF	$ 90	$ 635	$ -	$ 725
Tape, Sand, Prime, and Paint	Drywall	4640	SF	$ 789	$ 4,222	$ -	$ 5,011
Stain	Exposed Ceiling	1312	SF	$ 131	$ 302	$ -	$ 433
Paint	Interior and Closet Doors	10	EA	$ 135	$ 460	$ -	$ 595
Doors	Entry Door	1	EA	$ 618	$ 65	$ -	$ 683
	Interior Doors	8	EA	$ 630	$ 360	$ -	$ 990
	Closet Doors	4	EA	$ 211	$ 220	$ -	$ 431
	Sliding Glass Doors	1	EA	$ 428	$ 150	$ -	$ 578
Electrical							$ 7,215
Meter/Panel Box		1	EA	$ 149	$ 328	$ -	$ 477
Outlet	GFCI	10	EA	$ 136	$ 316	$ -	$ 451
	AFCI	12	EA	$ 240	$ 379	$ -	$ 618
	Dryer Outlet	1	EA	$ 61	$ 61	$ -	$ 122
	Range Outlet	1	EA	$ 90	$ 93	$ -	$ 183
	Lighting Outlet	41	EA	$ 587	$ 500	$ -	$ 1,087
Switch	Single	14	EA	$ 24	$ 319	$ -	$ 343
	Duplex	4	EA	$ 7	$ 160	$ -	$ 167
	Dimmer	2	EA	$ 56	$ 46	$ -	$ 102
Wire	#12 AWG (250' Roll)	2	EA	$ 238	$ -	$ -	$ 238
Fan light		2	EA	$ 278	$ 66	$ -	$ 344
Vanity light		2	EA	$ 112	$ 66	$ -	$ 177
Strip Lighting		6	EA	$ 189	$ 277	$ -	$ 466
Pendants		3	EA	$ 200	$ 146	$ -	$ 345
Recessed		12	EA	$ 306	$ 583	$ -	$ 888
Chandelier		1	EA	$ 49	$ 71	$ -	$ 120
Exterior Sconces		7	EA	$ 119	$ 340	$ -	$ 459
Spotlight		3	EA	$ 270	$ 146	$ -	$ 416
Garage Light		2	EA	$ 69	$ 143	$ -	$ 212
Plumbing							$ 10,218
Kitchen Sink		1	EA	$ 199	$ 153	$ -	$ 352
Bathroom Sink		2	EA	$ 78	$ 262	$ -	$ 340
Bathroom Faucet		2	EA	$ 98	$ -	$ -	$ 98
Shower		1	EA	$ 519	$ 153	$ -	$ 672
Shower Faucet		1	EA	$ 129	$ 66	$ -	$ 195
Bath Shower Combo		1	EA	$ 379	$ 182	$ -	$ 561
Bath Shower Combo Faucet		1	EA	$ 65	$ 85	$ -	$ 150
Toilets		2	EA	$ 238	$ 200	$ -	$ 438
Garbage Disposal		1	EA	$ 100	$ 35	$ -	$ 135
Electric Instant Water Heaters	Bedrooms	2	EA	$ 1,010	$ 200	$ -	$ 1,210
	Kitchen	1	EA	$ 425	$ 100	$ -	$ 525
Pex		150	LF	$ 323	$ 441	$ -	$ 764
Sewage		60	LF	$ 1,356	$ 731	$ -	$ 2,087
Hose Bib		2	EA	$ 13	$ 50	$ -	$ 63
Hose Bib Pipe		1	EA	$ 12	$ 25	$ -	$ 37
SOV		10	EA	$ 392	$ 56	$ -	$ 448
Hose Holder		2	EA	$ 40	$ 20	$ -	$ 60
Anti Scald Fitting		3	EA	$ 240	$ 45	$ -	$ 285
P Trap		7	EA	$ 253	$ 189	$ -	$ 442
Water Utility Line		40	LF	$ 269	$ 364	$ -	$ 633
Water Service Connection		1	EA	$ -	$ 268	$ -	$ 268
Water Meter		1	EA	$ 100	$ 50	$ -	$ 150
Pipe Heater for Cold Climates		4	EA	$ 225	$ 80	$ -	$ 305
Heating							$ 1,926.43
Wood Stove		1	EA	$ 658.83	$ 567.60	$ -	$ 1,226.43
Ceramic Heaters		4	EA	$ 594.64	$ 105.36	$ -	$ 700.00
Fire Sprinklers							$ 3,043
Water Motor		1	EA	$ 446	$ 99	$ -	$ 545
Sprinkler	Pendant	5	EA	$ 143	$ 117	$ -	$ 260
	Recessed	10	EA	$ 396	$ 235	$ -	$ 631
Tamper Switch		1	EA	$ 238	$ 23	$ -	$ 262
Piping		150	LF	$ 389	$ 239	$ -	$ 627
Tees		6	EA	$ 44	$ 170	$ -	$ 213
Elbows		6	EA	$ 30	$ 113	$ -	$ 143
Cap		8	EA	$ 19	$ 76	$ -	$ 95
Cross		6	EA	$ 40	$ 228	$ -	$ 268
Millwork							$ 9,918
Medicine cabinets		2	EA	$ 162	$ 30	$ -	$ 192
Kitchen Sink Cabinet		1	EA	$ 184	$ 38	$ -	$ 222
Over Head Cabinets		7	EA	$ 931	$ 315	$ -	$ 1,246
Kitchen Cabinets		7	EA	$ 1,379	$ 224	$ -	$ 1,603
Kitchen Corner Cabinet		1	EA	$ 149	$ 32	$ -	$ 181
Bathroom Cabinets		2	EA	$ 400	$ 76	$ -	$ 476
Countertop	Kitchen	28	LF	$ 3,302	$ 1,090	$ -	$ 4,393
	Bathrooms	2	EA	$ 1,053	$ 74	$ -	$ 1,127
Master Closet Shelving		4	EA	$ 143	$ 40	$ -	$ 183

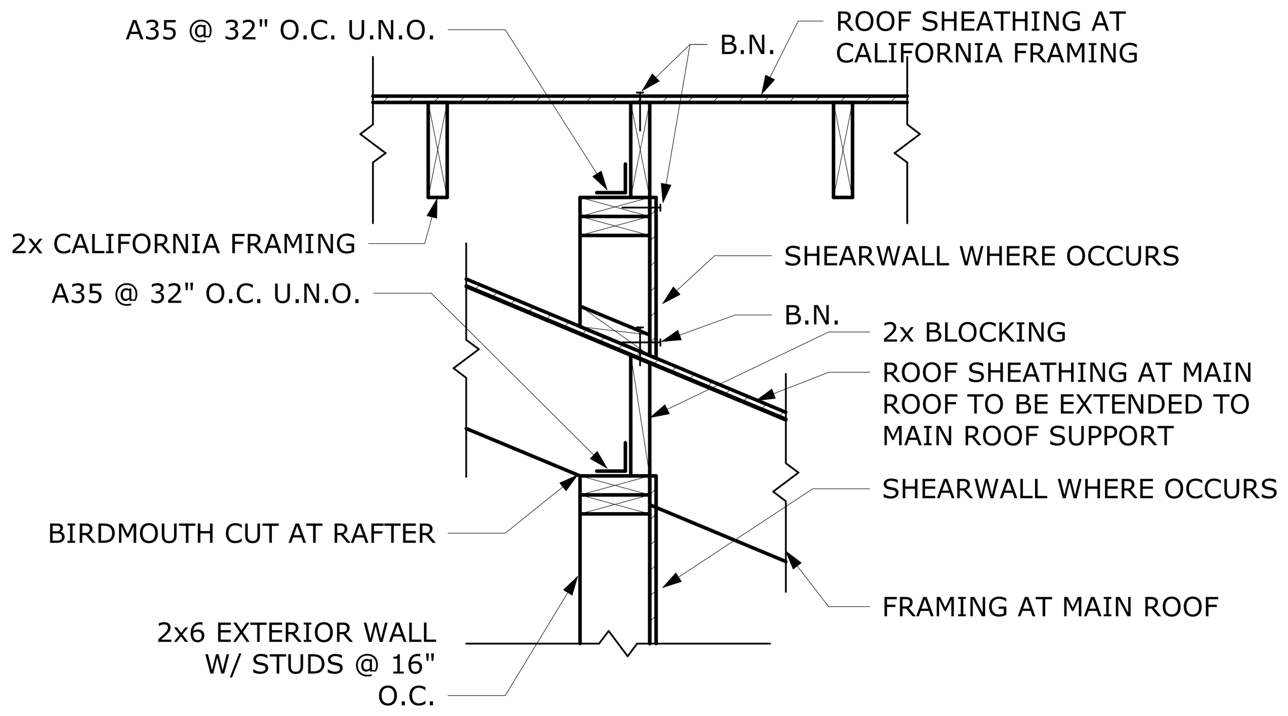
ARCE: Galen Amick
ARCE: Sarah Pascual
ARCH: Jackie Budidharma
ARCH: Evan Royer
CM: Brock Armstrong

Senior Project
780 South Davis Street
Weed, CA, 96094

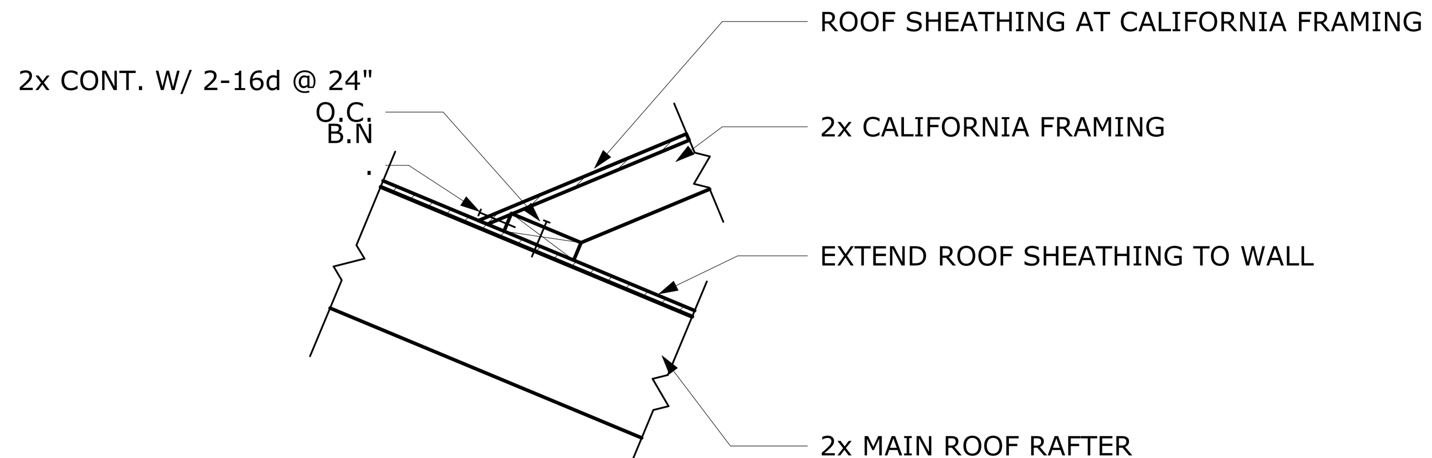
SF (Livable): 1062
SF (Garage): 1434
Cost: $ 149,601
Cost/SF: $ 104

Budget Cost Breakdown

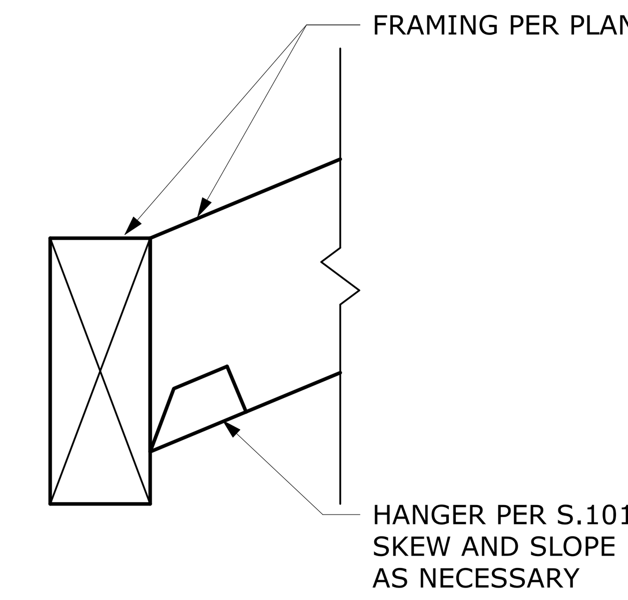
Item	Description	Estimate	Unit	Material	Labor	Equipment	Total
Master Closet Hanging Rods		2	EA	$ 52	$ 50	$ -	$ 102
Kids Closet Shelving		2	EA	$ 72	$ 20	$ -	$ 92
Kids Closet Handing Rods		2	EA	$ 52	$ 50	$ -	$ 102
Appliances						$	1,774
Microwave	Magic Chef	1	EA	$ 100	$ 10	$ -	$ 110
Dishwasher	Frigidaire	1	EA	$ 278	$ 75	$ -	$ 353
Fridge	Frigidaire	1	EA	$ 598	$ 100	$ -	$ 698
Range	Frigidaire	1	EA	$ 428	$ 75	$ -	$ 503
Range Hood	NuTone	1	EA	$ 60	$ 50	$ -	$ 110
Car Port						$	2,214
Wood	Studs (2x4)	226	BF	$ 167	$ 226	$ -	$ 393
	Top Plate (2x4)	36	LF	$ 31	$ 63	$ -	$ 94
	Bottom Plate (2x4)	24	LF	$ 20	$ 42	$ -	$ 63
	Sheathing (5/8")	448	SF	$ 125	$ 305	$ -	$ 430
	Header	36	BF	$ 27	$ 88	$ -	$ 114
Simpson Strong Walls		2	EA	$ 720.00	$ 400.00	$ -	$ 1,120.00
Fasteners						$	2,500
Allowance				$ -	$ -	$ -	$ 2,500
Shipping						$	665
High 20' Container		500	mi	$ -	$ 1.33	$ -	$ 665



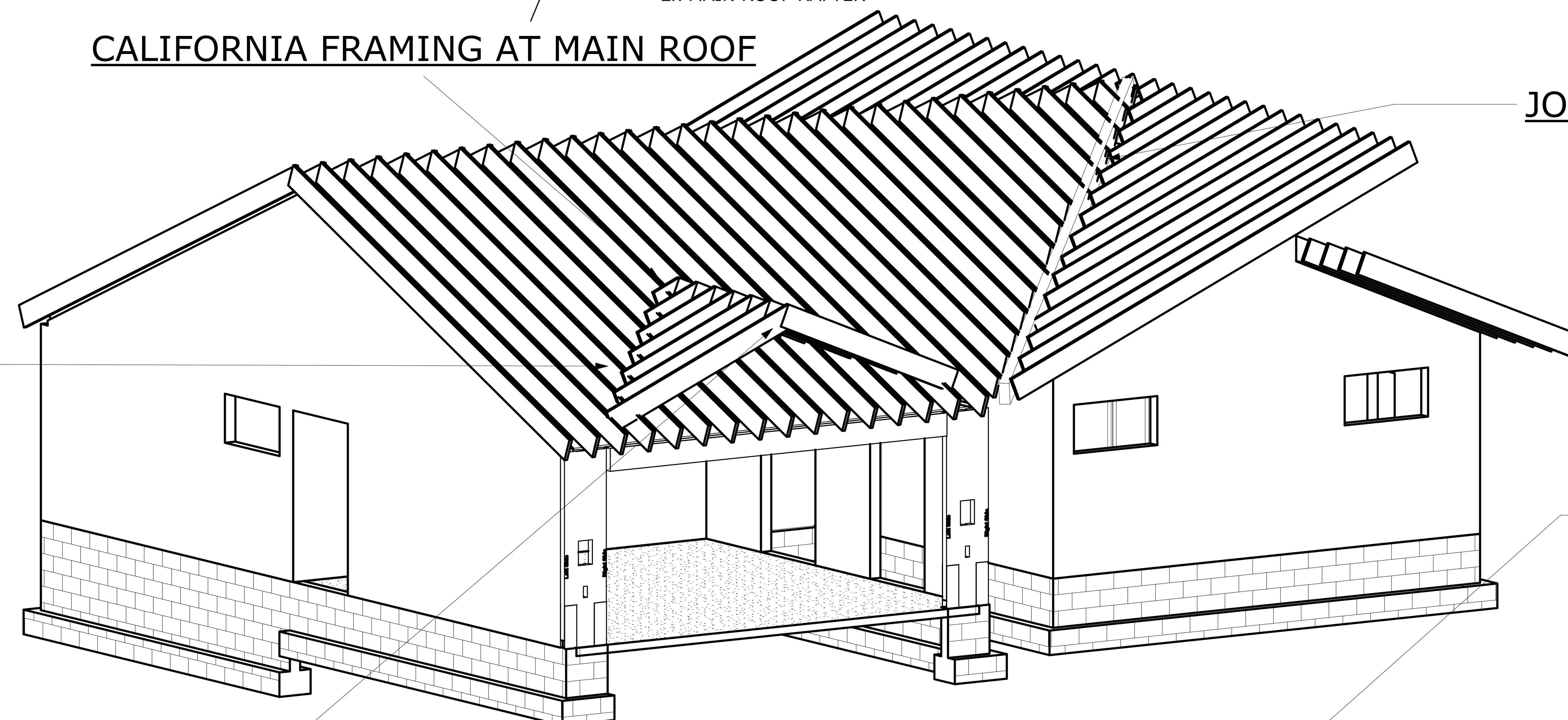
CALIFORNIA FRAMING AT SHEARWALL

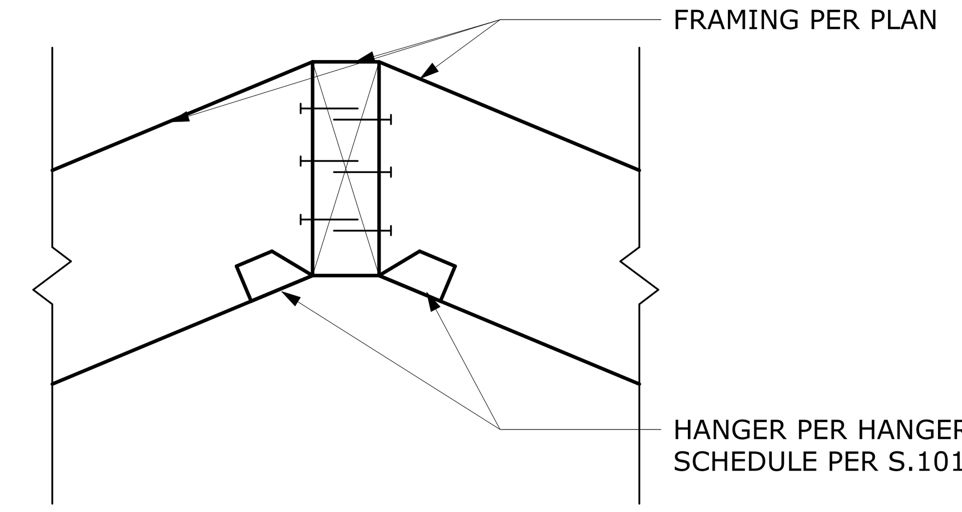


CALIFORNIA FRAMING AT MAIN ROOF

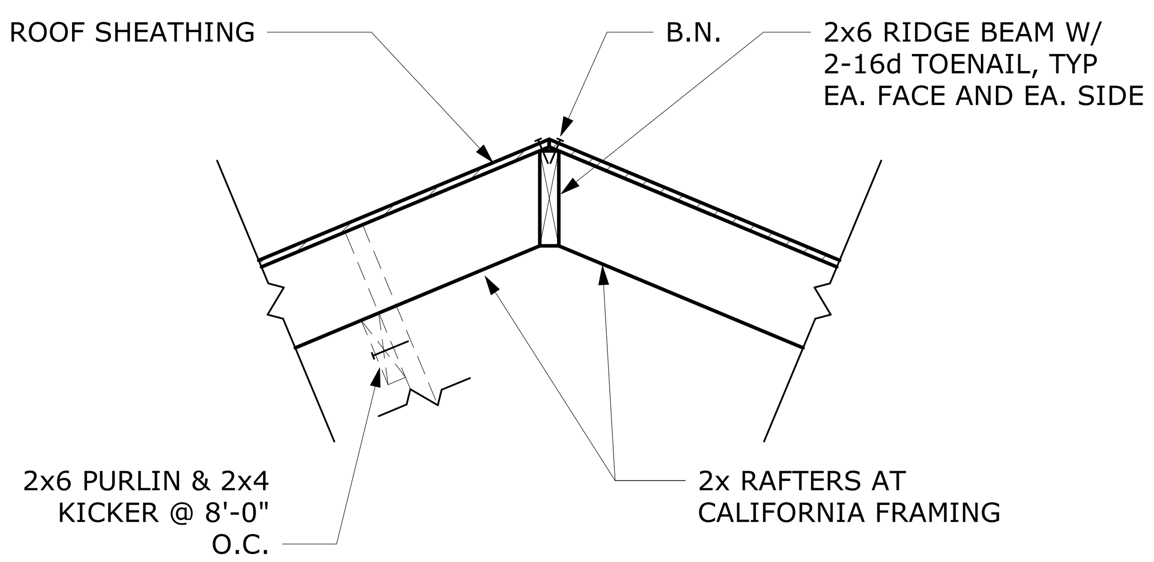


JOIST TO VALLEY BEAM

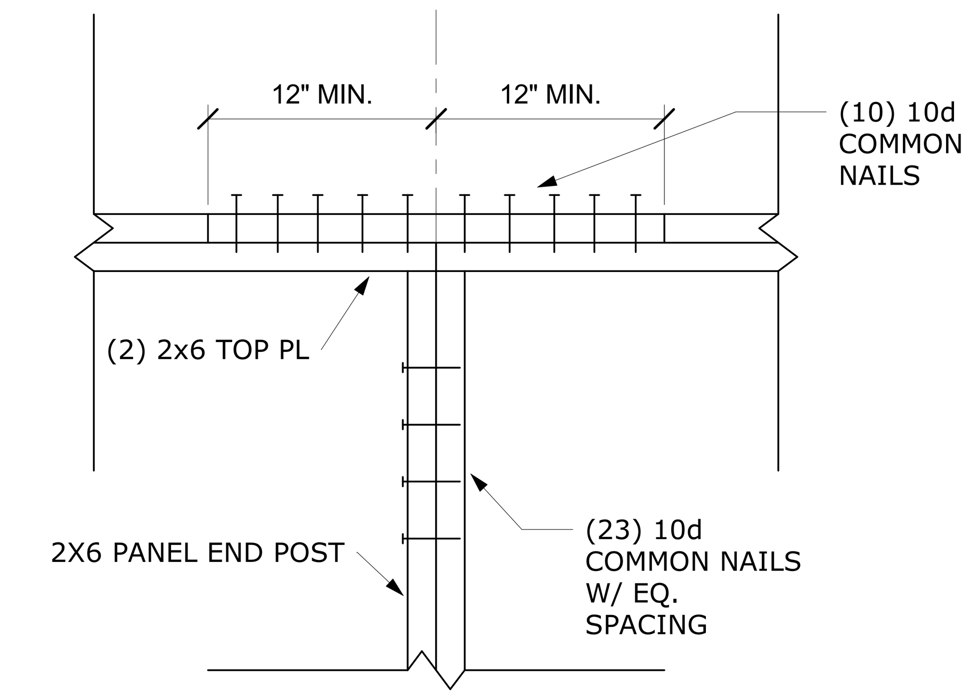




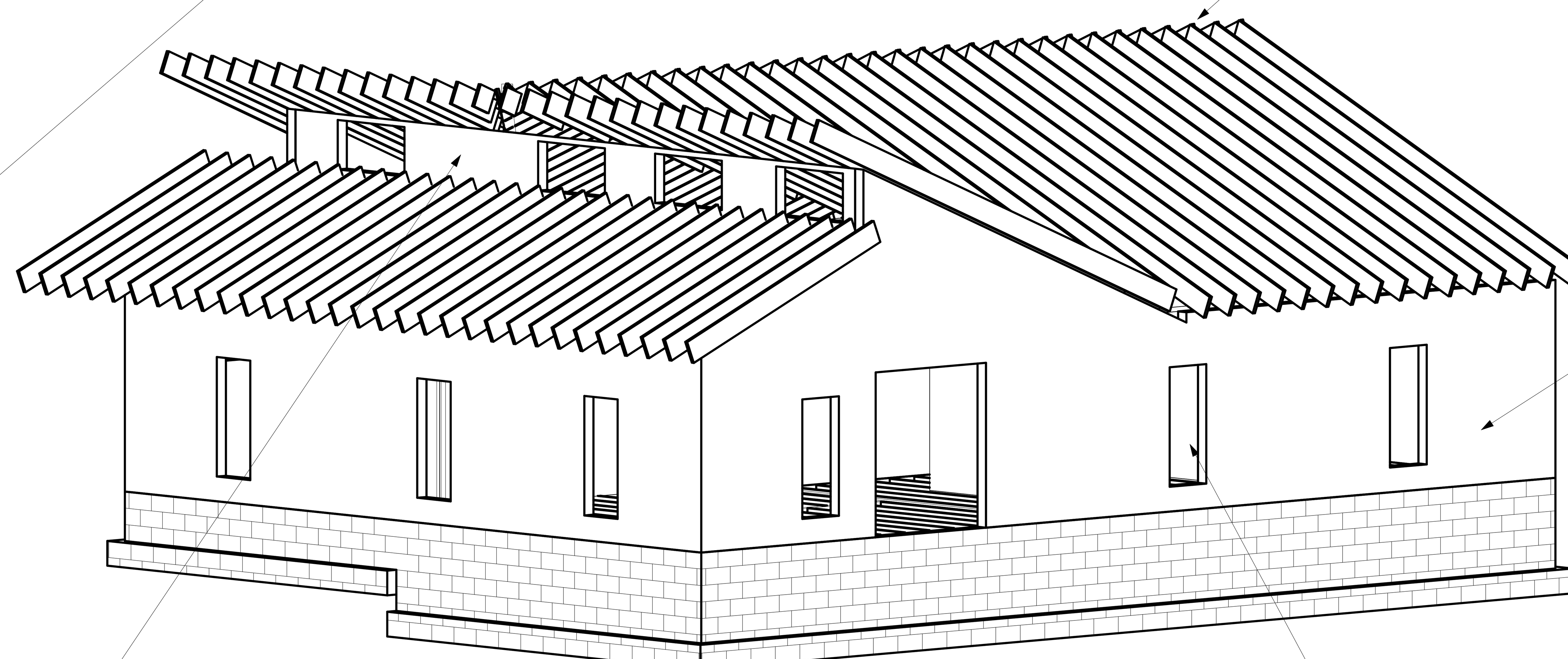
RAFTER TO RIDGE BEAM

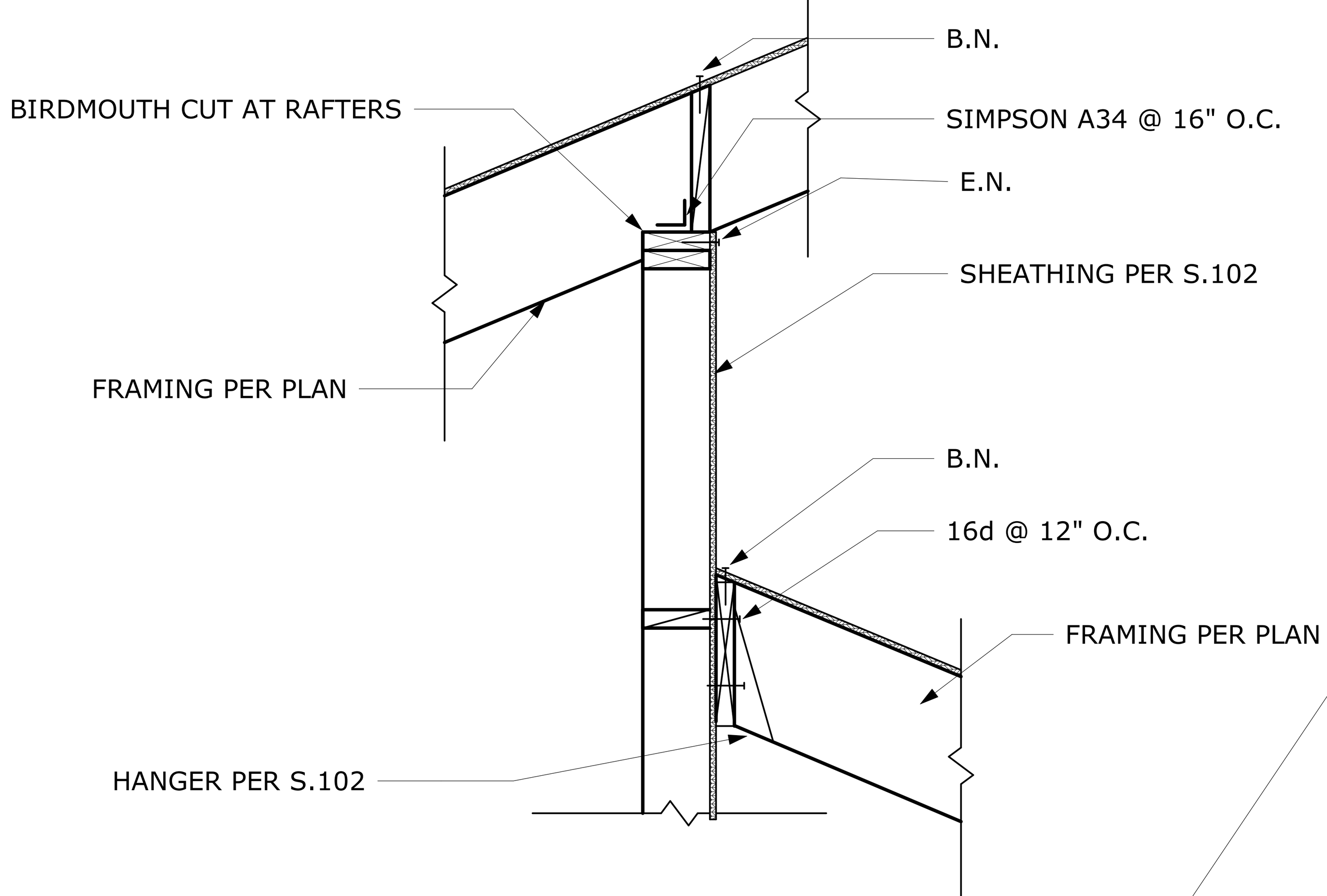


CALIFORNIA FRAMING RIDGE

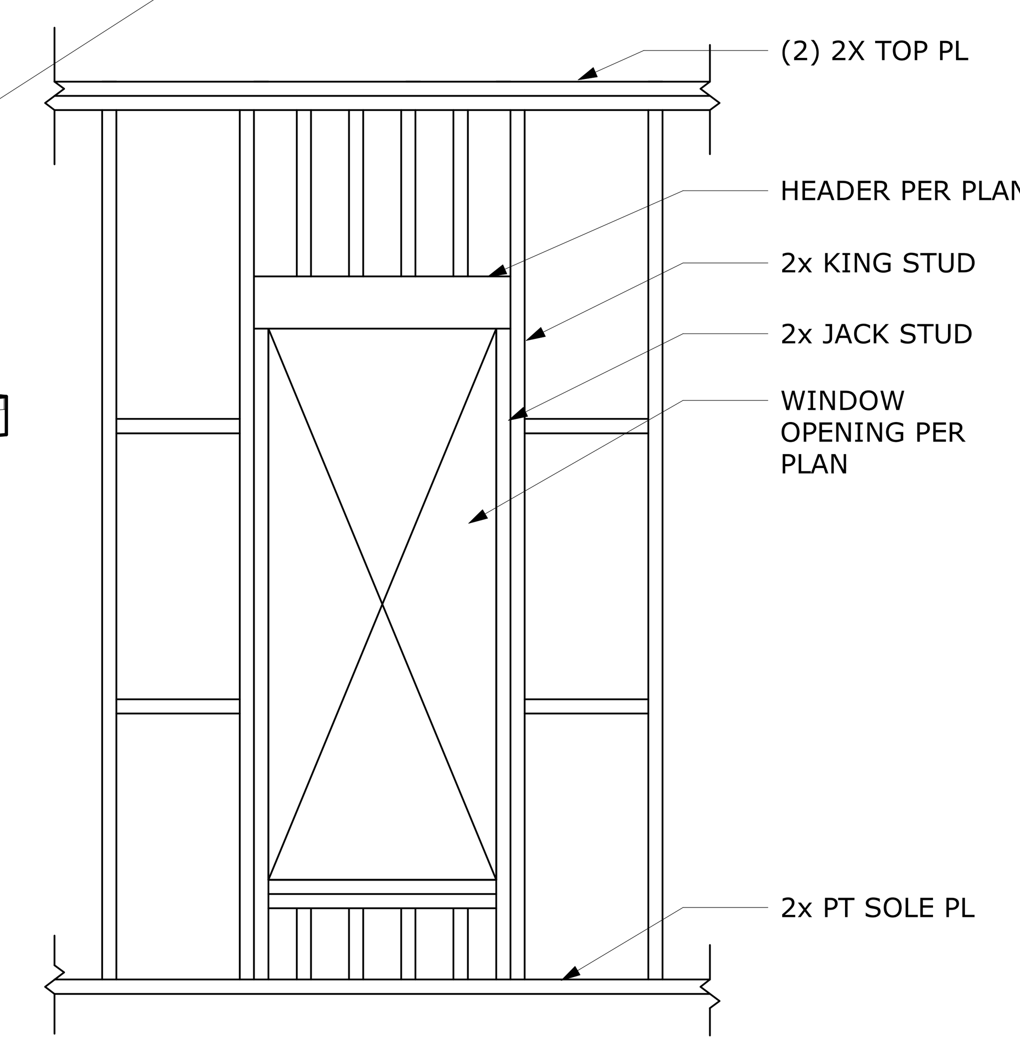


PANEL TO PANEL CONNECTION





CLERESTORY FRAMING

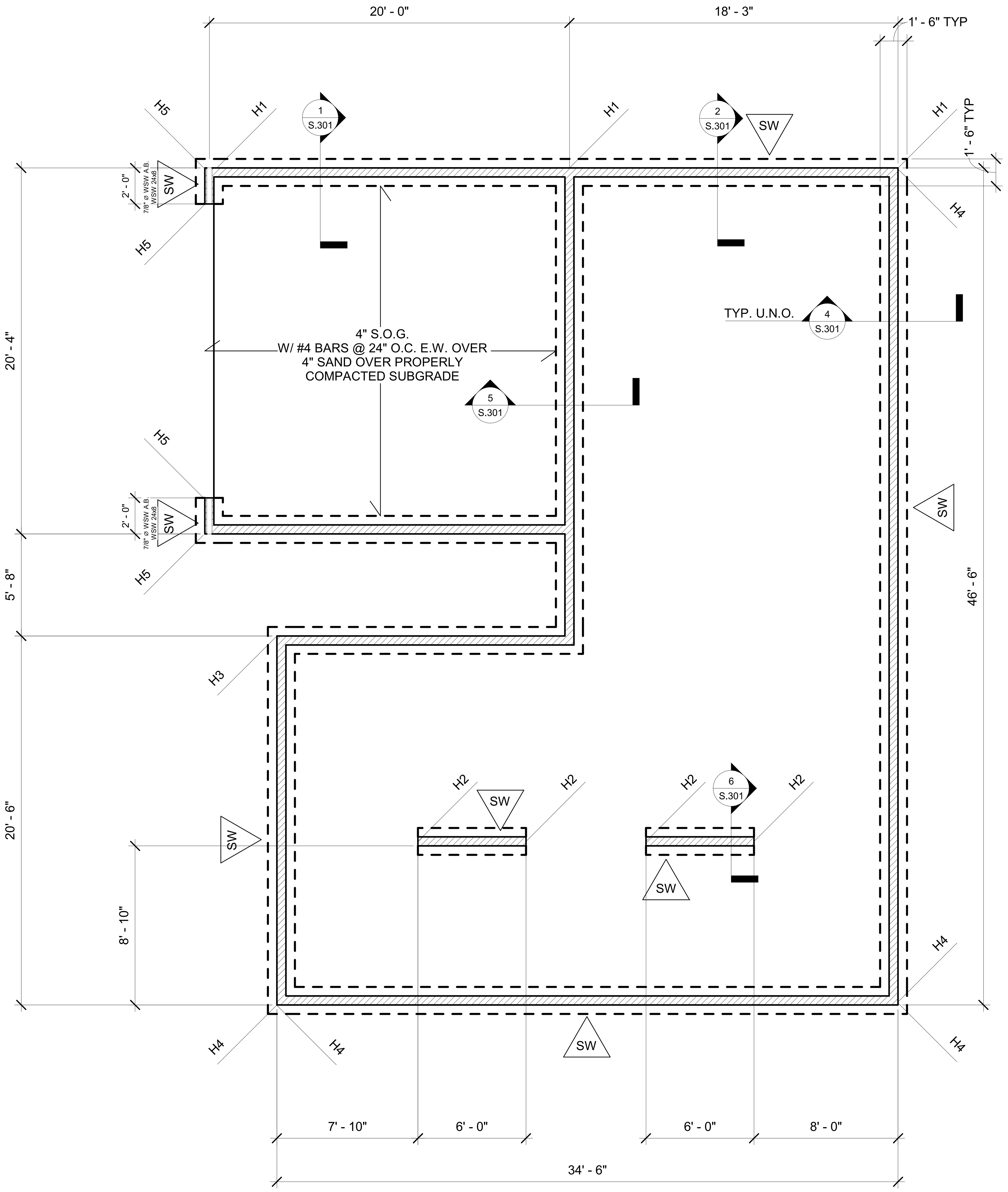


OPENING AT SHEARWALL

HARMONIOUS TECTONICS

Galen Amick - Brock Armstrong - Jackie Budidharma - Sarah Pascual - Evan Royer


INTERIOR BEARING WALL
PT 2X LEDGER
1/2" DIAM. A.B. @ 4' O.C.
FRAMING AND SHEATHING PER S.102
4" S.O.G.
HANGER PER S.102
0' - 6"
0' - 7"
18" MIN.
8" CMU STEM WALL
(2) #4 (B)
SEE PLAN
INTERIOR SHEAR WALL
NON-LOADBEARING INTERIOR WALL (2x4 WALL W/ STUDS @ 16" O.C. U.N.O)
FLOOR SHEATHING PER S.101
FLOOR FRAMING PER S.101
PERPENDICULAR FLOOR JOIST TO NON-BEARING INTERIOR WALL
SIMPSON STRONG WALL
INSTALL PER MANUFACTURER REQUIREMENTS
SHEARWALL WHERE OCCURS
A.B. PER PLAN
2x6 PT SOLE PLATE
4" S.O.G.
0' - 7"
0' - 6"
18" MIN.
#4 @ 24" O.C.
8" CMU STEM WALL
12" TYP.
SEE PLAN
(2) #4 (B)
SLAB ON GRADE
SHEARWALL WHERE OCCURS SEE S.102 FOR SHEATHING
℄
16d @ 12" O.C.
E.N.
A.B. PER S.101
SHEATHING PER S.102
0' - 7"
FRAMING PER S.102
HANGER PER S.102
8" CMU STEM WALL
(2) #4 (B)
FLOOR BEAM TO INTERIOR SHEARWALL
SHEATHING PER S.101
16d @ 12" O.C.
E.N.
SHEARWALL WHERE OCCURS
A.B. PER PLAN
2X6 PT SOLE PLATE
E.N.
FRAMING PER PLAN
0' - 7"
18" MIN.
2' - 0"
(2) #4 (B)
12" TYP.
SEE PLAN
FOUNDATION TO PARALLEL FLOOR JOIST
2' -6" TYP
TOP BARS STEPPED AREA (2) #4 MIN
#4 MIN
FACE OF STEPS SHALL BE CAST AGAINST UNDISTRUBED EARTH. IF EXCAVATION RAVELS, BACKFILL w/ CONC WHEN FTG IS CAST.
H
1'-6" MAX
2xH MIN
2xH MIN
BTM OF FTG
STEPPED FOOTING
SHEATHING PER PLAN
HANGER PER PLAN
FRAMING PER PLAN
JOIST TO BEAM
SHEATHING PER S.101
HANGER PER S.101
16d @ 12" O.C.
E.N.
SHEARWALL WHERE OCCURS
A.B. PER PLAN
2X6 PT SOLE PLATE
FRAMING PER PLAN
0' - 7"
18" MIN.
2' - 0"
(2) #4 (B)
12" TYP.
SEE PLAN
FOUNDATION TO PERPENDICULAR FLOOR JOIST
HARMONIOUS TECTONICS



1 Foundation Plan
1/4" = 1'-0"

FOUNDATION PLAN NOTES:

FOUNDATION STEM WALL:
8" THICK MIN 3 WYTHE (MIN) 8x8x16 CMU FULLY GROUTED w/ 4# VERTICAL REINF. AT 4' O.C. & #4 CONT. HORIZ. REINF. @ 16"

TRENCH FOOTING:
18" x 12" CONC STEPPED FOOTING PURED 24" BELOW GRADE (TO BEAR ON UNDISTURBED SOIL) WITH CONT #4 REINF.

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 LOACTIONS IN FIELD
5. ANCHORAGE @ 4' UNO (SEE GENERAL NOTES)
6. SOIL AT BEARING SHALL BE MINIMUM 1500 PSF CAPACITY ON UNDISTURBED SOIL OR COMPACTED STRUCTURAL FILL AND SHALL BE VERIFIED & APPROVED BY LICENCED GEO-TECHNICAL ENGINEER
7. LEGEND:

DENOTES 8" CMU STEM WALL

SW — DENOTES SHEAR WALL LOCATION

WSW A.B. / WSW Lxh / SW — DENOTES SIMPSON STRONGWALL LENGTH L & HEIGHT h WITH SIMPSON STRONWALL ANCHOR BOLT

HOLDOWN/STRAP SCHEDULE		
MARK	HOLDOWN/STRAP	CAPACITY (LBS)
H1	SIMPSON HD3B	1865
H2	SIMPSON HD7B	6645
H3	SIMPSON HDU2-SDS2.5	3075
H4	SIMPSON DTT2Z	1825
H5	7/8" ⌀ SIMPSON WSW A.B.	11900

SHEARWALL SCHEDULE						
MARK	APA SHEATHING TYPE	NAILING (BOUNDARY, EDGE, FIELD)	SOLE PLATE	WALL STUDS & BLOCKING	RIM/BLOCKING CONNECTION	ANCHOR SPACING
SW	15/32" STRUCTURAL 1	8d @ 6", 6", 6"	2x	2x	16d @ 12" O.C.	1/2" DIAM. @ 4' O.C.

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, SILL 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/SILL BOLTS AT EACH SILL PLATE 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 3" x 3" x 0.229" MIN PLATE WASHERS AT EACH ANCHOR BOLT
9. SILL BOLT EMBEDMENT IN CONCRETE SHALL BE MIN 7"

.

HARMONIOUS TECTONICS

G. AMICK
B. ARMSTRONG
J. BUDIDHARMA
S. PASCUAL
E. ROYER

1 GRAND AVE
SAN LUIS OBISPO, CA 93410

License SE Seal:

Project Title:

GNS - WEED HOUSING

Site:

780 S. DAVIS ST
WEED, CA 96094

Revisions		
No.	Desc.	Date

Author: Author

Checked by: Checker

Plot Date:

12/1/2017 12:11:58 AM

Sheet Name:

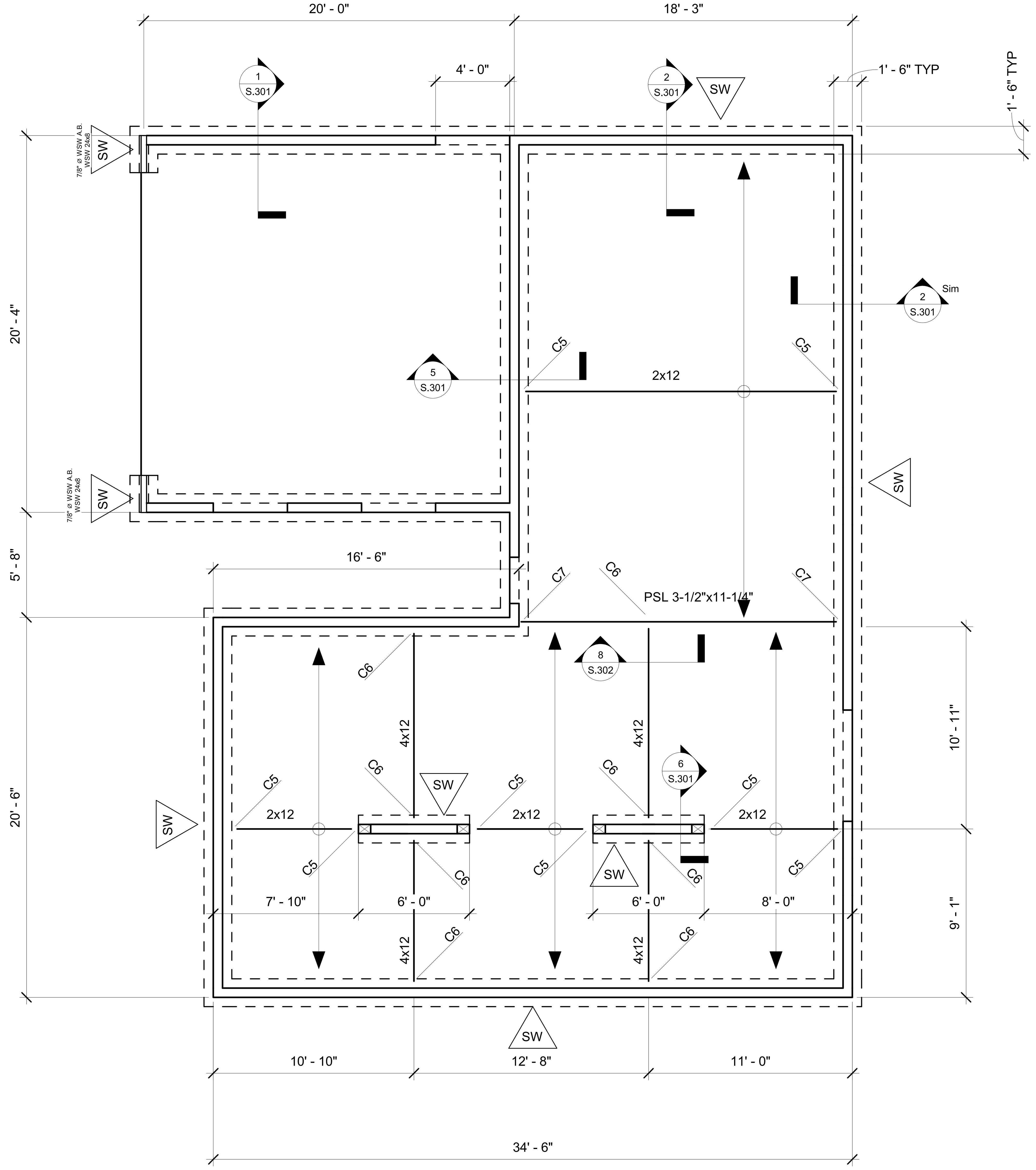
Foundation Plan

Scale

1/4" = 1'-0"

Sheet Number:

S.101



1 Floor Framing Plan
1/4" = 1'-0"

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 STRUCT I PANNEL 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. SPAN RATING 32/16 STAGGER JOINTS
4. PANEL BOUNDARY NAILING B.N. AT ALL BEAMS, JOISTS, BLOCKING, ECT.
5. ALL STRUCTURAL WALLS ARE TO BE 2X6 DF-L #2 STUDS @ 16" O.C. U.N.O.
6. SEE ARCHITECTURAL DRAWINGS FOR NON-LOADING BEARING INTERIOR WALLS AND PLUMBING WALL LOCATIONS.
7. LEGEND:

SWX — DENOTES SHEAR WALL.

DENOTES 2X6 WALL W/ STUDS @ 16" O.C.

DENOTES 6X8 P.T.DF-L #1 POST

HANGER SCHEDULE		
MARK	HANGER	CAPACITY (LBS)
C1	SIMPSON LRU267	980
C2	SIMPSON LSSU210	1145
C3	SIMPSON VPA2	1050
C4	SIMPSON MSC5 W/ H=12"	6290
C5	SIMPSON LU210	850
C6	SIMPSON HUC412	2380
C7	SIMPSON HUS410	3295
NOTE: ALL CONNECTORS TO BE INSTALLED PER MANUFACTURER REQUIREMENTS.		

SHEARWALL SCHEDULE						
MARK	APA SHEATHING TYPE	NAILING (BOUNDARY, EDGE, FIELD)	SOLE PLATE	WALL STUDS & BLOCKING	RIM/BLOCKING CONNECTION	ANCHOR SPACING
SW	15/32" STRUCTURAL 1	8d @ 6", 6", 6"	2x	2x	16d @ 12" O.C.	1/2" DIAM. @ 4' O.C.

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, SILL 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/SILL BOLTS AT EACH SILL PLATE 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 3" x 3" x 0.229" MIN PLATE WASHERS AT EACH ANCHOR BOLT
9. SILL BOLT EMBEDMENT IN CONCRETE SHALL BE MIN 7"

.

HARMONIOUS TECTONICS

G. AMICK
B. ARMSTRONG
J. BUDIDHARMA
S. PASCUAL
E. ROYER

1 GRAND AVE
SAN LUIS OBISPO, CA 93410

License SE Seal:

Project Title:

GNS - WEED HOUSING

Site:

780 S. DAVIS ST
WEED, CA 96094

Revisions		
No.	Desc.	Date

Author: Author

Checked by: Checker

Plot Date:

12/1/2017 12:11:58 AM

Sheet Name:

Floor Framing Plan

Scale

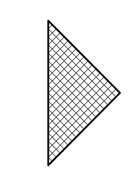
1/4" = 1'-0"

Sheet Number:

S.102

ROOF FRAMING PLAN NOTES:

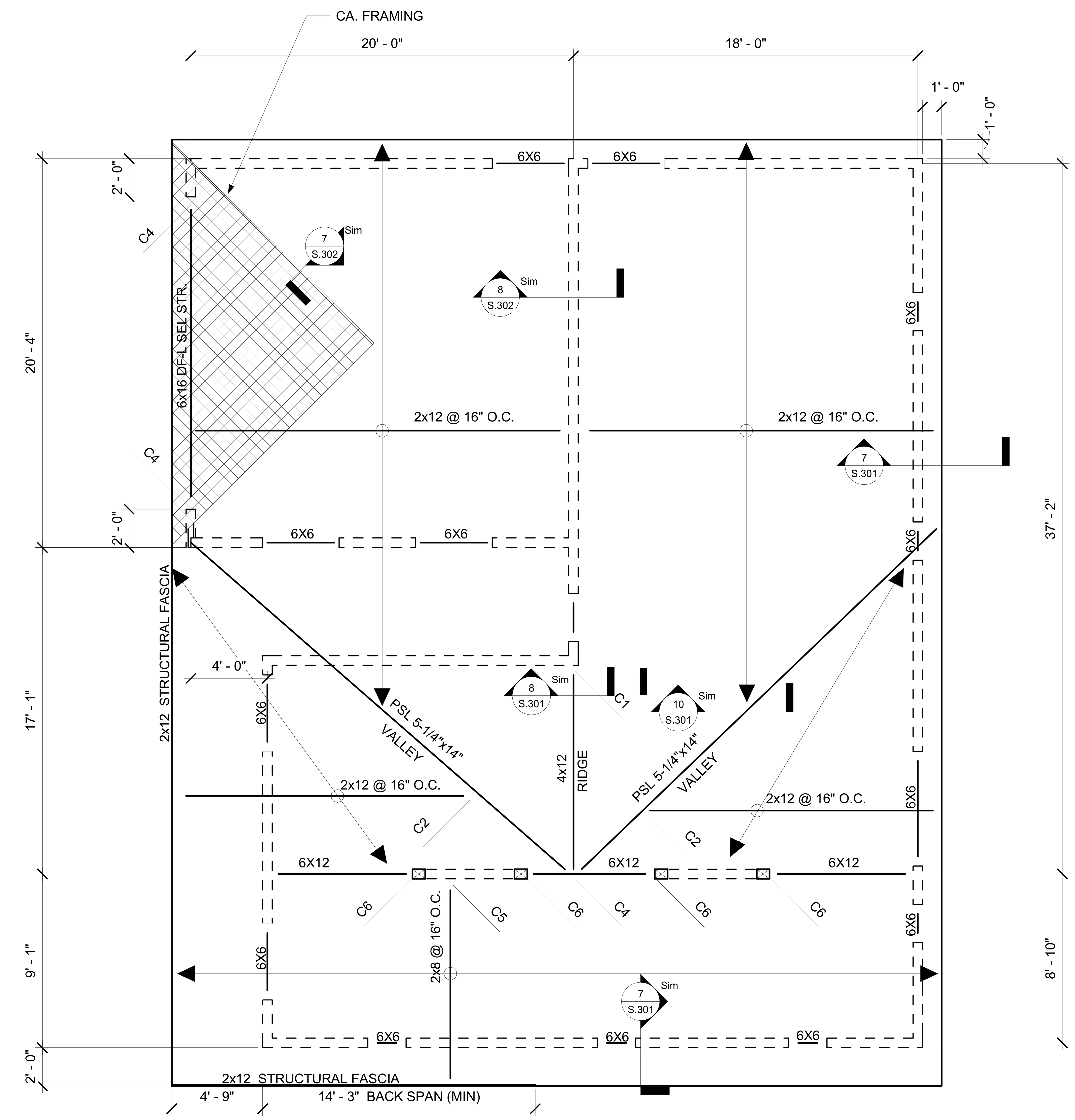
1. SEE GENERAL NOTES FOR SPECIFICATIONS.
2. RAFTERS SHALL BE INSTALLED AT 16" O.C. U.N.O.
3. ROOF OVERHANG SHALL BE 12" U.N.O.
4. ROOF SLOPE SHALL BE 5:12 U.N.O.
5. SHEAR CONNECTORS AND BLOCKING AT THE DOUBLE TOP PLATE SHALL BE INSTALLED PRIOR TO INSTALLATION OF ROOF SHEATHING.
6. ROOF SHEATHING SHALL BE 1/2" WOOD STRUCT I PANNEL 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 32/16 STAGGER JOINTS
7. PANEL BOUNDARY NAILING B.N. AT ALL BEAMS, JOISTS, BLOCKING, ECT.
8. DOUBLE TOP PLATES SHALL BE (2) 2X6 DF-L #2.
9. SEE HANGER SCHEDULE. ALL MANUFACTURED CONNECTORS SHALL BE INSTALLED PER MANUFACTURER REQUIREMENTS. USE SIMPSON HU HANGER WHERE NOT INDICATED.
10. PSL - PARALLEL STRAND LUMBER
11. LEGEND:


DENOTES CALIFORNIA FRAMING

HANGER SCHEDULE

MARK	HANGER	CAPACITY (LBS)
C1	SIMPSON LRU267	980
C2	SIMPSON LSSU210	1145
C3	SIMPSON HUS410	3295
C4	SIMPSON MSC5 W/ H=12"	6290
C5	SIMPSON LU210	850
C6	SIMPSON HUC412	2380
C7		

NOTE: ALL CONNECTORS TO BE INSTALLED PER MANUFACTURER REQUIREMENTS.



1 Roof Framing Plan
1/4" = 1'-0"

HARMONIOUS TECTONICS

G. AMICK
B. ARMSTRONG
J. BUDIDHARMA
S. PASCUAL
E. ROYER

1 GRAND AVE
SAN LUIS OBISPO, CA 93410

License SE Seal:

Project Title:

GNS - WEED HOUSING

Site:

780 S. DAVIS ST
WEED, CA 96094

Revisions

No.	Desc.	Date

Author: Author

Checked by: Checker

Plot Date:

12/1/2017 12:11:58 AM

Sheet Name:

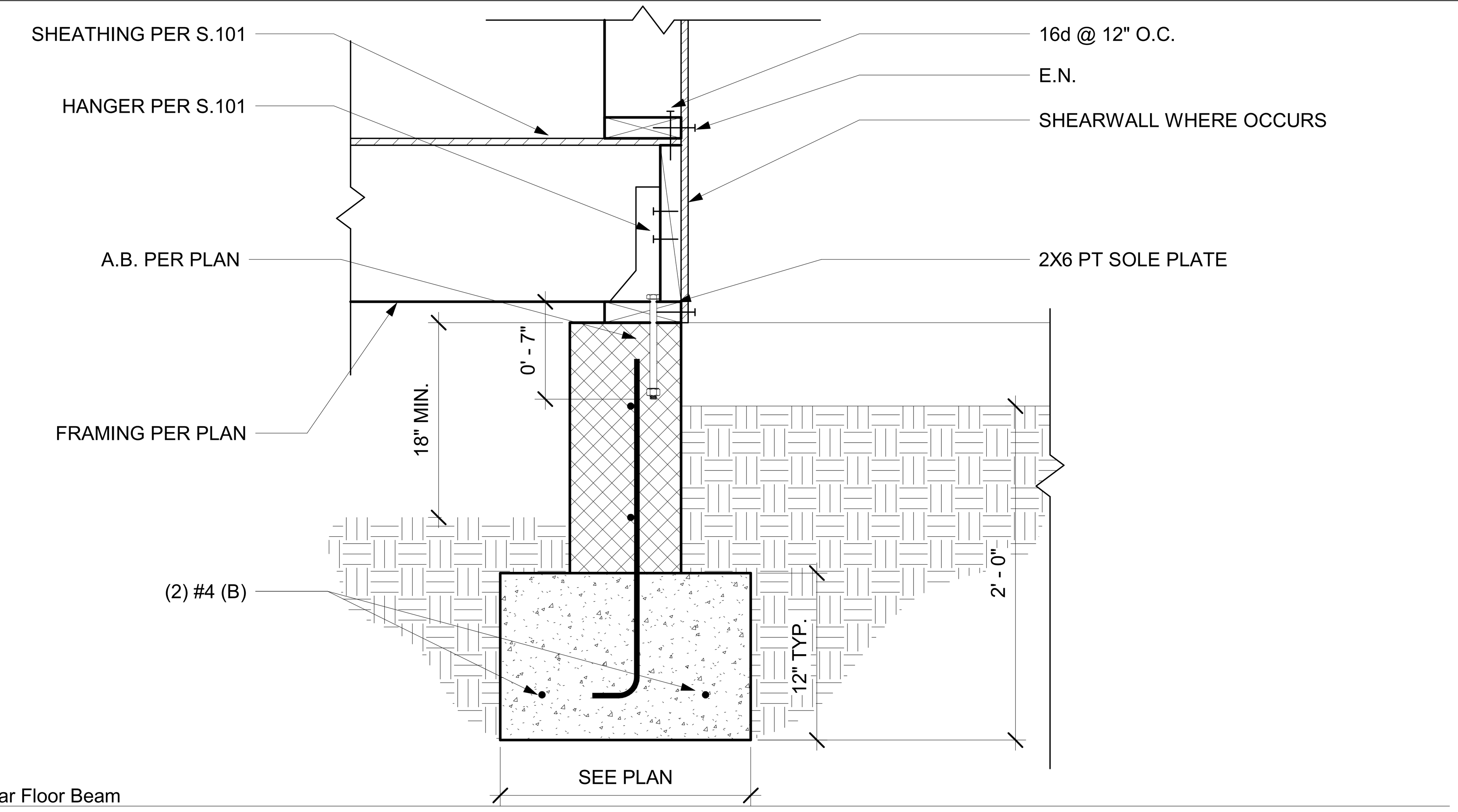
Roof Framing Plan

Scale

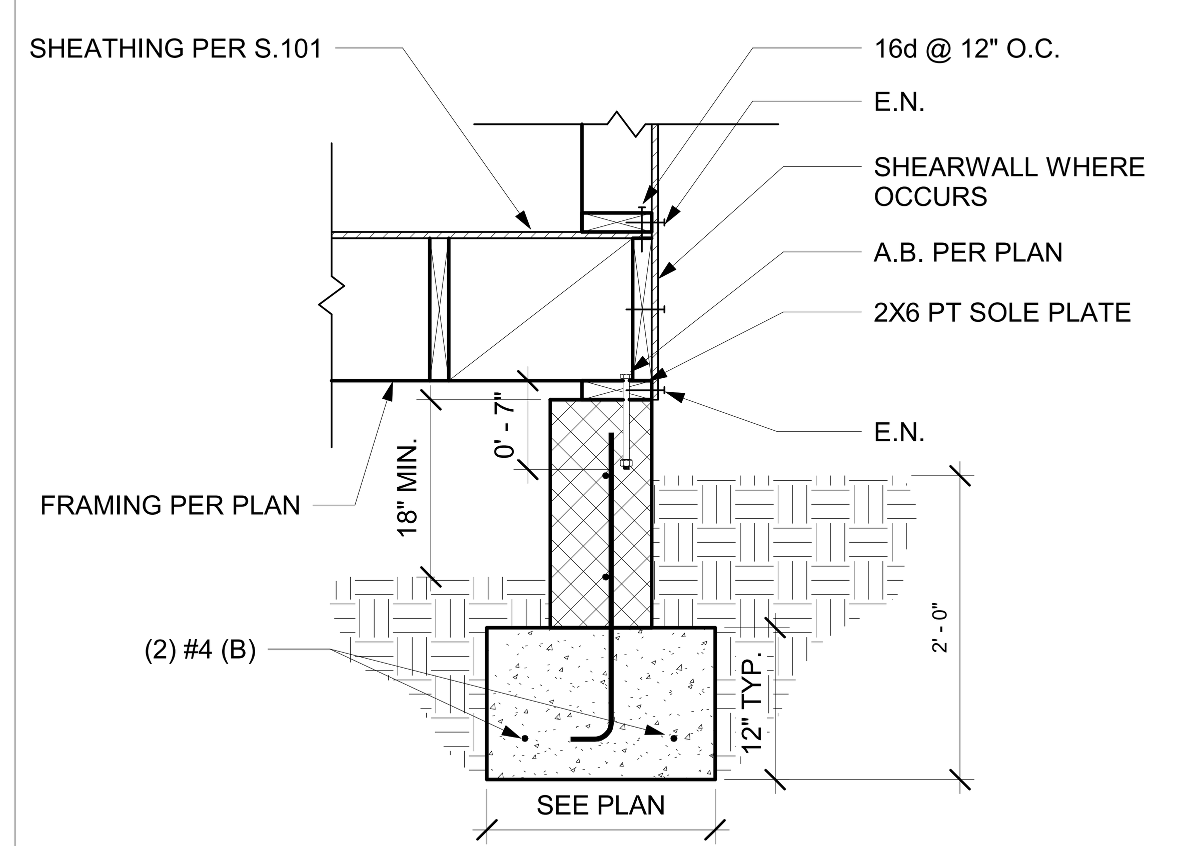
1/4" = 1'-0"

Sheet Number:

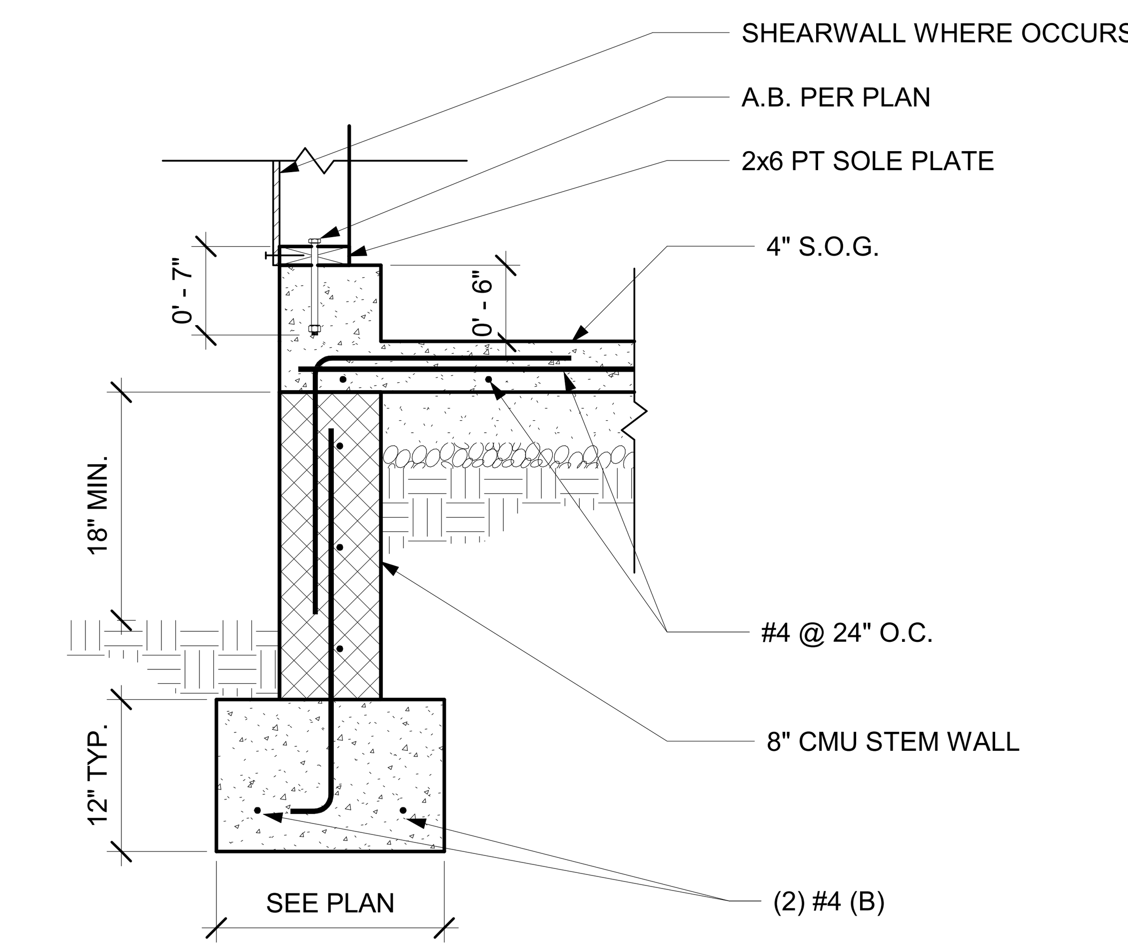
S.103



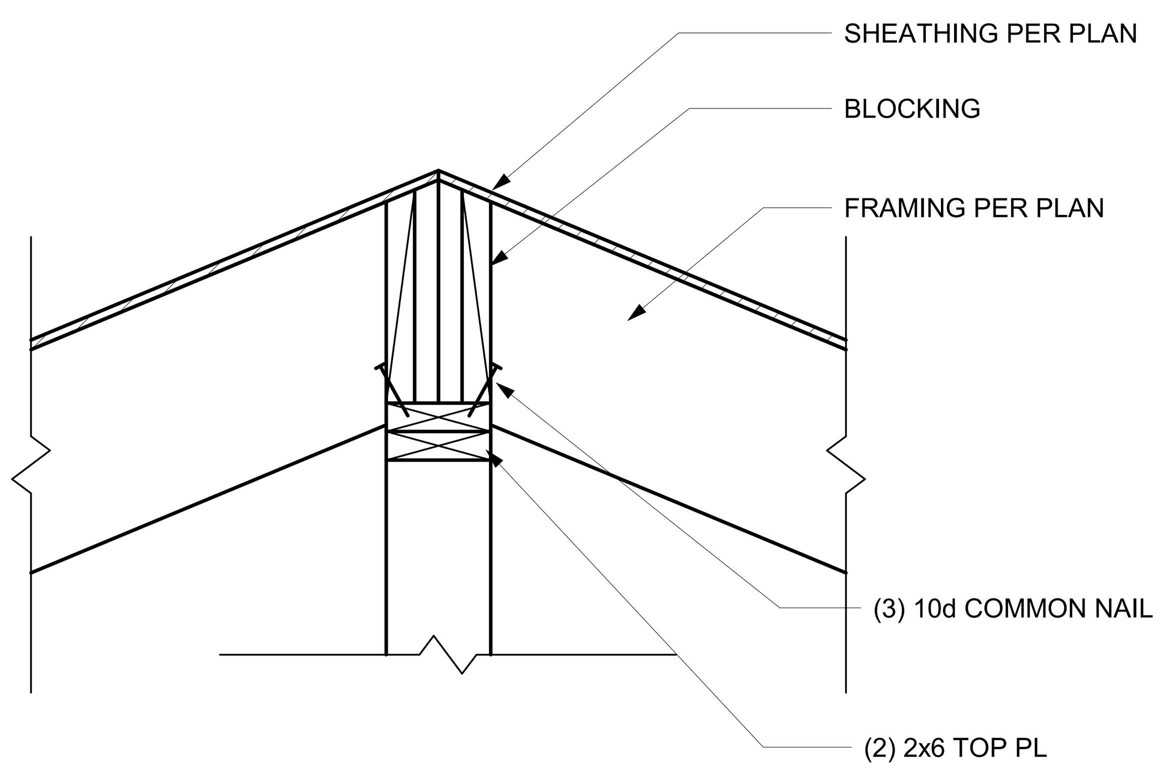
4 Foundation to Perpendicular Floor Beam
1 1/2" = 1'-0"



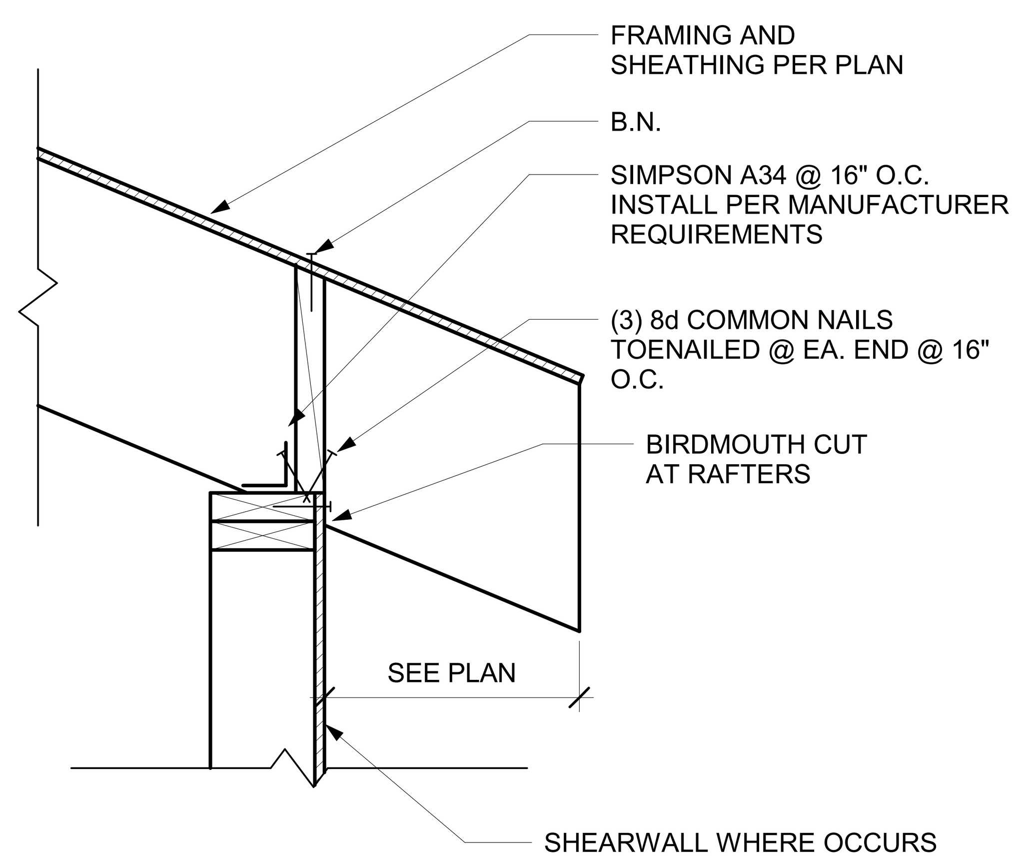
2 Foundation to Parallel Floor Beam
1" = 1'-0"



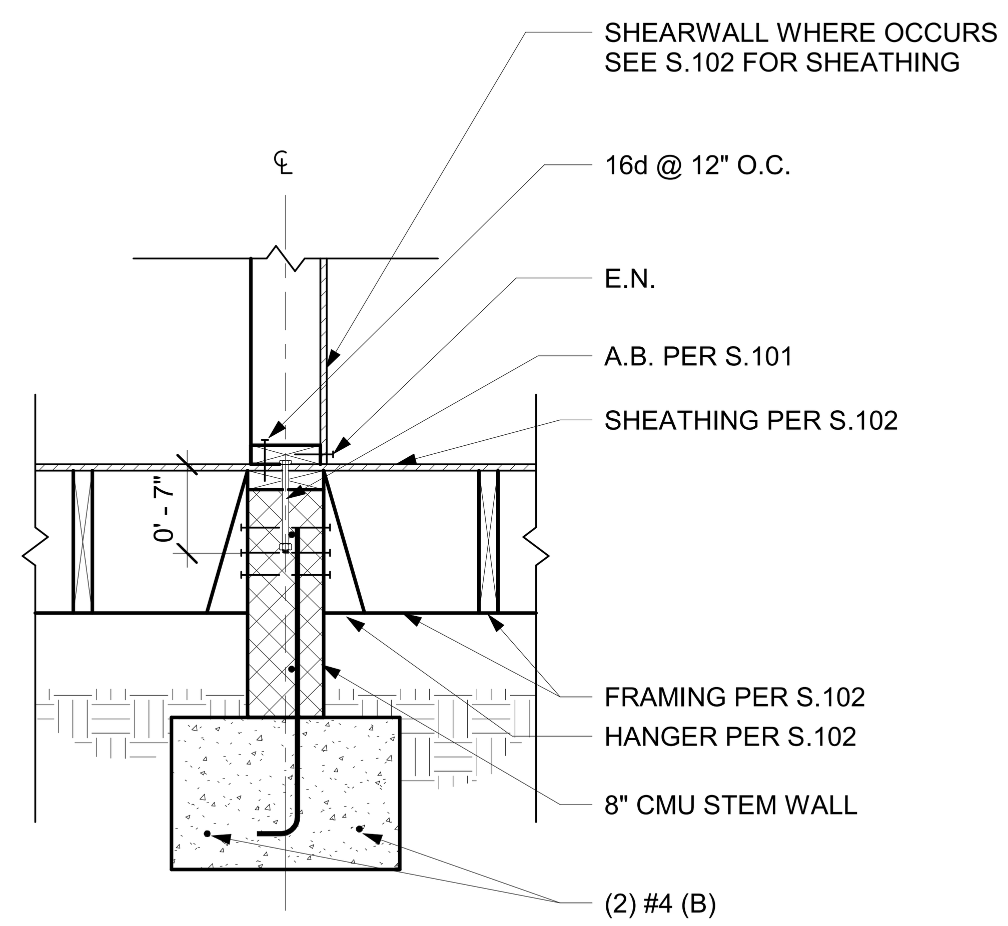
1 S.O.G. Detail
1" = 1'-0"



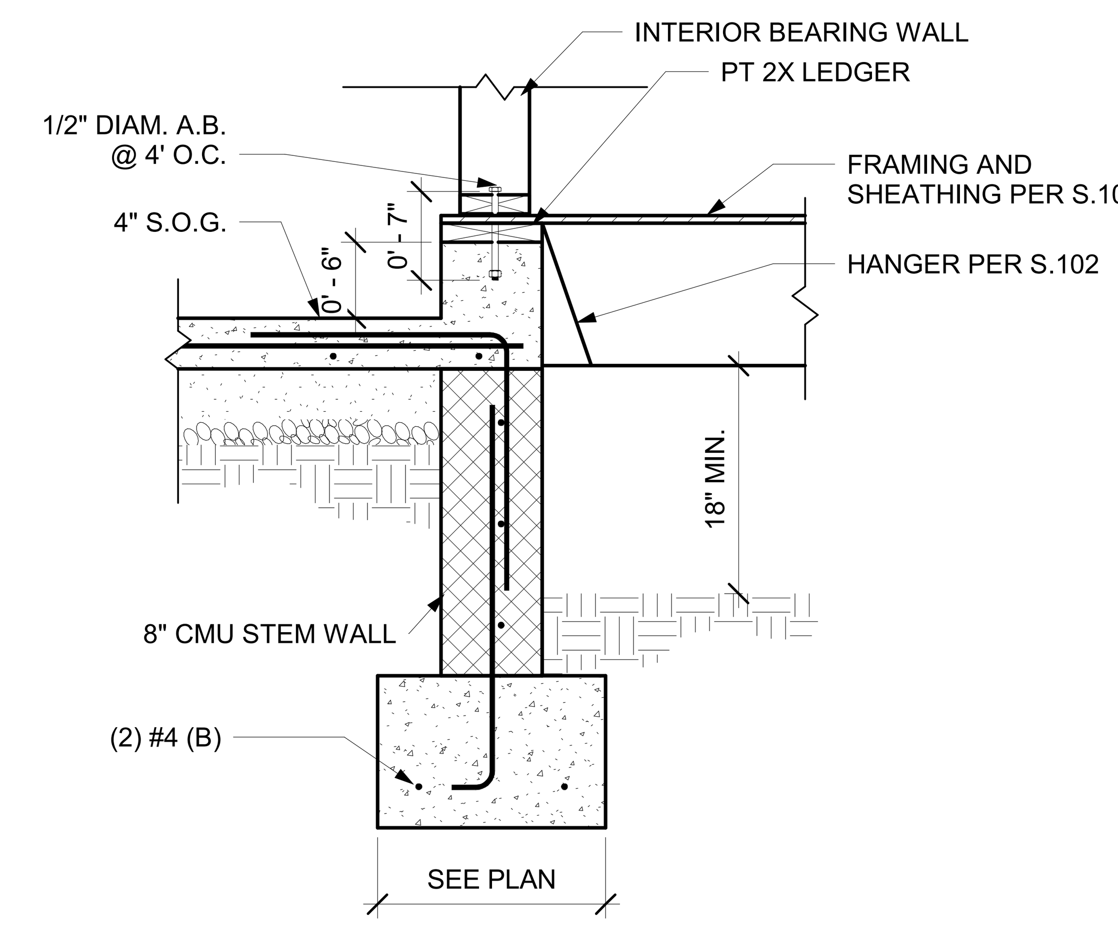
8 Ridge Beam to Interior Bearing Wall
1 1/2" = 1'-0"



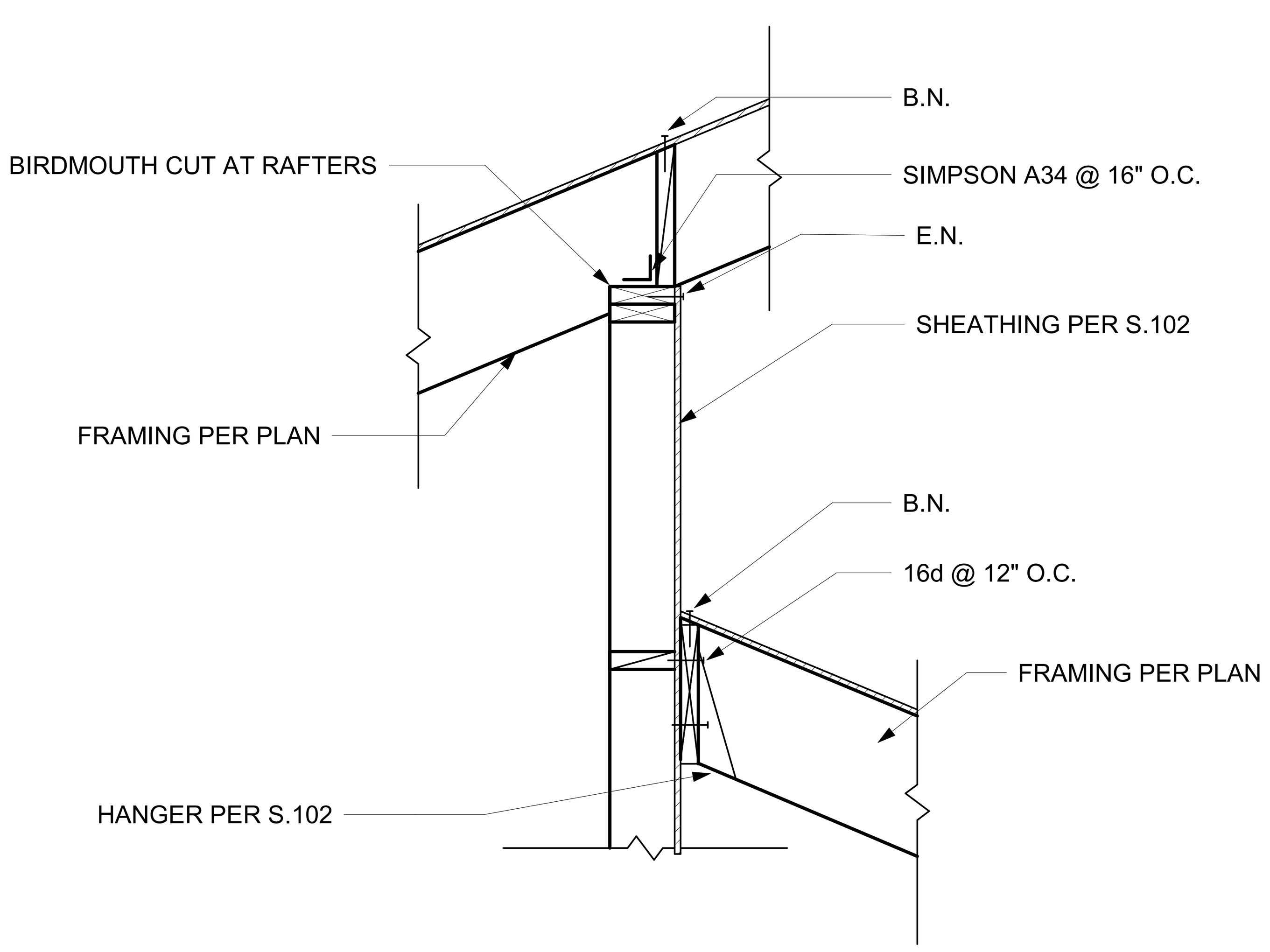
7 Rafter to Exterior Wall
1 1/2" = 1'-0"



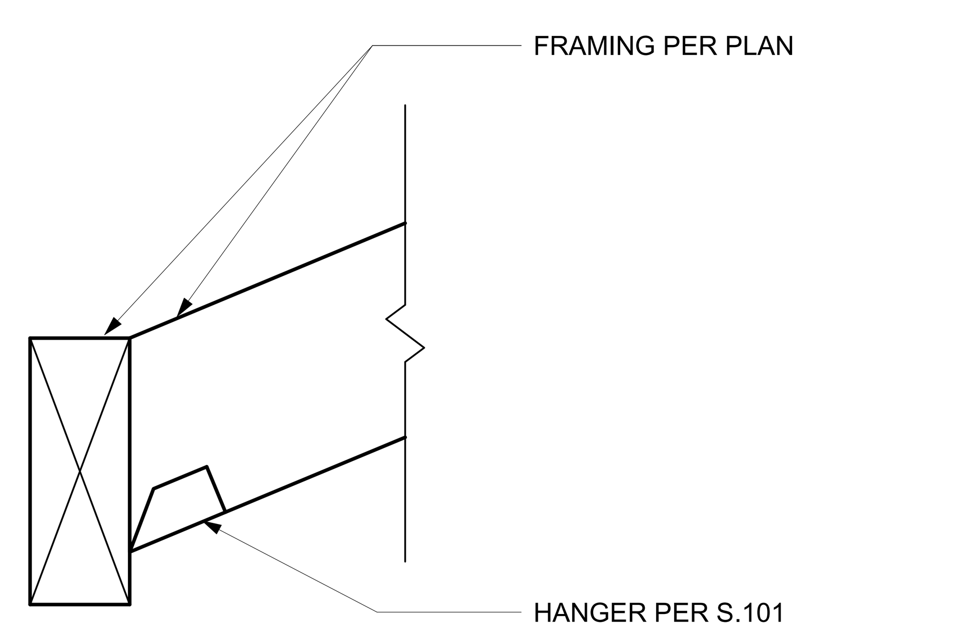
6 Floor Beam to Interior Shear Wall
1" = 1'-0"



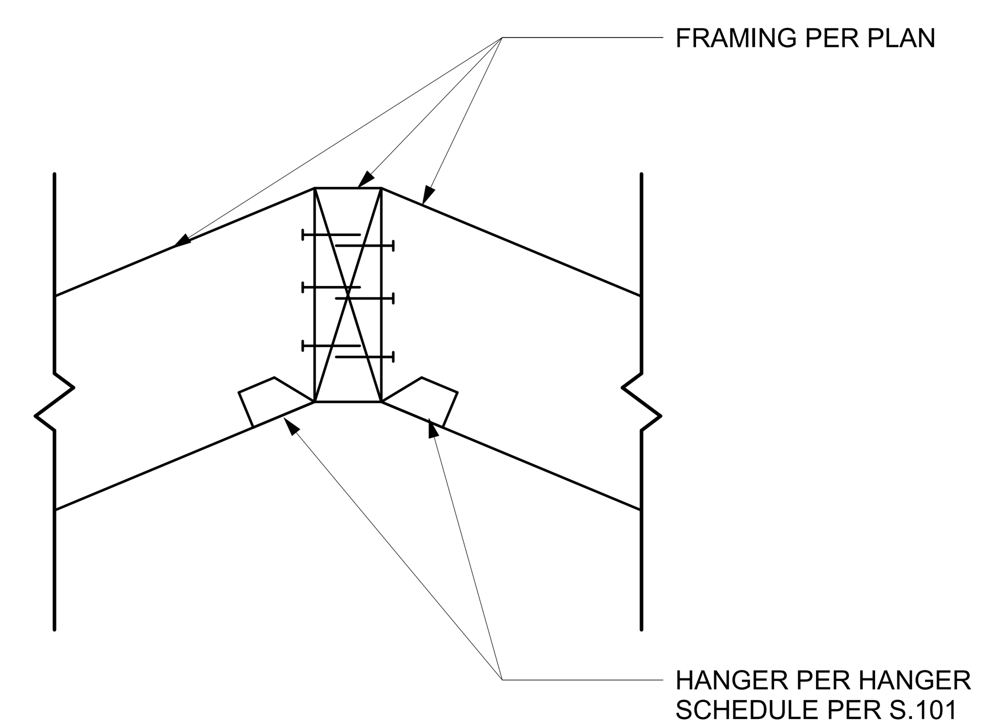
5 Interior Bearing Wall
1" = 1'-0"



12 Clerestory Detail
1" = 1'-0"



10 Joist to Valley Beam
1 1/2" = 1'-0"



9 Rafter to Ridge Beam
1 1/2" = 1'-0"

HARMONIOUS TECTONICS

G. AMICK
B. ARMSTRONG
J. BUDIDHARMA
S. PASCUAL
E. ROYER

1 GRAND AVE
SAN LUIS OBISPO, CA 93410

License SE Seal:

Project Title:

GNS - WEED HOUSING

Site:

780 S. DAVIS ST
WEED, CA 96094

Revisions

No.	Desc.	Date

Author: Author

Checked by: Checker

Plot Date:

12/1/2017 12:11:58 AM

Sheet Name:

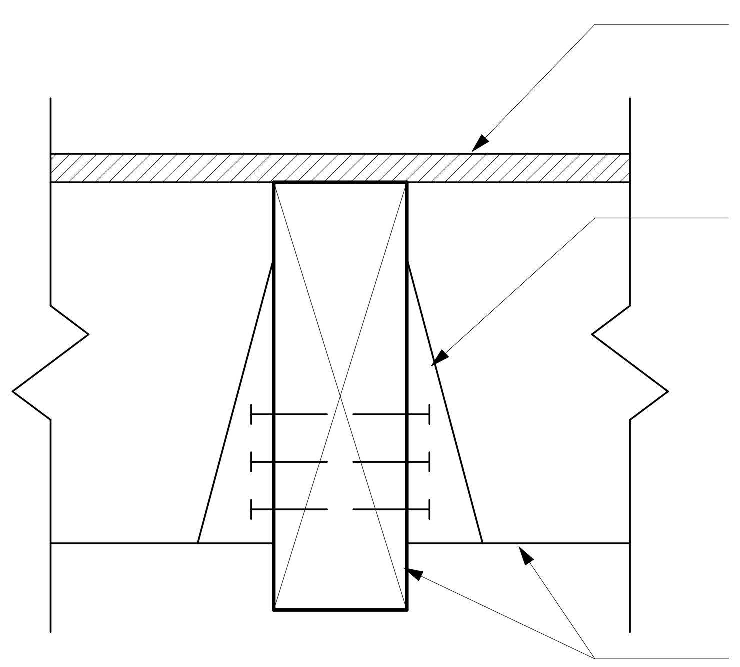
Details

Scale

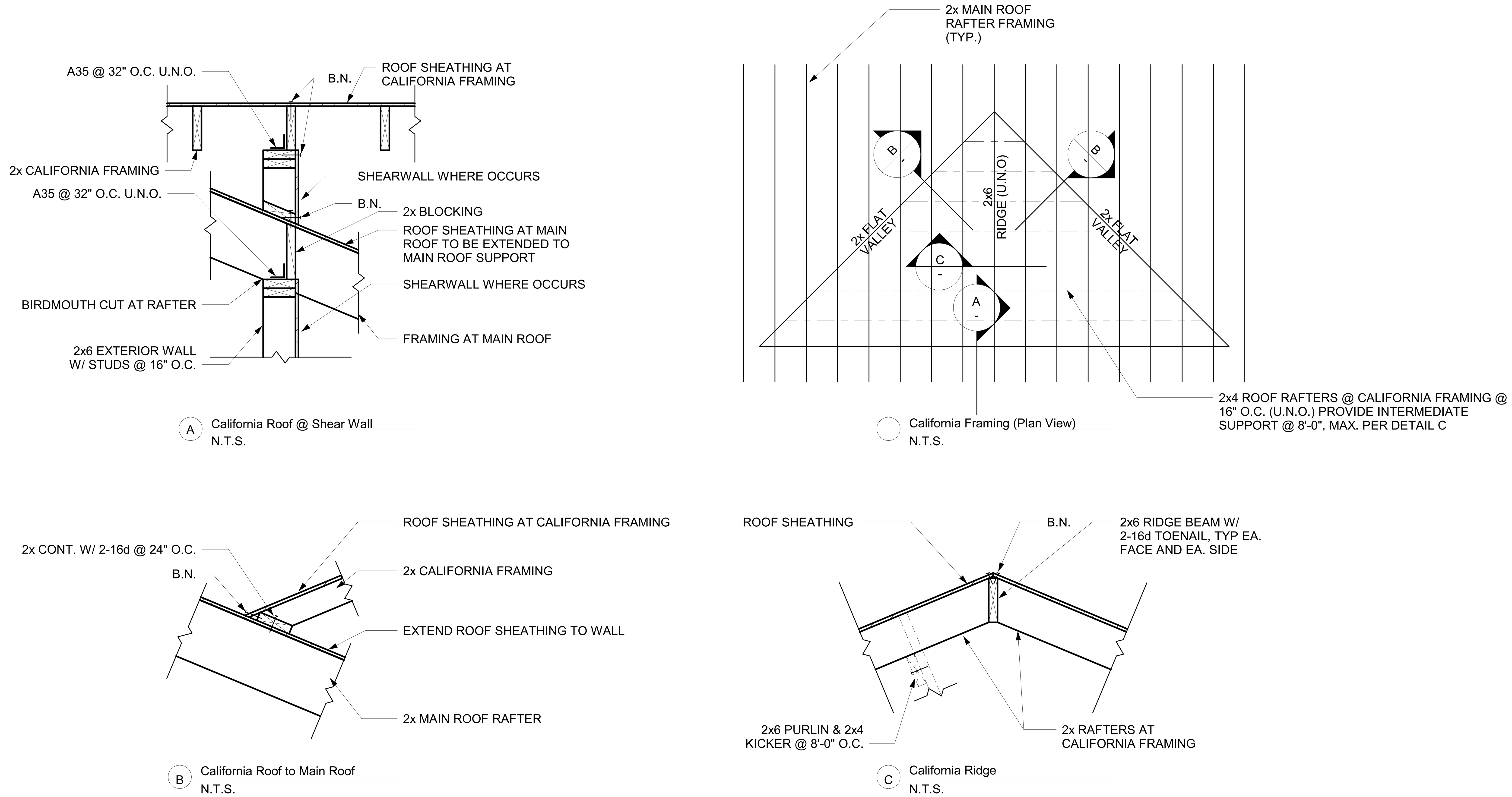
As indicated

Sheet Number:

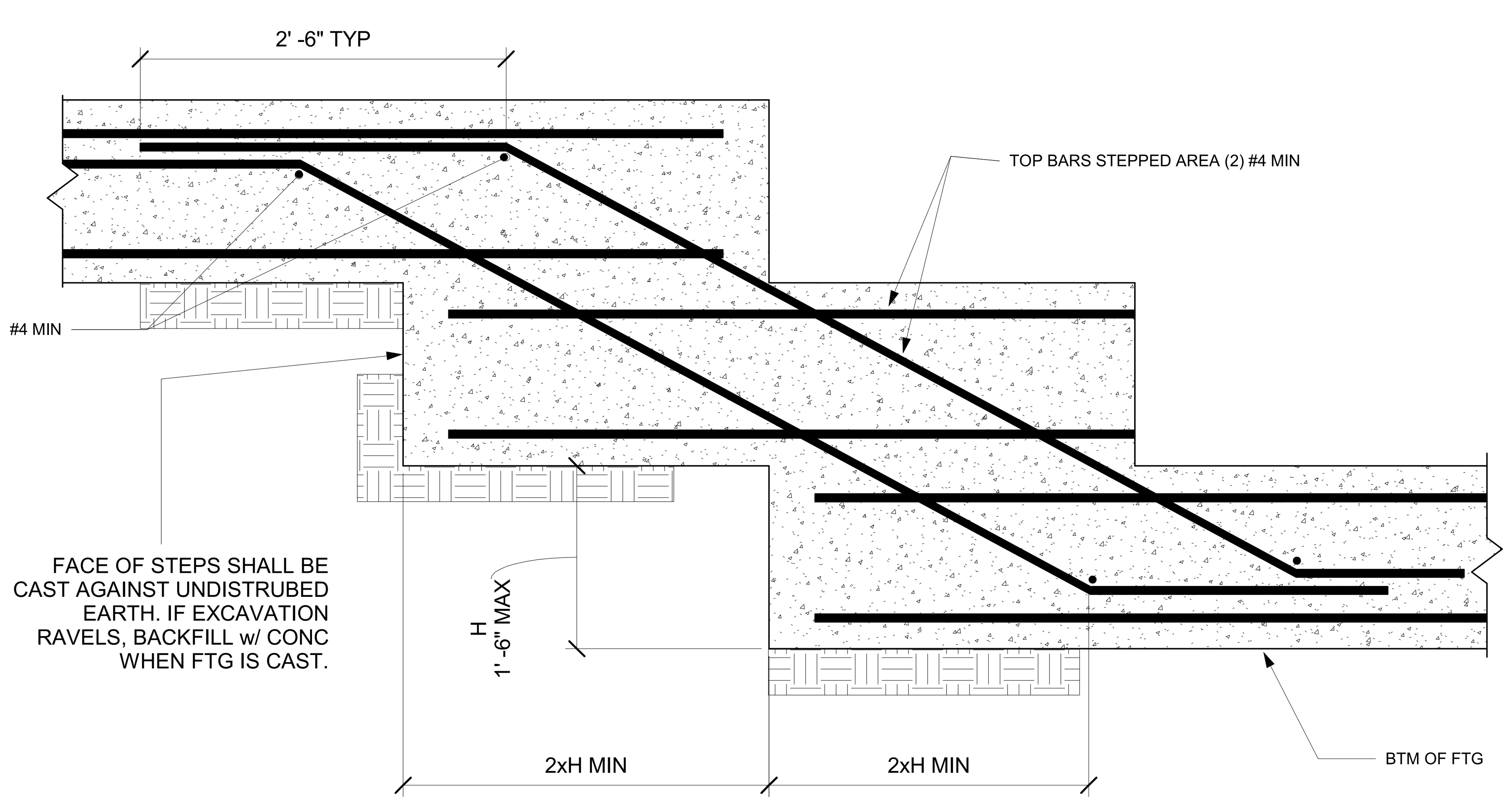
S.301



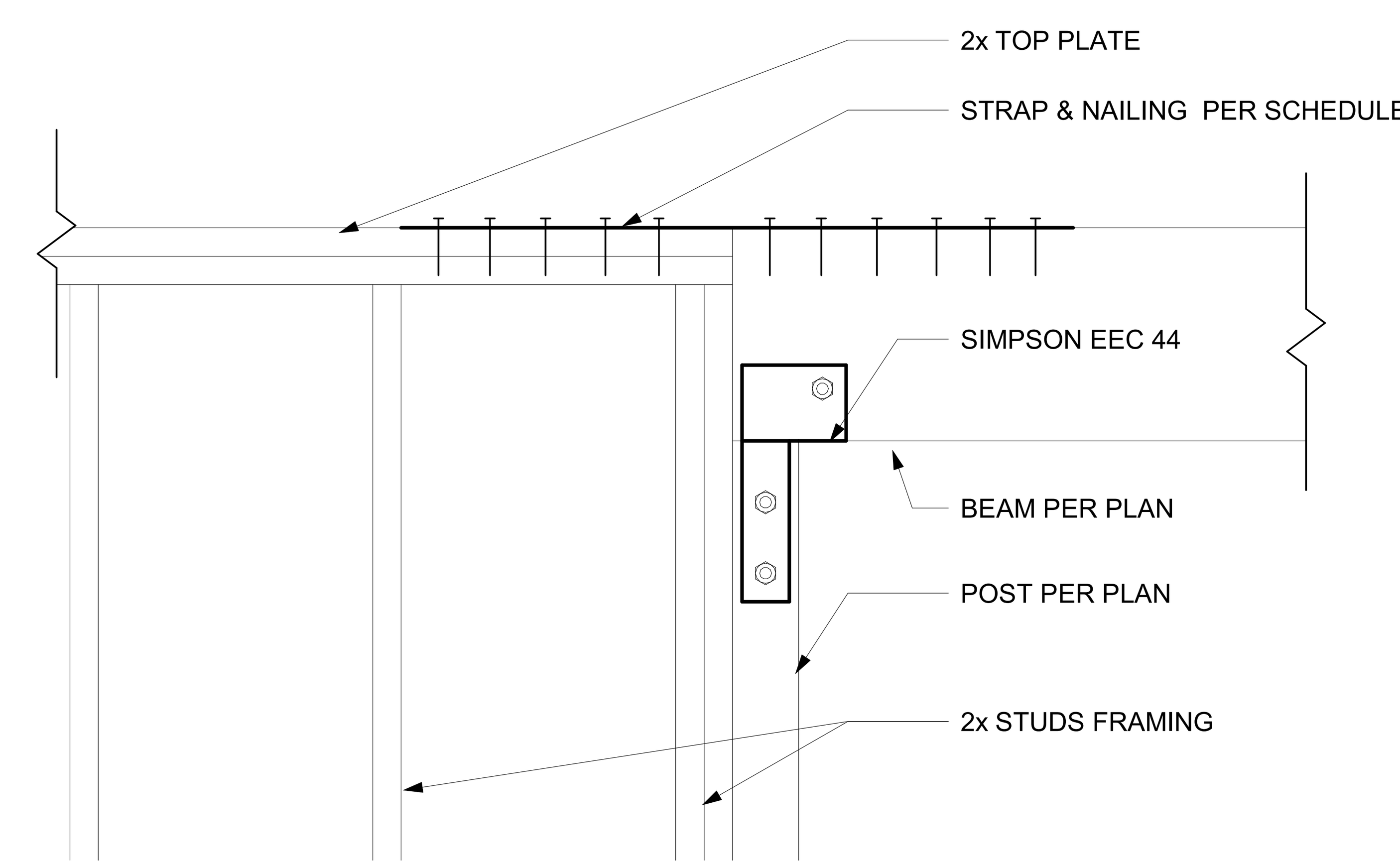
8 Typical Joist to Beam
3" = 1'-0"



7 Typical California Framing
1" = 1'-0"



12 Typical Stepped Footing
1 1/2" = 1'-0"



10 Beam to Shear Wall
1 1/2" = 1'-0"

HARMONIOUS TECTONICS

G. AMICK
B. ARMSTRONG
J. BUDIDHARMA
S. PASCUAL
E. ROYER

1 GRAND AVE
SAN LUIS OBISPO, CA 93410

License SE Seal:

Project Title:

GNS - WEED HOUSING

Site:

780 S. DAVIS ST
WEED, CA 96094

Revisions

No.	Desc.	Date

Author: Author

Checked by: Checker

Plot Date:

12/1/2017 12:11:59 AM

Sheet Name:

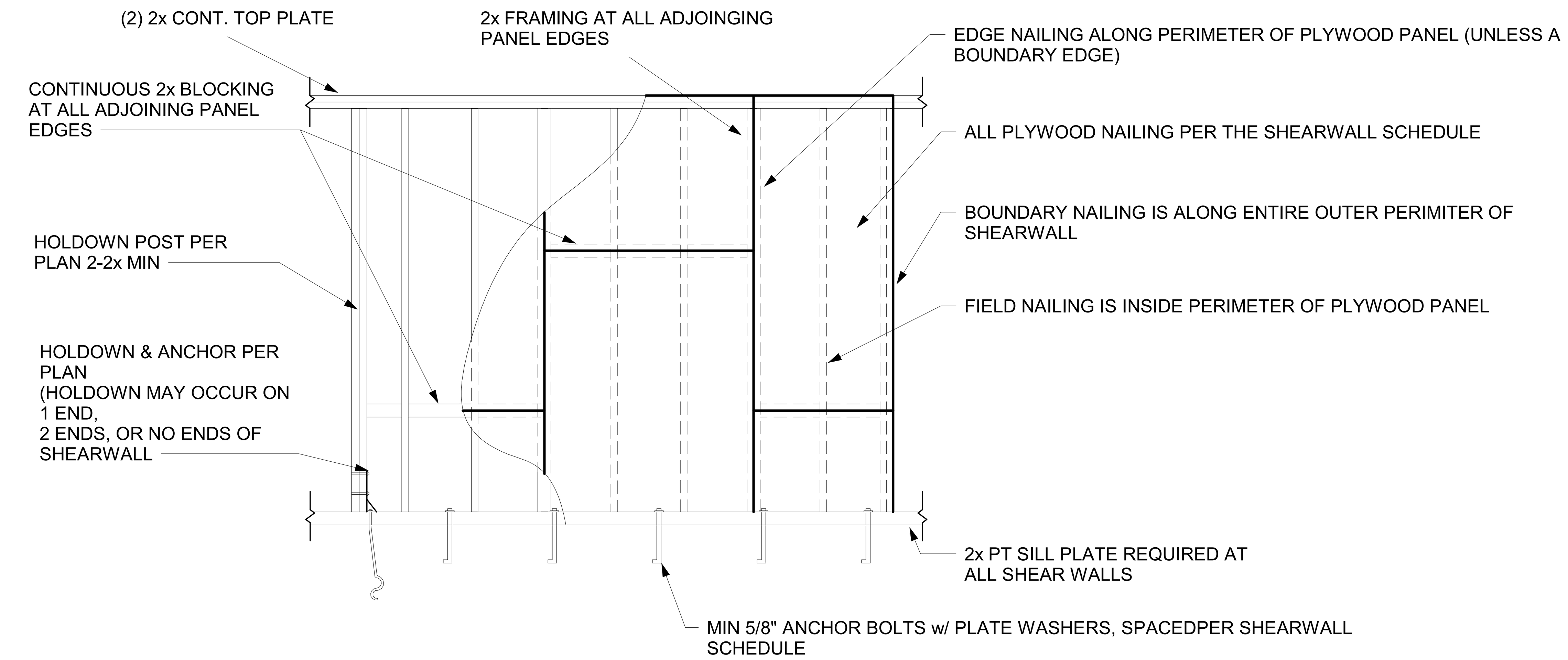
Details

Scale

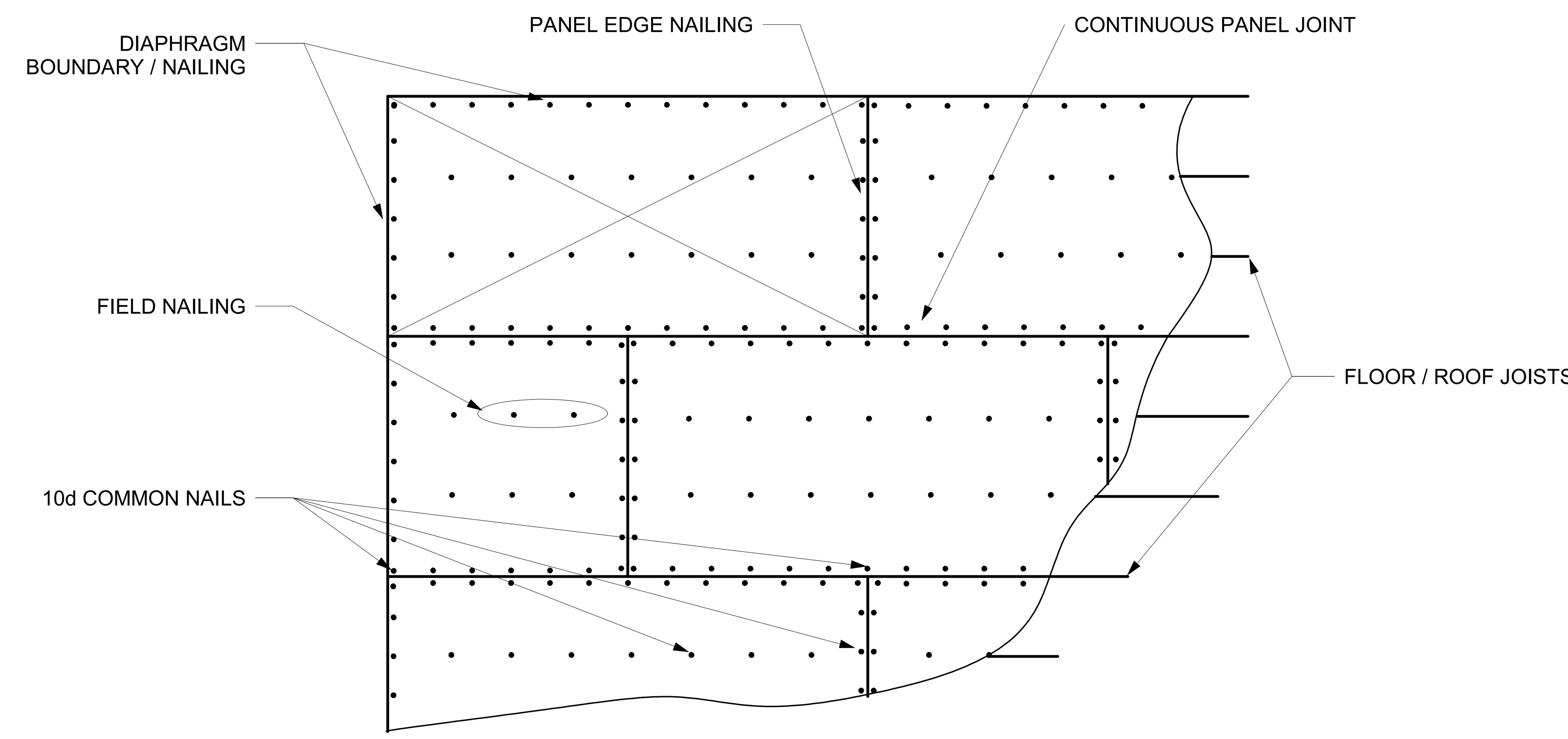
As indicated

Sheet Number:

S.302



1 Shear Wall Nailing
1/2" = 1'-0"



2 Typical Diaphragm Nailing
1/2" = 1'-0"

HARMONIOUS TECTONICS

G. AMICK
B. ARMSTRONG
J. BUDIDHARMA
S. PASCUAL
E. ROYER

1 GRAND AVE
SAN LUIS OBISPO, CA 93410

License SE Seal:

Project Title:

GNS - WEED HOUSING

Site:

780 S. DAVIS ST
WEED, CA 96094

Revisions

No.	Desc.	Date

Author: Author

Checked by: Checker

Plot Date:

12/1/2017 12:11:59 AM

Sheet Name:

Details

Scale

1/2" = 1'-0"

Sheet Number:

S.303

GENERAL STRUCTURAL NOTES

(THE FOLLOWING APPLY UNLESS NOTED OTHERWISE ON THE PLANS.)

CRITERIA

1. ALL MATERIALS, WORKMANSHIP, DESIGN, AND CONSTRUCTION SHALL CONFORM TO THE DRAWINGS, SPECIFICATIONS, THE 2016 CALIFORNIA BUILDING CODE (CBC), AND THE CITY OF WEED CODE MODIFICATIONS TO THE (CBC).

2. DESIGN LOADING CRITERIA

DEAD LOADS
ROOF 14 PSF
FLOOR 12 PSF

LIVE LOADS
ROOF LIVE LOAD 20 PSF
FLOOR LIVE LOAD (RESIDENTIAL) 40 PSF

WIND Vs=110 MPH, Iw=1.0, EXPOSURE C

EARTHQUAKE (EQUIVALENT LATERAL FORCE PROCEDURE) RISK CATEGORY II,
Ss=0.736g, S1=0.328g, Sds=0.594g, Sd1=0.381g
Ie=1.0, SITE CLASS D
SEISMIC DESIGN CATEGORY=D
R=6.5 (LIGHT-FRAME WOOD WALLS)
Vb (N-S)=5.9 K, Vb (E-W)=5.9 K
Cs (N-S)=0.091, Cs (E-W)=0.091

SEE PLANS FOR ADDITIONAL LOADING CRITERIA

3. STRUCTURAL DRAWINGS SHALL BE USED IN CONJUNCTION WITH ARCHITECTURAL DRAWINGS FOR BIDDING AND CONSTRUCTION. CONTRACTOR SHALL VERIFY DIMENSIONS AND CONDITIONS FOR COMPATIBILITY AND SHALL NOTIFY ARCHITECT OF ANY DISCREPANCIES PRIOR TO CONSTRUCTION.

4. CONTRACTOR SHALL VERIFY ALL EXISTING DIMENSIONS, MEMBER SIZES, AND CONDITIONS PRIOR TO COMMENCING ANY WORK. ALL DIMENSIONS OF EXISTING CONSTRUCTION SHOWN ON THE DRAWINGS ARE INTENDED AS GUIDELINES ONLY AND MUST BE VERIFIED.

5. CONTRACTOR SHALL PROVIDE TEMPORARY BRACING FOR THE STRUCTURE AND STRUCTURAL COMPONENTS UNTIL ALL FINAL CONNECTIONS HAVE BEEN COMPLETED IN ACCORDANCE WITH THE PLANS.

6. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL SAFETY PRECAUTIONS AND THE METHODS, TECHNIQUES, SEQUENCES, OR PROCEDURES REQUIRED TO PERFORM HIS WORK. THE STRUCTURAL ENGINEER HAS NO OVERALL SUPERVISORY AUTHORITY OR ACTUAL AND/OR DIRECT RESPONSIBILITY FOR THE SPECIFIC WORKING CONDITIONS AT THE SITE AND/OR 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 OWNER, CONTRACTORS, OR OTHER ENTITIES OR PERSONS AT THE PROJECT SITE.

7. CONTRACTOR-INITIATED CHANGES SHALL BE SUBMITTED IN WRITING TO THE ARCHITECT AND STRUCTURAL ENGINEER FOR APPROVAL PRIOR TO FABRICATION OR CONSTRUCTION. CHANGES SHOWN ON SHOP DRAWINGS ONLY WILL NOT SATISFY THIS REQUIREMENT.

8. DRAWINGS INDICATE GENERAL AND TYPICAL DETAILS OF CONSTRUCTION. WHERE CONDITIONS ARE NOT SPECIFICALLY INDICATED, BUT ARE OF SIMILAR CHARACTER TO DETAILS SHOWN, SIMILAR DETAILS OF CONSTRUCTION SHALL BE USED, SUBJECT TO REVIEW AND APPROVAL BY THE ARCHITECT AND THE STRUCTURAL ENGINEER.

9. ALL STRUCTURAL SYSTEMS WHICH ARE TO BE COMPOSED OF COMPONENTS TO BE FIELD ERECTED SHALL BE SUPERVISED BY THE SUPPLIER DURING MANUFACTURING, DELIVERY, HANDLING, STORAGE, AND ERECTION IN ACCORDANCE WITH INSTRUCTIONS PREPARED BY THE SUPPLIER.

10. SHOP DRAWINGS FOR
REINFORCING STEEL (FOR BOTH CONCRETE AND MASONRY CONSTRUCTION),
STRUCTURAL COMPOSITE LUMBER
SHALL BE SUBMITTED TO THE ARCHITECT AND STRUCTURAL ENGINEER FOR REVIEW PRIOR TO FABRICATION OF THESE ITEMS.

CONTRACTOR SHALL SUBMIT WALL ELEVATION DRAWINGS OF AT LEAST 1/8" = 1'-0" SCALE INDICATING LOCATIONS OF CONNECTION EMBEDMENTS AND WALL OPENINGS FOR REVIEW PRIOR TO CONSTRUCTION. CONTRACTOR SHALL COORDINATE WITH REINFORCEMENT SHOP DRAWINGS.

ALL SHOP DRAWINGS (EXCEPT REINFORCING STEEL) SHALL ALSO BE SUBMITTED TO THE CITY OF WEED DEPARTMENT OF PLANNING AND DEVEOPMENT.

11. SHOP DRAWING REVIEW: DIMENSIONS AND QUANTITIES ARE NOT REVIEWED BY THE ENGINEER OF RECORD, THEREFORE, MUST BE VERIFIED BY THE CONTRACTOR. CONTRACTOR SHALL REVIEW AND STAMP DRAWINGS PRIOR TO REVIEW BY ENGINEER OF RECORD. CONTRACTOR SHALL REVIEW DRAWINGS FOR CONFORMANCE WITH THE MEANS, METHODS, TECHNIQUES, SEQUENCES, AND OPERATIONS OF CONSTRUCTION, AND ALL SAFETY PRECAUTIONS AND PROGRAMS INCIDENTAL, THERETO, SUBMITTALS SHALL INCLUDE A REPRODUCIBLE AND ONE COPY; REPRODUCIBLE WILL BE MARKED AND RETURNED.

SHOP DRAWINGS SUBMITTALS PROCESSED BY THE ENGINEER ARE NOT CHANGE ORDERS. THE PURPOSE OF SHOP DRAWING SUBMITTALS BY THE CONTRACTOR IS TO DEMONSTRATE TO THE ENGINEER THAT THE CONTRACTOR UNDERSTANDS THE DESIGN CONCEPT, BY INDICATING WHICH MATERIAL IS INTENDED TO BE FURNISHED AND INSTLLED AND BY DETAILING THE INTENDED FABRICATION AND INSTALLATION METHODS. IF DEVIATIONS, DISCREPANCIES, OR CONFLICTS BETWEEN SHOP DRAWING SUBMITTALS AND THE CONTRACT DOCUMENTS ARE DISCOVERED EITHER PRIOR TO OR AFTER SHOP DRAWING SUBMITTALS ARE PROCESSED BY THE ENGINEER, THE DESIGN DRAWINGS AND SPECIFICATIONS SHALL CONTROL AND SHALL BE FOLLOWED.

SHOP DRAWINGS OF DESIGN BUILDING COMPONENTS INCLUDING STAIRS AND EXTERIOR CLADDING SHALL INCLUDE THE DESIGNING PROFESSIONAL ENGINEER'S STAMP, STATE OF CALIFORNIA AND SHALL BE APPROVED BY THE COMPONENT DESIGNER PRIOR TO CURSORY REVIEW BY THE ENGINEER OF RECORD FOR LOADS IMPOSED ON THE BASIC STRUCTURE. THE COMPONENT DESIGNER IS RESPONSIBLE FOR CODE CONFORMANCE AND ALL NECESSARY CONNECTIONS NOT SPECIFICALLY CALLED OUT ON ARCHITECTURAL OR STRUCTURAL DRAWINGS. SHOP DRAWINGS SHALL INDICATE MAGNITUDE AND DIRECTION OF ALL LOADS IMPOSED ON BASIC STRUCTURE. DESIGN CALCULATIONS SHALL BE MADE AVAILABLE UPON REQUEST.

12. STRUCTURAL OBSERVATION: AS NOTED IN SECTION 1709 OF THE 2015 INTERNATIONAL BUILDING CODE, STRUCTURAL OBSERVATION IS REQUIRED FOR THIS PROJECT. STRUCTURAL OBSERVATION MEANS THE VISUAL OBSERVATION OF THE STRUCTURAL SYSTEM, INCLUDING BUT NOT LIMITED TO, THE ELEMENTS AND CONNECTIONS AT SIGNIFICANT CONSTRUCTION STAGES AND THE COMPLETED STRUCTURE FOR GENERAL CONFORMANCE TO THE APPROVED PLANS AND SPECIFICATIONS. STRUCTURAL OBSERVATION DOES NOT INCLUDE OR WAIVE THE RESPONSIBILITY OF THE INSPECTIONS REQUIRED BY SECTIONS 108 AND CHAPTER 17 OF THE INTERNATIONAL BUILDING CODE.

IN OUR STRUCTURAL OBSERVATION, WE WILL SELECT PORTIONS OF WORK TO REVIEW CLOSELY AS WELL AS OBSERVE THE STRUCTURAL SYSTEM FOR GENERAL CONFORMANCE TO THE APPROVED PLANS AND SPECIFICATIONS. SUCH REVIEW PROCEDURES WILL BE CONDUCTED IN ACCORDANCE WITH COMMONLY ACCEPTED STANDARDS OF PRACTICE. THE BUILDING OFFICIAL UNDERSTANDS THAT SUCH PROCEDURES INDICATE ACTUAL CONDITIONS ONLY WHERE THE REVIEW IS PERFORMED AND THAT THE RESULTS WILL BE INFERRED TO EXIST IN OTHER AREAS NOT REVIEWED.

THE BUILDING OFFICIAL ALSO RECOGNIZES THAT STRUCTURAL REVIEW IS A TECHNIQUE EMPLOYED TO MINIMIZE THE RISK OF PROBLEMS ARISING DURING CONSTRUCTION. STRUCTURAL OBSERVATION BY THE DESIGN PROFESSIONAL DOES NOT CONSTITUTE WARRANTY OR GUARANTEE OF ANY TYPE. IN ALL CASES, THE CONTRACTOR SHALL RETAIN RESPONSIBILITY FOR THE QUALITY OF WORK AND FOR ADHERENCE OT THE APPROVED PLANS AND SPECIFICATIONS.

GEOTECHNICAL

13. FOUNDATION NOTES: SUBGRADE PREPARATION INCLUDING DRAINAGE, EXCAVATION, COMPACTION, AND FILLING REQUIREMENTS, SHALL CONFORM STRICTLY WITH RECOMMENDATIONS GIVEN IN THE SOILS REPORT OR AS DIRECTED BY THE SOILS ENGINEER. FOOTINGS SHALL BEAR ON SOLID UNDISTRIBUTED EARTH (CONTROLLED, COMPACTED STRUCTURAL FILL OR BOTH) AT LEAST 18" BELOW LOWEST ADJACENT FINISHED GRADE. FOOTING DEPTHS/ELEVATIONS SHOWN ON PLANS (OR IN DETAILS) ARE MINIMUM AND FOR GUIDANCE ONLY; THE ACTUAL ELEVATIONS OF FOOTINGS MUST BE ESTABLISHED BY THE CONTRACTOR IN THE FILED WORKING WITH THE TESTING LAB AND SOILS ENGINEER. BACKFILL BEHIND ALL RETAINING WALLS WITH FREE DRAINING GRANULAR FILL AND PROVIDE FOR SUBSURFACE DRAINAGE AS NOTED IN THE SOILS REPORT.

ALLOWABLE SOIL PRESSURE 1,500 PSF

LATERAL EARTH PRESSURE (RESTRAINED/UNRESTRAINED) 60 PCF/35 PCF

CONCRETE

14. CONCRETE SHALL BE MIXED, PROPORTIONED, CONVEYED, AND PLACED IN ACCORDANCE WITH IBC SECTION 1905 AND ACI 318-14. CONCRETE SHALL ATTAIN A 28-DAY STRENGTH OF f'c = 3,000 PSI AND MIX SHALL CONTAIN NOT LESS THAN 5-1/2 SACKS OF CEMENT PER CUBIC YARD AND SHALL BE PROPORTIONED TO PRODUCE A SLUMP OF 5" OR LESS.

THE MINIMUM AMOUNTS OF CEMENT AND MAXIMUM AMOUNTS OF WATER MAY BE CHANGED IF A CONCRETE PERFORMANCE MIX IS SUBMITTED TO THE STRUCTURAL ENGINEER AND THE CITY OF WEED DEPARTMENT OF PLANNING AND DEVELOPMENT FOR APPROVAL TWO WEEKS PRIOR TO PLACING ANY CONCRETE. THE CONCRETE PERFORMANCE MIX SHALL INCLUDE THE AMOUNTS OF CEMENT, FINE AND COARSE AGGREGATE, WATER AND ADMIXTURES AS WELL AS THE WATER CEMENT RATIO, SLUMP, CONCRETE YIELD, AND SUSTANTIATING STRENGTH DATA IN ACCORDANCE WITH IBC 1905.3. THE USE OF A PERFORMANCE MIX REQUIRES BATCH PLANT INSPECTION, THE COST OF WHICH SHALL BE PAID BY THE GENERAL CONTRACTOR. REVIEW OF MIX SUBMITTALS BY THE ENGINEER OF RECORD INDICATES ONLY THAT INFORMATION PRESENTED CONFORMS GENERALLY WITH CONTRACT DOCUMENTS. CONTRACTOR OR SUPPLIER MAINTAINS FULL RESPONSIBILITY FOR SPECIFIED PERFORMANCE.

ALL CONCRETE WITH SURFACES EXPOSED TO STANDING WATER SHALL BE AIR-ENTRAINED WITH AN AIR-ENTRAINING AGENT CONFORMING TO ASTM C260, C494M, AND C618. TOTAL AIR CONTENT FOR FROST-RESISTENT CONCRETE SHALL BE IN ACCORDANCE WITH TABLE 1904.2.1 OF THE INTERNATIONAL BUILDING CODE.

15. REINFORCING STEEL SHALL CONFORM TO ASTM A615 (INCLUDING SUPPLEMENTS S1), GRADE 60, fy = 60,000 PSI. EXCEPTIONS: ANY BARS SPECIFICALLY SO NOTED ON THE DRAWINGS SHALL BE GRADE 40, fy = 40,000 PSI. GRADE 60 REINFORCING BARS INDICATED ON DRAWINGS TO BE WELDED SHALL CONFORM TO A706. REINFORCING COMPLYING WITH ASTM A615 (S1) MAY BE WELDED ONLY IF MATERIAL PROPERTY REPORTS INDICATING CONFORMANCE WITH WELDING PROCEDURES SPECIFIED IN A.W.S. D1.4 ARE SUBMITTED.

16. REINFORCING STEEL SHALL BE DETAILED (INCLUDING HOOKS AND BENDS) IN ACCORDANCE WITH ACI SP66-94 AND 318-02. LAP ALL CONTINUOUS REINFORCEMENT #5 AND SMALLER 40 BAR DIAMETERS OR 2'-0" MINIMUM, PROVIDE CORNER BARS AT ALL WALL AND FOOTING INTERSECTIONS. LAP CORNER BARS #5 AND SMALLER 40 BAR DIAMETERS OR 2'-0" MINIMUM. LAPS OF LARGER BARS SHALL BE MADE IN ACCORDANCE WITH ACI 318-02, CLASS B. LAP ADJACENT MATS OF WELDED WIRE FABRIC A MINIMUM OF 8" AT SIDES AND ENDS.

NO BARS PARTIALLY EMBEDDED IN HARDENED CONCRETE SHALL BE FIELD BENT UNLESS SPECIFICALLY SO DETAILED OR APPROVED BY THE STRUCTURAL ENGINEER.

17. CONCRETE PROTECTION (COVER) FOR REINFORCING STEEL SHALL BE AS FOLLOWS:

FOOTINGS AND OTHER UNFORMED SURFACES CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH	3"
FORMED SURFACES EXPOSED TO EARTH (i.e., WALLS BELOW GROUND) OR WEATHER (#6 BARS OR LARGER)	2"
(#5 BARS OR SMALLER)	1-1/2"
COLUMN TIES OR SPIRALS AND BEAM STIRRUPS	1-1/2"
SLABS AND WALLS (INTERIOR FACE) GREATER OF (BAR DIAMETER PLUS 1/8") OR	3/4"

ANCHORAGE

18. MIN 7" EMBED. FOR ALL ANCHORS TO FOUNDATION.

MASONRY

19. CONCRETE MASONRY UNIT WALLS SHALL BE CONSTRUCTED OF GRADE N, TYPE I UNITS, CONFORMING TO ASTM C90, LAID IN A RUNNING BOND. MORTAR SHALL BE TYPE "S" PER TABLE 2103.7 OF THE IBC. GROUT SHALL CONFORM TO IBC REQUIREMENTS AND ATTAIN A MINIMUM COMPRESSIVE STRENGTH OF 2,000 PSI AT 28 DAYS, DESIGN f'_m = 1,500 PSI. STRENGTH SHALL BE VERIFIED BY THE UNIT STRENGTH METHOD IN ACCORDANCE WITH IBC SECTION 2105.2. FULL STRESSES ARE REQUIRED. ALL MASONRY SHOULD BE SOLID GROUTED.

UNLESS NOTED OTHERWISE, PROVIDE THE FOLLOWING REINFORCEMENT:

4" WALLS	#4 @ 48" O.C. VERT.	3/16 dia. WIRE JOINT REINFORCING AT 8" O.C. HORIZ.
6" WALLS	#4 @ 48" O.C. VERT.	(2) #4 @ 48" O.C. HORIZ.
8" WALLS	#5 @ 48" O.C. VERT.	(2) #4 @ 48" O.C. HORZ.
10" WALLS	#5 @ 40" O.C. VERT.	(2) #5 @ 48" O.C. HORZ.
12" WALLS	#5 @ 32" O.C. VERT.	(2) #5 @ 40" O.C. HORZ.

CONCRETE MASONRY UNITS TO BE FULLY GROUTED.

IN ADDITION, PROVIDE (1) #5 (#4 @ 6" AND 4" WALLS) VERT. AT EACH SIDE OF OPENINGS. AT WALL CORNERS AND INTERSECTIONS AND AT FREE ENDS OF WALLS AND (2) #4 HORIZ. AT ELEVATED FLOOR AND ROOF LEVELS, AT TOPS OF WALLS AND ABOVE AND BELOW ALL OPENINGS. ALL HORIZONTAL REINFORCEMENT SHALL BE PLACED IN BOND BEAMS. EXTEND REINFORCEMENT AROUND OPENINGS 2'-0" BEYOND FACE OF OPENING. IF 2'-0" IS UNAVAILABLE EXTEND AS FAR AS POSSIBLE AND HOOK. PROVIDE CORNER BARS TO LAP HORIZONTAL REINFORCING AT CORNERS AND INTERSECTIONS.

WOOD

23. FRAMING LUMBER SHALL BE KILN DRIED OR MC-19, AND GRADED AND MARKED IN CONFORMANCE WITH W.C.L.I.B. STANDARD GRADING RULES FOR WEST COAST LUMBER NO. 17, LATEST EDITION. FURNISH TO THE FOLLOWING MINIMUM STANDARDS.

JOISTS: (2X, 3X, AND 4X MEMBERS) DOUGLAS FIR NO. 1 OR BTR. MINIMUM BASE VALUE, F_b = 1,200 PSI

DOUGLAS FIR NO. 2 MINIMUM BASE VALUE, F_b = 900 PSI

BEAM AND STRINGERS: (INCLUDING 6 X AND LARGER MEMBERS) DOUGLAS FIR NO. 1 MINIMUM BASIC DESIGN STRESS, F_b = 1,350 PSI

POSTS AND TIMBERS: DOUGLAS FIR NO. 1 MINIMUM BASIC DESIGN STRESS, F_C = 1,000 PSI

STUDS PLATES & MISCELLANEOUS LIGHT FRAMING DOUGLAS FIR NO. 2

2X AND 3X TONGUE AND GROOVE DECKING HEM-FIR COMMERCIAL DEX, F_b = 1,350 PSI

24. GLUED LAMINATED MEMBERS SHALL BE FABRICATED IN CONFORMANCE WITH ASTM AND AITC STANDARDS IN A CITY OF SAN LUIS OBISPO CERTIFIED PLANT. EACH MEMBER SHALL BEAR AN A.I.T.C. IDENTIFICATION MARK AND SHALL BE ACCOMPANIED BY AN A.I.T.C. CERTIFICATE OF CONFORMANCE. CERTIFICATES OF CONFORMANCE MUST BE MADE AVAILABLE TO BUILDING INSPECTORS. CITY INSPECTION IS REQUIRED PRIOR TO COVERING GLUED LAMINATED MEMBERS. ALL SIMPLE SPAN BEAMS SHALL BE DOUGLAS FIR COMBINATION 24F-V4 OR 24F-1.8E, F_b = 2,400 PSI, Ft = 1100 PSI. ALL CANTILEVERED BEAMS SHALL BE DOUGLAS FIR COMBINATION 24F-V8, Fb = 2,400 PSI, Fv = 240 PSI.

HARMONIOUS TECTONICS

G. AMICK
B. ARMSTRONG
J. BUDIDHARMA
S. PASCUAL
E. ROYER

1 GRAND AVE
SAN LUIS OBISPO, CA 93410

License SE Seal:

Project Title:

GNS - WEED HOUSING

Site:

780 S. DAVIS ST
WEED, CA 96094

Revisions

No.	Desc.	Date

Author: Author

Checked by: Checker

Plot Date:

12/1/2017 12:11:59 AM

Sheet Name:

General Notes

Scale

Sheet Number:

SN.101

25. PARALLEL STRAND LUMBER (PSL) SHALL BE MANUFACTURED UNDER A PROCESS APPROVED BY THE NATIONAL RESEARCH BOARD. EACH PIECE SHALL BEAR A STAMP OR STAMPS NOTING THE NAME AND PLANT NUMBER OF THE MANUFACTURER, THE GRADE, THE NATIONAL RESEARCH BOARD NUMBER, AND THE QUALITY CONTROL AGENCY. ALL LSL LUMBER SHALL BE MANUFACTURED IN ACCORDANCE WITH NER-126 USING DOUGLAS FIR VENEER GLUED WITH A WATERPROOF ADHESIVE MEETING THE REQUIREMENTS OF ASTM D2559 WITH ALL GRAIN PARALLEL WITH THE LENGTH OF THE MEMBER. F_b = 2600 PSI, E = 1.8 x 10^6 PSI, Fv = 285 PSI (FOR 1.8E MEMBERS)

DESIGN SHOWN ON PLANS IS BASED ON LUMBER MANUFACTURED BY THE TRUS-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 I.C.B.O. APPROVAL FOR EQUAL OR GREATER LOAD CAPACITIES. ALL JOIST HANGERS AND OTHER HARDWARE SHALL BE COMPATIBLE IN SIZE WITH MEMBERS PROVIDED.

26. PREFABRICATED PLYWOOD WEB JOIST DESIGN SHOWN ON PLANS IS BASED ON JOIST MANUFACTURED BY THE TRUS-JOIST CORPORATION. ALTERNATE PLYWOOD WEB JOIST 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 I.C.B.O. APPROVAL FOR EQUAL OR GREATER LOAD CAPACITIES. ALL JOIST HANGERS AND OTHER HARDWARE SHALL BE COMPATIBLE IN SIZE WITH PLYWOOD WEB JOIST PROVIDED.

TRUSS SUPPLIERS NOTE: THE TRUSS CONFIGURATIONS, INCLUDING DEPTHS AND MEMBER SIZES SHOWN ON THE DRAWINGS, INDICATE THE DESIRED TRUSS CONFIGURATION AND ARE TO BE COMPLIED WITH WHEREVER POSSIBLE. IF A TRUSS MANUFACTURER IS UNABLE TO MEET THE LOAD REQUIREMENTS SPECIFIED WITH THE TRUSS CONFIGURATION INDICATED. THE MANUFACTURER IS TO SUBMIT WRITTEN NOTICE TO THAT AFFECT TO THE ARCHITECT PRIOR TO SUBMITTING A COST PROPOSAL OR BID.

IF A DIFFERENT SYSTEM IS PROPOSED THAT REQUIRES REVISIONS TO PRESENT STRUCTURAL FRAMING OR DETAILS, SUCH SYSTEM SHALL BE CONSIDERED SUBJECT TO THE APPROVAL OF THE OWNER, ARCHITECT, AND STRUCTURAL ENGINEER.

IT IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR AND TRUSS MANUFACTURER TO VERIFY THE WEIGHT AND LOCATIONS OF ALL MECHANICAL EQUIPMENT PRIOR TO SUBMITTING SHOP DRAWINGS. IT SHALL BE NOTED IN THE TRUSS MANUFACTURER'S BID WHETHER OR NOT AN ALLOWANCE HAS BEEN MADE FOR MECHANICAL UNITS.
TRUSS SHOP DRAWINGS WILL NOT BE REVIEWED WITHOUT CALCULATIONS STAMPED BY A LICENSED STRUCTURAL ENGINEER.

27. PLYWOOD SHEATHING SHALL BE STRUCTURAL I. ORIENTED STRAND BOARD OF EQUIVALENT THICKNESS, EXPOSURE RATING AND PANEL INDEX MAY BE USED IN LIEU OF PLYWOOD. SEE PLANS FOR THICKNESS, PANEL IDENTIFICATION INDEX AND NAILING REQUIREMENTS.

28. ALL WOOD PLATES IN DIRECT CONTACT WITH CONCRETE OR MASONRY SHALL BE PRESSURE-TREATED WITH AN APPROVED PRESERVATIVE, PROVIDE 2 LAYERS OF ASPHALT IMPREGNATED BUILDING PAPER BETWEEN UNTREATED LEDGERS, BLOCKING, ETC. AND CONCRETE OR MASONRY.

29. TIMBER CONNECTORS CALLED OUT BY LETTERS AND NUMBERS SHALL BE "STRONG-TIE" BY SIMPSON COMPANY, AS SPECIFIED IN THEIR CATALOG NO. C-C-2015 EQUIVALENT DEVICES BY OTHER MANUFACTURERS MAY BE SUBSTITUTED, PROVIDED THEY HAVE ICBO APPROVAL FOR EQUAL OR GREATER LOAD CAPACITIES. PROVIDE NUMBER AND SIZE OF FASTENERS AS SPECIFIED BY MANUFACTURER. CONNECTORS SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. WHERE CONNECTOR STRAPS CONNECT TWO MEMBERS, PLACE ONE-HALF OF THE NAILS OR BOLTS IN EACH MEMBER. ALL BOLTS IN WOOD MEMBERS SHALL CONFORM TO ASTM A307. PROVIDE WASHERS UNDER THE HEADS AND NUTS OF ALL BOLTS AND LAG SCREWS BEARING ON WOOD. UNLESS NOTED OTHERWISE, ALL NAILS SHALL BE COMMON. ALL SHIMS SHALL BE SEASONED AND DRIED AND THE SAME GRADE (MINIMUM) AS MEMBERS CONNECTED. ALL JOISTS SHALL BE CONNECTED TO FLUSH BEAMS WITH "LUS" SERIES JOIST HANGERS.

ALL CONNECTIONS IN CONTACT WITH PRESSURE TREATED WOOD, SHALL BE OF HOT DIPPED GALVANIZED STEEL OR STAINLESS STEEL. HOT DIPPED GALVANIZED FASTENERS SHOULD CONFORM TO ASTM STANDARD 153, AND HOT DIPPED GALVANIZED CONNECTORS SHOULD CONFORM TO ASTM STANDARD A653 (CLASS G-185). STAINLESS STEEL FASTENERS AND CONNECTORS SHOULD BE TYPE 304 OR 316. NOTE: ELECTROPLATED GALZANIZED FASTENERS AND CONNECTORS ARE NOT TO BE USED WITH PRESSURE TREATED WOOD. SIMPSON PRODUCT FINISHES CORRESPONDING TO THE ABOVE REQUIREMENTS ARE ZMAX (HOT DIPPED GALVANIZED) AND SST300 (STAINLESS STEEL).

30. WOOD FASTENERS:

A. NAIL SIZES SPECIFIED ON DRAWINGS ARE BASED ON THE FOLLOWING SPECIFICATIONS:

SIZE	LENGTH	DIAMETER
6d	2"	0.113"
8d	2-1/2"	0.131"
10d	3"	0.148"
12d	3-1/4"	0.148"
16d	3-1/2"	0.162"

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

NAIL SIZE	EQUIVALENT STAPLE	MINIMUM LENGTH
6d	16 GA.	1-3/4"
8d	15 GA.	1-3/4"
10d	13 GA	1-3/4"

IF CONTRACTOR PROPOSES THE USE OF ALTERNATE STAPLES, THEY SHALL SUBMIT STAPLE SPECIFICATIONS TO THE STRUCTURAL ENGINEER (PRIOR TO CONSTRUCTION) FOR REVIEW AND APPROVAL.

C. NAILS AND STAPLES – PLYWOOD (APA RATED SHEATHING) FASTENERS TO FRAMING SHALL BE DRIVEN FLUSH TO FACE OF SHEATHING WITH NO COUNTERSINKING PERMITTED.

31. WOOD FRAMING NOTES – THE FOLLOWING APPLY UNLESS OTHERWISE SHOWN ON THE PLANS:

A. ALL WOOD FRAMING DETAILS NOT SHOWN OTHERWISE SHALL BE CONSTRUCTED TO THE MINIMUM STANDARDS OF THE UNIFORM BUILDING CODE. MINIMUM NAILING, UNLESS OTHERWISE NOTED, SHALL CONFORM TO TABLE 2304.10.1 OF THE INTERNATIONAL BUILDING CODE. UNLESS NOTED OTHERWISE, ALL NAILS SHALL BE AS SPECIFIED ABOVE. COORDINATE THE SIZE AND LOCATION OF ALL OPENINGS WITH MECHANICAL AND ARCHITECTURAL DRAWINGS. PROVIDE WASHERS UNDER THE HEADS AND NUTS OF ALL BOLTS AND LAG SCREWS BEARING ON WOOD.

B. WALL FRAMING: ALL STUD WALLS SHOWN AND NOT OTHERWISE NOTED SHALL BE 16" O.C. TWO STUDS MINIMUM SHALL BE PROVIDED AT THE END OF ALL WALLS AND AT EACH SIDE OF ALL OPENINGS. TWO 2 x 8 HEADERS SHALL BE PROVIDED OVER ALL OPENINGS NOT OTHERWISE NOTED. SOLID BLOCKING FOR WOOD COLUMNS SHALL BE PROVIDED THROUGH FLOORS TO SUPPORTS BELOW. PROVIDE SOLID BLOCKING BETWEEN STUDS AT MID-HEIGHT OF ALL STUD WALLS OVER 10' IN HEIGHT.

WALLS SHALL HAVE A SINGLE BOTTOM PLATE AND A DOUBLE TOP PLATE. END NAIL TOP PLATE TO EACH STUD WITH TWO 16d NAILS, AND TOENAIL OR END NAIL EACH STUD TO BOTTOM PLATE WITH TWO 16d NAILS. FACE NAIL DOUBLE TOP PLATE WITH 16d AT 12" O.C. AND LAP MINIMUM 2'-0" AT JOINTS AND PROVIDE FIVE 10d NAILS AT EQUAL SPACING. EACH SIDE OF JOINT.

ALL STUD WALLS SHALL HAVE THEIR LOWER WOOD PLATES ATTACHED TO WOOD FRAMING BELOW WITH 16d NAILS AT 12" O.C. STAGGERED OR BOLTED TO CONCRETE WITH 5/8" DIAMETER ANCHOR BOLTS (WITH 7" MINIMUM EMBEDMENT)@ 4'-0" O.C. UNLESS INDICATED OTHERWISE. PROVIDE 2" x 2" x 3/16" PLATE WASHERS AT ALL ANCHOR BOLTS. INDIVIDUAL MEMBERS OF BUILT-UP POSTS SHALL BE NAILED TO EACH OTHER WITH 16d @ 12" O.C. STAGGERED. REFER TO THE PLANS AND SHEAR WALL SCHEDULE FOR REQUIRED SHEATHING AND NAILING. WHEN NOT OTHERWISE NOTED, PROVIDE GYPSUM WALLBOARD ON INTERIOR SURFACES NAILED TO ALL STUDS, TOP AND BOTTOM PLATES AND BLOCKING WITH NAILS AT 7" O.C. USE 5d COOLER NAILS FOR 1/2" GWB AND 6d COOLER NAILS FOR 5/8" GWB. PROVIDE 1/2" (NOM.) APA RATED SHEATHING (SPAN RATING 24/0) ON EXTERIOR SURFACES NAILED AT ALL PANEL EDGES (BLOCK UNSUPPORTED EDGES), TOP AND BOTTOM PLATES WITH NAILS @ 6" O.C. AND TO ALL INTERMEDIATE STUDS AND BLOCKING WITH NAILS @ 12" O.C. ALLOW 1/8" SPACING AT ALL PANEL EDGES AND ENDS.

C. FLOOR AND ROOF FRAMING: PROVIDE DOUBLE JOISTS UNDER ALL PARALLEL PARTITIONS THAT EXTEND OVER MORE THAN HALF THE JOIST LENGTH AND AROUND ALL OPENINGS IN FLOORS OR ROOFS UNLESS OTHERWISE NOTED. PROVIDE SOLID BLOCKING AT ALL BEARING POINTS.

TOENAIL JOISTS TO SUPPORTS WITH TWO 16d NAILS. ATTACH TIMBER JOISTS TO FLUSH HEADERS OR BEAMS WITH SIMPSON METAL JOIST HANGERS IN ACCORDANCE WITH NOTES ABOVE. NAIL ALL MULTI-JOIST BEAMS TOGETHER WITH 16d @ 12" O.C. STAGGERED. ATTACH RAFTERS AT BEARING LINES WITH H2.5 @ 48" O.C. UNLESS OTHER METAL CONNECTIONS ARE PROVIDED.

UNLESS OTHERWISE NOTED ON THE PLANS, APA RATED ROOF AND FLOOR SHEATHING SHALL BE LAID UP WITH STRENGTH AXIS PERPENDICULAR TO SUPPORTS AND NAILED WITH NAILS @ 6" O.C. TO FRAMED PANEL EDGES AND OVER STUD WALLS AS SHOWN ON PLANS AND @ 12" O.C. TO INTERMEDIATE SUPPORTS. PROVIDE APPROVED PLYWOOD EDGE CLIPS CENTERED BETWEEN JOISTS/TRUSSES AT UNBLOCKED ROOF SHEATHING EDGES. ALL FLOOR SHEATHING EDGES SHALL HAVE APPROVED TONGUE-AND-GROOVE JOINTS OR SHALL BE SUPPORTED WITH SOLID BLOCKING. ALLOW 1/8" SPACING AT ALL PANEL EDGES AND ENDS OF ALL ROOF AND FLOOR SHEATHING. TOENAIL BLOCKING TO SUPPORTS WITH 16d @ 12" O.C. UNLESS OTHERWISE NOTED. AT BLOCKED FLOOR AND ROOF DIAPHRAGMS PROVIDE FLAT 2X BLOCKING AT ALL UNFRAMED PLYWOOD PANEL EDGES AND NAIL WITH EDGE NAILING SPECIFIED.

TONGUE AND GROOVE STUCTURAL ROOF AND FLOOR DECKING SHALL BE INSTALLED AS FOLLOWS:

2X DECKING SHALL BE TOENAILED THORUGH THE TONGUE AND FACENAILED WITH ONE 16d NAIL PER PIECE PER SUPPORT.

3X AND 4X DECKING SHALL BE TOENAILED WITH ONE 40d NAIL AND FACENAILED WITH ONE 60d NAIL PER SUPPORT. COURSES SHALL BE SPIKED TOGETHER WITH 8" SPIKES AT 30" O.C. (MAXIMUM) AND AT 10" (MAXIMUM) FROM EACH END OF EACH PIECE. SPIKES SHALL BE INSTALLED IN PREDRILLED EDGE HOLES.

HARMONIOUS TECTONICS

G. AMICK
B. ARMSTRONG
J. BUDIDHARMA
S. PASCUAL
E. ROYER

1 GRAND AVE
SAN LUIS OBISPO, CA 93410

License SE Seal:

Project Title:

GNS - WEED HOUSING

Site:

780 S. DAVIS ST
WEED, CA 96094

Revisions

No.	Desc.	Date

Author: Author

Checked by: Checker

Plot Date:

12/1/2017 12:11:59 AM

Sheet Name:

General Notes

Scale

Sheet Number:

SN.102

STRUCTURAL CALCULATIONS

for

GNS - Weed Housing Project
(ARCE 415)

HARMONIOUS TECTONICS

ARCE: GALEN AMICK
SARAH PASCUAL

DATE: 12/1/2017

Table of Contents

Harmonious Tectonics

HarT
arce: galen amick | sarah pascual

Load Takeoff

Roof Dead Load

Single Ply	1.0 psf
Sheathing (1/2")	1.5 psf
Insulation	3.0 psf
Framing	2.5 psf
MEP	1.0 psf
Ceiling (Gyp)	3.1 psf
Misc	0.9 psf
	13.0

Load on Horiz. Plane:
(5:12)... 13 x 1.08 = 14.0 psf

DL = 14.0 psf

Floor Dead Load

Flooring (Vinyl Tile)	1.4 psf
Sheathing (3/4")	2.3 psf
Framing (2x12 @ 16" O.C.)	2.5 psf
Insulation	3.0 psf
MEP	1.0 psf
Misc	1.5 psf
	11.7 psf

DL = 12 psf

Roof Live Load: (LRF1)

Lo =	20 psf
LR = LoR1R2	19 psf
R2 =	0.95 (5:12)
R1 = 1	At < 200 ft2
R1 = 1.2-.001At	200ft2 < At < 600 ft2
R1 = 0.6	At > 600 ft2
R2 = 1.2-0.05F = 1	

Floor Live Loads

Typical Residential	40 psf

Misc. Dead Loads

Interior Walls	10.0 psf
Exterior Walls	23.0 psf

Ceiling Load 10 psf

Snow Load

Flat Roof (pf = 0.7*Ce*Ct*Is*pg) 60 psf

Cs = 0.78

Sloped Roof (ps = Cs*pf, for 5:12)

46.8 psf

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCES	CALCULATIONS	ANSWER
ASCE 7-10 Table 28.5-1	WIND DESIGN	
	· ENCLOSED, SIMPLE DIAPHRAGM, LOW RISE	✓
	STEP 1: RISK CATEGORY	II
	STEP 2: BASIC WIND SPEED, V	110 mph
	STEP 3: WIND LOAD PARAMETERS	
	EXPOSURE:	C
	K_{zt}:	1.0
Fig. 28.6-1	STEP 4: WIND PRESSURE, p_{s30}	
	HORIZONTAL (A, B, C, D)	26.6/7.0/17.7/-3.9
	VERTICAL (E, F, G, H)	-23.1/-16.0/-16.0/-12.2
	OVERHANGS (E_{OH}, G_{OH})	-32.3/-25.3
Fig. 28.6-1	STEP 5: ADJUSTMENT FACTOR, λ	1.21
Eq. 28.6-1	STEP 6: DETERMINE p_s	

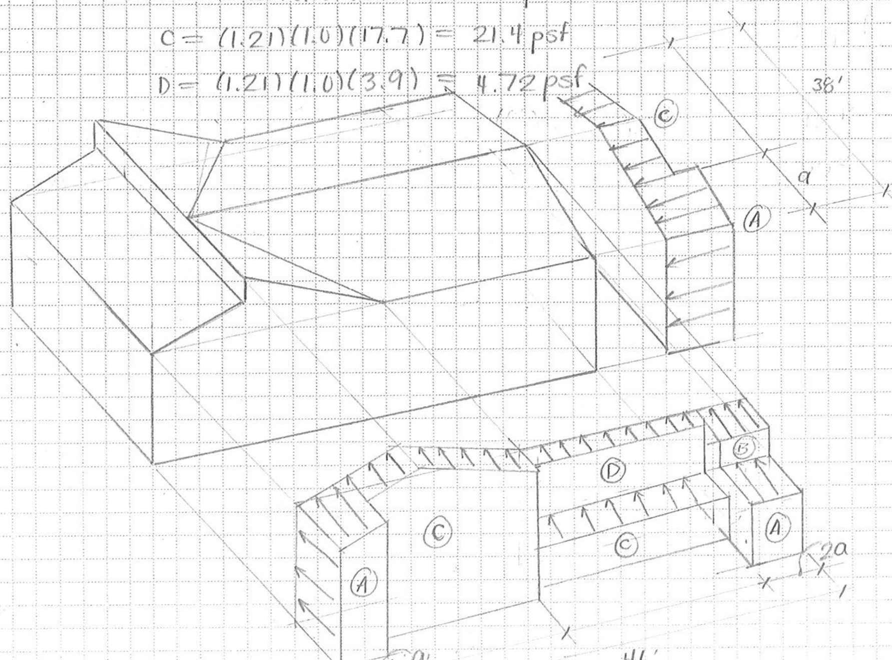
$p_s = \lambda K_{zt} p_{s30}$

A) = (1.21)(1.0)(26.6) = 32.2 psf

B = (1.21)(1.0)(7.0) = 8.47 psf

C = (1.21)(1.0)(17.7) = 21.4 psf

D = (1.21)(1.0)(3.9) = 4.72 psf



$a = \min \begin{cases} 0.10(34') = 3.4' \\ 0.4(17') = 6.8' \end{cases}$

NOT LESS THAN: $\begin{cases} 0.04(34') = 1.36 < 3.4' ✓ \\ 3' < 3.4' ✓ \end{cases}$

∴ a = 3.4'

h ≈ 15', θ =

W2

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE	CALCULATIONS	ANSWER

CASE A

$A = 32.2\,psf \times \frac{8'}{2} \times (2 \times 3.4') = 876\,\#$

$B = 8.47\,psf \times 8' \times (2 \times 3.4') = 461\,\#$

$C = 21.4\,psf \times \frac{8'}{2} \times (18' - 6.8') = 959\,\#$

$D = 4.72\,psf \times 8' \times (18' - 6.8') = 423\,\#$

$\Sigma = 2719\,\#$

CASE B

$A = 32.2\,psf \times 8' \times 3.4' = 876\,\#$

$C = 21.4\,psf \times 8' \times (46' - 18' - 3.4') = 4212\,\#$

$\Sigma = 5088\,\#$

TOTAL $V_{wind} = 4553\# + 5088\# = 7807\#$ (LRFD)

$0.6W = 4684\,\#$ (ASD) ← E-W WIND (WORST CASE)

N-S WIND DEMAND

CASE B

$A = 32.2\,psf \times 8' \times 3.4' = 876\,\#$

$C = 21.4\,psf \times 8' \times (38' - 3.4') = 5924\,\#$

$\Sigma = 6800\,\#$ (LRFD)

$0.6W = 4080\,\#$ (ASD) ← N-S WIND (WORST CASE)

HARMONIOUS TECTONICS HarT

PROJECT	2017 IPD WEED RESIDENTIAL
	DATE
SCOPE	

REFERENCE	CALCULATIONS	ANSWERS

SEISMIC BASE SHEAR

Pg G-

ROOF DL ADJUSTED FOR SLOPE = 14 psf
INTERIOR WALL DL = 10 psf
EXTERIOR WALL DL = 23 PSF
FLOOR DL = 12 PSF

SNOW LOAD CONTRIBUTION (S)
ASCE 7 § 12.7.2
P_f = 60 PSF   60 psf > 30 psf
S = $0.20 p_s$ = 0.20(47 PSF) = 9.4 psf

SEISMIC WEIGHT

ROOF = AREA x WEIGHT = 1955 ft² x 14 psf = 27,370 #
SLOPED ROOF WALL (A) = 69 ft² x 23 psf = 1587#
GARAGE BACK WALL (B) = 208 ft² x 10 psf = 2080#
SOUTH WALL (1) = 148 ft² x 23 psf = 3404#
WEST WALL (C) = 80 ft² x 23 psf = 1840#
CLEARSTORY = 82 ft² x 23 psf = 1886#
INT SLOPED WALL (2) = 80 ft² x 10 psf = 800#
MASTER RAISED WALL = 60 ft² x 10 psf = 600#
INT. PANEL WALL = $L \times \frac{h}{2} \times WT.$ = $120_{FT} \times \frac{8^{FT}}{2} \times 10\,psf$ = 4800#
EXT PANEL WALL = $L \times \frac{h}{2} \times WT$ = $146 \cdot \frac{8^{FT}}{2} \times 23\,psf$ = 13,432#
SNOW LOAD = AREA x $0.2\,p_s$ = 1955 ft² x 0.2(47 psf) = 18,377#

W = 76,167# ← W

USGS

SEISMIC DESIGN CRITERIA

RISK CATEGORY = II
I_e = 1.0
DESIGN CATEGORY = D
SDS = 0.594
SD1 = 0.384
T = 0.086 < TL 8sec

$V = C_s W$ = 0.091 (76,167#)
= 6,931# ← V

ASCE 7-10 TABLE 12.2-1

STRUCTURAL SYSTEM

BEARING WALL (LIGHT FRAME W/ WOOD STR PANELS)
RESPONSE MOD. FACTOR R = 6.5
OVER STRENGTH FACTOR Ω_0 = 2

$C_s = \frac{S_{DS}}{\frac{R}{I_e}}$ = 0.091

S2

USGS Design Maps Summary Report

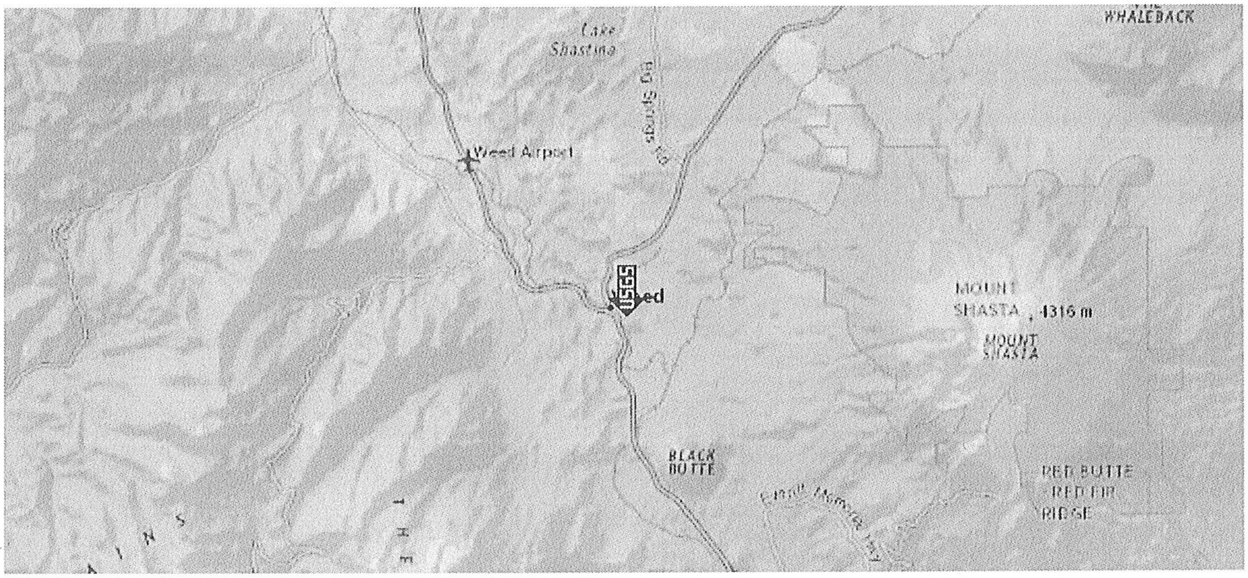
User–Specified Input

Building Code Reference Document 2012/2015 International Building Code (which utilizes USGS hazard data available in 2008)

Site Coordinates 41.42891°N, 122.37939°W

Site Soil Classification Site Class D – "Stiff Soil"

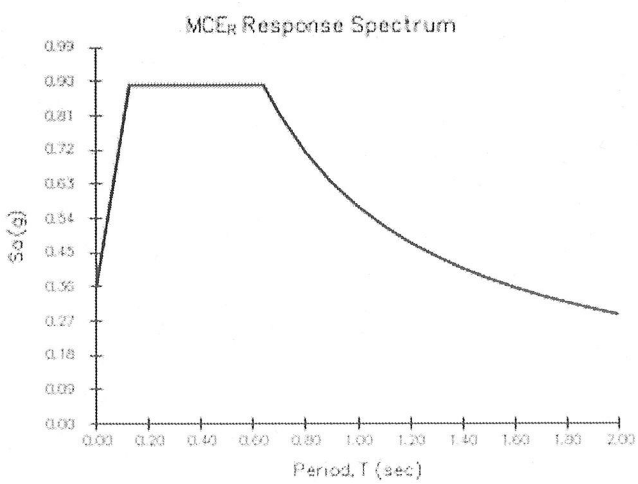
Risk Category I/II/III

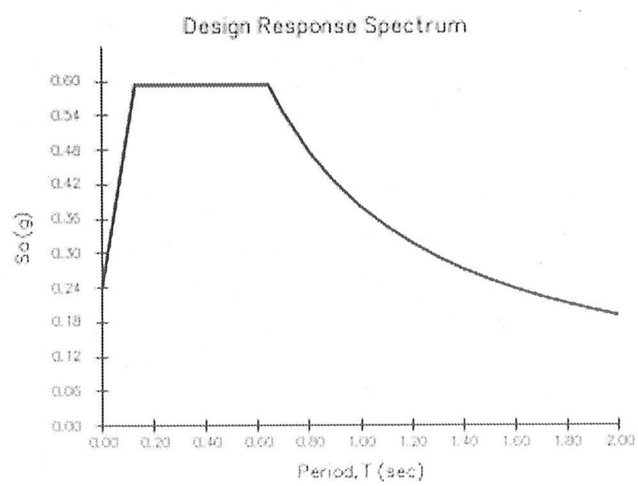


USGS–Provided Output

S_S =	0.736 g	S_{MS} =	0.891 g	S_{DS} =	0.594 g
S_1 =	0.328 g	S_{M1} =	0.572 g	S_{D1} =	0.381 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.



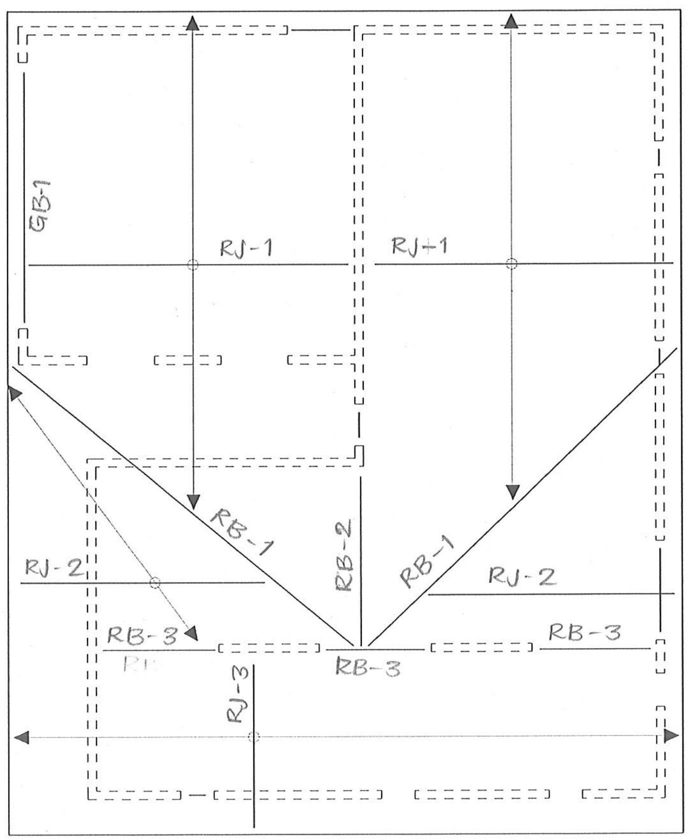


Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

ROOF FRAMING DESIGN: KEY PLAN



HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE	CALCULATIONS	ANSWER

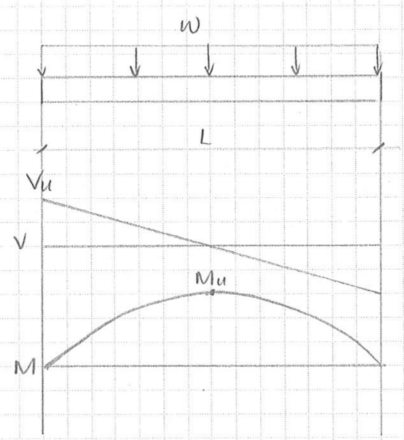
ROOF FRAMING DESIGN

LOAD COMBOS:

$$D+S = \frac{(14.0\,psf + 46.8\,psf)}{1.15} = \frac{60.8\,psf}{1.15} = 52.9\,psf$$

$$D+0.75(\cancel{L}^{0}+S) = \frac{(14.0\,psf + 0.75(46.8\,psf))}{1.15} = \frac{49.1\,psf}{1.15} = 42.7\,psf$$

∴ D+S GOVERNS = 60.8psf



TYPICAL ROOF JOIST (RJ-1)

$L = 19'$

$w = 60.8\,psf \times \frac{16''}{12} = 81.07\,plf$

$V_u = \frac{81.07\,plf \times 19'}{2} = 770\,\#$

$M_u = \frac{81.07\,plf\,(19')^2}{8} = 3658\,\#\,ft$

NDS Table 4a, Table 1b — TRY 2x12 DF-L #1 OR BTR.

$f_b = \frac{M}{S} = \frac{3658\#' \times 12''}{31.64\,in^3} = 1387\,psi$

NDS Table 4.3.1 — $F_b' = F_b(C_D \cdot \cancel{C_M} \cdot \cancel{C_t} \cdot \cancel{C_L} \cdot C_F \cdot \cancel{C_{fu}} \cdot \cancel{C_i} \cdot C_r)$

$= 1200\,psi\,(1.15)(1.0)(1.15)$

$= 1587\,psi > f_b$ ✓

∴ OK FOR FLEXURE

$f_v = \frac{1.5V}{A} = \frac{1.5(770\,\#)}{16.88\,in^2} = 68.4\,psi$

$F_v' = F_v(C_D \cdot \cancel{C_M} \cdot \cancel{C_t} \cdot \cancel{C_i})$

$= 180\,psi\,(1.15)$

$= 207\,psi > f_v$ ✓

∴ OK FOR SHEAR

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE	CALCULATIONS	ANSWER

$$\Delta_{D+S} = \frac{5wL^4}{384EI} = \frac{5(81.07\,plf)(19')^4(12")^3}{384(1.8E6\,psi)(178\,in^4)} = \underline{0.742"}$$

$$\Delta_{allow_{D+S}} = \frac{L}{180} = \frac{18' \times 12"}{180} = \underline{1.2"} > \Delta_{D+S} \checkmark$$

$$\Delta_L = \frac{5w_L L^4}{384EI} = \frac{5(19psf \cdot \frac{16}{12})(19')^4(12")^3}{384(1.8E6\,psi)(178\,in^4)} = \underline{0.232"}$$

$$\Delta_{allow_L} = \frac{L}{240} = \frac{18' \times 12"}{240} = \underline{0.9"} > \Delta_L \checkmark$$

∴ OK FOR DEFLECTION

USE 2x12 DF-L #1 OR BTR @ 16" O.C. ← RJ-1

TYPICAL VALLEY JOIST (RJ-2)

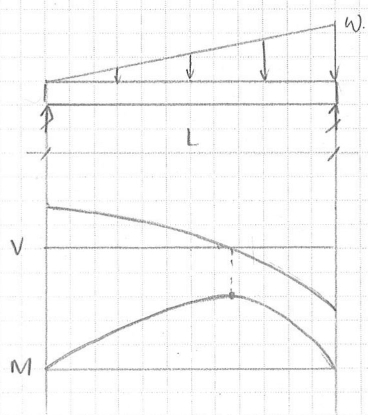
L = 18'

$w = 60.8\,plf \cdot \frac{16"}{12} = 81.07\,plf$

∴ SAME LOADING AND LESS LENGTH THAN RJ-1

USE 2x12 DF-L #1 OR BTR @ 16" O.C. ← RJ-2

TYPICAL VALLEY BEAM (RB-1)



L = 26'

$w = 60.8\,psf \cdot 12' = 730\,plf$

$$V_u = \frac{2(0.5 \cdot 730\,plf \cdot 26')}{3} = \underline{6323\#}$$

$$M_u = 0.128(0.5 \cdot 730\,plf \cdot 26')(26') = \underline{31,565\#ft}$$

HARMONIOUS TECTONICS **HarT**

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE	CALCULATIONS	ANSWER

WEYERHAEUSER CATALOG

TRY PSL $5\frac{1}{4}" \times 14"$ ($E = 2.2E6\,psi$, $I = 1201\,in^4$)

$M = 40{,}740\,\#\cdot ft$

$V = 14{,}210\,\#$

$$\Delta_{D+S} = \frac{0.013WL^3}{EI} = \frac{0.013(0.5 \cdot 730plf \cdot 26')(26' \cdot 12")^3}{(2.2E6\,psi)(1201 in^4)} = \underline{0.95"}$$

$$\Delta_{allow\,D+S} = \frac{L}{180} = \frac{26 \times 12}{180} = \underline{1.73"} > \Delta_{D+S} \checkmark$$

$$\Delta_L = \frac{0.013WL^3}{EI} = \frac{0.013(0.5(19psf \cdot 12')26')(26' \cdot 12')^3}{(2.2E6\,psi)(1201 in^4)} = \underline{0.50"}$$

$$\Delta_{allow\,L} = \frac{L}{240} = \frac{26 \times 12}{240} = \underline{1.30"} > \Delta_L \checkmark$$

∴ OK FOR DEFLECTION

USE PSL $5\frac{1}{4}" \times 14"$ ← RB-1

RIDGE BEAM (RB-2)

$L = 11'$

$w = 60.8\,psf \cdot 12' = 730\,plf$

$$V_u = \frac{2(0.5 \cdot 730plf \cdot 11')}{3} = \underline{2675\,\#}$$

$$M_u = 0.128(0.5 \cdot 730plf \cdot 11')(11') = \underline{5650\,\#\cdot ft}$$

TRY 4x12 DF-L #2

$$f_b = \frac{M}{S} = \frac{5650\#\cdot ft \cdot 12"}{73.83 in^3} = \underline{918.3\,psi}$$

$$F_b' = F_b(C_D \cdot \cancel{C_M} \cdot \cancel{C_t} \cdot \cancel{C_L} \cdot C_F \cdot \cancel{C_{fu}} \cdot \cancel{C_i} \cdot \cancel{C_r})$$
$$= 900psi(1.15)(1.1)$$
$$= \underline{1139\,psi} > f_b \checkmark$$

∴ OK FOR FLEXURE

$$f_v = \frac{1.5V}{A} = \frac{1.5(2675\#)}{39.38 in^2} = \underline{101.9\,psi}$$

$$F_v' = F_v(C_D \cdot \cancel{C_M} \cdot \cancel{C_t} \cdot \cancel{C_i})$$
$$= 180psi(1.15)$$
$$= \underline{207\,psi} > f_v \checkmark$$

∴ OK FOR SHEAR

$$\Delta_{D+S} = \frac{0.013WL^3}{EI} = \frac{0.013(0.5 \cdot 730plf \cdot 11')(11' \cdot 12')^3}{(1.6E6\,psi)(415.3 in^4)} = \underline{0.181"}$$

$$\Delta_{allow\,D+S} = \frac{L}{180} = \frac{11' \times 12"}{180} = \underline{0.73"} > \Delta_{D+S} \checkmark$$

∴ OK FOR DEFLECTION

USE 4X12 DF-L #2

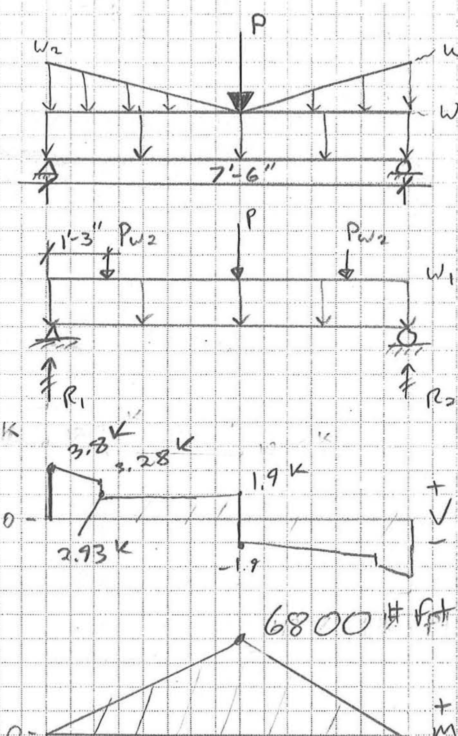
HARMONIOUS TECTONICS **HarT**

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

RB3 DESIGN

THIS BEAM DESIGN WILL BE USED FOR ALL 3 BEAMS SUPPORTING



D = 13psf
S = 47psf

P = REACTION FROM RIDGE BEAM

W_1 = SUB ROOF LOADING

W_2 = RXN FROM VALLEY BEAM TRIBUTARY AREA.

$P = \left(\frac{11 \times 11.5}{2}\right) \times (D+S)$

$P = 126.5\# \times (13+47)\,psf = 3.8^{KK}$

$W_1 = T_{WIDTH} \times (D+S) = 4.5' \times 60\,psf$

$W_1 = 405\,PLF = 0.41\,KLF$

$0 < x \leq 3.75'$

$W_2 = 0.842(x) \times (D+S)$

$$P_{W2} = \frac{0.842(3.75)^2}{2} \times (D+S)$$

$P_{W2} = 0.36\,K$

$R_1 = R_2 = 3.8^K$

$$\Delta MAX = \frac{P\ell^3}{48EI} = \frac{126.5\#(47psf)(90in)^3}{48(1{,}600{,}000\,psi)\,I} = 0.25\,in$$

$\Delta ALLOW = \ell/360 = 90/360 = 0.25\,in$

$I_{REQ} = 57\,in^4$

NDS 2015

$V_{MAX} = 3.8^K$ SHEAR GOVERNED?

$M_{MAX} = 6{,}800\,\#\text{-}ft = 81{,}600\,\#\text{-}in$

$\Delta_{ALLOW} = 0.25\,in$

$$A_{REQ} = \frac{1.5\,V}{F_V'} = 30\,in^2$$

$$S_{REQ} = \frac{M}{F_b'} = \frac{6800 \times 12}{1350 \times 1.15} = 52.56\,in^3$$

$I_{REQ} = 57\,in^4$

TRY 6x12 DF-L No. 1

R6

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

RB3 DESIGN CONT.

NDS 2015

6x12 DF-L No 1

A = 63.25 in²

S_x = 121.2 in³

I_x = 697.1 in⁴

$f_v = \frac{3}{2}\frac{V}{A} = 1.5 \times (3800\#/63.25 in^2)$

f_v = 90.12 psi

$F_v' = F_v \cdot C_D = 170 psi \times 1.15 = 196 psi > 90$ ✓

$f_b = \frac{M}{S} = \frac{6800 \# ft \times 12}{121.2 in^3} = 673.26$ psi

$F_b' = F_b \times C_D \times C_L = 1350 \times 1.15 \times 1.0 = 1553$ psi

1553 psi > 673.26

$\Delta_{MAX} = \frac{PL^3}{48EI} + \frac{5wL^4}{384EI}$

P_Δ = (126.5 ft 47 psf) + 720 #

w_Δ = 212 plf

$\Delta_M = \frac{L^3}{EI}\left(\frac{P}{48} + \frac{5wL}{384}\right)$

$\Delta_M = \frac{(7.5' \times 12)^3}{1,600,000(I)}\left(\frac{6666\#}{48} + \frac{5(212 plf)(7.5 \times 12)}{384}\right)$

$\Delta_M = 6.53 \times 10^{-4} \times (387.31) = 0.25$ in ✓

USE 6x12 DF-L NO. 1

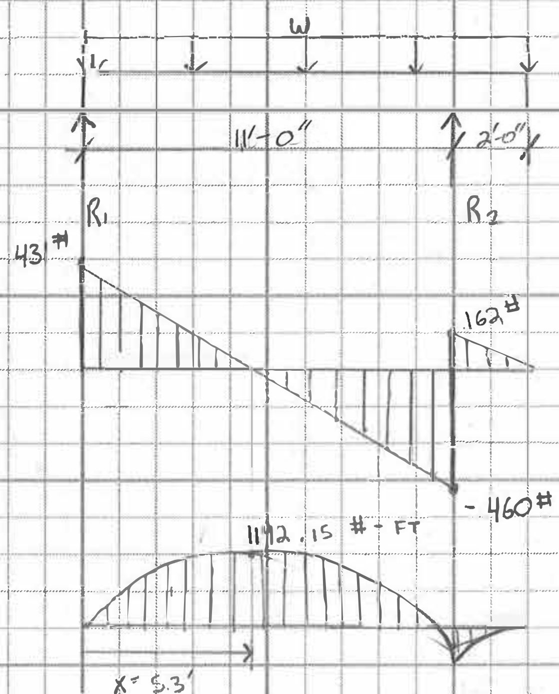
R7

HARMONIOUS TECTONICS **HarT**

arce: galen amick | sarah pascual

TITLE	
NAME	DATE

ROOF FRAMING (RJ-3)



$w = D + S = (14 + 47)\ psf \left(\frac{16}{12}\right) = 81\ PLF$

$R_1 = \frac{w}{2(11)}(11^2 - 2^2) = 431\#$

$R_2 = \frac{w}{2(11)}(11' + 2)^2 = 622\#$

TRY 2x8 DF-L #2-BTR

NDS T4.3.1

$F_b' = F_b(C_d \cdot C_L \cdot C_F \cdot C_r) = 1428\ psi$ (900psi, 1.15, 1.0, 1.2, 1.15)

$f_b = \frac{M}{S} = \frac{1142\#\text{-}ft\left(\frac{12"}{1'}\right)}{13.14\ in^3} = 1043\ psi < 1428\ psi$ ✓

$F_v' = F_v \cdot C_d = 180\ psi(1.15) = 207\ psi$

$f_v = \frac{3}{2}\frac{V}{A} = \frac{1.5(460\#)}{10.88\ in^2} = 63\ psi < 207\ psi$ ✓

$\frac{SL}{TL} = \frac{240}{360} = 0.67$ SNOW LOAD GOVERNS $\ell/240 = 132"/240 = 0.55"$

$\Delta_{MAX} = \frac{wx}{24EI\ell}(\ell^4 - 2\ell^2x^2 + \ell x^3 - 2a^2\ell^2 + 2a^2x^2) = 0.152\ in < 0.55"$ ✓

NDS T.1B

$\ell = 11' = 132\ in$

$a = 2' = 24\ in$

$x = 5.3' = 64\ in$

NDS T4A

$w = 47\ PLF = 5.64\ LB/inch$

$I = 47.63\ in^4$

$E = 1{,}600{,}000\ psi$

USE 2x8 DF-L No. 2 BTR

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

GARAGE BEAM (GB-1)

$w = 60.8\,psf \times 10' = 608\,plf$

$V_u = \frac{608\,plf \times 16'}{2} = \underline{4864\,\#}$

$M_u = \frac{608\,plf\,(16')^2}{8} = \underline{19456\,\#\text{-}ft}$

TRY 6X16 DF-L SEL. STR

$f_b = \frac{19456\,\#\text{-}ft \times 12}{220.2\,in^3} = \underline{1060\,psi}$

$F_b' = 1600\,psi\,(1.15)(0.97)^{*} = \underline{1782\,psi} > f_b$ ✓

$*\,C_F = \left(\frac{12}{d}\right)^{\frac{1}{9}} = \left(\frac{12}{16}\right)^{\frac{1}{9}} = 0.97$

∴ OK FOR FLEXURE

$f_v = 1.5\left(\frac{4864\,\#}{85.25\,in^2}\right) = \underline{85.6\,psi}$

$F_v' = 170\,psi\,(1.15) = \underline{195.5\,psi} > f_v$ ✓

∴ OK FOR SHEAR

$\Delta_{DIS} = \frac{5(608\,plf)(16')^4(12'')^3}{384(1.6E6\,psi)(1707\,in^4)} = \underline{0.33''}$

$\Delta_{allow} = \frac{16' \times 12''}{180} = \underline{1.07''} > \Delta_{DIS}$ ✓

∴ OK FOR DEFLECTION

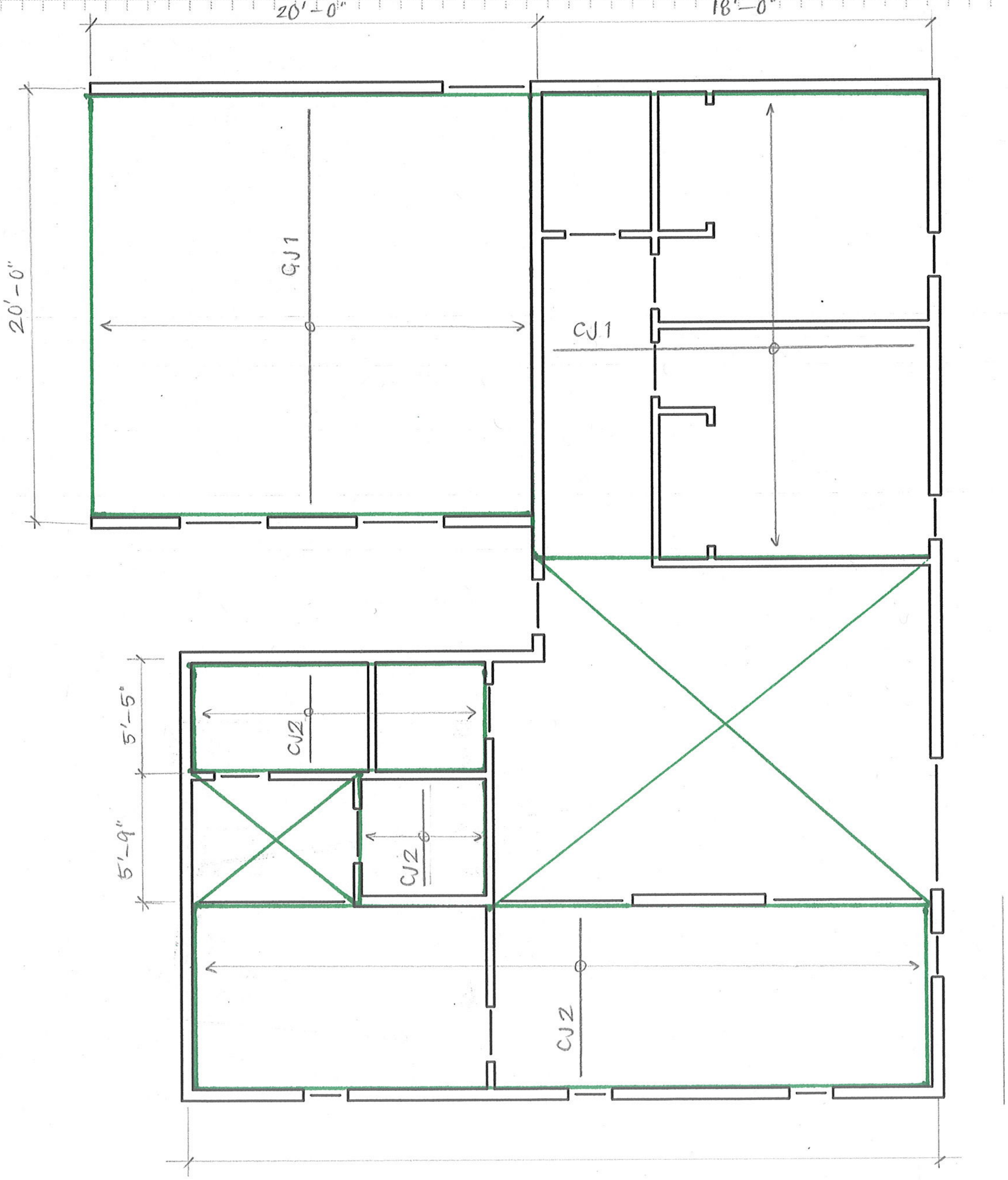
∴ USE 6X16 DF-L SEL. STR ← GB-1

R9

HARMONIOUS TECTONICS HarT

PROJECT	2017 IPD WEED RESIDENTIAL	
NAME		DATE
SCOPE		

CEILING JOIST DESIGN – KEY PLAN

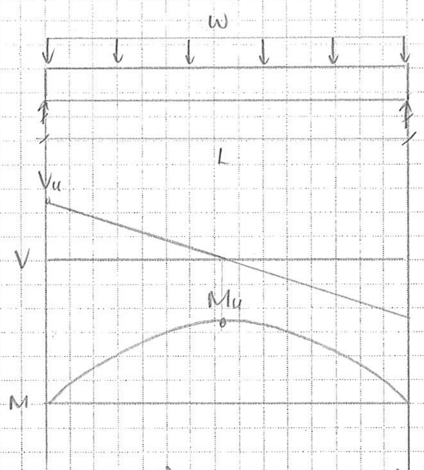


HARMONIOUS TECTONICS HarT

PROJECT	2017 IPD WEED RESIDENTIAL
NAME	DATE
SCOPE	

REFERENCE		ANSWER

CEILING JOISTS



$D = 14\ psf$
$L_r = 20\ psf$
$D + L_r = 34\ psf$

CJ1 (L = 20')

$w = 34\ psf \times 2' = 68\ plf$

$V_u = \frac{68\ plf \times 20'}{2} = \underline{680\#}$

$M_u = \frac{68\ plf\ (20')^2}{8} = \underline{3400\#\text{-}ft.}$

TRY 2×12 DF-L #1

$f_b = \frac{3400\#' \times 12"}{31.64\ in^3} = \underline{1290\ psi}$

$F_b' = 1000\ psi\ (1.25)(1.0)(1.15) = \underline{1438\ psi} > f_b$ ✓

∴ OK FOR FLEXURE

$f_v = \frac{1.5(680\#)}{16.88\ in^2} = \underline{60.43\ psi}$

$F_v' = 180\ psi\ (1.25) = \underline{225\ psi} > f_v$ ✓

∴ OK FOR SHEAR

$\Delta_{D+L} = \frac{5(68\ plf)(20')^4(12")^3}{384(1.7E6\ psi)(178\ in^4)} = \underline{0.81"}$

$\Delta_{D+L\ (IBC)} = \frac{20 \times 12}{180} = \underline{1.33"} < \Delta_{D+L}$ ✓

$\Delta_L = \frac{5(20\ psf \times 2')(20')^4(12")^3}{384(1.7E6\ psi)(178\ in^4)} = \underline{0.48"}$

$\Delta_{L\ (IBC)} = \frac{20 \times 12}{240} = 1" > \Delta_L$ ✓

∴ OK FOR DEFLECTION

∴ USE 2×12 DF-L #1 @ 2'0.C. FOR CJ1 ← CJ1

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

CJ2 (L = 8.83')

$w = 34\,psf \cdot 2' = 68\,plf$

$V_u = \frac{68\,plf \cdot 8.83'}{2} = 300.3\#$

$M_u = \frac{(68\,plf)(8.83)^2}{8} = 663\#\cdot ft$

TRY 2×6 DF-L #2

$f_b = \frac{663\#' \cdot 12}{7.56 in^3} = 1053\,psi$

$F_b' = 900\,psi\,(1.25)(1.3)(1.15) = 1682\,psi > f_b$ ✓

∴ OK FOR FLEXURE

$f_v = \frac{1.5(300.3\#)}{8.25 in^2} = 54.6\,psi$

$F_v' = 180\,psi\,(1.25) = 225\,psi > f_v$ ✓

∴ OK FOR SHEAR

$\Delta_{D+L} = \frac{5(68\,plf)(8.83')^4(12")^3}{384(1.6E6\,psi)(20.8 in^4)} = 0.28"$

$\Delta_{D+L\,(IBC)} = \frac{8.83 \times 12}{180} = 0.59" > \Delta_{D+L}$ ✓

$\Delta_L = \frac{5(20\,psf \cdot 2)(8.83')^4(12")^3}{384(1.6E6\,psi)(20.8 in^4)} = 0.16"$

$\Delta_{L\,(IBC)} = \frac{8.83 \times 12}{240} = 0.44" > \Delta_L$ ✓

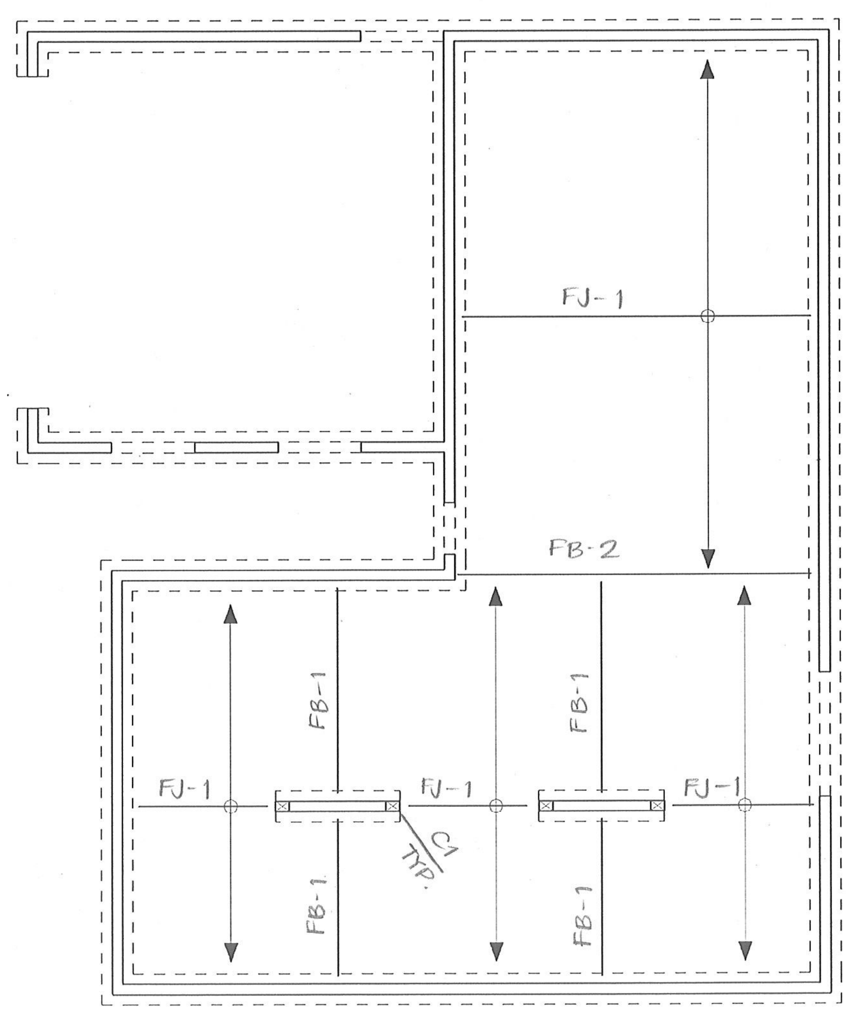
∴ OK FOR DEFLECTION

∴ USE 2×6 DF-L #2 @ 2'O.C. FOR CJ2 ← CJ 2

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

FLOOR FRAMING DESIGN : KEY PLAN



HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE	CALCULATIONS	ANSWER

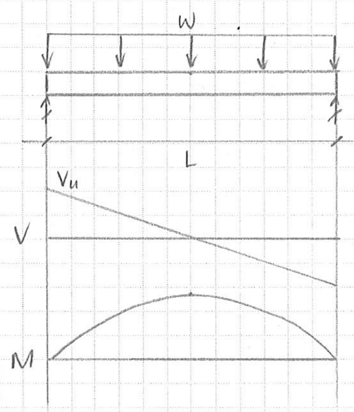
FLOOR FRAMING DESIGN

LOAD COMBOS:

$$D+L = \frac{(12psf + 40psf)}{1.0} = 52psf$$

$$D+0.75L = \frac{(12psf + 0.75(40psf))}{1.0} = 42psf$$

∴ D+L GOVERNS = 52 psf



TYPICAL FLOOR JOIST (FJ-1)

$L = 18'$

$$w = 52psf \cdot \frac{16''}{12'} = 69.33plf$$

$$V_u = \frac{69.33plf \cdot 18'}{2} = \underline{624\#}$$

$$M_u = \frac{69.33plf \cdot (18')^2}{8} = \underline{2808\#ft}$$

TRY 2X12 DF-L #1

$$f_b = \frac{M}{S} = \frac{2808\#' \times 12}{31.64 in^3} = \underline{1065psi}$$

$$F_b' = F_b(C_D \cdot \cancel{C_M} \cdot \cancel{C_t} \cdot \cancel{C_L} \cdot C_F \cdot \cancel{C_{fu}} \cdot \cancel{C_i} \cdot C_r)$$

$$= 1000psi(1.0)(1.0)(1.15)$$

$$= \underline{1150psi} > f_b \checkmark$$

∴ OK FOR DEFLECTION

$$f_v = \frac{1.5V}{A} = \frac{1.5(624\#)}{16.88in^2} = \underline{55.5psi}$$

$$F_v' = F_v(C_D \cdot \cancel{C_M} \cdot \cancel{C_t} \cdot \cancel{C_i})$$

$$= 180psi(1.0)$$

$$= 180psi > f_v \checkmark$$

∴ OK FOR SHEAR

$$\Delta_{D+L} = \frac{5wL^4}{384EI} = \frac{5(69.33plf)(18')^4(12'')^3}{384(1.7E6psi)(178in^4)} = \underline{0.54''}$$

$$\Delta allow_{D+L} = \frac{L}{180} = \frac{18' \times 12''}{180} = \underline{1.20''}$$

∴ OK FOR DEFLECTION

USE 2X12 DF-L #1 ← FJ-1

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

FB 1 $(L = 11.17')$

$w = 52\,psf \times 10' = 520\,plf$

$V_u = \frac{520\,plf \times 11.17'}{2} = 2904\#$

$M_u = \frac{(520\,plf)(11.17')^2}{8} = 8110\#'$

TRY 4x12 DF-L #1 OR BTR.

$f_b = \frac{8110\#' \times 12}{73.83\,in^3} = 1318\,psi$

$F_b' = 1200\,psi\,(1.0)(1.1) = 1320\,psi > f_b$ ✓

∴ OK FOR FLEXURE

$f_v = \frac{1.5(2904\#)}{39.38\,in^2} = 111\,psi$

$F_v' = 180\,psi\,(1.0) = 180\,psi > f_v$ ✓

∴ OK FOR SHEAR

$\Delta_{D+L} = \frac{5(520\,plf)(11.17')^4(12'')^3}{384(1.8E6\,psi)(415.3\,in^4)} = 0.24''$

$\Delta_{D+L\,(IBC)} = \frac{11.17' \times 12}{180} = 0.74'' > \Delta_{D+L}$ ✓

$\Delta_L = \frac{5(40\,psf \times 10')(11.17)(12)^3}{384(1.8E6\,psi)(415.3\,in^4)} = 0.187''$

$\Delta_{L\,(IBC)} = \frac{11.17 \times 12}{240} = 0.56'' > \Delta_L$ ✓

∴ OK FOR DEFLECTION

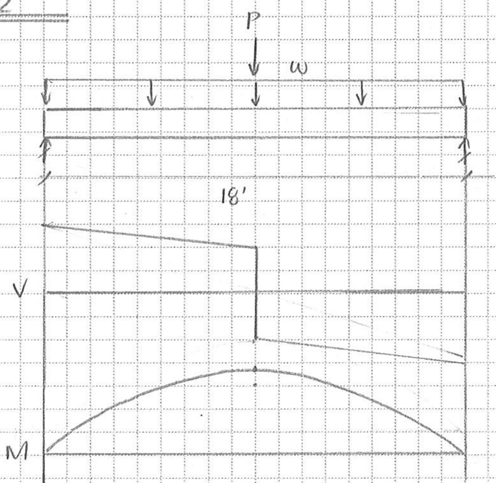
∴ USE 4x12 DF-L #1 OR BTR ← FB1

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

FB2



$w = 52\,psf \times \left(\frac{16"}{24}\right) = 34.67\,plf$

$P = 52\,psf \times \left(10' \times \frac{11.17}{2}\right) = 2904\#$

$V_u = \frac{(34.67\,plf \times 18') + 2904\#}{2}$

$= 1764\#$

$V_2 = 1764\# - (34.67\,plf \times 9')$

$= 1452\#$

$M_u = \frac{1}{2}(1764 + 1452)(9')$

$= 14{,}472\#'$

TRY PSL 3½" × 11¼"

M = 17970 #-ft

V = 8035 #

$\Delta_{D+L} = \frac{5(34.67\,plf)(18')^4(12)^3}{384(2.2E6\,psi)(415\,in^4)} + \frac{(2904\#)(18 \times 12)^3}{48(2.2E6\,psi)(415\,in^4)} = 0.76"$

$\Delta_{D+L\,IBC} = \frac{18 \times 12}{180} = 1.2 > \Delta_{D+L}$ ✓

$\Delta_L = \frac{5(40\,psf \times \frac{16}{24})(18')^4(12)^3}{384(2.2E6\,psi)(415\,in^4)} + \frac{(40\,psf \times 10 \times \frac{11.17}{2})(18 \times 12)^3}{48(2.2E6\,psi)(415\,in^4)} = 0.58"$

$\Delta_{L\,IBC} = \frac{18 \times 12}{240} = 0.9" > \Delta_L$ ✓

∴ USE PSL 3½" × 11¼" ← FB2

HARMONIOUS TECTONICS **HarT**
arce: galen amick | sarah pascual

TITLE Structural Calculations	
NAME	DATE

CLEAR SPAN COLUMN C-1

$P = 8.1k + 11.29k = 19.39^K$ GOVERNING LOAD: D+S

$K_x = 0.8$ (FIX-PINNED) ASSUMPTION

6x 8 x 14 DF-L No. 1

$A: 41.25 in^2$ NDS TABLE 1B
$S_x: 51.56 in^3$
$I_x = 193.4 in^4$

$$\frac{l_e}{d} = \left(\frac{k_e l}{d}\right)_y = \frac{0.8\ (14ft \times 12 in/ft)}{5.5 in} = 24.44$$

$$E'_{min} = E_{min}\,(C_m^{1.0} \cdot C_t^{1.0} \cdot C_i^{1.0} \cdot C_T) \quad > 2\times4 \qquad \text{NDS 4.3.1}$$

580,000 psi

$E_{min} = 580,000$ psi

$$F_{cE} = \frac{0.822\,E'_{min}}{(l_e/d)^2} = \frac{0.822\ (580,000 psi)}{(24.44)^2} = 798.17\,psi \qquad \text{NDS TABLE 4D}$$

$$F^*_c = F_c\,(C_D \cdot C_m \cdot C_t \cdot C_F \cdot C_i) = 1150\ psi \qquad \frac{F_{cE}}{F^*_c} = \frac{798.1}{1150} = 0.694$$

1000 psi 1.15

$$C_p = \frac{1 + F_cE/F^*_c}{2c} - \sqrt{\left(\frac{1+F_cE/F^*_c}{2c}\right)^2 - \frac{F_cE/F^*_c}{c}} = 0.555$$

$F'_c = F^*_c\,C_p = 1150 psi\,(0.555) = 638.25\,psi$

$P_{ALLOW} = F'_c A = 26.33$ kips $> 19.39^K$ OKAY

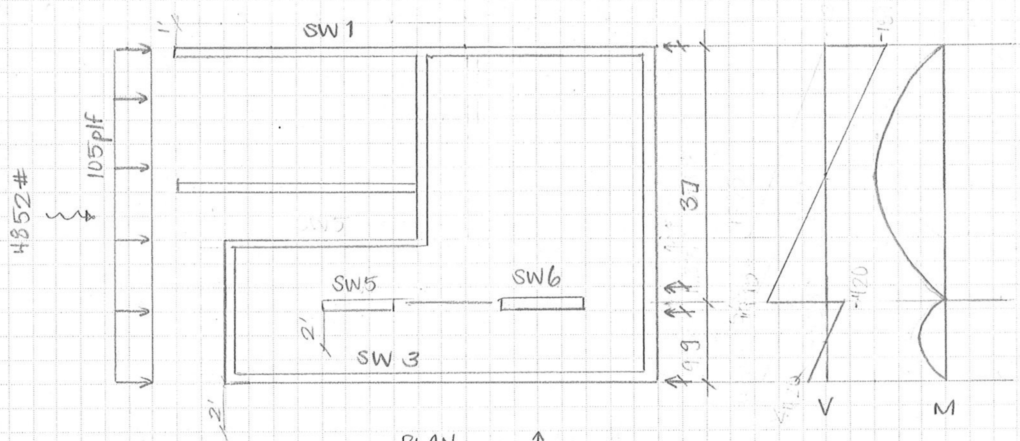
C-1 USE 6x8 x 14' DF-L No 1 POST

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE	CALCULATIONS	ANSWER

SHEAR WALL DESIGN (E-W)



PLAN (NTS.)

$V = 6931\#$ (LRFD)

$= 4852\#$ (ASD)

$w = \frac{4852\#}{46'} = 105\ plf$

$R_1 = \frac{105plf \cdot 8'}{2} = 420\#$

$R_2 = \frac{105plf \cdot 36'}{2} = 1890\#$

$M_1 = \frac{105plf(8')^2}{8} = 840\#'$

$M_2 = \frac{105plf(36')^2}{8} = 17010\#'$

FORCES @ SW:

SW1 = 1890#
SW3 = 420#
SW5/6 = 2310#

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

SW1 - SHEATHING DESIGN

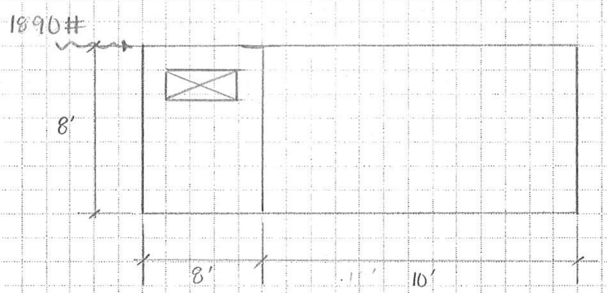


Table 4.3.4 — $\frac{h}{b} = \frac{8}{10} = 0.8$ { < 2 NO REDUCTION FOR l_{eff}; < 3.5 OK FOR BLOCKED }

$l_{eff} = 10'$

$v = \frac{V}{l_{eff}} = \frac{1890\#}{10'} = 189$ plf

DEMAND $= 2v = 378$ plf

Table 4.3A — CAPACITY = 520 plf

NAILING = 6", 6", 6

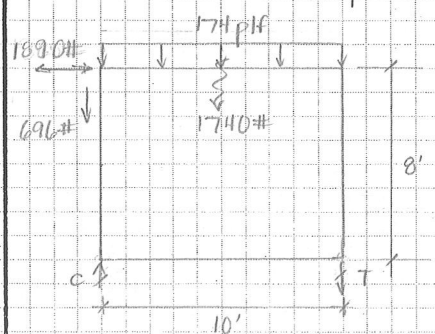
∴ USE 1/2" SHEATHING W/ 8d COMMON NAILS @ 6", 6", 6" → SHEATHING

DEFLECTION CHECK NOT REQ'D FOR ARCE 4.15

DETERMINE MAX C/T FORCES

ASCE 7 (2.4.1)

WALL WEIGHT: 8' × 20 psf/face = 160 plf   HEADER: 174 plf × 4' = 696#
ROOF WEIGHT: 1' × 14 psf/ = 14 plf
174 plf



$D + 0.7E = (1.0 + 0.14 S_{DS})D \pm 0.7\rho Q_E$ (S_{DS} = 0.594, ρ = 1.0)

$= 0.92D \pm 0.7 Q_E$ (MAX. COMP.)

$0.6D + 0.7E = (0.6 - 0.2 S_{DS})D + 0.7\rho Q_E$ (S_{DS} = 0.594, ρ = 1.0)

$= 0.48D + 0.7Q_E$ (MAX TENS.)

$\Sigma M_o = 0 = (1890\# \times 0.7)(8') + (1740\# \times 0.92)(5') + (696\# \times 0.92)(10') - C_{max}(10')$

$C_{max} = 2.5^k$

$\Sigma M_o = 0 = (1890\# \times 0.7)(8') + (1740\# \times 0.46)(5') - T_{max}(10')$

$T_{max} = 1.5^k$

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

CHECK END POSTS (CHORDS FOR COMPRESSION)

DEMAND: $C_{max} = 2.5^K$
$T_{max} = 1.15^K$

TRY (2) 2x6 DF-L #2

$f_c = \frac{P}{A} = \frac{2500\#}{2(8.25 in^2)} = 152 psi$

$F'_c = F_c (C_D \cdot C_M \cdot C_t \cdot C_F \cdot C_i \cdot C_p)$
$C_D = 1.6, \; C_F = 1.1$

NDS (3.7-1)

$C_p = \frac{1+\left(\frac{F_{cE}}{F_c^*}\right)}{2c} - \sqrt{\left(\frac{1+\left(\frac{F_{cE}}{F_c^*}\right)}{2c}\right)^2 - \left(\frac{F_{cE}/F_c^*}{c}\right)}$

$\frac{l_e}{d} = \frac{(8 \cdot 12) - (3 \cdot 1.5)}{5.5} = 16.64 < 50$ ✓

$F_{cE} = \frac{0.822 E_{min}'}{(l_e/d)^2} = \frac{0.822 (580E3 psi)}{(16.64)^2} = 1723 psi$ } $\frac{F_{cE}}{F_c^*} = 0.725$

$F_c^* = (1350 psi)(1.6)(1.1) = 2376 psi$

$C_p = \frac{1+0.725}{2(0.8)} - \sqrt{\left(\frac{1+0.725}{2(0.8)}\right)^2 - \left(\frac{0.725}{0.8}\right)} = 0.572$

$F'_c = 2376 psi (0.572) = 1359 psi > f_c$

∴ OK FOR COMPRESSION ∥ TO GRAIN

CHECK COMPRESSION ⊥ TO GRAIN

$F_{c\perp}' = F_{c\perp} (C_M \cdot C_t \cdot C_i \cdot C_b)$

NDS 3.10-2

$C_b = \frac{l_b + 0.375}{l_b} = \frac{1.5 + 0.375}{1.5} = 1.25$

$F_{c\perp}' = 625 psi (1.25) = 781.25 psi > f_c$

∴ (2) 2x6 DF-L #2 OK FOR END POSTS ← END POSTS

SIZE HOLDOWNS

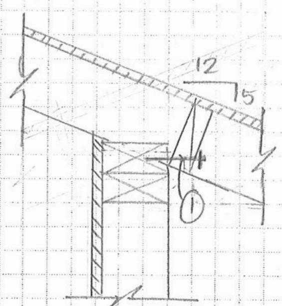
∴ USE SIMPSON HD3B W/ CAPACITY = 1865#
(T_{max} = 1160#)

HARMONIOUS TECTONICS **HarT**

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

SHEAR TRANSFER @ LINE 1 (SW1)



IBC 2015 Table 2304.10.1

$V_u = \frac{1890\#}{10'} = 189\ PLF < 200\ PLF$ USE IBC REQ.

① NAILING INTO BLOCKING:

NDS C12.5.4-1
NDS Table 12N

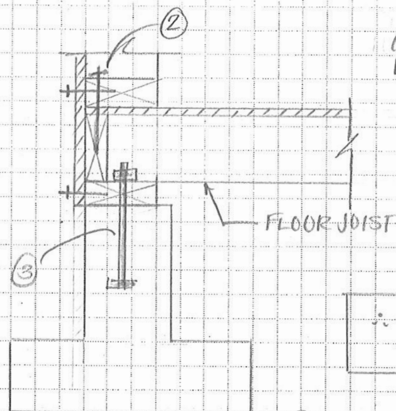
CHECK (3) 8d COMMON, EA. END TOENAIL

$l_m = L\cos 30° - \frac{L}{3}$

$= 3\cos 30° - \frac{3}{3}$

$= 1.60"$

$p = \frac{l_m}{\cos 30} = \frac{1.60}{\cos 30} = 1.85"$



$6D = 6(0.131") = 0.786" < p$ ✓

$10D = 10(0.131") = 1.31" < p$ ✓

$Z' = Z(C_D \cdot C_M \cdot C_t \cdot C_g \cdot C_\Delta \cdot C_{eg} \cdot C_{di} \cdot C_{tn})$

$= (97\ \#/nail)(1.6)(0.83) \times 6\ nails$

$= 773\ \#$

$S_{REQ} = \frac{773\#}{189\ PLF} = 4.1' > 16"$ (RAFTER SPACING) ✓

∴ CHOOSE (3) 8d COMMON NAILS EA. END TOENAILED @ 16" O.C. (MATCH RAFTERS) ← SHEAR TRANSFER @ ROOF

② FOR BOTTOM PLATE TO RIM JOIST OF FLOOR JOIST

Table 12N

TRY 16d (D = 0.162")

$P = 3.5 - 1.5" - 3/4" = 1.25"$ $\begin{cases} 6D = 0.972" > 1.25 \\ 10D = 1.62" < 1.25 \end{cases}$

$\frac{P}{10D} = \frac{1.25}{1.62} = 0.77$

$Z' = Z(C_D \cdot C_M \cdot C_t \cdot C_g \cdot C_\Delta \cdot C_{eg} \cdot C_{di} \cdot C_{tn})\frac{P}{10D}$

$= (141\#)(1.6)(0.77)$

$= 174\#$

$s = \frac{174\#}{189\ plf} \times 12" = 12"\ o.c.$

∴ CHOOSE 16d COMMON NAIL @ 12" O.C. ← BOTTOM PL TO RIM JOIST

Table 12E

③ ANCHOR BOLT TRY 1/2" Ø
(Table 12E FOR CONC. ASSUME MASONRY SIMILAR BEHAVIOR TO CONC.)

$Z_{||}' = (650\#)(1.6) = 1040\#$

$s = \frac{1040\#}{189\ plf} = 5.5'$

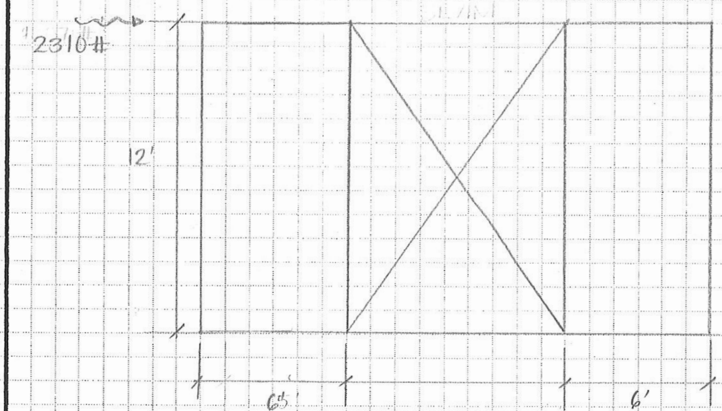
∴ CHOOSE 1/2" DIAM AB @ 4' O.C ← A.B.

HARMONIOUS TECTONICS **HarT**

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

SW5 & SW 6 – SHEATHING DESIGN



$\frac{h}{b} = \frac{12}{6} = 2$ { < 2 NO REDUCTION FOR l_{eff} ; < 3.5 OK FOR BLOCKED }

$l_{eff} = 12'$

$v = \frac{V}{l_{eff}} = \frac{2310\#}{12'} = 193$ plf

DEMAND = 2v = 385 plf

CAPACITY = 520 plf

NAILING = 8d @ 6, 6, 6

> ∴ USE ½" SHEATHING
> W/ 8d COMMON NAILS @ 6, 6, 6

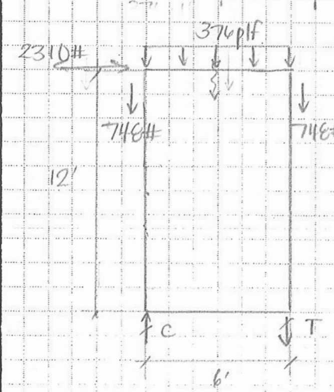
DEFLECTION CHECK NOT REQ'D

DETERMINE MAX T/C FORCES

WALL WT :	12' × 20 psf/face	=	240 plf
CLERESTORY :	4' × 20 psf/face	=	80 plf } 136
ROOF WT :	4' × 14 psf	=	56 plf }
		Σ =	376 plf

BEAM 1: 136 plf × 7.5/2 = 510#
BEAM 2: 136 plf × 11/2 = 748#

DESIGN FOR GREATER BEAM



D + 0.7E = 0.92D + 0.7E

$\Sigma M_T = 0 = (376 \times 0.92)(3') + (748 \times 0.92)(6') + (2310\# \times 0.7)(12') - C_{max}(6)$

> $C_{max} = 4.1^K$

0.6D + 0.7E = 0.48D + 0.7E

$\Sigma M_C = 0 = -(376 \times 0.48)(3') - (748 \times 0.48)(6) + (2310 \times 0.7)(12) - T_{max}(6)$

> $T_{max} = 2.8^K$

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE | ANSWER

CHECK END POSTS (CHORDS FOR COMPRESSION)

DEMAND $C_{max} = 4.1^K$
$T_{max} = 2.8^K$

TRY (2) 2x6 DF-L #2

$$f_c = \frac{P}{A} = \frac{4100\#}{2(8.25 in^2)} = 248.5 psi$$

$$F_c' = F_c (C_D \cdot C_M \cdot C_t \cdot C_F \cdot C_i \cdot C_P)$$
$C_D = 1.6 \quad C_F = 1.1$

$$\frac{l_e}{d} = \frac{(12 \cdot 12) - (3 \cdot 1.5)}{5.5} = 25.4 < 50 \checkmark$$

$$F_{cE} = \frac{0.822(580E3)}{(25.4)^2} = 741 psi$$

$$F_c^* = (1350 psi)(1.6)(1.1) = 2376 psi$$

$$\frac{F_{cE}}{F_c^*} = 0.312$$

$$C_P = \frac{1 + 0.312}{2(0.8)} - \sqrt{\left(\frac{1+0.312}{2(0.8)}\right)^2 - \left(\frac{0.312}{0.8}\right)} = 0.289$$

$$F_c' = 2376 psi (0.289) = 687 psi > f_c \checkmark$$

∴ OK FOR COMPRESSION ∥ TO GRAIN

CHECK COMP. ⊥ TO GRAIN

$$F_{c\perp}' = F_{c\perp} (C_M \cdot C_t \cdot C_i \cdot C_b)$$

$$C_b = \frac{1.5 + 0.375}{1.5} = 1.25$$

$$F_{c\perp}' = 625 psi (1.25) = 781.25 psi > f_c \checkmark$$

∴ (2) 2x6 DF-L #2 OK FOR END POSTS → END POSTS

SIZE HOLDOWNS

∴ USE SIMPSON HD7B W/CAPACITY = 6645 # > T_{max} = 2.8K

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

SHEAR TRANSFER @ LINE 2 (SW 5X6)

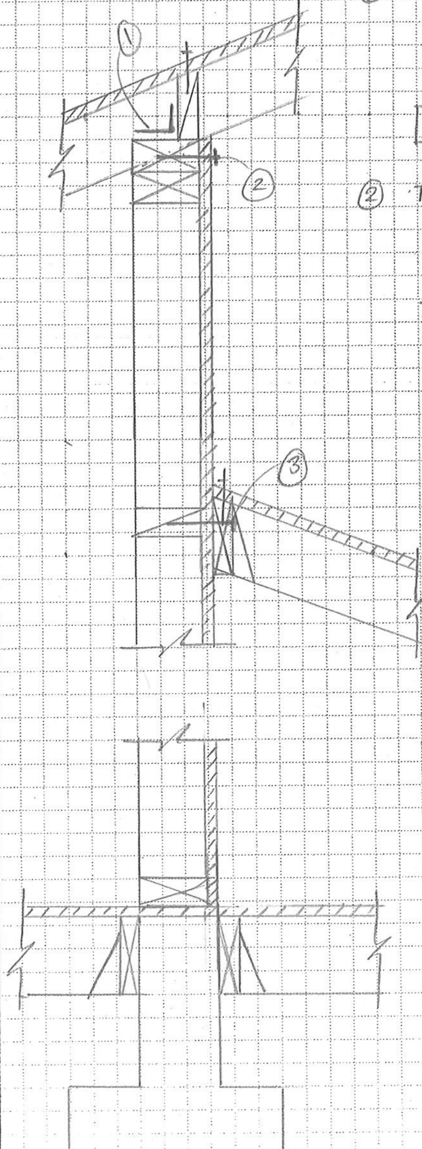
$V_u = \frac{2310\#}{12'} = 192.5\ plf$

SHEAR TRANSFER @ BLOCKING:

(1) TRY SIMPSON A34 CLIP. (515#)

$S = \frac{515\#}{192.5 plf} = 2.67' > 16"$ (RAFTER SPACING)

∴ USE SIMPSON A34 (515#) @ 16" O.C ← (1)



(2) TRY 16d (D = 0.162")

$P = 3.5" - 0.5" - 3/4" = 2.25"$ { 6D = 0.972 < P ; 10D = 1.25 < P

$Z' = (141\#)(1.6) = 225.6\#$

$S = \frac{225.6\#}{192.5 plf} \cdot 12" = 14"$

∴ USE 16d COMMON NAIL @ 12" O.C ← (2)

(3) TRY 16d (D = 0.162")

$P = 3.5" - 1.5" - 3/4" = 1.25"$ { 6D = 0.972 < P ; 10D = 1.25 = P

$Z' = (141\#)(1.6) = 225.6\#$

$S = \frac{225.6\#}{192.5 plf} \cdot 12" = 14"$

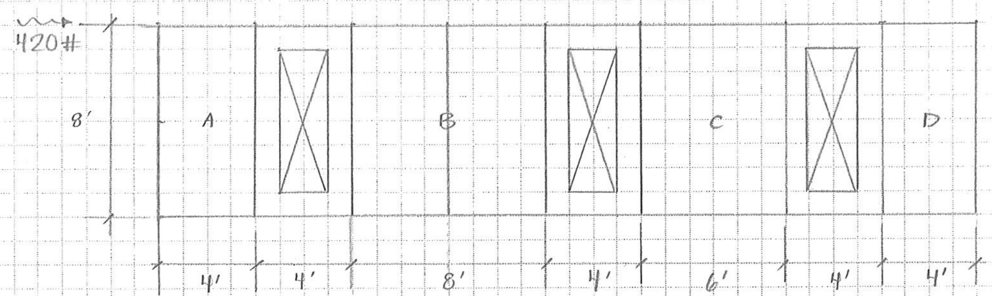
∴ USE 16d COMMON NAIL @ 12" O.C ← (3)

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

SW 3 – SHEATHING DESIGN



	h	b	h/b	REDUCE	l_{eff}
A	8	4	2	—	4
B	8	8	1	—	8
C	8	6	1.33	—	6
D	8	4	2	—	4
Σ					22'

$v = \frac{V}{l_{eff}} = \frac{420\#}{22'} = 19.1\,plf$

DEMAND = 2v = 38.2 plf

DEMAND LESS THAN THAT OF SW1, SW5, SW6

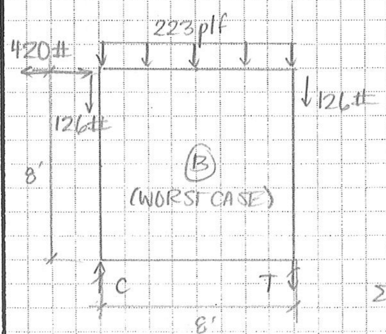
∴ USE 15/32" STRUCTURAL 1 W/8d COMMON NAILS @ 6, 6, 6

DEFLECTION NOT REQ'D

DETERMINE MAX T & C FORCES

WALL WT: 8' × 20 psf/face = 160 plf
ROOF WT: 4.5' × 14 psf = 63 plf
Σ = 223 plf

HEADER: 63 plf × 2' = 126#



D + 0.7E = 0.92D + 0.7E (MAX COMP)

$\Sigma M_T = 0 = (223\,plf \times 0.92)(4') + (126\# \times 0.92)(8') + (420\# \times 0.7)(8') - C_{max}(8')$

$C_{max} = 1.23^k$

0.6D + 0.7E = 0.48D + 0.7E (MAX TENS.)

$\Sigma M_C = 0 = (223\,plf \times 0.48)(4') - (126\# \times 0.48)(8') + (420\# \times 0.7)(8') - T_{max}(8')$

$T_{max} = 783\#$

SIZE HOLDOWN

∴ USE DTT2Z W/ T_{max} = 1825# ← HOLDOWN

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL
DATE
SCOPE

REFERENCE		ANSWER
Simpson C-L-SW17	N-S DIR SHEARWALL DESIGN (A)	
	V@ line A = 2718#	
	V TRIBUTARY TO GARAGE = 1360#	
	Simpson WSW 24x8 — V_{ALLOW} / V_u	
	ALLOW P = 7,500# — 4,945 > 1,360# ✓	
	V_{ALLOW} = 4,945	
	Hold down for Simpson WSW	
	DEMAND(T) = $\frac{1360\# \times 8ft}{2(24in - 4in)}$ = 2856#	
	WSW AB 7/8" T ALLOW = 11,900# — 11,900# > 2,856# ✓	
	USE (2) Simpson WSW 24x8 W/ 7/8 ⌀ WSW AB FOR GARAGE.	SW @ CARPORT

HARMONIOUS TECTONICS HarT

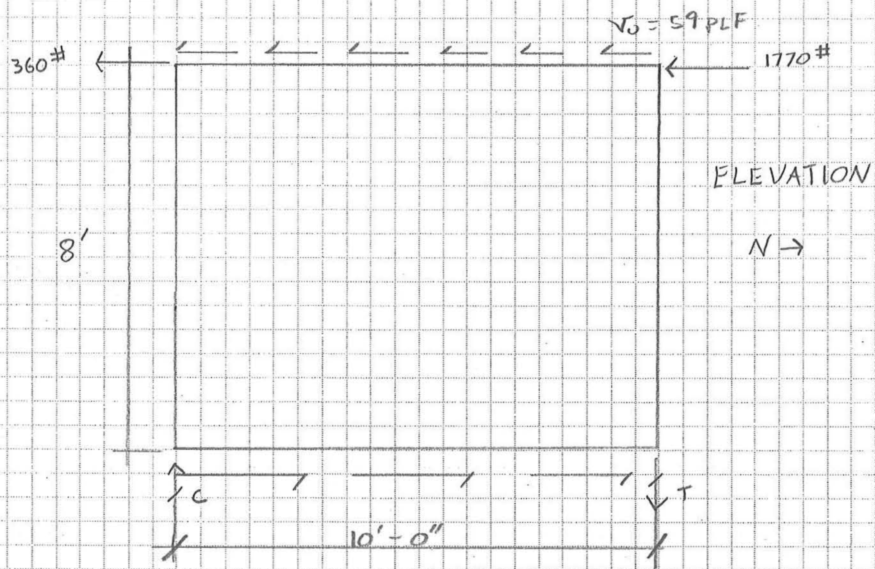
PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

SHEAR WALL DESIGN N-S LINE (A)

ASSUMPTIONS

- SEGMENTED DESIGN
- ASD
- ASPECT RATIO < 2:1 UNBLOCKED



V = 1770# + 360# + 59 PLF (10') = 2720#

V_{USW} = V/ℓ = 2720/10' = 272 PLF ← V_{USW}

ASPECT RATIO: 8'/10 = 0.8 < 2 ✓

NDS 2015 SDPWS

- WOOD STR PANELS 15/32 in THICKNESS
- 10d COMMON NAILS W/MIN FASTNER PENETRATION 1-½ in
- 6 in EDGE NAILING / 12 in FIELD

← SHEAR WALL DESIGN

V_{SW} = 620/2 = 310 > 272 PLF ✓

UPLIFT

$\Sigma M_C = 0 = -1770^{\#}(8') - 360^{\#}(8') - (59_{PLF}(10')(8')) + T(10')$

T = 2176# ← TENSION DEMAND

SIMPSON WOOD CONN. 2017-18

HOLD DOWN

USE HDU2-SDS2.5 T_{ALLOW} = 3075# > 2176# ✓ ← HOLD DOWN

HARMONIOUS TECTONICS HarT

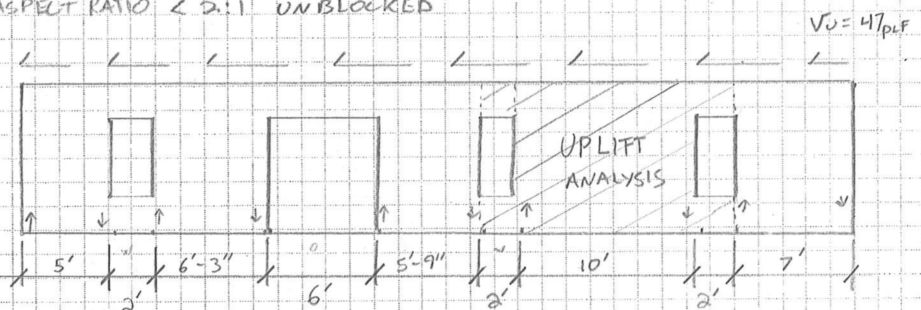
PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

SHEAR WALL DESIGN N-S LINE (C)

ASSUMPTIONS

- SEGMENTED DESIGN
- ASD
- ASPECT RATIO < 2:1 UNBLOCKED



$\Sigma b = 34'$

$V = v\,\Sigma b \quad v = V/\Sigma b = 2146^{\#}/34 = 63.6\ PLF$ ← $V_{U\,SW}$

$V_{DESIGN} = 127.2\ PLF$

ASPECT RATIO WORST CASE = 5/8 = 0.625 < 2 ✓ UNBLOCKED

NDS 2015 SDPWS

- 15/32" WOOD STR PANELS (MIN GRAVITY)
- 6d W/MIN 1¼ PENETRATION USE 10d 1-½" PENETRATION
- 6 in EDGE NAILING 12 in FIELD NAILING

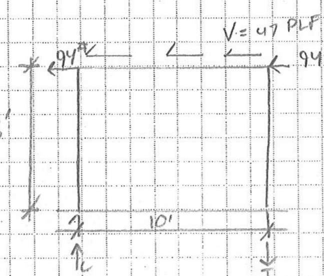
← SHEAR WALL DESIGN

$V_{U\,SW} = 310\ PLF > 63.6\ PLF$ ✓

UPLIFT

$\Sigma M = -(94 + 94 + (47 \cdot 10'))(8') + T(9.5)$

$T = 554^{\#}$



$T_{MAX} = 554^{\#}$ ← TENSION DEMAND WORST CASE

HOLD DOWN

SIMPSON WOOD CONN. 2017-2018

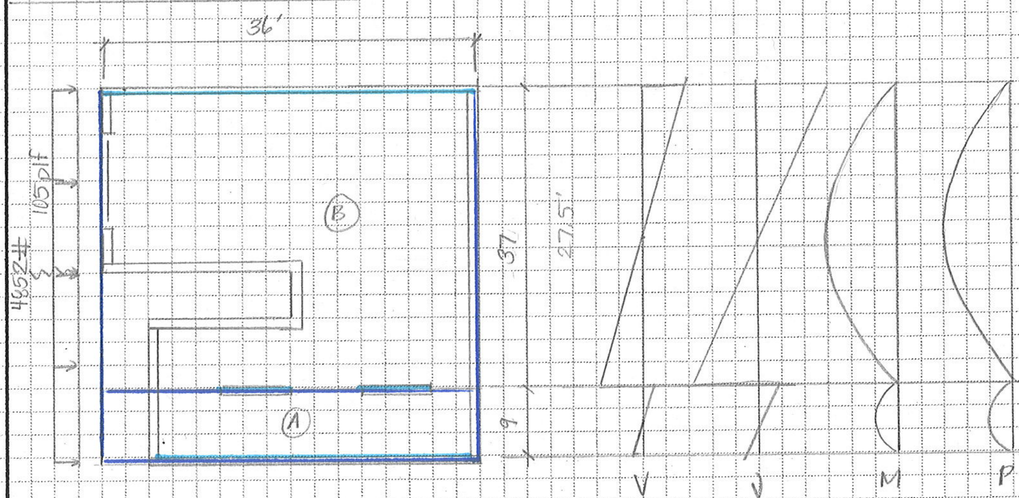
USE SIMPSON DTT 1Z $T_{ALLOW} = 910^{\#}$ W/ 10d COMMON > 554# ← HOLD DOWN

HARMONIOUS TECTONICS HarT

PROJECT	2017 IPD WEED RESIDENTIAL
NAME	DATE
SCOPE	

REFERENCE | ANSWER

DIAPHRAGM DESIGN



$V_{max} = \frac{(105 plf)(37')}{2} = 1943\#$ $M_{max} = \frac{(105 plf)(37')^2}{8} = 17970\#'$

$v_{max} = \frac{1943\#}{36'} = 54 plf$ $P_{chord\,max} = \frac{17970\#'}{36'} = 500\#$

(A) ASPECT RATIOS $\frac{36'}{9'} = 4$ = MAX L/W RATIO ✓ (BLOCKED)

DEMAND = 2v = 108 plf

CAPACITY = 540 plf

NAILING = 8d @ 6, 6, 12 (CASE 3)

∴ USE 1/2" SHEATHING W/8d COMMON NAILS @ 6,6,12 BLOCKED

(B) ASPECT RATIOS: $\frac{36}{37} = 0.97 < 3:1$ (UNBLOCKED) ✓

DEMAND = 108plf

CAPACITY = 480plf

NAILING = 8d @ 6, 6, 12 (CASE 1)

∴ USE 1/2 SHEATHING W/8d COMMON NAILS @ 6,6,12 UNBLOCKED

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

DIAPHRAGM DESIGN - GRAVITY

ASSUMPTIONS

- ROOF DL = 14 psf
- ROOF LIVE = 19 psf
- SHEATHING EDGES SUPPORTED
- JOISTS @ 16" O.C.

TOTAL LOAD ROOF = 33 psf

PANEL SPAN RATING (ROOF / FLOOR)

IBC 2304.8(3)

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

L14

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE	CALCULATIONS	ANSWER
	DIAPHRAGM DESIGN N-S SEISMIC	
	DESIGN ASSUMPTIONS	
	• FLEXIBLE DIAPHRAGM	
	• UNBLOCKED	
	• ASD	
	DEFLECTION ✓	
NDS 2015 SDPWS T 4.2.4	ASPECT RATIO: L/W = 38'/46' = 0.83:1 < 3:1 ✓	
	UN-BLOCKED OK ✓	
	SHEAR DEMAND	
	V_{MAX} = 2,206# → $v = V/d$ = 2718# / 46' = 60 pLF	← V_{ASD}
	DIAPHRAGM DESIGN	
NDS 2015 SDPWS T4.2C	• SHEATHING GRADE: SHEATHING; SINGLE FLOOR	
	• COMMON NAIL SIZE: 10d / 6" EDGE / 12" FIELD	
	• MINIMUM FASTNER PENETRATION: 1-3/8"	
	• MINIMUM PANEL THICKNESS: 15/32 (due to AVAILIBILITY)	← UN BLOCKED DIAPHRAGM DESIGN N-S
	• MINIMUM OF NOMINAL WIDTH OF NAILED FACE @ SUPPORTED EDGE: 2in	
	• ASSUME CASE 2,3,4,5,6	
	V_s = 480 pLF 480/2 = 240 240 pLF > 60 pLF ✓	

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE | ANSWER

DIAPHRAGM DESIGN N-S SEISMIC

W = 76,167#

V = CsW = 0.091(76,167#)
= 6,931#

0.7V = 0.7(6,931) = 4,852#

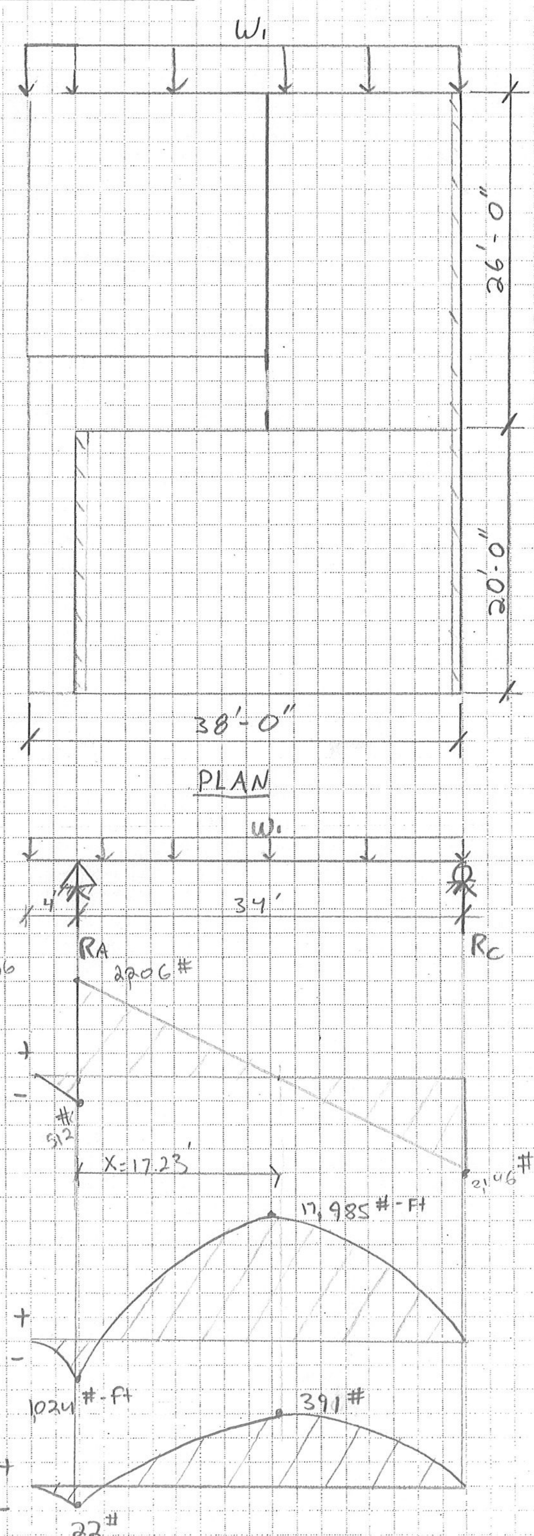
LOADING W/ WEIGHT OF WALLS IN DIAPHRAGM WEIGHT.

$W_1 = 0.7\frac{V}{A} \cdot d = \frac{4,852\#}{1,748 ft^2} \cdot 46'$

W_1 = 128 plf

$R_A = \frac{W_1}{2(34')} \times (38')^2 = 2,718\#$

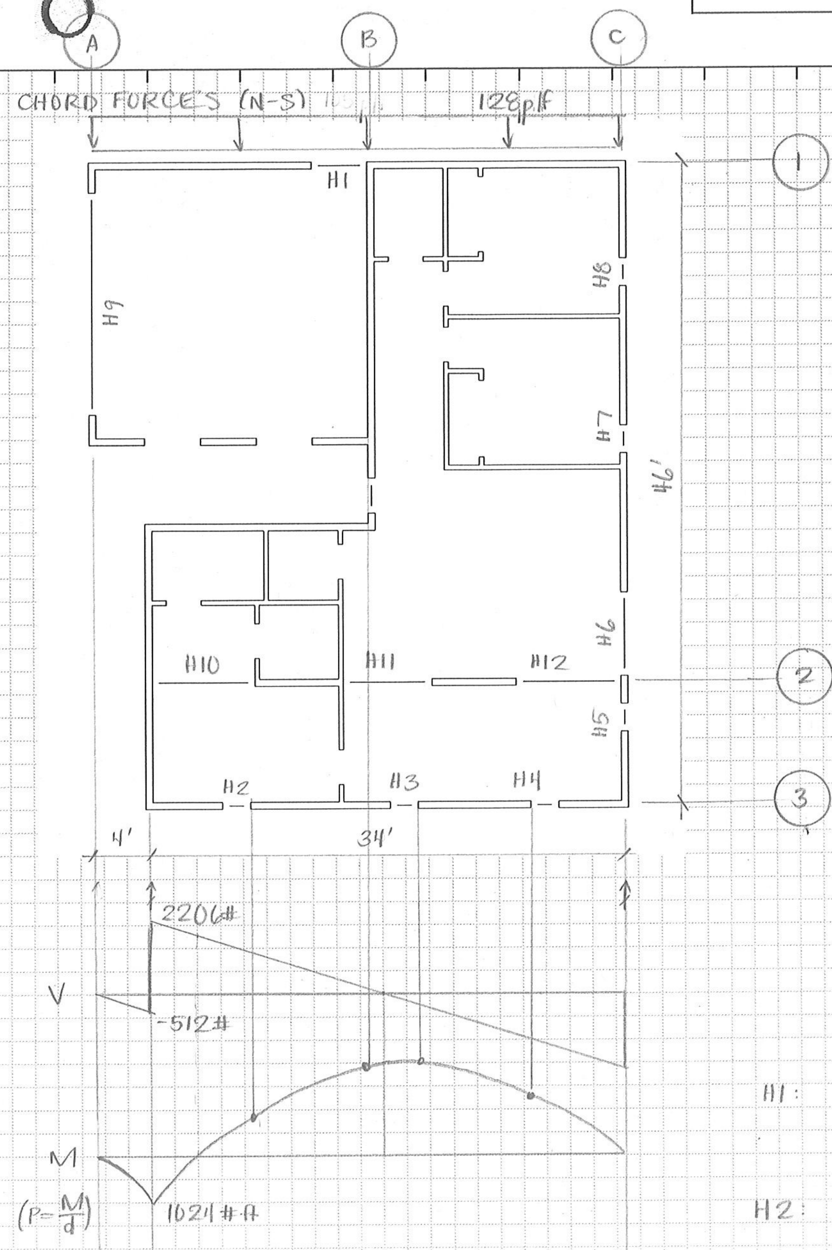
$R_B = \frac{W_1}{2(34')} \times (34^2 - 4^2) = 2,146\#$



L16

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	



H1: $M_{max} \approx 17985$ #·ft

$P_{chord} \approx$ 391#

H2: M_{max} (x = 7) = 5018 #·ft

P_{chord} = 109.1#

H3: $M_{max} \approx 17985$ #·ft.

P_{chord} = 391#

H4: M_{max} (x = 31) = 11882 #·ft

P_{chord} = 258.3#

* FOR $0 < x < 4$

$$M(x) = -\frac{128x^2}{2}$$

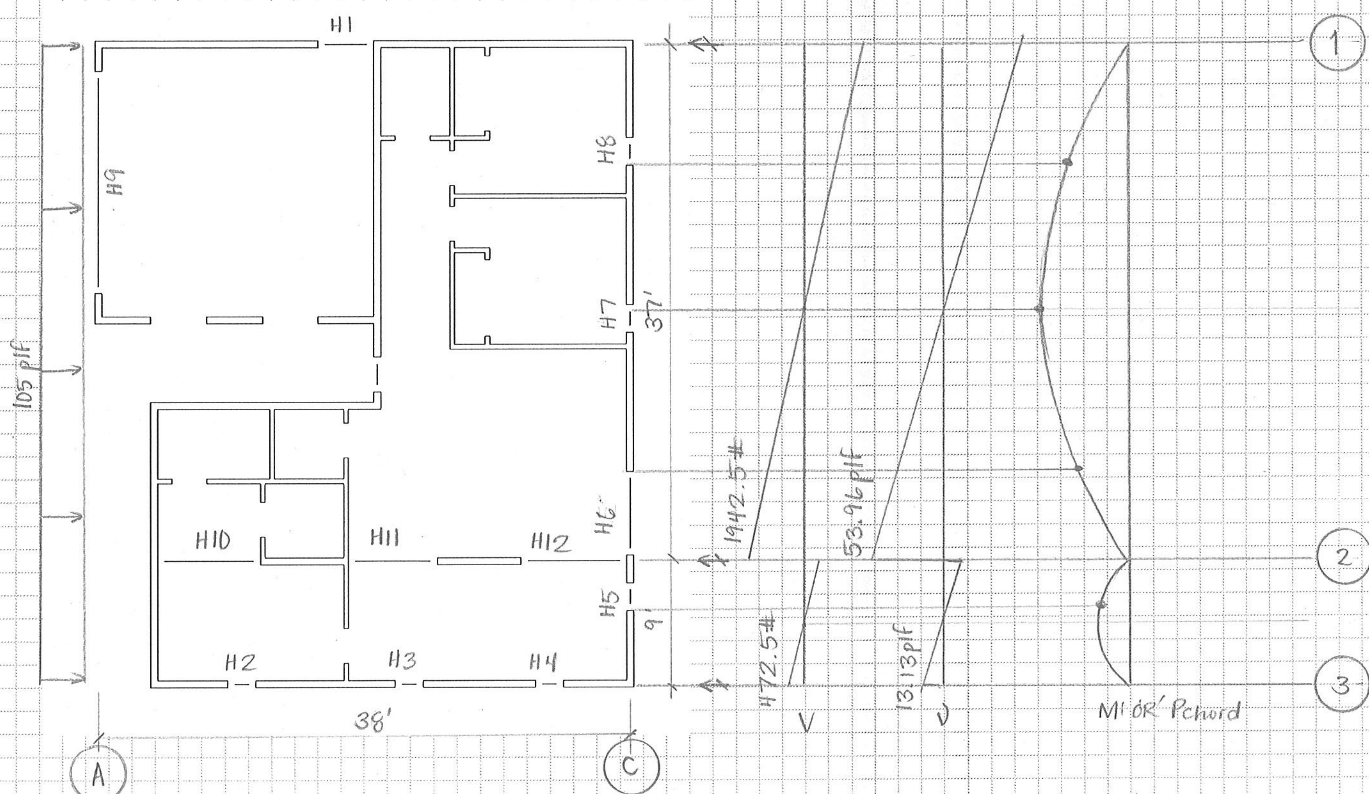
FOR $4 < x < 38$

$$M(x) = -\frac{128}{2}(x-4)^2 + 2206(x-4) - 1021$$

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

CHORD FORCES (E-W)



FOR 0 < x < 9

$$M(x) = -\frac{105}{2}x^2 + 472.5x$$

FOR 9 < x < 46

$$M(x) = -\frac{105}{2}(x-9)^2 + 1942.5(x-9)$$

H5: Mmax (x = 5') = 1050 #-ft

Pchord = 27.63#

H6: Mmax (x = 15') = 9765 #-ft

Pchord = 257 #

H7: Mmax (x = 27.5') = 17970 #-ft

Pchord = 473#

H8: Mmax (x = 37') = 13230 #-ft

Pchord = 348.2#

H9: Mmax ≈ 17970 #-ft

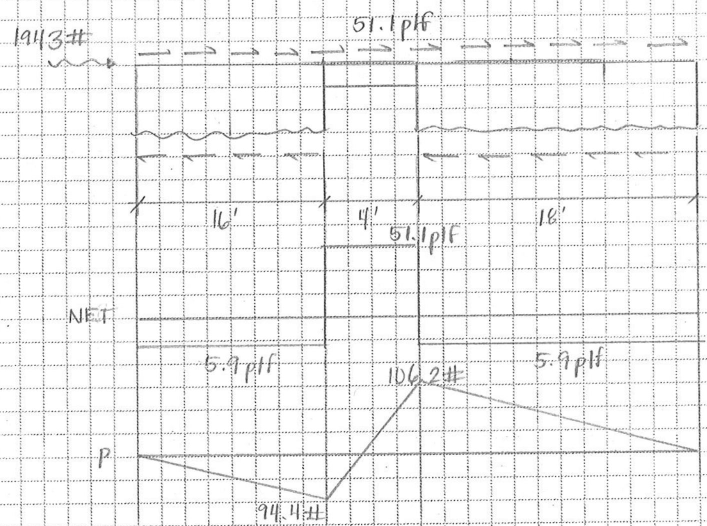
Pchord ≈ 473#

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE | ANSWER

COLLECTOR FORCE @ LINE 1 (H1)



$v_{wall} = \frac{1943\#}{34'} = 57 plf$

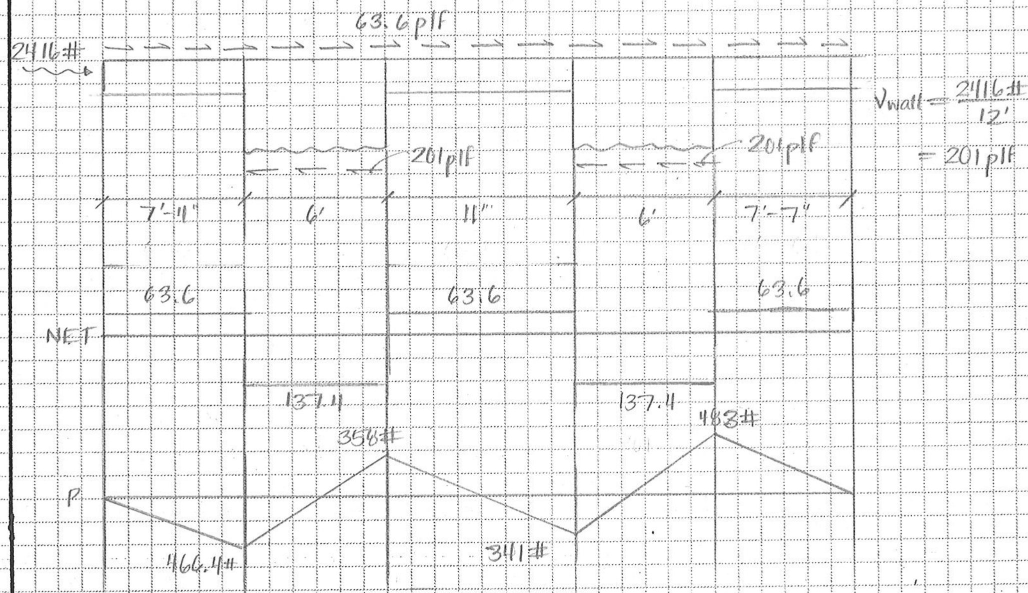
H1 : $P_{collector}$ = 106.2# ← H1 (COLLECTOR)

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

COLLECTOR FORCE @ LINE 2



H10: $P_{collector}$ = 466.4#
H11 $P_{collector}$ = 358#
H12 $P_{collector}$ = 483#

$P_{collector}$:
H10
H11
H12

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL

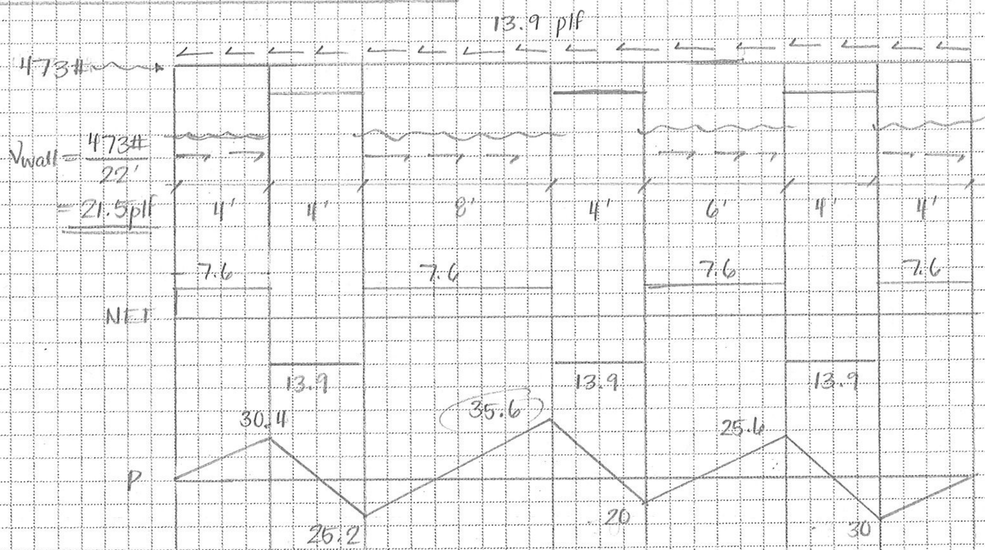
NAME

DATE

SCOPE

REFERENCE | ANSWER

COLLECTOR FORCE @ LINE 3



H2 : Pcollector = 30.4 #

H3 : Pcollector = 35.6 #

H4 : Pcollector = 30 #

Pcollector
H2
H3
H4

HARMONIOUS TECTONICS HarT

PROJECT	2017 IPD WEED RESIDENTIAL
NAME	DATE
SCOPE	

REFERENCE		ANSWER

N-S COLLECTOR DESIGN

ASCE 7 §12.4

LOAD COMBINATION

(1+ 0.14SDS)D + 0.7ρQE

ρ = 1.0

QE = V

COLLECTOR (A)

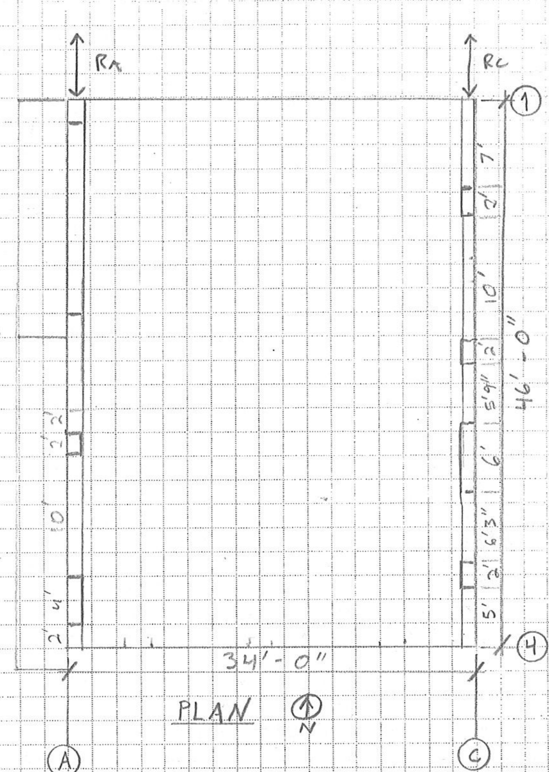
V = 2718#

vu = UNIT SHEAR = V/L = 2718#/46'

vu = 59 pLF

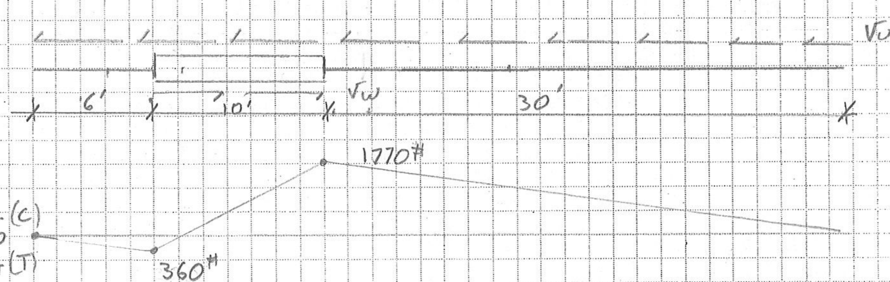
vu SW DEMAND = 2718#/10'

vu sw = 272 pLF



PLAN (A) N

STRUT FORCE (A)



T/C MAX (A) = 1770#

T/C MAX (A)

HARMONIOUS TECTONICS HarT

PROJECT	2017 IPD WEED RESIDENTIAL
NAME	DATE
SCOPE	

REFERENCE		ANSWER
	CHORD / COLLECTOR DESIGN (E-W)	
	DESIGN WORST CASE @ LINE 2 (W/ 6X12 DF-L No.1)	
	$T_{max} = 483\#$, $M_{max} = 6800\#\cdot ft.$	
NDS 3.9-1, 2	$\frac{f_t}{F_t'} + \frac{f_b}{F_b^*} \leq 1.0$ & $\frac{f_b - f_t}{F_b^{**}} \leq 1.0$	
	$f_t = \frac{P}{A} = \frac{483\#}{63.25 in^2} = 7.64 psi$	
NDS Table 4D	$F_t' = F_t(C_D \cdot C_M \cdot C_t \cdot C_F \cdot C_i)$ $= 675 psi (1.15)(1.0)$ $= 776.25 psi$	
pg. R7 (GRAVITY)	$f_b = 673.26 psi$	
	$F_b^* = F_b(C_D \cdot C_M \cdot C_t \cdot C_F \cdot C_{fu} \cdot C_i \cdot C_r)$ $= 1350 psi (1.15)(1.0)$ $= 1553 psi$	
	$F_b^{**} = 1553 psi$	
	$\frac{7.64}{776.25} + \frac{673.26}{1553} = 0.44 < 1.0$ ✓	
	$\frac{673.26 - 7.64}{1553} = 0.43 < 1.0$ ✓	
	∴ 6x12 DF-L No. 1 OK FOR COMBINED LOADING ←	H10, H11, H12

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE | ANSWER

CHORD/COLLECTOR DESIGN (E-W)

DESIGN FOR WORST CASE @ LINE C (W/ (3) 2x6 DF-L No. 2)

$T_{max} = 473\#$

$w = (14\,psf + 46.8\,psf) \times \left(\frac{15'}{2}\right) = 456\,plf$

$V_u = \frac{456\,plf \cdot 6'}{2} = 1368\#$

$M_u = \frac{456\,plf \cdot (6')^2}{8} = 2052\#\,ft$

$f_b = \frac{2052\#\,ft \cdot 12''}{3(7.56\,in^3)} = 1085.7\,psi$

$F_b' = 900\,psi(1.15)(1.3) = 1345.5\,psi > f_b$ ✓

∴ OK FOR FLEXURE

$f_v = 1.5\left(\frac{1368\#}{3(8.25\,in^2)}\right) = 82.91\,psi$

$F_v' = 180\,psi\,(1.15) = 207\,psi > f_v$ ✓

∴ OK FOR SHEAR

$\Delta_{D+S} = \frac{5(456\,plf)(6')^4(12'')^3}{384(1.6E6\,psi)(76.26\,in^4)} = 0.11''$

$\Delta_{allow} = \frac{6 \times 12}{180} = 0.4'' > \Delta_{D+S}$ ✓

∴ OK FOR DEFLECTION

$f_t = \frac{473\#}{3(8.25\,in^2)} = 19.11\,psi$

$F_t' = 575\,psi\,(1.15)(1.3) = 1196\,psi > f_t$ ✓

COMBINED LOADING

$\frac{19.11}{1196} + \frac{1085.7}{1345.5} = 0.82 < 1.0$ ✓

$\frac{1085.7 - 19.11}{1345} = 0.79 < 1.0$ ✓

∴ OK FOR COMBINED TENSION & BENDING

∴ USE (3) 2X6 DF-L No. 2 FOR HEADERS @ LINE C — H6, H7, H8

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE	CALCULATIONS	ANSWER

COLLECTOR DESIGN (A)

ASCE 7 2010 12.4 — LOAD COMBINATION

$(1 + 0.14\,S_{DS})D + 0.7\rho Q_E$

$\rho = 1.0$

$Q_E = V$

$D = D_{ROOF} + SNOW = 13\,psf + 47\,psf = 60\,psf$

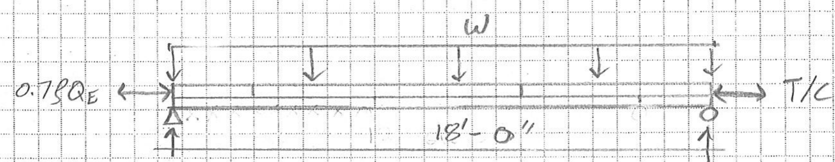
$0.7\rho Q_E = 0.7(1.0)\frac{1770\#}{0.7} = 1770\#$

$W = (1 + 0.14\,S_{DS})D\,(TRIB\,WIDTH) = 1 + 0.14(0.091)(60\,psf)(12\,ft)$

$W = 730\,PLF$

COLLECTOR FROM GARAGE HEADER TO SW IN LINE (A)

ON SUPPORTED LENGTH ABOVE GARAGE



$S_x\,REQ = \frac{M}{F'_b} = \frac{730\,PLF \times (18')^2\,12\,in/ft}{8 \times 2000\,psi} = 178\,in^3$

DF-L SEL STR

$F_b' = F_b \times C_D \times C_F \times C_r = 1600\,psi \times 1.25 \times 1.0 \times 1.0 = 2000\,psi$

TRY 6×16 DF-L SEL STR

$A = 85.25\,in^2$
$S_x = 220.2\,in^3$
$I_x = 1707\,in^4$

$f_t = \frac{T}{A} = 1770\# / 85.25\,in^2 = 21\,psi$

$F_T' = F_T \times C_D \times C_F = 950\,psi \times 1.6 \times 1.0 = 1520\,psi > 21\,psi$ ✓

$f_c = C/A = 1770 / 85.25 = 21\,psi$

$F_c' = F_c \times C_D \times C_F \times C_P = 1100\,psi \times 1.6 \times 1.0 \times 1.0 = 1600 > 21\,psi$ ✓

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

COLLECTOR DESIGN (A)

6x16 COLLECTOR/HEADER COMBINED LOADING CHECK CONT.

$F_b = M/S_x = \frac{w l^2}{8} \times \frac{1}{S_x} = \frac{730 \text{ plf} \times (18')^2 \times 12}{8 \times 220.2 \text{ in}^3} = 1611$ #-in

$F_b' = F_b \times C_D \times C_L \times C_F = 1600 \text{ psi} \times 1.25 \times 0.97 = 1940 \text{ psi} > 1611$ ✓

NDS 2015

$F_b = 1600$ psi

NDS SUPP. 2015

$C_D = 1.25$

$C_L = 1.0$ ENDS HELD IN PLACE VIA HANGERS

$C_F = (12/15.5)^{1/9} = 0.97$

COMBINED COMPRESSION & BENDING

$$\left(\frac{f_c}{F'_c}\right)^2 + \frac{f_b}{F'_b\left(1 - (f_c/F_{cE})\right)} \leq 1.0$$

$$F_{cE} = \frac{0.822\, E'_{min}}{(l_e/d)^2}$$

$$\left(\frac{21}{1600 \text{ psi}}\right)^2 + \frac{1611}{1940 \text{ psi}\left(1 - (21/578)\right)} \leq 1.0$$

$F_{cE} = 578$

$l_e = 2.06\,(18' \times 12''/') = 445$ in

$0.86 \leq 1.0$ ✓

$E'_{min} = 580{,}000$ psi

(AXIAL LOAD HAS LITTLE IMPACT ON GARAGE HEADER)

USE 6x16 DF-L SEL STR ← DESIGN OF COLLECTOR/HEADER ABOVE GARAGE (H9)

* COLLECTOR ALONG LINE (A) WILL BE SAME AS COLLECTOR ALONG LINE (C).

HARMONIOUS TECTONICS HarT

PROJECT	2017 IPD WEED RESIDENTIAL
NAME	DATE
SCOPE	

REFERENCE		ANSWER
	COLLECTOR DESIGN N-S ALONG (A)	
	COLLECTOR DESIGNED WORST CASE FOR TRANSVERSE & LONGITUDINAL LOADING	
	$W_T = 0.7 (6,931) / 46' = 106$ plf	
	$V_{MAX} = 1770\#$ ←	V_{MAX}
	$M = \frac{W_T L^2}{8} = \frac{106 \text{ plf} (46')^2}{8} = 28,037$ K-ft	
MAXIMUM CHORD FORCE N-S DIR	CHORD FORCE = M/b = 28.037 K-ft / 34' = 825 lbs ←	C.F. MAX
	AXIAL FORCE 2X6 DF-L No.2 TYPICAL PBL TOP PL	V_{MAX} GOVERNS
	A = 8.25 in²	
	Sx = 7.56 in²	
	I = 20.8 in⁴	
	Ft	
	$f_t = V/A = 1770\# / 8.25 in^2 = 215$ psi	
NDS 2015	$F_t' = F_t \times C_D \times C_F = 575 psi \times 1.6 \times 1.1 = 1012 psi > 215 psi$ ✓ ←	F_T'
	$f_c = V/A = 215$ psi	
	$F_c' = F_c \times C_D \times C_F = 1350 psi \times 1.6 \times 1.1 = 2376 psi > 215 psi$ ✓ ←	F_c'
	USE 2x6 DF-L NO.2 TYP COLLECTOR U.N.O. ←	H1, H2, H3, H4, H5
	* 1770# IS THE HIGHEST STRUT FORCE IN THE N-S LOADING DIR ∴ U.N.O. ALL COLLECTORS WILL BE 2x6 DF-L No.2	

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE	CALCULATIONS	ANSWER

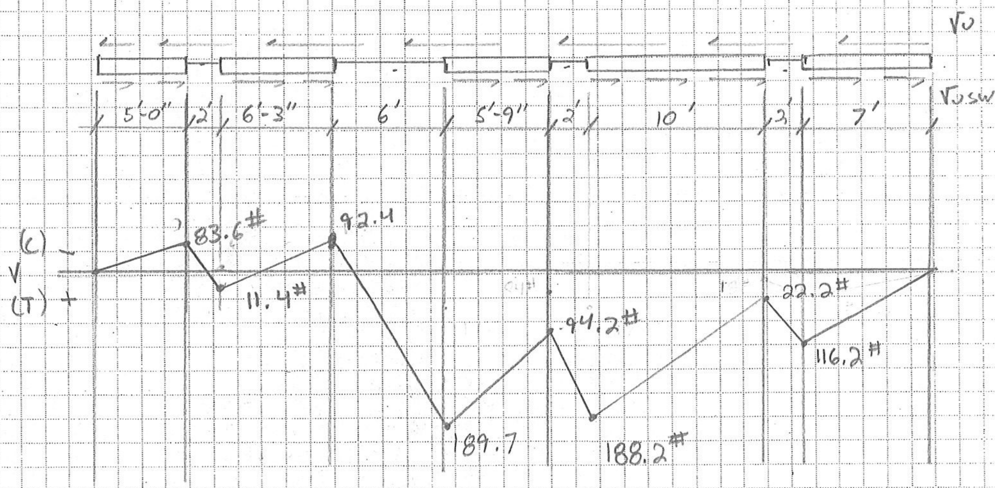
N-S COLLECTOR DESIGN

COLLECTOR Ⓒ

V = 2,146#

Vu = V/l = 2,146/46' = 47 PLF ← Vu

Vu SW = 2,146/34' = 63.6 PLF ← Vu SW



T/C MAX = 190# ← T/C MAX Ⓒ

190# < 1770# [USE LINE Ⓐ COLLECTOR DESIGN 2x6 DF-L No.2 OKAY]

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL

NAME

DATE

SCOPE

REFERENCE

ANSWER

CHORD/COLLECTOR SUMMARY

MEMBER	CHORD (#)	COLLECTOR (#)	DESIGN
H1	391	106.2	2x6 DBL. TOP PL
H2	109.1	30.4	2x6 DBL. TOP PL
H3	391	35.6	2x6 DBL. TOP PL
H4	258.3	30	2x6 DBL TOP PL
H5	27.6	83.6	2x6 DBL. TOP PL
H6	257	189.7	(3) 2x6 DF-L #2
H7	473	188.2	(3) 2x6 DF-L #2
H8	348.2	116.2	(3) 2x6 DF-L #2
H9	473	1770	6x16 DF-L SEL STR.
H10	—	466.4	6x12 DF-L #1
H11	—	358	6x12 DF-L #1
H12	—	483	6x12 DF-L #1

HARMONIOUS TECTONICS HarT

PROJECT: 2017 IPD WEED RESIDENTIAL
NAME:
DATE:
SCOPE:

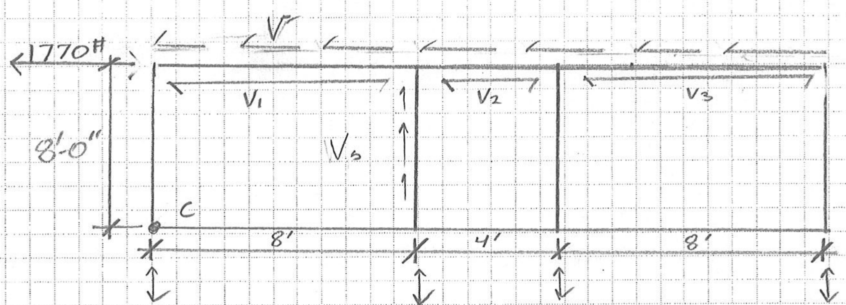
REFERENCE		ANSWER
	GRAVITY CONNECTIONS -	
	A) RAFTER TO RIDGE BEAM	
IBC 2015 Table 2304.10.1	$V_u = 770$#	
	∴ USE SIMPSON LRU26Z W/CAPACITY = 980#	
	B) RAFTER TO INTERIOR WALL	
	$V_u = 770$#	
	∴ USE SIMPSON VPA2 W/CAPACITY = 1050#	
	C) RAFTER TO VALLEY BEAM	
	$V_u = 770$#	
	∴ USE SIMPSON LSSU210 W/CAPACITY = 1145#	
	D) VALLEY BEAMS & RIDGE BEAM TO 6X12 BEAM	
	$V_u = $ { 6323# (VALLEY); 2675# (RIDGE) }	
	∴ USE SIMPSON MSC5 W/H = 12" W/CAPACITY = 6150# (VALLEY) = 3220# (RIDGE)	
	E) LOWER ROOF RAFTER TO BEAM/WALL	
	$V_u = 431$#	
	∴ USE SIMPSON JB28 W/CAPACITY = 1050#	
	F) COLUMN TO FOUNDATION	
	$P_u = 19.39^K$	
	∴ USE SIMPSON CBSQ86-SDS2 W/CAPACITY = 20915#	

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

PANEL TO PANEL NAILING REQUIRED



V = 59 PLF

$V_i = V \times l_i$

$V_1 = 59\ PLF \times 8' = 472^{\#}$

$V_2 = 59 \times 4' = 236^{\#}$

$V_3 = 59 \times 8' = 472^{\#}$

THIS PANEL TO PANEL NAILING 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 (A). THIS PANNEL NAILING WILL BE TYPICAL UNLESS NOTED IN PLAN.

$\Sigma M_C = 0 = (1770^{\#} + 472^{\#} + 236^{\#} + 472^{\#})\ 8'^{H} - \text{UPLIFT}\ (8'^{L})$

UPLIFT = 2,950#

V_S = UPLIFT / H = 370 PLF

NDS 2015 — $Z' = Z \times C_D \times C_M \times C_t \times C_g \times C_\Delta = 118^{\#} \times 1.6 \times 0.7 = 132.16^{\#}$ ← NAIL CAPACITY

$C_D = 1.6$ EQ

$C_M = 0.7$ / $d < 1/4"$

$C_t = 1.0$ < 100°F

$C_g = 1.0$ NO BOLT

$C_\Delta = 1.0$ $d < 1/4$

$Z = 118^{\#}$ 10d COMMON

1½ SIDE MEMBER t

$\frac{\text{NAILS REQ}}{\text{FOOT}}\ \frac{V_S'}{Z'} = \frac{370\ PLF}{132.16} = 2.8$ NAILS

2.8 NAILS/FT × h = 23 NAILS / PANEL ← NAILS PER PANEL

MIN - (23) 10d COMMON NAILS FULL PENETRATION

REQ PER PANEL CONNECTION.

SPACE EVENLY ALONG HEIGHT & STAGGER

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

GRAVITY CONNECTIONS

A) RAFTER TO RIDGE BEAM

IBC 2015 Table 2304.10.1

$V_u = 770\#$

∴ USE SIMPSON LRU26Z W/CAPACITY = 980#

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

$V_u = \begin{cases} 6323\# \text{ (VALLEY)} \\ 2675\# \text{ (RIDGE)} \end{cases}$

∴ USE SIMPSON MSC5 W/H = 12" W/CAPACITY = 6450# (VALLEY)
= 3220# (RIDGE)

E) LOWER ROOF RAFTER TO BEAM/WALL

$V_u = 431\#$

∴ USE SIMPSON JB28 W/CAPACITY = 1050#

F) COLUMN TO FOUNDATION

$P_u = 19.39^k$

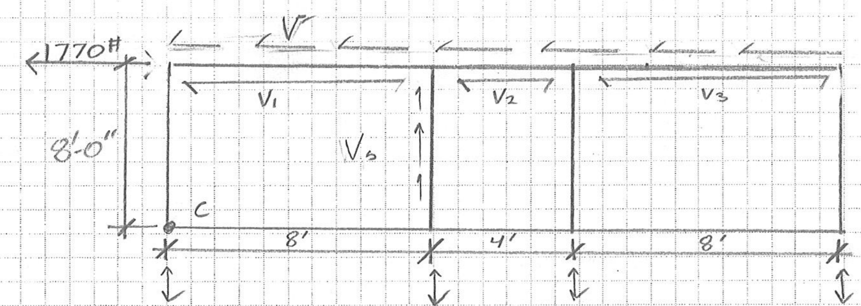
∴ USE SIMPSON CBSQ86-SDS2 W/CAPACITY = 20915#

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

PANEL TO PANEL NAILING REQUIRED



$V = 59$ PLF

$V_i = V \times l_i$

$V_1 = 59 \text{ PLF} \times 8' = 472^{\#}$

$V_2 = 59 \times 4' = 236^{\#}$

$V_3 = 59 \times 8' = 472^{\#}$

This panel to panel nailing 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 Ⓐ. This pannel nailing will be typical unless noted in plan.

$\Sigma M_C = 0 = (1770^{\#} + 472^{\#} + 236^{\#} + 472^{\#})\ 8'^{H} - \text{UPLIFT}\ (8'^{L})$

UPLIFT = 2,950 #

V_S = UPLIFT / H = 370 PLF

NDS 2015 — $Z' = Z \times C_D \times C_M \times C_t \times C_g \times C_\Delta = 118^{\#} \times 1.6 \times 0.7 = 132.16^{\#}$ ← NAIL CAPACITY

$C_D = 1.6$ EQ

$C_M = 0.7$ $d < 1/4"$

$C_t = 1.0$ $< 100°F$

$C_g = 1.0$ NO BOLT

$C_\Delta = 1.0$ $d < 1/4$

$Z = 118^{\#}$ 10d COMMON

1½ SIDE MEMBER t

$\frac{\text{NAILS REQ}}{\text{FOOT}} = \frac{V_S'}{Z'} = \frac{370 \text{ PLF}}{132.16} = 2.8$ NAILS

2.8 NAILS/FT × h = 23 NAILS/PANEL ← NAILS PER PANEL

MIN - (23) 10d COMMON NAILS FULL PENETRATION REQ PER PANEL CONNECTION.

SPACE EVENLY ALONG HEIGHT & STAGGER

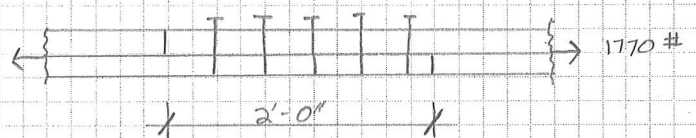
REFERENCE		ANSWER

N-S LAP SPLICE DESIGN

$V_{MAX} = 1770^{\#}$

$C_{F\,MAX} = 825^{\#}$

CBC R602.3.2 — MIN TOP PLATE SPLICE LENGTH = 24"



NDS 2015

D = 0.148 in Ø 10d common

$l = 3in$, $l_s = 1.5in$, $t_s = 1.5in$

$F_{yb} = 90\,KSi$ 90,000 psi

G = 0.50

$F_e = 4650$ psi

$Z' = Z \times C_D \times C_g = 118psi \times 1.6 \times 1.0 = 189^{\#}/NAIL$ ← Z'

$N = V/Z' = 1770^{\#}/189 = 9.36$ USE 10 NAILS ← N

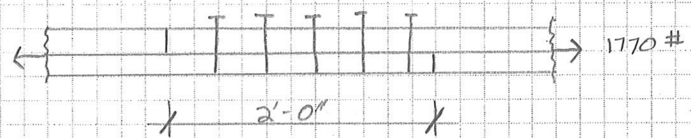
MIN DESIGN LAP SPLICE

[USE 2' SPLICE WITH (10)-10d COMMON NAILS 3in LONG STAGGERED]

CN3

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER
	N-S LAP SPLICE DESIGN	
	$V_{MAX} = 1770$ #	
	$C_{F\,MAX} = 825$ #	
CBC R602.3.2	MIN TOP PLATE SPLICE LENGTH = 24"	
		
NDS 2015	D = 0.148 in Ø 10d common	
	l = 3in, l_s = 1.5in t_s = 1.5in	
	F_{yb} = 90 ksi 90,000 psi	
	G = 0.50	
	F_e = 4650 psi	
	$Z' = Z \times C_D \times C_g$ = 118psi × 1.6 × 1.0 = 189#/NAIL ←	Z'
	N = V/Z' = 1770#/189 = 9.36 USE 10 NAILS ←	N
	MIN DESIGN LAP SPLICE	
	[USE 2' SPLICE WITH (10)-10d COMMON NAILS 3in LONG STAGGERED]	

HARMONIOUS TECTONICS HarT

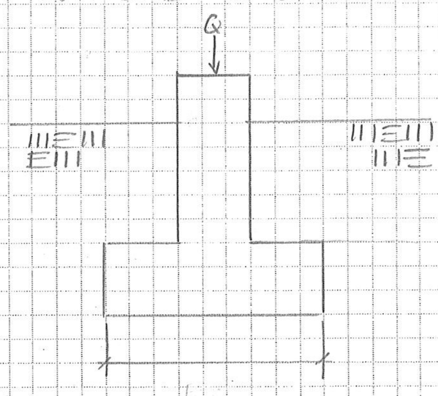
PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE	

REFERENCE		ANSWER

FOUNDATION DESIGN

SOILS CRITERIA:

- SITE CLASS: D
- IBC Table 1806.2 — VERTICAL FOUNDATION PRESSURE = 2000 psf
- LATERAL BEARING PRESSURE = 150 psf/ft BELOW NATURAL GRADE
- COEFFICIENT OF FRICTION = 0.25
- FROST LINE = 12" BELOW GRADE



HARMONIOUS TECTONICS HarT

PROJECT	2017 IPD WEED RESIDENTIAL
NAME	DATE 11/6/17
SCOPE	INSULATION COST ANALYSIS

RIGID INSULATION OPTION ANALYSIS

R VALUE ASSEMBLY = Σ (%)(R-Component)

	WALL COMPONENT	R VALUE	
WALL CAVITY 83.61% OF WALL	FBC	0.500	
	AIR	0.286	
	SHEATHING	0.500	
	ROCK WOOL	23.000	
	DRY WALL	0.560	
		24.846	(W/ BAT + R13) 37.846 (W/ NO BAT + 2x R13 RIDGID) 27.846
STRUCTURE 16.39% OF WALL	FBC	0.506	
	AIR	0.286	
	SHEATHING	0.500	
	DRY WALL	0.560	
	STUD	6.880	
		8.726	(W/ R-13 THERMAL GAP) 21.726

WITHOUT ANY RIDGID INSULATION

R = (0.8361)(24.846) + (0.1639)(8.726) = 22.20 ← NO RIGID + 0 COST ($2500)

U = 1/R = 0.045

WITH ONE SHEET R13 RIDGID INSULATION

R = (0.8361)(37.846) + (0.1639)(21.726) = 35.70 ← BAT + (1) SHEET R-13 + $2500

U = 0.028

WITH TWO SHEETS R-13 RIDGID & NO BAT

R = (0.8361)(27.846) + (0.1639)(21.726) = 26.84 ← NO BAT + (2) SHEETS R-13 + $4100

U = 0.037

HARMONIOUS TECTONICS HarT

PROJECT 2017 IPD WEED RESIDENTIAL	
NAME	DATE
SCOPE INSULATION / THERMAL BRIDGE	

FRAMING TO INSULATED PANEL WALL RATIO

EXTERIOR WALL AREA = 122' x 8' = 976 ф (L = 122', h = 8')

DOUBLE T PL & SILL AREA = 122' x (4.5"/12") = 46 ф (t = 4.5")

122' x 12 = 1464"

1464" x (1.5" STUD t / 16" O.C. FRAMING) = 137.25" = 11.44'

SURFACE AREA OF STUDS IN TOTAL PANEL WALL FACE = LENGTH OF STUD x h = 11.44' x 8' = 91.52 ф

PANEL WALL CONNECTIONS = 24 PANELS = 23 CONNECTIONS

ADDITIONAL 2x STUD SURFACE TO ADDITIONAL CONNECTIONS = 23 CONNECTIONS x t BOARD x h

= 23 x (1.5"/12") x 8' = 23 ф

TOTAL WALL AREA MADE UP OF STUDS = (46 + 91.52 + 23) ф = 160.52 ф

PERCENT OF WALL (STUDS) = 160 ф / 976 ф = 16.39 %