Weed, CA Housing Project

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

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

By Trenton Jay Pichel
December 1, 2017

Project Description

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

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

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

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

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

affordable

floorplan
simple but sophisticated floorplans reduces the amount of walls and constructive elements

heating and cooling
The investment in higher quality building components is mitigated by

the elimination of expensive heating and cooling systems.

spatial efficient

High ratio of usable area to gross built area
Open floorplan and circulationactive arrangement of the rooms inimizes hallways and dead space

The Shelf
a raised shelf-system provides additional storage and allows more usable floor space below

energy efficient

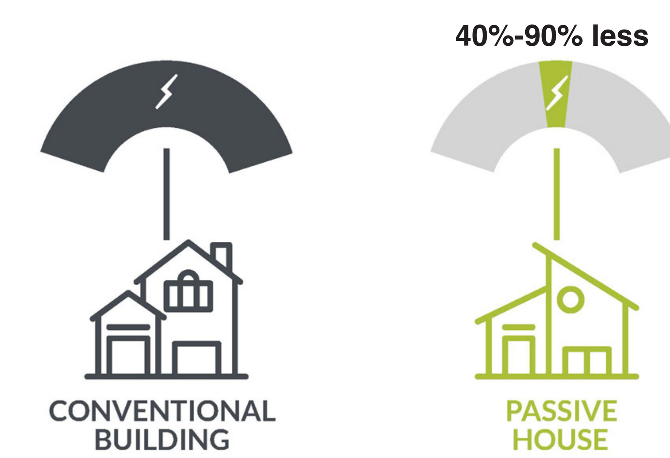
building shape
aiming a A/V-ratio below 0.7 reduces surfaces through which heat can be lost

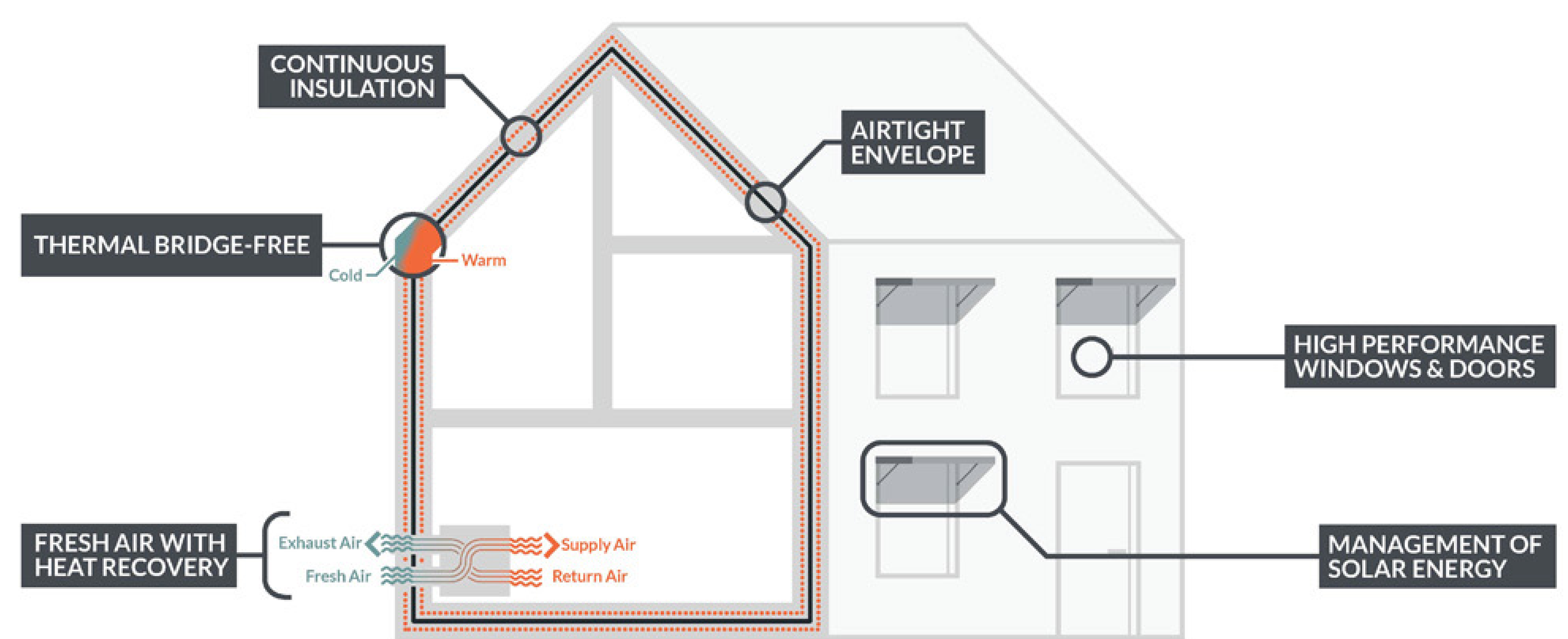
site strategy

wall assembly and thermal envelope
a well insulatet wall assemblys and continuous insulating envelope reduces heatloss through the surfaces/walls

airtightness
reducing the air change rate leads to a lower exchange of hot and cold air

heating and cooling demand





PASSIV HOUSE PRINCIPLES

passive house principles

Building to the Passive House Standard reduces our buildings' operational energy demand to an optimized extent through passive measures and components such as insulation, airtightness, heat recovery, solar heat gains, solar shading and incidental internal heat gains. Passive House reliably delivers up to approximately a 90% reduction in heating and cooling demand and up to a 75% reduction in overall primary energy demand when compared to our existing building stock.
Passive Houses are uniquely raising our expectations of what sustainable high-performance buildings can be and should be.

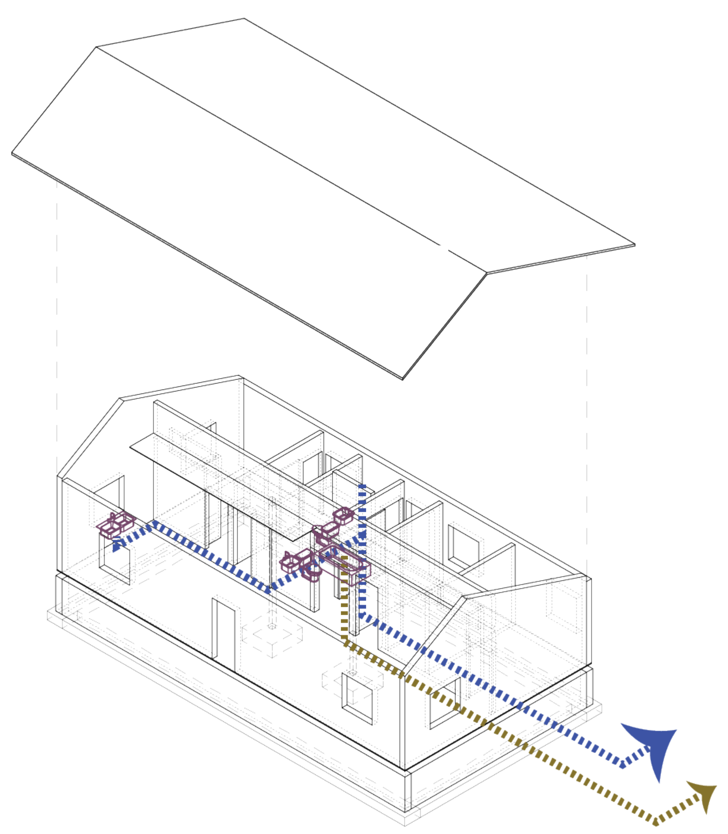
Regular home*
2015 average monthly consuption US= 901 kWh/household/month
Average price= $0.1699/kWh
901kWh/household/month*$0.1699/kWh=$153,08/month

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

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

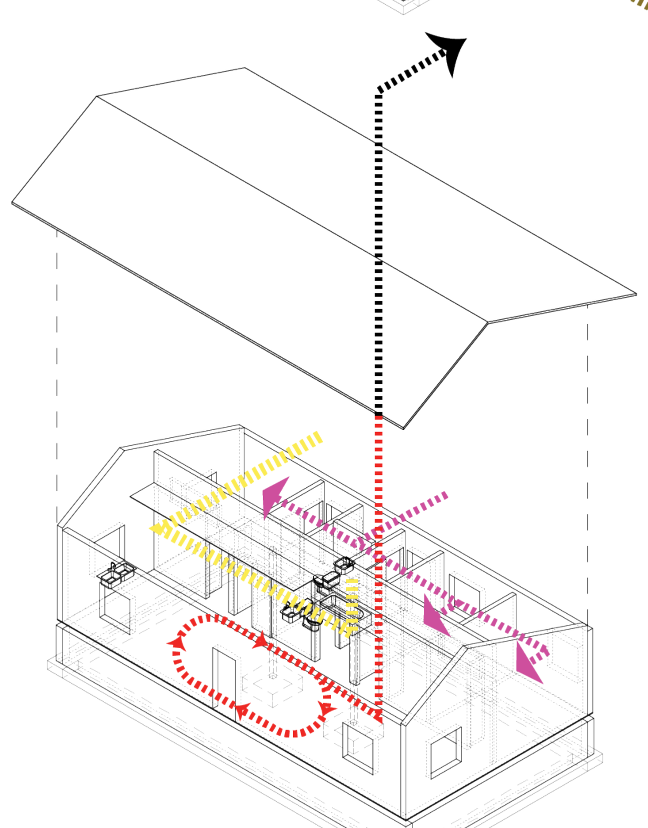
HAPPY HOMES

BECK, LEE, LUNDHAL, PICHEL, VERGARA



Water Management

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



Heating Systems

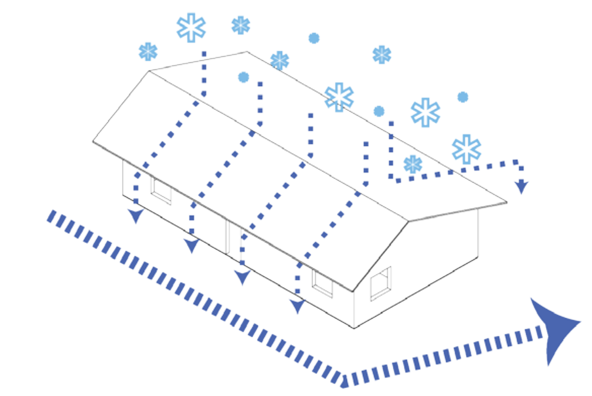
Primary Heating Source
-A technical room, located at an exterior wall allows immediate heating and less connection for the systems
-the Heat Pump is lovated in the garage
-Ductless Mini-Split Heat Pumps
Modulated heating based on temperature
- One outdoor unit and three indoor units focused mainly on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

HAPPY HOMES

BECK, LEE, LUNDHAL, PICHEL, VERGARA

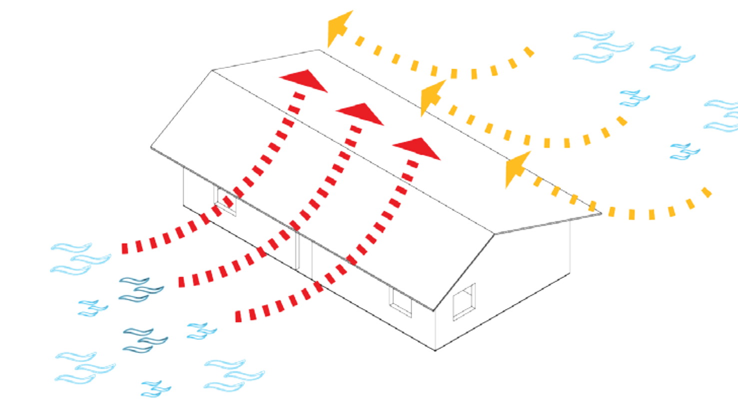
water management

Roof shape and material choice to effectively shed snow and direct water downhill.



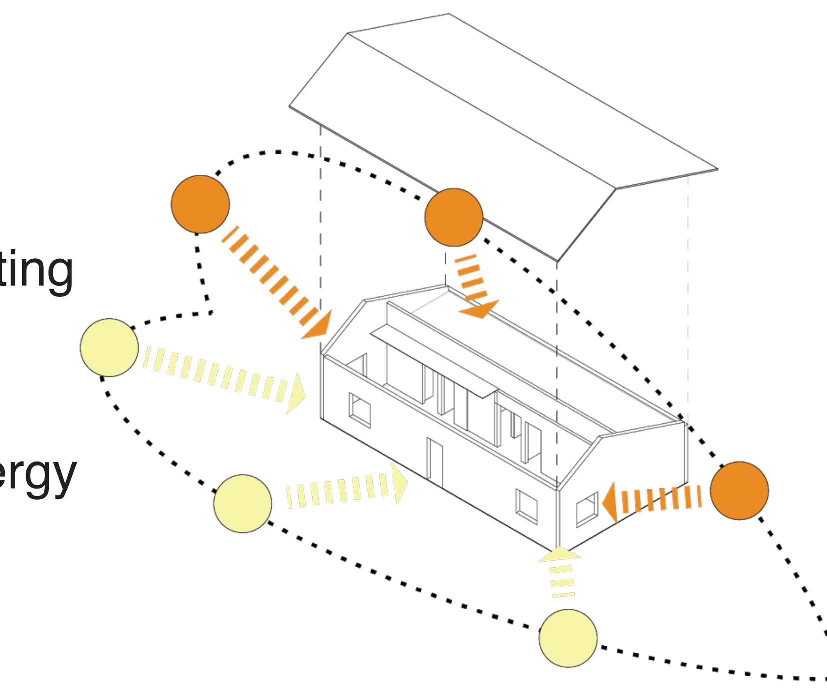
wind

Roof structure angled to take on high wind loads predominantly from the south and partially from the north while preserving the look of the neighborhood



sunlight

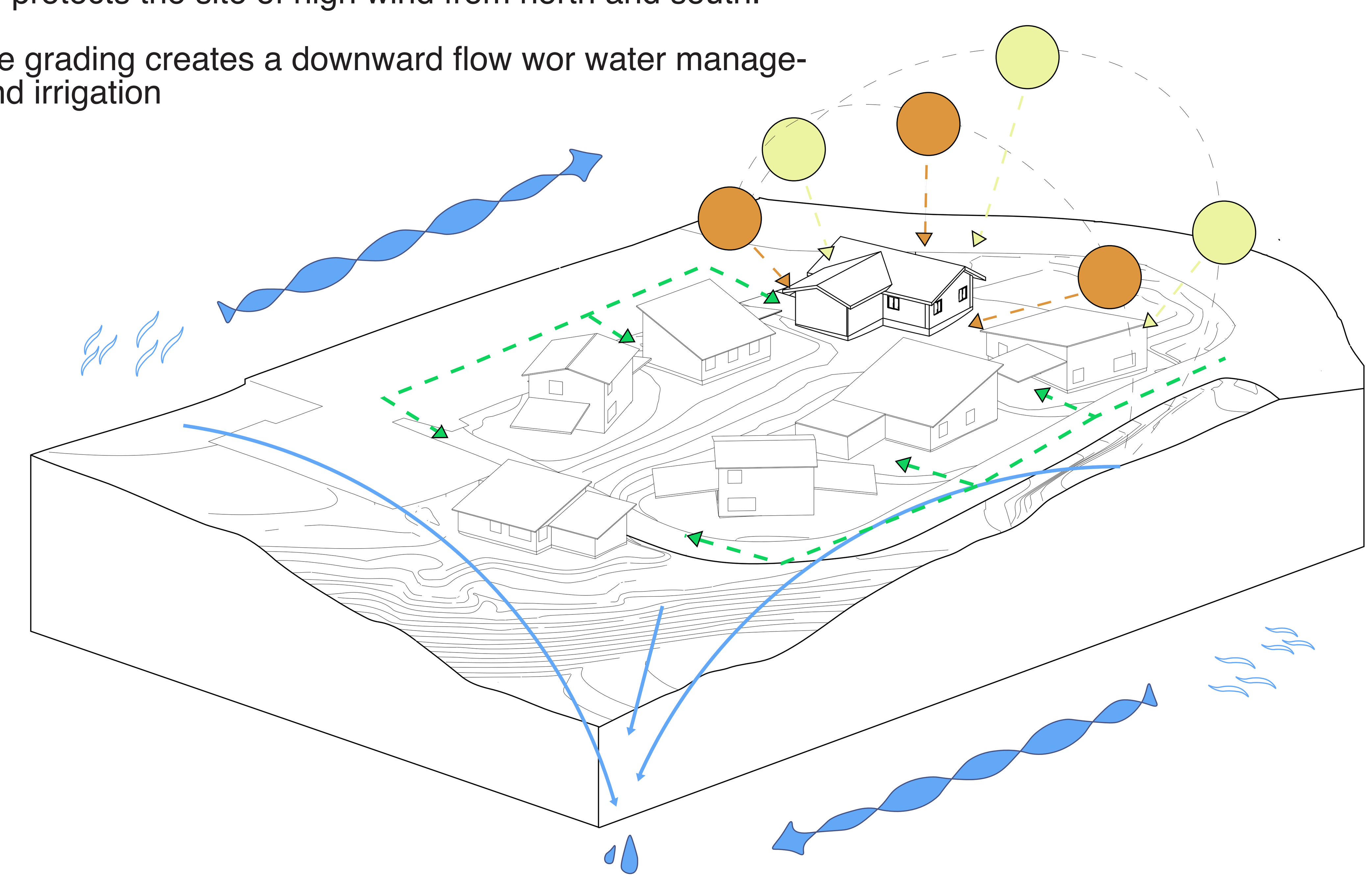
Wide shape to be exposed to the sun for passive solar heating
Rotated towards true south for maximum exposure
Windows to heat the more spacious living room taking into consideration solar angle
High R-values means more heat retention and reduced energy consumption due to heating



site strategy

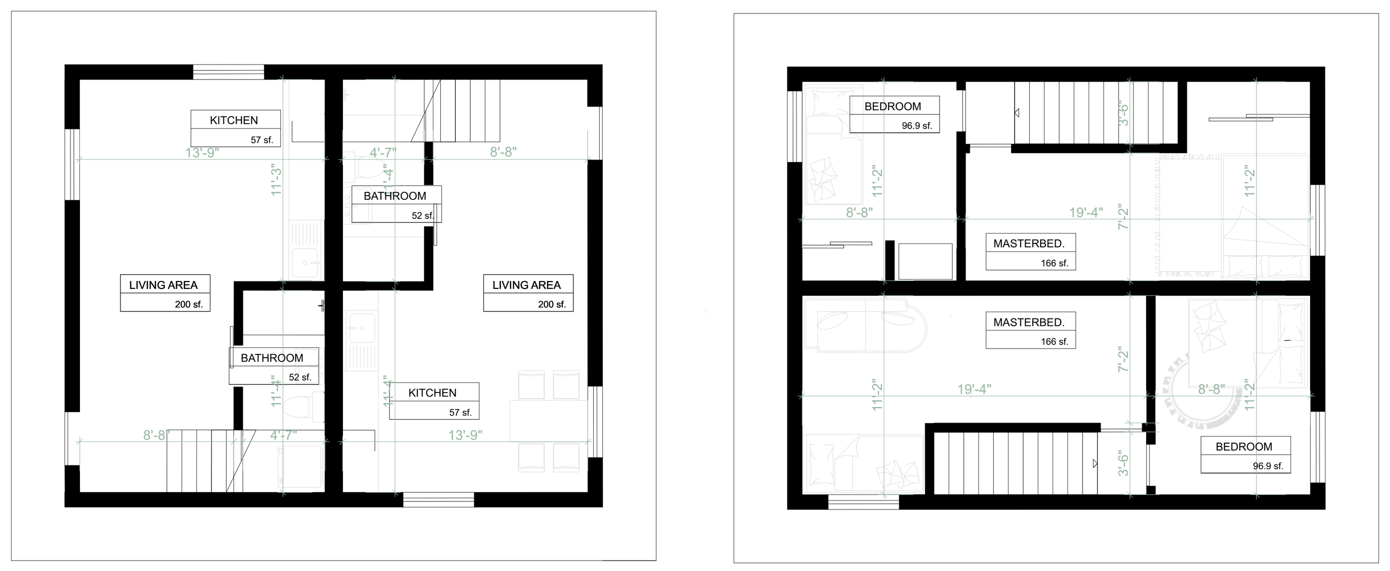
Slightly grading the exiting topography creates circulation and adrees several issues; The building orientation and roof shape not only mazimes solar exposure and provides thermal comfort but also protects the site of high wind from north and south.

Also, the grading creates a downward flow wor water manage-ment and irrigation

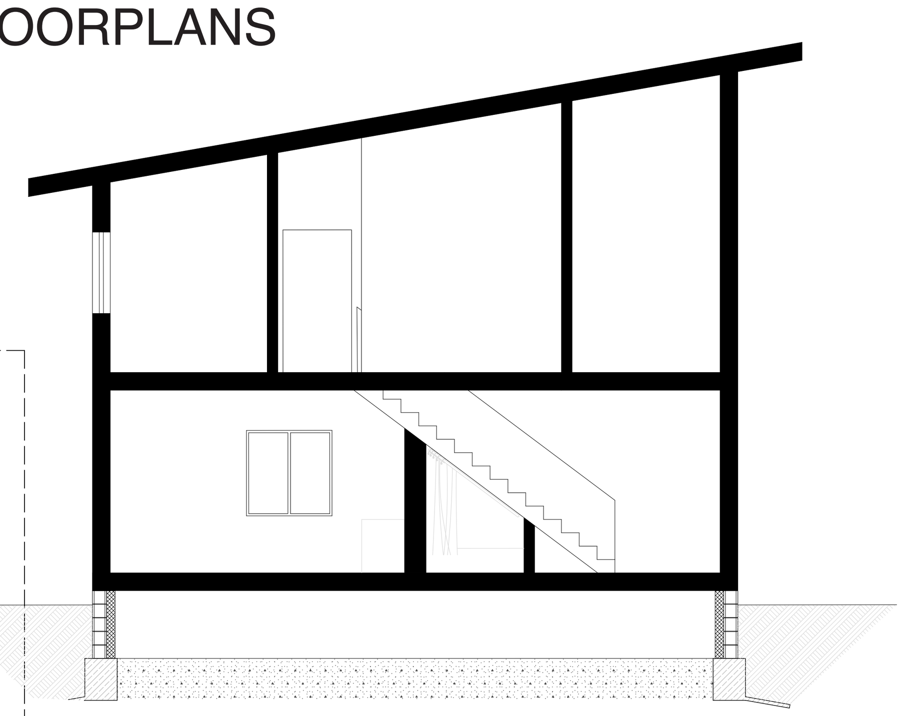


LEVEL 1

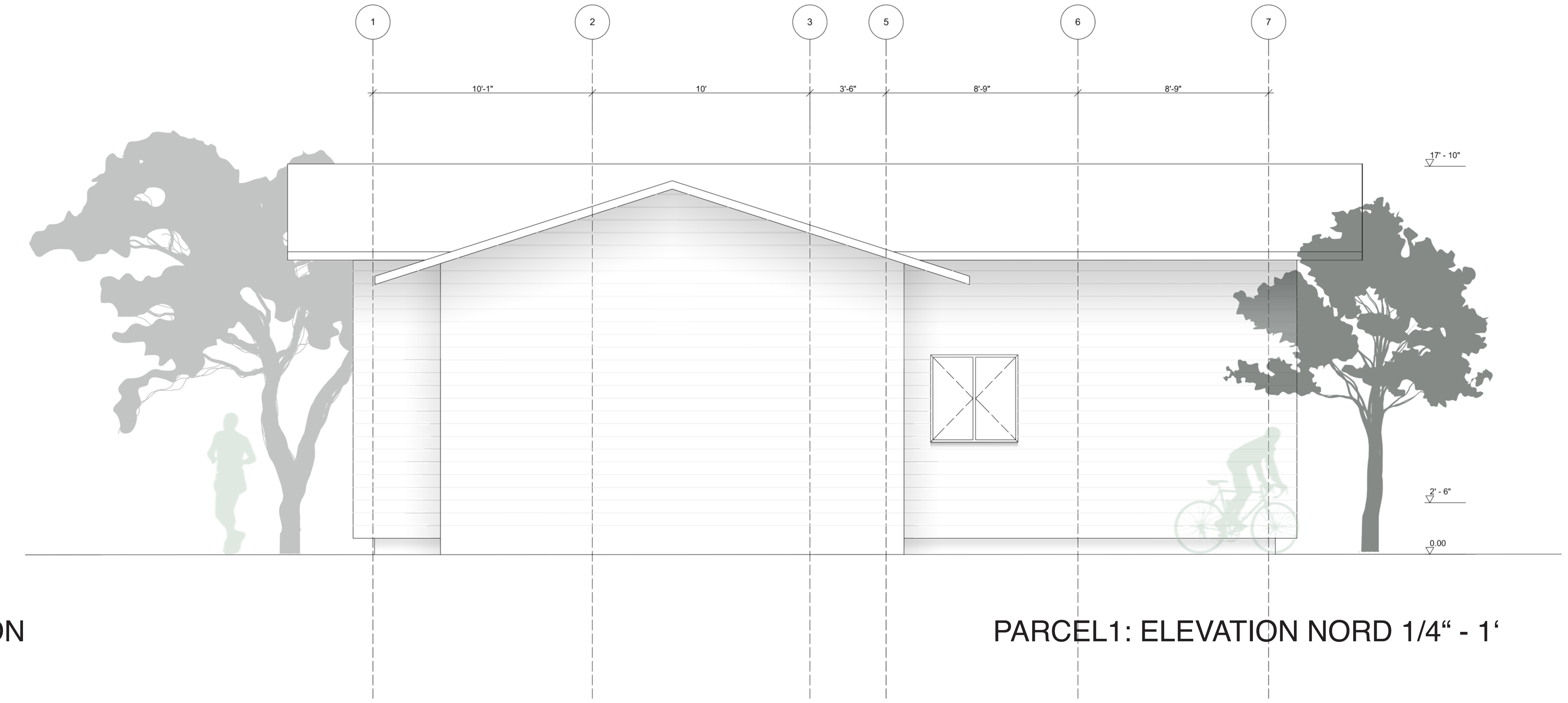
LEVEL 2



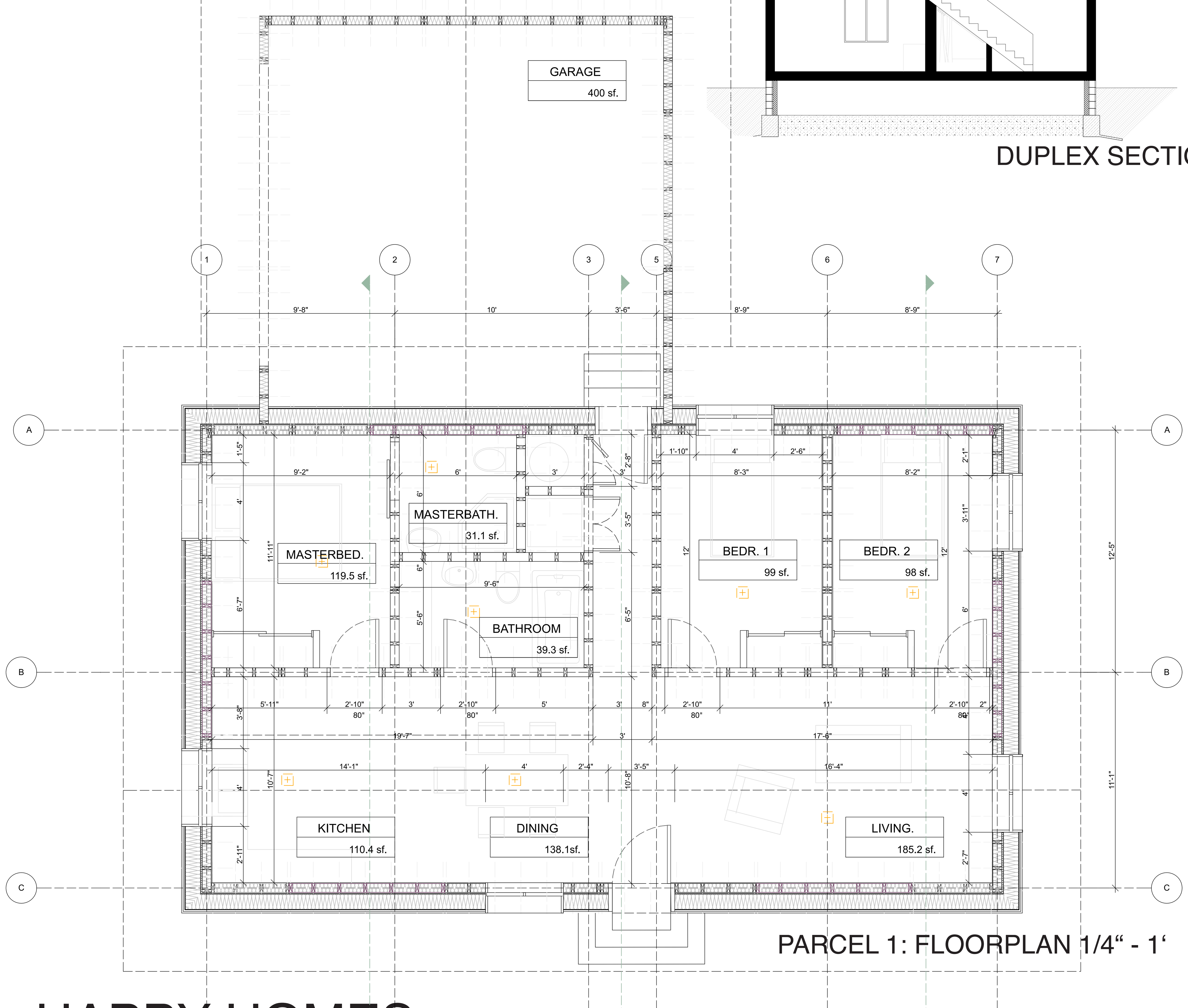
DUPLEX FLOORPLANS



DUPLEX SECTION



PARCEL1: ELEVATION NORD 1/4“ - 1‘

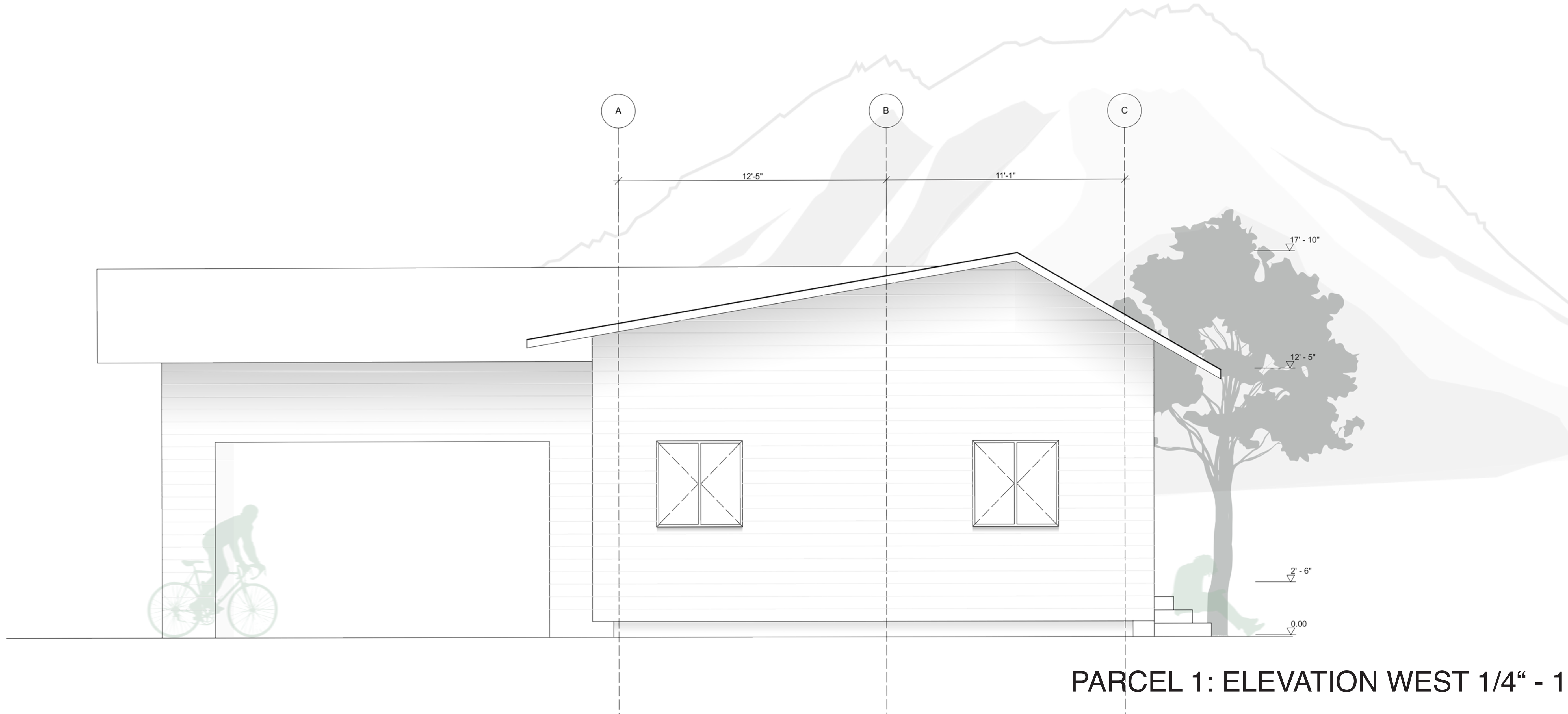


PARCEL 1: FLOORPLAN 1/4“ - 1‘

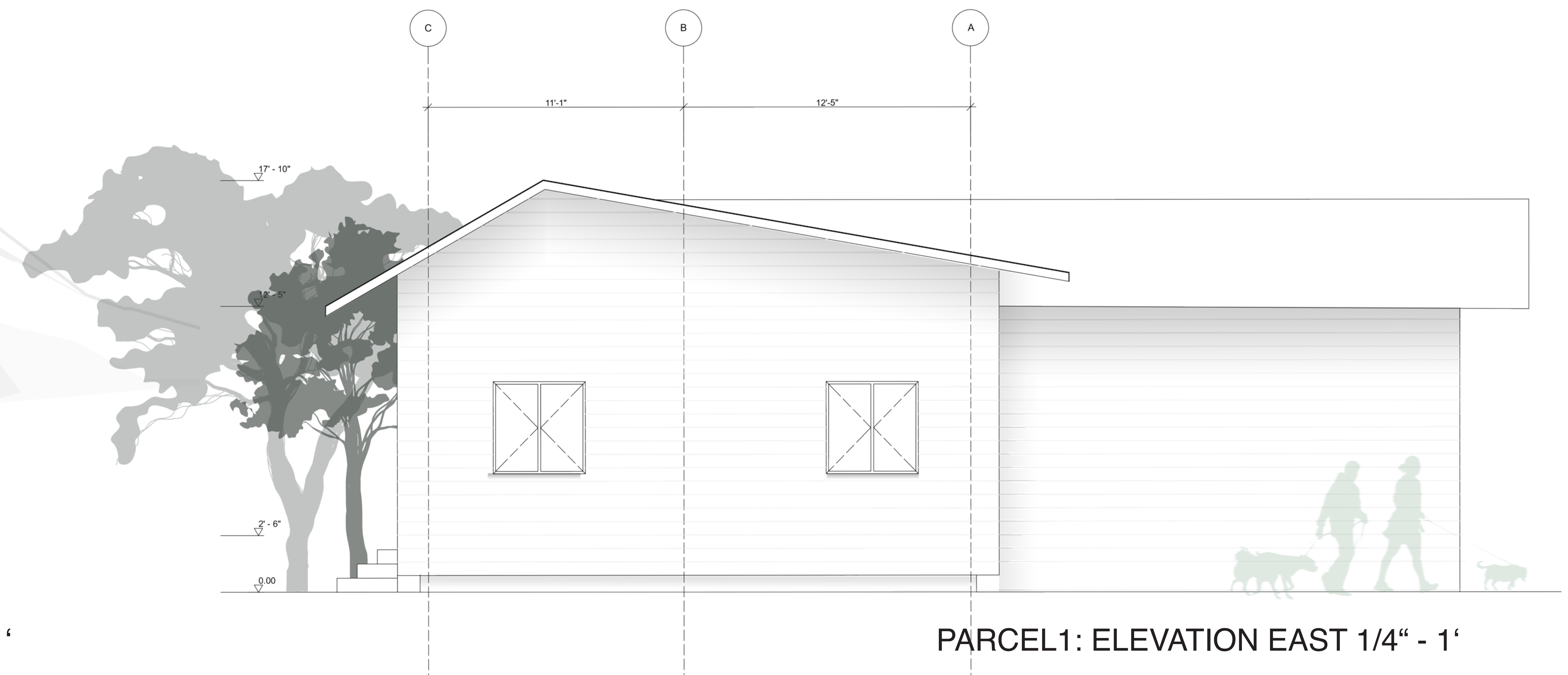
PARCEL1: ELEVATION SOUTH 1/4“ - 1‘

HAPPY HOMES

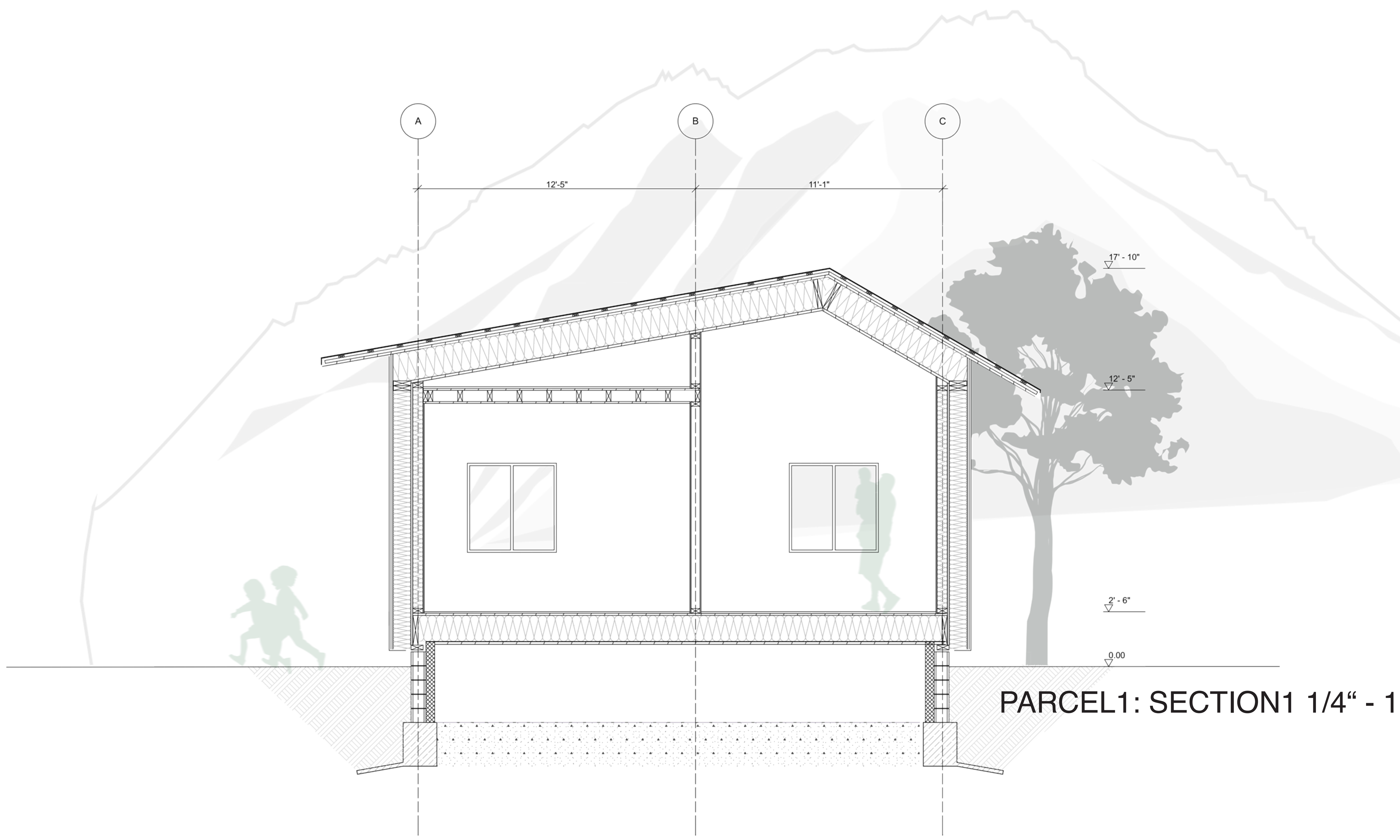
BECK, LEE, LUNDHAL, PICHEL, VERGARA



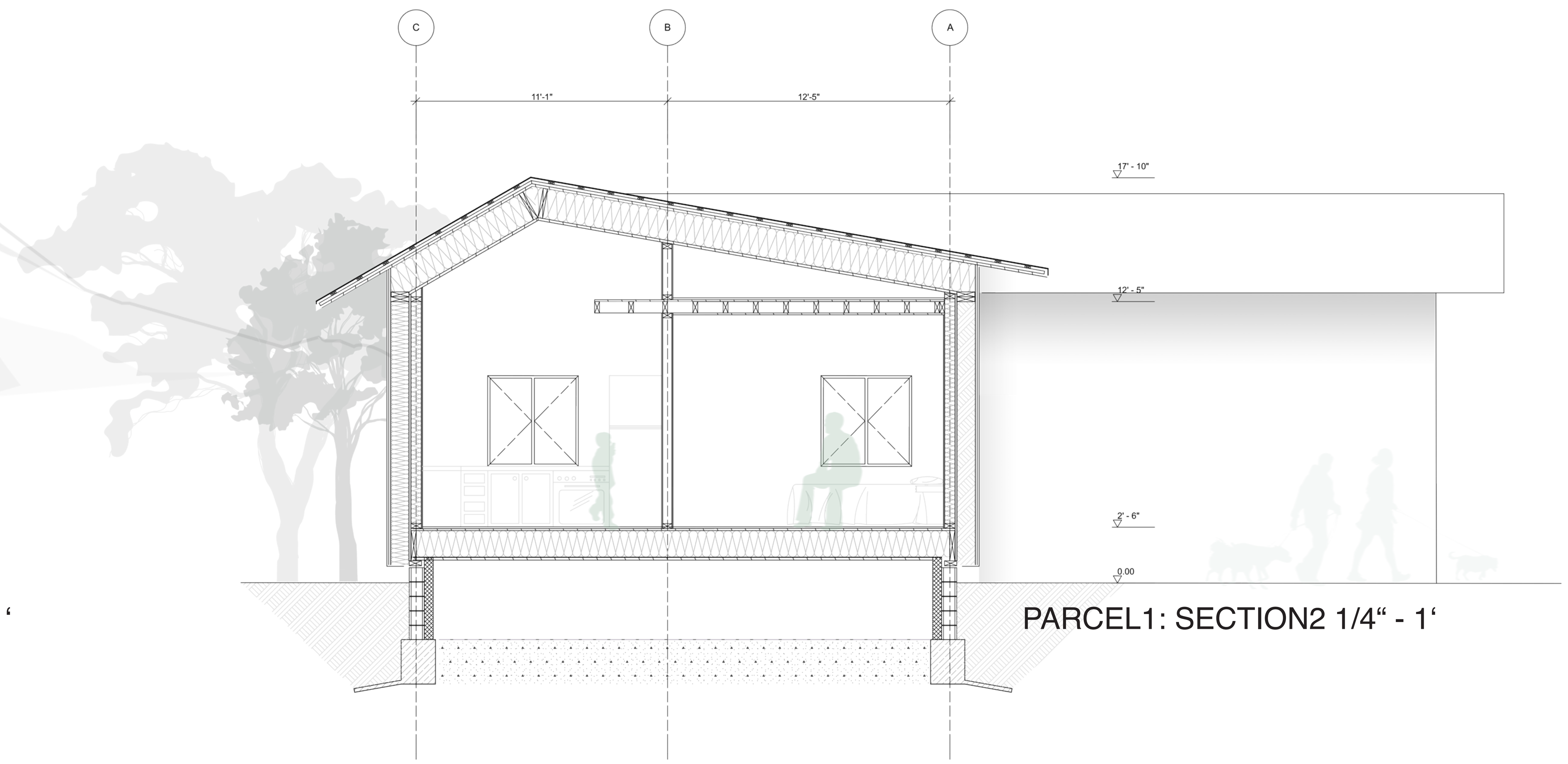
PARCEL 1: ELEVATION WEST 1/4" - 1'



PARCEL1: ELEVATION EAST 1/4" - 1'



PARCEL1: SECTION1 1/4" - 1'



PARCEL1: SECTION2 1/4" - 1'

HAPPY HOMES

BECK, LEE, LUNDHAL, PICHEL, VERGARA

ROOF R-62,66

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

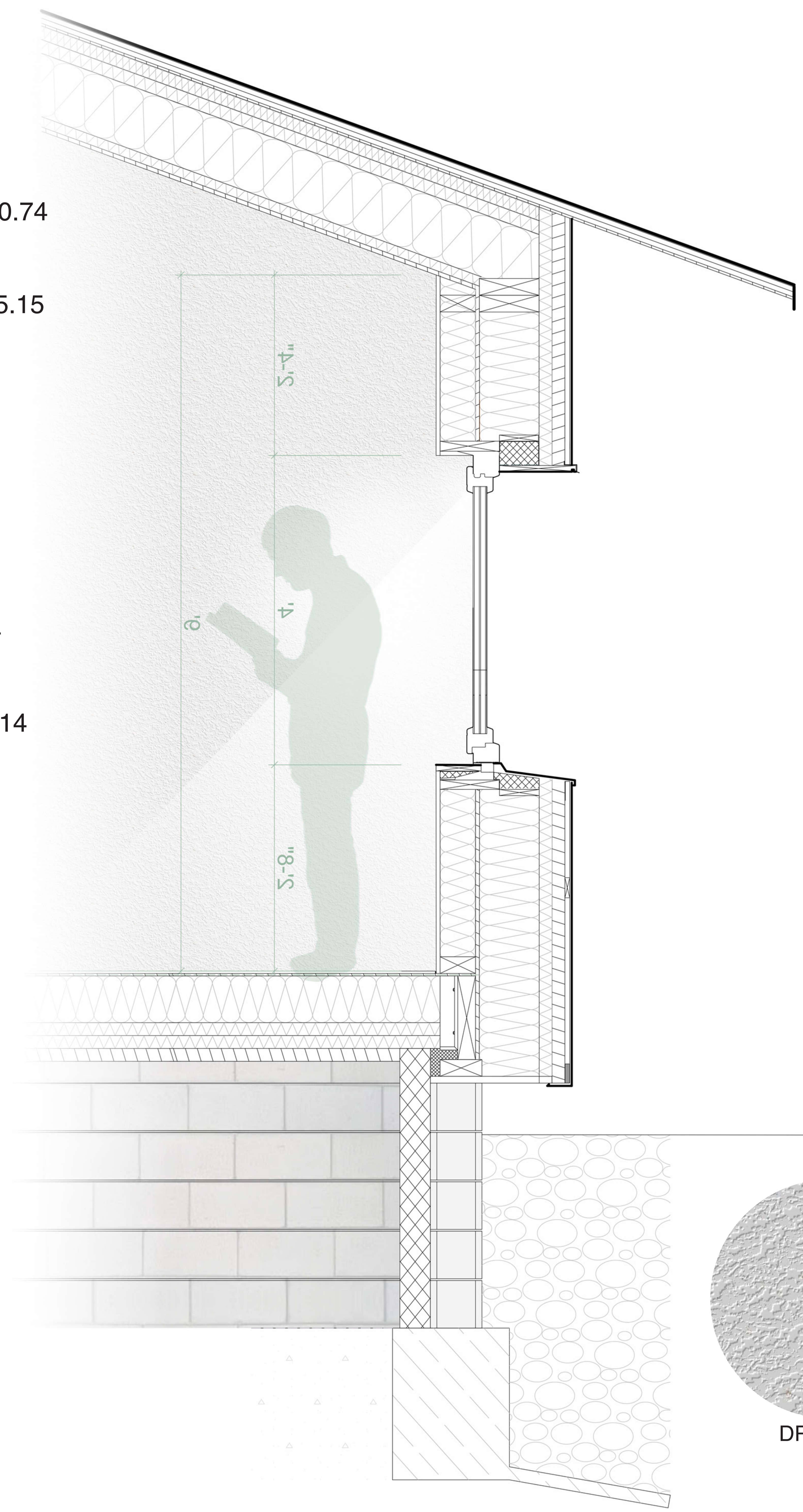
WALL ASSEMBLY R-66.266

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

FLOOR ASSEMBLY R-61.436

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

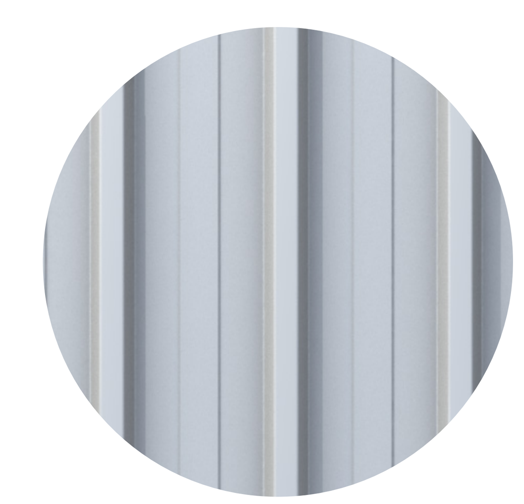
DETAIL SECTION 1“ - 1‘



ELEVATION 1“ - 1‘

DRYWALL

LINOLIUM

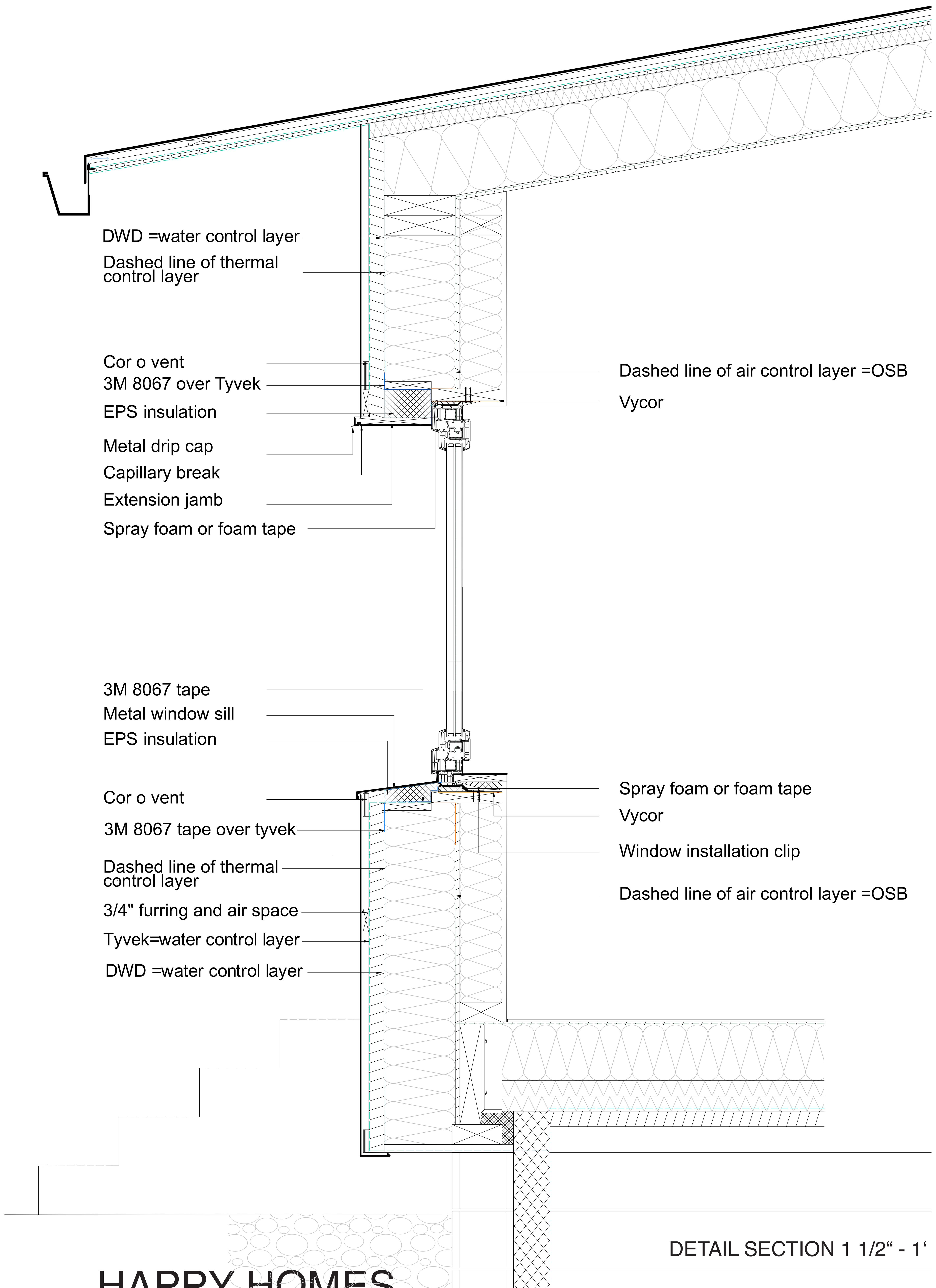


METAL ROOFING

FIBRE CEMENT CLADDING

HAPPY HOMES

BECK, LEE, LUNDHAL, PICHEL, VERGARA



DETAIL SECTION 1 1/2" - 1'

HAPPY HOMES

BECK, LEE, LUNDHAL, PICHEL, VERGARA

Construction Estimate

Estimate for: Great Northern Services
Location: Weed, California

Description	QTY	Unit	Unit Costs	Total Costs
Concrete				
Structural concrete, Conitnous Footing	46	C.Y	$ 25.20	$ 1,157.33
Structural concrete, Slab on grade (3000 psi), 4" thick	400	S.F	$ 3.34	$ 1,336.00
Rebar - Material Only	379	lbs	$ 1.32	$ 499.96
Miscellanious				$ 751.28
			Concrete Subtotal	**$ 3,744.57**
Masonry				
CMU Blocks	426	SF	$ 12.49	$ 5,320.74
Miscellanious				$ 3,620.64
			Masonry Subtotal	**$ 8,941.38**
Wood, Plastics & Composites				
2x6 Exterior Walls	190	LF	$ 20.77	$ 3,946.30
2x4 Interior Walls	105	LF	$ 19.36	$ 2,032.80
2x10 Roof Rafters	1824	LF	$ 3.81	$ 6,949.76
2x8 Floor Joists	1389	LF	$ 2.12	$ 2,944.68
OSB for Wall	1751	SF	$ 1.76	$ 3,082.35
OSB for Roof	3500	SF	$ 1.56	$ 5,460.00
Miscellanious				$ 9,561.96
			Wood, Plastics & Composites Subtotal	**$ 33,977.84**
Thermal				
Roof				
Cellulose				$ 4,100.00
XPS				$ 3,020.00
Insulated Sheathing				$ 8,380.00
Floor				
Cellulose				$ 3,075.00
Insulated Sheathing				$ 9,945.00
Walls				
Cellulose				$ 5,794.62
XPS				$ 2,708.94
Miscellanious				$ 17,615.37
			Thermal Subtotal	**$ 54,638.93**
Openings				
Windows				$ 3,467.22
Door*				$ 4,872.78
Garage Door				$ 2,094.78
			Opening Subtotal	**$ 10,434.78**
Finishes				
Linoleum Flooring	1128	SF	$ 5.37	$ 6,057.36
Gypsum				$ 4,334.64
Miscellanious				$ 6,509.91
			Finishes Subtotal	**$ 16,901.91**
Specialties				
Bathroom Assecories				$ 653.54
			Specialties Subtotal	**$ 653.54**
Equipment				
MXZ H2i High Efficiency Heat Pumps				$ 3,199.00
			Rebate	$ (1,500.00)
PLATINUM™ Hybrid Electric Water Heater				$ 1,723.01
			Rebate	$ (600.00)
Miscellanious				$ 4,443.41
			Equipment Subtotal	**$ 7,265.42**
Furnishings				
Cabinets				$ 1,266.96
Countertops				$ 779.67
Miscellanious				$ 37.74
			Furnishing Subtotal	**$ 2,084.37**
MEP & HVAC				
3 Fixture Lavatory	2	Ea	$ 5,603.76	$ 11,207.52
Lights				$ 1,291.36
Miscellanious				$ 7,738.73
			MEP & HVAC Subtotal	**$ 20,237.61**
Other				
Rigging				$ 5,000.00
Transportation				$ 6,000.00
			Total**	**$ 169,880.35**

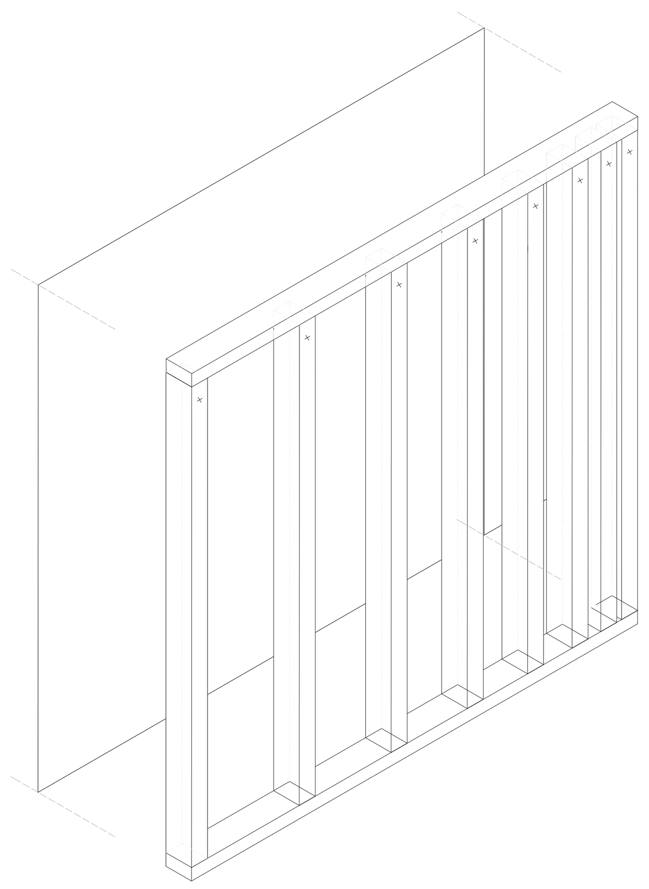
*Only hardware, the doors are included in the Wood, Plastics & Composite Section
**Numbers were calculated with Overhead and Profit

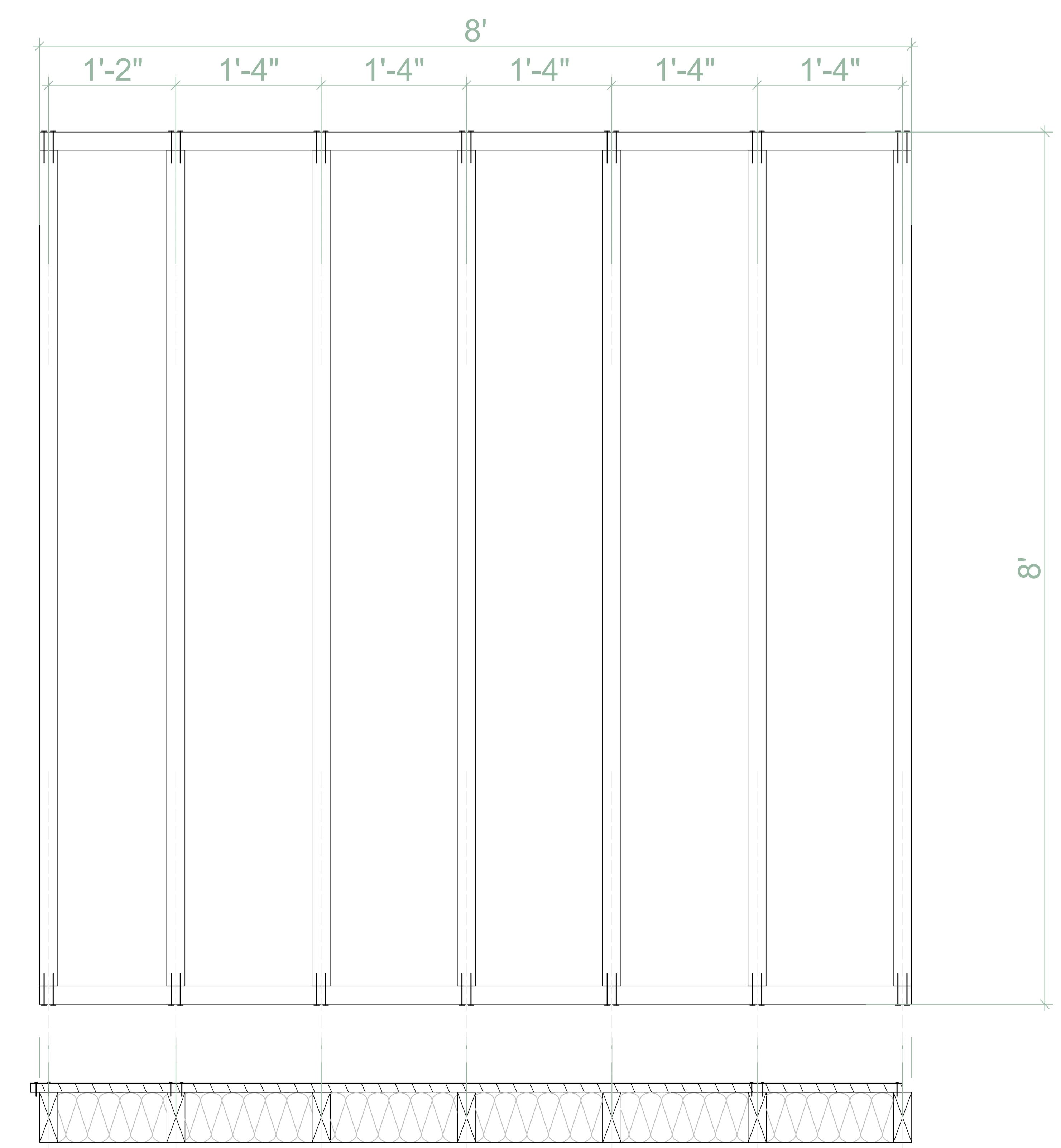
Construction Estimate

Estimate For: Great Nothern Services
Location: Weed, California

Description	Quantity	Unit	Unit Costs	Cost
Nails, plain, 16d	10	lbs	$ 1.54	$ 15.40
Nails, drywall, plain	20	lbs	$ 1.82	$ 36.40
Wood blocking, to wood construction, 2" x 6"	27	LF	$ 4.00	$ 108.00
Partitions, 2" x 4" studs, 16" O.C.*	105	LF	$ 19.36	$ 2,032.80
Partitions, 2" x 6" studs, 16" O.C.*	190	LF	$ 20.77	$ 3,946.30
Headers over openings, 2" x 6"	43	LF	$ 4.78	$ 205.54
Wood framing, partitions, for horizontal blocking, 2" x 6", add	16	LF	$ 3.14	$ 50.24
Sheathing, oriented strand board, 5/8" thick, on walls	1752	SF	$ 1.76	$ 3,083.52
Sheathing Joint Tape, factory laminated water resistant barrier, 3-1/2"	1314	LF	$ 0.49	$ 643.86
Rigging				$ 5,000.00
Transportaiton	3	Trip	$ 2,000.00	$ 6,000.00
			Construction Total	**$ 21,122.06**

*includes single bottom plate and double top plate





TYPICAL PANEL 1 10" - 1'

Examples for Fabrication of Passive Houses

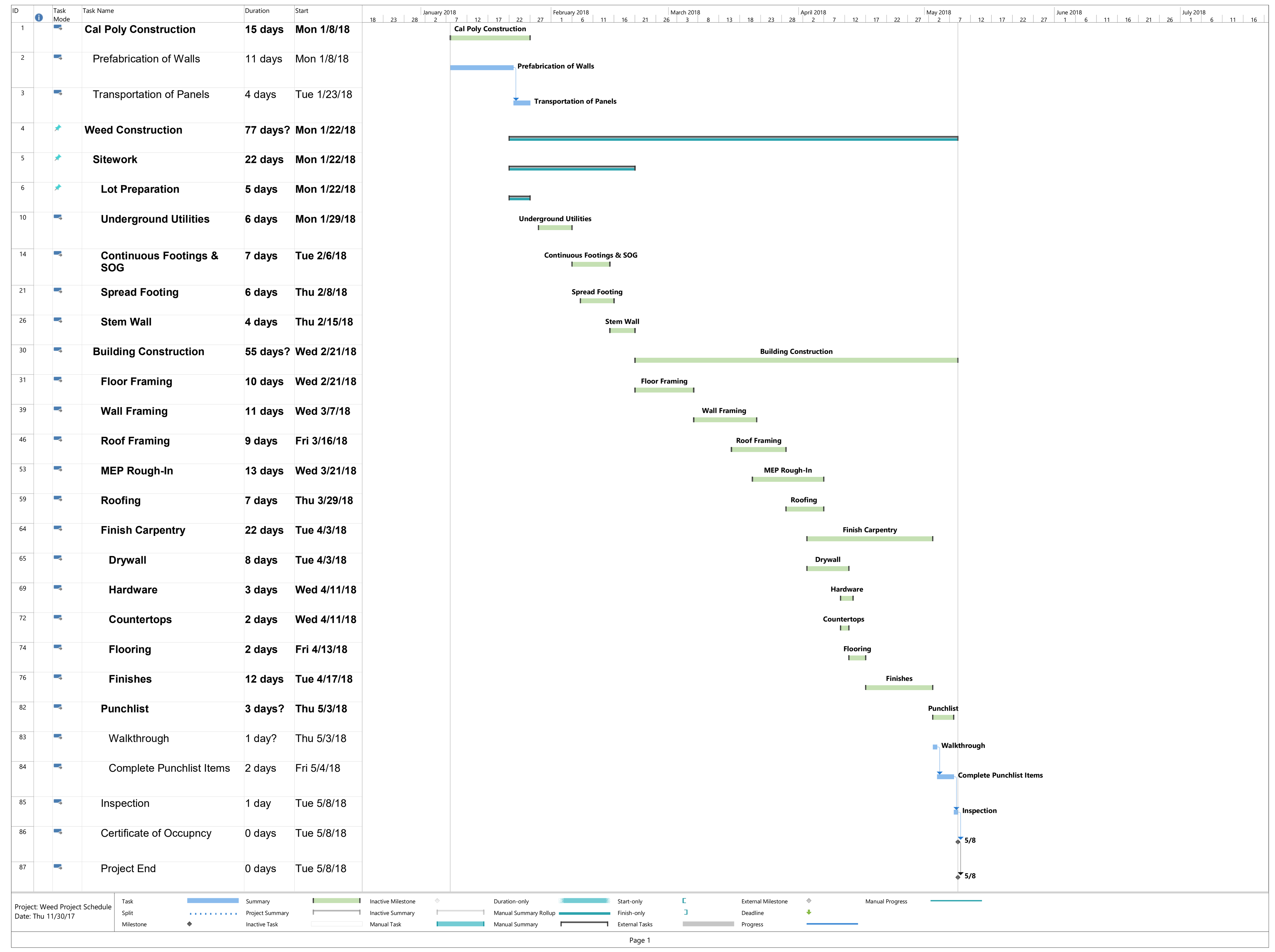
Knox House by EcoCor
- Similar environmental design conditions: snow, wind, heating and cooling, forest
- Hybrid Double Wall System
- airtightness: 28 ACH/50 and dropping


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


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


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

Schedule



ID	Task Name	Duration	Start
1	**Cal Poly Construction**	**15 days**	**Mon 1/8/18**
2	Prefabrication of Walls	11 days	Mon 1/8/18
3	Transportation of Panels	4 days	Tue 1/23/18
4	**Weed Construction**	**77 days?**	**Mon 1/22/18**
5	**Sitework**	**22 days**	**Mon 1/22/18**
6	**Lot Preparation**	**5 days**	**Mon 1/22/18**
10	**Underground Utilities**	**6 days**	**Mon 1/29/18**
14	**Continuous Footings & SOG**	**7 days**	**Tue 2/6/18**
21	**Spread Footing**	**6 days**	**Thu 2/8/18**
26	**Stem Wall**	**4 days**	**Thu 2/15/18**
30	**Building Construction**	**55 days?**	**Wed 2/21/18**
31	**Floor Framing**	**10 days**	**Wed 2/21/18**
39	**Wall Framing**	**11 days**	**Wed 3/7/18**
46	**Roof Framing**	**9 days**	**Fri 3/16/18**
53	**MEP Rough-In**	**13 days**	**Wed 3/21/18**
59	**Roofing**	**7 days**	**Thu 3/29/18**
64	**Finish Carpentry**	**22 days**	**Tue 4/3/18**
65	**Drywall**	**8 days**	**Tue 4/3/18**
69	**Hardware**	**3 days**	**Wed 4/11/18**
72	**Countertops**	**2 days**	**Wed 4/11/18**
74	**Flooring**	**2 days**	**Fri 4/13/18**
76	**Finishes**	**12 days**	**Tue 4/17/18**
82	**Punchlist**	**3 days?**	**Thu 5/3/18**
83	Walkthrough	1 day?	Thu 5/3/18
84	Complete Punchlist Items	2 days	Fri 5/4/18
85	Inspection	1 day	Tue 5/8/18
86	Certificate of Occupncy	0 days	Tue 5/8/18
87	Project End	0 days	Tue 5/8/18

Project: Weed Project Schedule
Date: Thu 11/30/17

Rigging Cost Estimate

Cost of renting a Gradall

Cost to rent for a day	$833
Cost to rent for a week	$2,500
Cost to rent for a month	$7,500

Product Specifications

Year: 2003
Manufacturer: Gradall
Model: XL4300 II
Operating Weight (lbs): 43,580

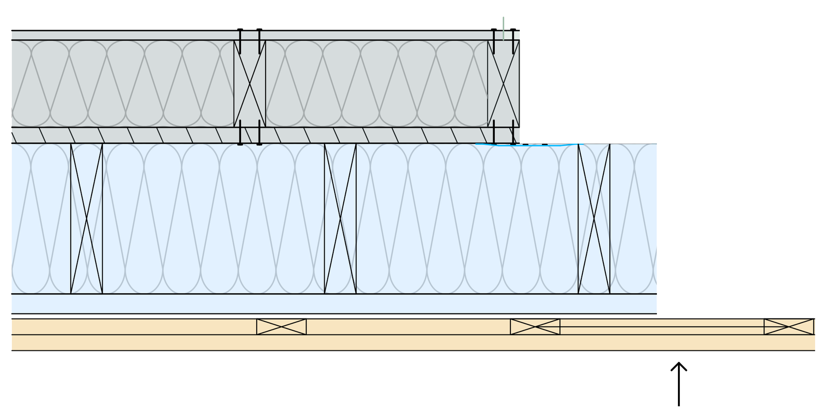
Summary

Prefabricated wall assembly units units (approx.)	44
Number of days for transportation from SLO to Weed	4 days
Duration to install prefabricated panels	9 days
Days of buffer	1 day
Estimate of time needed	2 weeks
Cost per week	$2,500
Total Cost of rigging prefabricated panels:	**$5,000**

*Estimate obtained from Rentalyard.com

Panelization

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

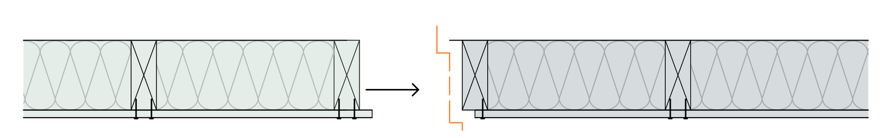


1 Drywall
Stud-Wall, Insulation
OSB

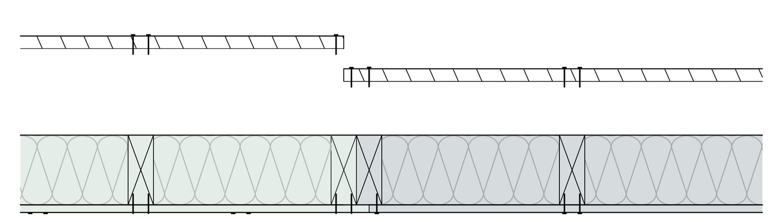
2 second Insulation layer
DWD board

3 furring and counter furring
fiber cement cladding

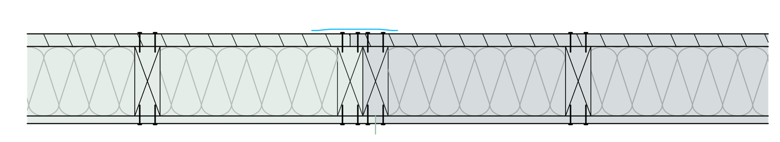
1 put panels together



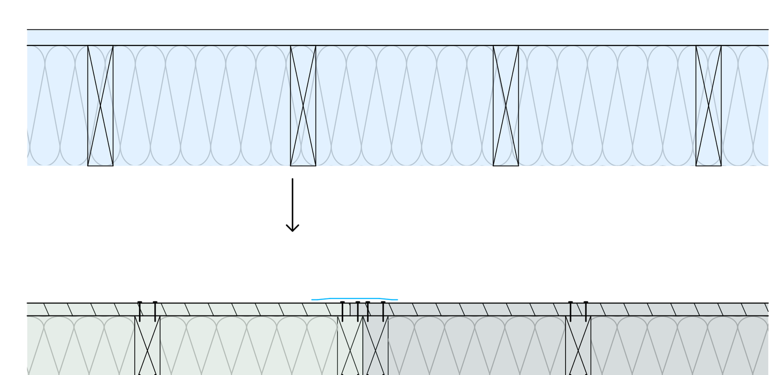
2 nail together



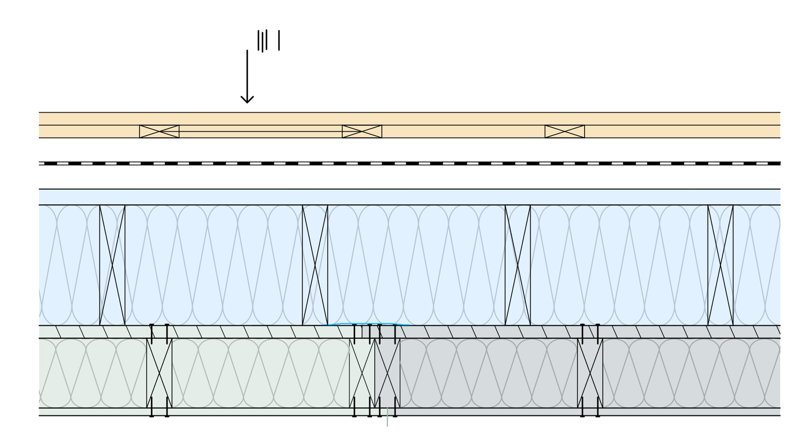
3 apply fluid on OSB seams
required to ensure airtight envelope



4 apply second layer panel



5 assemble facade
apply vapor permeable sheating and the third layer panel by fixing it with nails/screws



HAPPY HOMES

BECK, LEE, LUNDHAL, PICHEL, VERGARA

Weed, CA Housing Project

Structural Calculation and Drawing Package

Happy Homes

Trenton Jay Pichel

December 1, 2017

ARCE 415 Cal Poly San Luis Obispo

Table of Contents

L-0

USGS Design Maps Summary Report

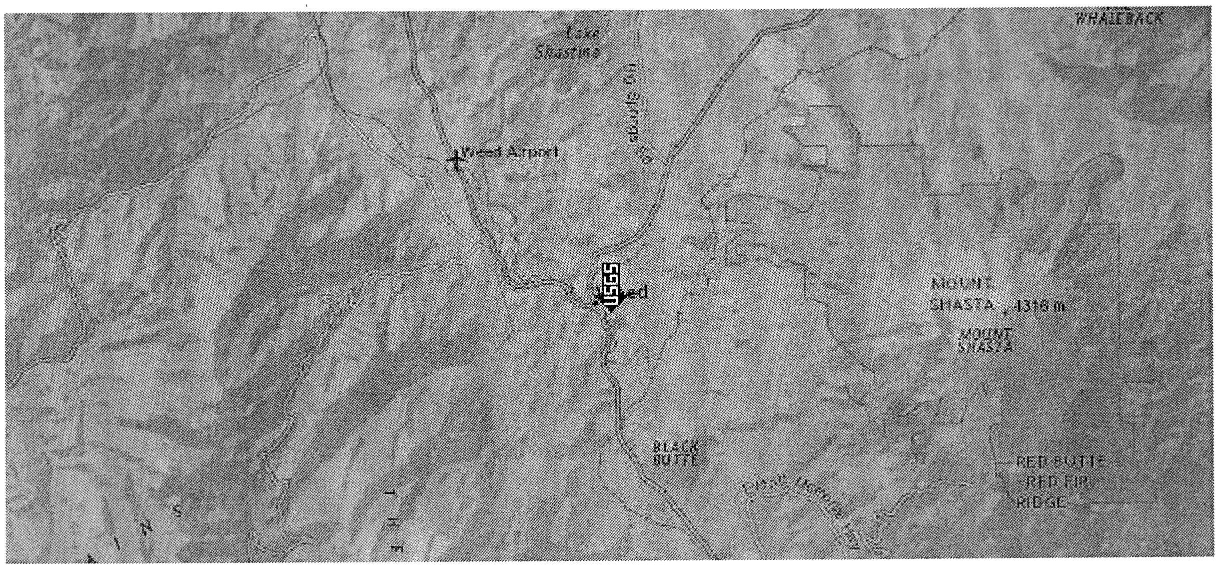
User–Specified Input

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

Site Coordinates 41.42891°N, 122.37939°W

Site Soil Classification Site Class D – "Stiff Soil"

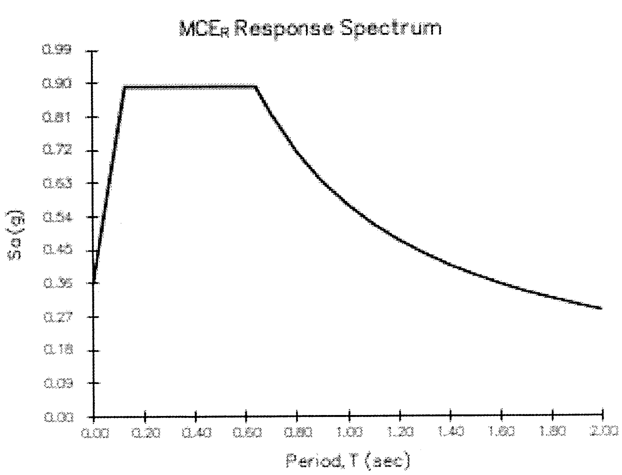
Risk Category I/II/III

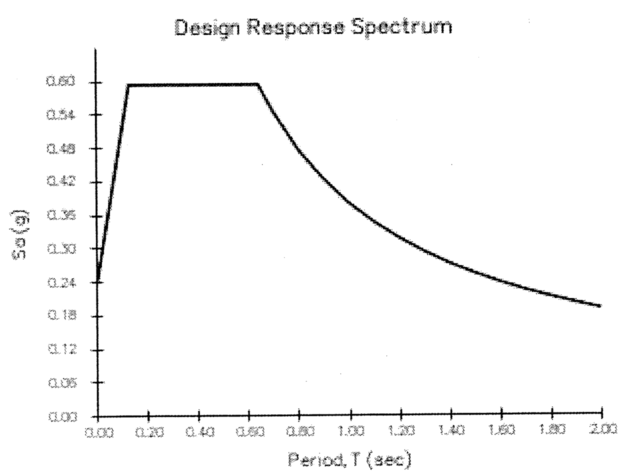


USGS–Provided Output

$S_S =$ 0.736 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.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

LOAD TAKE OFF

ROOF:

1 1/2" VERCO HSB-36 GALVINIZED ROOF DECK, 20 GAGE	2.2 psf
6" CLOSED-CELL SPRAY INSULATION @ R6 PER INCH THICKNESS $\rightarrow (2\,pcf)(0.5\,ft)$	1.0 psf
2x10 DF-L RAFTERS @ 24" O.C. $\rightarrow 35\,pcf\,(1.5\,in)(9.25\,in)\left(\frac{1\,ft^2}{144\,in^2}\right)/\left(\frac{24\,in}{12\,in}\right)$	6.7 psf
1/2" GYPSUM BOARD CEILING $\rightarrow \left(5.0\,\frac{psf}{in}\right)(0.5\,in)$	2.5 psf
MEP + SPRINKLERS	4.5 psf
	16.9 psf
MISCELLANEOUS	3.1 psf
TOTAL DEAD TO WALLS	20.0 psf
18" EXTERIOR WALL ASSEMBLY $\rightarrow \dfrac{(23\,psf)(129\,ft)\left(\frac{12\,in}{18\,in}\right)(8\,ft)}{(41\,ft)(23.5\,ft)}$	19 psf
6" INTERIOR WALL ASSEMBLY $\rightarrow \dfrac{(15\,psf)(128\,ft)\left(\frac{12\,in}{16\,in}\right)(8\,ft)}{(41\,ft)(23.5\,ft)}$	12.0 psf
SEISMIC LOAD TO ROOF	51 psf
PITCHED ROOF	20 psf
TOTAL LIVE TO ROOF (REDUCIBLE)	20 psf

✓

FLOOR:

VINYL TILE FLOORING	1.4 PSF
3/4" OSB SHEATHING	3.0 PSF
2×8 DF-L #2 JOISTS @ 16" O.C. $\rightarrow (35\,pcf)(1.5\,in)(7.25\,in)\left(\frac{1\,ft^2}{144\,in^2}\right)$	2.6 PSF
6" CLOSED-CELL SPRAY INSULATION, @ R6 PER INCH THICKNESS $\rightarrow (2\,pcf)(0.5\,ft)$	1.0 PSF
TOTAL DEAD TO BEAMS	8.0 PSF
2×8 DF-L #2 BEAMS $\rightarrow (35\,pcf)(1.5\,in)(7.25\,in)\left(\frac{1\,ft^2}{144\,in^2}\right)$	2.6 PSF
MEP	2.0 PSF
	12.6 PSF
MISCELLANEOUS	1.4 PSF
TOTAL DEAD TO WALLS	14.0 PSF
18" EXTERIOR WALL ASSEMBLY $\rightarrow \frac{(23\,psf)(129\,ft)\left(\frac{12\,in}{18\,in}\right)(10\,ft)}{(41\,ft)(23.5\,ft)}$	23.1 PSF
6" INTERIOR WALL ASSEMBLY $\rightarrow \frac{(15\,psf)(128\,ft)\left(\frac{12\,in}{18\,in}\right)(10\,ft)}{(41\,ft)(23.5\,ft)}$	15.0 PSF
SEISMIC LOAD TO FLOOR	52 PSF
ONE FAMILY DWELLING, NON HABITABLE ATTIC W/STORAGE	20 PSF
TOTAL LIVE TO FLOOR	20 PSF

SEISMIC LOADING CRITERIA

SEISMIC WEIGHT:

$$ROOF = (51\ psf)\left(\frac{17\,FT}{15\,FT} + \frac{12\,FT}{9\,FT}\right)(41\,FT)(23.5\,FT) = 121.21^{kips}$$

$$FLOOR = (52\ psf)(41\,FT)(23.5\,FT) \qquad 50.10^{kips}$$

TOTAL 171.31^{kips}

ASCE 7-10 12.8.1.1

SEISMIC RESPONSE COEFFICIENT:

$$C_s = \frac{S_{DS}}{R/I} = \frac{0.594}{6.5/1} = 0.09138$$

$$T = (0.02)(14\,FT)^{0.75} = 0.145 \leq 16 = T_L$$ ✓

ASCE 7-10 12.8.1

BASE SHEAR:

$$V = C_s W_{TOTAL} = (0.09138)(171.31\,kips) = 15.65^{kips}$$

ASCE 7-10 12.3.4.2

REDUNDANCY FACTOR:

→ FOR N-S DIRECTION

WALL	LENGTH	HEIGHT	H/L	L/ΣL
A	8 FT	18 FT	2.25>1	8FT/24FT ≤ 0.33
B	8 FT	18 FT	" "	" "
C	8 FT	18 FT	" "	" "
Σ	24 FT			

$\therefore \rho_{N-S} = 1.0$

→ FOR E-W DIRECTION

WALL	LENGTH	HEIGHT	H/L	L/ΣL
1	8 FT	10 FT	0.25	0.2 ≤ 0.33
2	8 FT	10 FT	" "	" "
3	8 FT	10 FT	" "	" "
4	8 FT	10 FT	" "	" "
5	8 FT	10 FT	" "	" "
Σ	40 FT			

$\therefore \rho_{E-W} = 1.0$

✓

ASCE 7-10
12.8.3

VERTICAL DISTRIBUTION OF BASE SHEAR

→ FOR ROOF

$$C_{vx} = \frac{wh^k}{\Sigma wh^k} = \frac{(121.21\ \text{KIP})(14\ \text{FT})}{(121.21\ \text{KIP})(14\ \text{FT}) + (50.10\ \text{KIPS})(1\ \text{FT})} = 0.97$$

→ FOR FLOOR

$$C_{vx} = \frac{(50.10\ \text{KIP})(1\ \text{FT})}{(1747.04\ \text{K FT})} = 0.03$$

= 1.00 ✓

STORY FORCES:
(NEGLECT LOFT AND FLOOR SEISMIC LOADING)

$$F_{x_{ROOF,\ N\text{-}S}} = \rho C_{vx} V = (1.0)(0.97)(15.65\ \text{KIP}) = 15.18\ \text{KIP}$$

$$F_{x_{ROOF,\ E\text{-}W}} = (1.0)(0.97)(15.65\ \text{KIP}) = 15.18\ \text{KIP}$$

HORIZONTAL DISTRIBUTION OF BASE SHEAR

→ FOR ROOF

$$V_{x_{N\text{-}S}} = \Sigma F_x = 15.18\ \text{KIP}$$

$$V_{x_{E\text{-}W}} = \Sigma F_x = 15.18\ \text{KIP}$$

SDPWS
§4.3.3.4.1

EFFECTIVE LENGTHS

→ FOR N-S DIRECTION

WALL	HEIGHT	LENGTH	H/L	REDUCED CAPACITY	ℓ_{EFF}
A-C	18 FT	8 FT	2.5>2.0	2(8FT)/18 FT=0.89	0.89(8FT)=7.1FT

→ FOR E-W DIRECTION

WALL	HEIGHT	LENGTH	H/L	REDUCED CAPACITY	ℓ_{EFF}
1-5	10 FT	8 FT	1.25≯2.0	-	8 FT

OUT OF PLANE SEISMIC FORCES

ASCE 7-10
12.11.1

$$f_p = 0.4 S_{DS} I_e W = 0.4(0.594)(1.0)(19\ \text{psf}) = 4.51\ \text{psf}$$

✓

WIND LOADING CRITERIA

ASCE 710 T. 1.5-1	RISK CATEGORY	II
F. 26.5-1A	BASIC WIND SPEED	110 MPH
§ 26.7.3	EXPOSURE CATEGORY	C
	TOPOGRAPHIC FACTOR, K_{ZT}	1 (ASSUMED)
F. 30.5-1	WIND PRESSURES, $P_{NET\,30}$	20.8, -22.6 (ZONE 4) 20.8, -27.2 (ZONE 5)
F. 30.5-1	ADJUSTMENT FACTOR, λ	1.21

ADJUSTED WIND PRESSURES

$$P_{NET} = \lambda K_{zt} P_{NET\,30} = (1.21)(1)(20.8\,psf) = 25.17\,psf$$

$$P_{NET} = 25\ psf > 4.51\ psf = f_p$$

∴ WIND GOVERNS FOR OUT OF PLANE FORCES

SNOW LOADING CRITERIA

SNOW LOAD, P_f = 60 psf

ROOF SLOPE FACTOR
W/ METAL DECKING, C_s = 0.7 (WARM)
= 0.9 (COLD)

ASCE 7-10
T. 7-2
T. 7-3

DESIGN SNOW LOAD

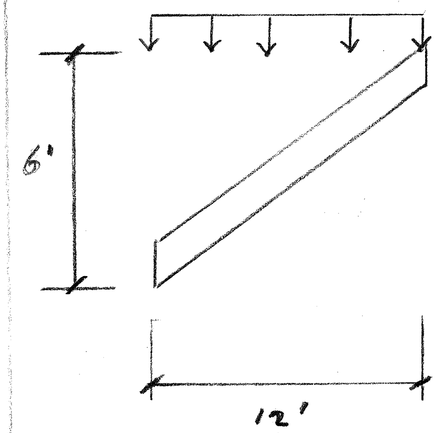
$S = 0.7(60\ psf)$ = 42 psf (WARM)
$= 0.9(60\ psf)$ = 54 psf (COLD)

F. 7-2a
F. 7-2c

✓

GRAVITY DESIGIN

TYPICAL 7:12 ROOF RAFTER (WARM ROOF)



$D: 20\,psf\left(\frac{24\,in}{12\,in}\right)\left(\frac{13.5\,FT}{12\,FT}\right) = 45\,plf$

$L_R: 20\,psf\left(\frac{24\,in}{12\,in}\right) = 40\,plf$

$S: 42\,psf\left(\frac{24\,in}{12\,in}\right) = 84\,plf$

ASCE 7-10 2.4-1

LOAD COMBINATIONS:

③ $D+S = 45\,plf + 84\,plf = 129\,plf$

DEMANDS:

$$M = \frac{wl^2}{8} = \frac{(129\,plf)(12\,FT)^2}{8} = 2322\,FT\,lbs$$

$$V = \frac{wl}{2} = \frac{(129\,plf)(12\,FT)}{2} = 774\,lbs$$

IBC 2015 T. 1604.3

$L.L. = \frac{l}{240}$, $T.L. = \frac{l}{180}$

$\rightarrow \frac{L.L.}{T.L.} = \frac{180}{240} = 0.75$

AND

$$\frac{L.L.}{T.L.} = \frac{(60\,psf + 20\,psf)}{\left[60\,psf + 20\,psf + 20\,psf\left(\frac{15}{12}\right)\right]} = 0.76 \not< 0.75 \quad \text{USE } \frac{l}{240}$$

$$\Delta = \frac{5wl^4}{384EI} = \frac{l}{240}$$

$$\rightarrow EI = \frac{5wl^3}{384}(240) = \frac{5(130\,plf/12\,in)\left[(12\,FT)(12\,in)\right]^3(240)}{384} = 101 \times 10^6\ lb\,in^2$$

$$I_{REQ} = \frac{EI}{E'} = \frac{101\times10^6\ lb\,in^2}{1.60\times10^6\ psi} = 63.18\ in^4$$

✓

SIZE SELECTION:

* TRY 2x10 DF-L #2

$E = 1.60 \times 10^6$ psi $\quad I_{xx} = 98.93$ in^4

$F_b = 900$ psi $\quad S_x = 21.39$ in^3

$F_v = 180$ psi $\quad A = 13.88$ in^2

$F_{c\perp} = 625$ psi

CAPACITY:

$F_b' = F_b(C_d C_F C_r) = (900\,psi)(1.15)(1.10)(1.15) \quad = 1309.38\,PSI$

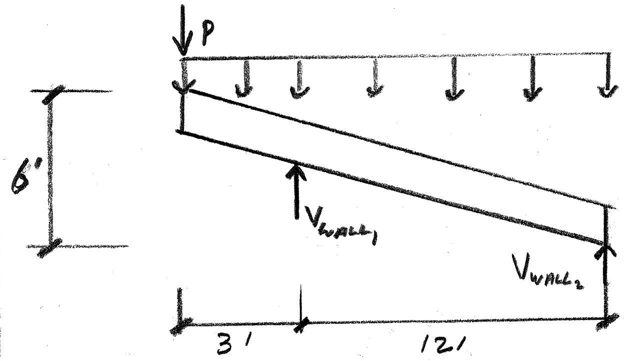
$\sigma_{max} = \frac{M}{S} \Rightarrow M_{ALLOW} = F_b' S = (1309.38\,psi)(21.39\,in^3) \quad = 2333.97$ FT lbs ≥ 2322 FT lbs ✓

$F_v' = F_v(C_D) = (180\,psi)(1.15) \quad = 207\,PSI$

$\tau = \frac{VQ}{IT} \Rightarrow V_{ALLOW} = \frac{F_v' A}{1.5} = \frac{(207\,psi)(13.88\,in^2)}{1.5} \quad = 1915$ lbs ≥ 774 lbs ✓

$\therefore$ USE 2x10 DF-L #2 RAFTERS @ 24" O.C. FOR 7/12 ROOF

TYPICAL 3:12 ROOF RAFTER (COLD ROOF)



$D: 20psf\left(\frac{24in}{12in}\right)\left(\frac{17FT}{15FT}\right) = 57plf$

$S: 54psf\left(\frac{24in}{12in}\right) = 108plf$

$L_r: 20psf\left(\frac{24in}{12in}\right) = 40plf$

P: SHEAR FROM RAFTER = 774 lbs
SEE PREVIOUS

LOAD COMBINATION:

③ $D+S = 57plf + 108plf = 165plf$

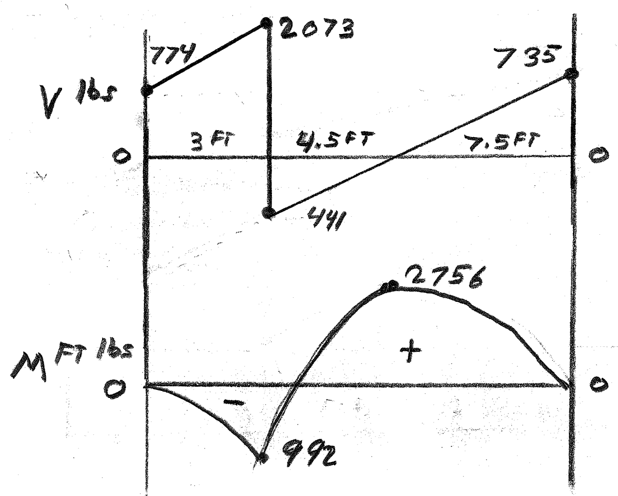
DEMANDS:

$+\circlearrowleft \Sigma M_{V_{WALL_2}} = 0 = P\ell_T + w\ell x - V_{WALL_1}\ell_1$

$V_{WALL_1} = [(774lbs)(3FT+12FT) + (165plf)(15FT)(15FT/2)]/12FT = 2514\ lbs$

$+\uparrow \Sigma F_y = 0 = -P - w\ell + V_{WALL_1} + V_{WALL_2}$

$V_{WALL_2} = (774lbs) + (165plf)(15FT) - 2514lbs = 735\ lbs$



$\Delta_{LL} = \ell/240 = (12FT)(12in)/240 = 0.6in$

$\Delta_{TL} = \ell/180 = (12FT)(12in)/180 = 0.8in$

✓

CAPACITY:

* TRY 2x12 DF-L #2

$I_{xx} = 178.0\ in^4$
$S_{xx} = 31.64\ in^3$
$A = 16.88\ in^2$

$F_b' = (900psi)(1.15)(1.0)(1.15)$ $= 1190\ psi$

$M = (1190psi)(31.64in^3)/12in$ $= 3138\ ft\ lbs$
$\geq 2756\ ft\ lbs$ ✓

$F_v' = (180psi)(1.15)$ $= 207\ lbs$

$V = (207lbs)(16.88in^2)/1.5$ $= 2329\ lbs$
$\geq 2073\ lbs$ ✓

$$\Delta_{\substack{BETWEEN \\ SUPPORTS}} = \frac{\omega x}{24EI\ell}(\ell^4 - 2\ell^2x^2 + \ell x^3 - 2a^2\ell^2 + 2a^2x^2)$$

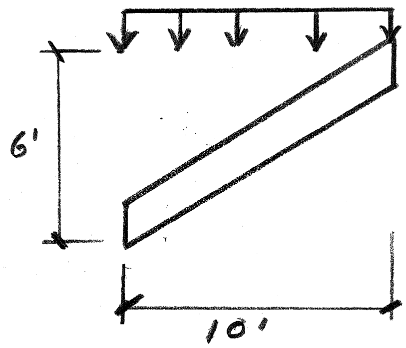
$$\frac{(165plf/12in)(7.5ft)(12in)}{24(1.6\times10^6 psi)(178in^4)(144in)}\left[(144in)^4 - 2(144in)^2(90in)^2 + (144in)(90in)^3 - 2(36in)^2(144in)^2 + 2(36in)^2(90in)^2\right]$$

$= 0.21\ in$
$\leq 0.6\ in$ ✓

$\boxed{\text{∴ USE 2x12 DF-L #2 RAFTERS @ 24" O.C. FOR 4/12 ROOF}}$

✓

TYPICAL GARAGE ROOF RAFTER (COLD ROOF)



$$D: 20psf\left(\frac{24in}{12in}\right)\left(\frac{11.67\,FT}{12in}\right) = 39\ plf$$

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

$$S = 54psf\left(\frac{24in}{12in}\right) = 108plf$$

LOAD COMBINATIONS

③ $D + S = 39\ plf + 108\ plf = 147\ plf$

DEMANDS:

$M = (147\ plf)(10FT)^2/8 = 1838\ FT\ lbs$

$V = (147\ plf)(10FT)/2 = 735\ lbs$

$$EI = \frac{5(147\ plf/12in)\left[(10FT)(12in)\right]^3(240)}{384} = 66.15\times10^6\ lb\ in^2$$

$$I_{REQ} = \frac{66.15\times10^6\ lb\ in^2}{1.6\times10^6\ psi} = 41.34\ in^4$$

CAPACITY:

* TRY 2x10 DF-L #2

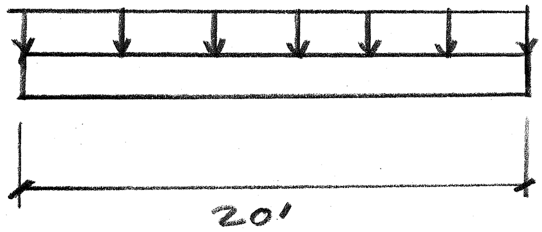
M = SEE PREVIOUS $= 2334\ FT\text{-}lbs \geq 1838\ FT\ lbs$ ✓

V = SEE PREVIOUS $= 1915\ lbs \geq 735\ lbs$ ✓

$$\boxed{\text{USE 2x10 DF-L \#2 RAFTERS @ 24" O.C. FOR GARAGE}}$$

✓

RIDGE BEAM @ GARAGE (COLD)



LOADING:

$A_T = (20\,FT)(10\,FT) = 200\,FT^2$ ∴ NO LIVE LOAD REDUCTION

D: 20 PSF (10 FT) = 200 PLF

L_R: 20 PSF (10 FT) = 200 PLF

S: 54 PSF (10 FT) = 540 PLF

LOAD COMBINATIONS:

③ D + S = 200 PLF + 540 PLF = 740 PLF

DEMANDS:

$M = (740\,PLF)(20\,FT)^2/8$ = 37 FT KIPS

$V = (740\,PLF)(20\,FT)/2$ = 7.40 KIPS

$\Delta = \dfrac{5(740\,PLF/12\,IN)[(20\,FT)(12\,IN)]^3(240)}{384}$ = 2664×10^6 lb in²

$I_{REQ} = \dfrac{(2664 \times 10^6\ lb\,in^2)}{1.8 \times 10^6\ psi}$ = 1480 in²

* TRY 6 3/4" × 13 1/2" GLULAM
* ASSUME 24F-V4 DF/DF

$I_{xx} = 1384\,in^2$ $E = E_{min} = 1.8 \times 10^6\,psi$
$S_x = 205\,in^3$
$A = 91.13\,in^3$

✓

GRAVITY DESIGN

CAPACITY:

$$C_V = \left(\frac{21}{\ell}\right)^{1/x}\left(\frac{12}{d}\right)^{1/x}\left(\frac{5.125}{b}\right)^{1/x}$$

$$= \left(\frac{21}{20FT}\right)^{1/10}\left(\frac{12}{13.5IN}\right)^{1/10}\left(\frac{5.125}{6.75IN}\right)^{1/10} \quad = 0.97 \le 1.0 \checkmark$$

$F_b' = (2400psi)(1.15)(0.97) \quad = 2677.2psi$

$M = (2677.2psi)(205IN^3) \quad = 45.74 FT KIPS \ge 37 FT KIPS \checkmark$

$F_v' = (265psi)(1.15) \quad = 305psi$

$V = (305psi)(91.13IN^3)/1.5 \quad = 18.5 KIPS \ge 7.40 KIPS \checkmark$

$E'I = (1.80 \times 10^6 psi)(1384IN^4) \quad = 2491 \times 10^6 lb IN^2$

* CHECK DEMANDS WITH SELF WEIGHT

$SW = (35pcf)(91.13IN^2)/144IN^2 \quad = 22.15 PLF$

$M = (22.15plf)(20FT)^2/8 \quad = 1.11 FT KIPS$

$V = (22.15plf)(20FT)/2 \quad = 0.22 KIPS$

$$EI = \frac{5(22.15plf)/12IN\,[(20FT)(12IN)]^3(240)}{384} \quad = 79.79 \text{ lb IN}^2$$

DEMANDS + SELF WEIGHT

$M_T = 37 KIPFT + 1.11 KIPFT \quad = 38.1 KIPFT \le 45.74 KIPFT \checkmark$

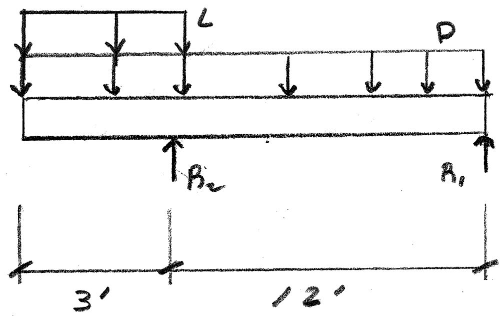
$V_T = 7.40 KIPS + 0.22 KIPS \quad = 7.62 KIPS \le 18.5 KIPS \checkmark$

$EI_T = 2491 \times 10^6 + 79.74 \times 10^6 \quad = 2570 \times 10^6 lb IN^2 \le 2664 \times 10^6 lb IN^2 \checkmark$

$\boxed{\therefore \text{ USE } 6\,3/4'' \times 13\,1/2'' \text{ GLULAM } 24\text{-}V4 \text{ DF/DF RIDGE BEAM}}$

✓

TYPICAL CEILING JOIST



$D: 14\,psf\left(\frac{16\,in}{12}\right) = 19\,plf$

$L: 20\,psf\left(\frac{16\,in}{12}\right) = 27\,plf$

ASCE 7-10
2.4-1

LOAD COMBINATIONS:

② $D+L = 19\,plf + 27\,plf \qquad = 46\,plf$

DEMANDS:

$M\,(\text{BETWEEN SUPPORTS}) = \frac{\omega x}{2\ell}(\ell^2 - a^2 - x\ell)$

$= \frac{(19\,plf)(6\,ft)}{2\,(12\,ft)}\left[(12\,ft)^2 - (3\,ft)^2 - (6\,ft)(12\,ft)\right] = 300\,lb\,ft$

$M\,(\text{CATILEVER}) = \frac{\omega}{2}(a - x_1)^2 = \frac{(46\,plf)}{2}(3\,ft - 1.5\,ft)^2 \qquad = 51\,lb\,ft$

$V\,(\text{AT SUPPORTS}) = \Sigma m_{R_1} = 0 = (46\,plf)(15\,ft)(7.5\,ft) - R_2(12\,ft) = 425\,lbs$

$\Sigma F_y = 0 = -(46\,plf)(15\,ft) + 425\,lbs + R_1 \qquad = 255.1\,lbs$

$\Delta\,(\text{BETWEEN SUPPORTS}) = \frac{\omega x}{24EI\ell}(\ell^4 - 2\ell^2x^2 + \ell x^3 - 2a^2\ell^2 + 2a^2x^2)$

$= \frac{(19\,plf/12\,in)(72\,in)}{24EI\,(144\,in)}\left[(144\,in)^4 - 2(144\,in)^2(72\,in)^2 + (144\,in)(72\,in)^3 - 2(36\,in)^2(144\,in)^2 + 2(36\,in)^2(72\,in)^2\right]$

$= \frac{7.5\times10^6}{EI} = \frac{\ell}{240}$

$\Rightarrow EI = \frac{(7.5\times10^6)(240)}{(144\,in)} \qquad = 12.56\,lb\,in^2$

$I_{REQ} = \frac{12.56\times10^6\,lb\,in^2}{1.60\times10^6\,psi} \qquad = 7.85\,in^4$

TRY 2×6 DF-L #2 $\quad I_{xx} = 20.80\,in^4$
$S_{xx} = 7.56\,in^3$
$A = 8.25\,in^2$

✓

CAPACITY:

$F_b' = (900\,psi)(1.25)(1.3)(1.15)$ $= 1681.88\,psi$

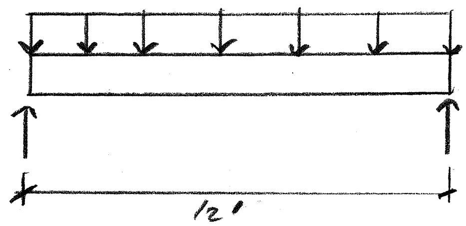
$m_{max} = (1681.88\,psi)(7.56\,in^3)$ $= 1060\,ft\,lbs$
$\geq 300\,ft\,lbs$ ✓

$V_{allow} = (225\,psi)(8.25\,in^2)/1.5$ $= 1238\,lbs$
$\geq 425\,lbs$

∴ USE 2x6 DF-L #2 @ 16"O.C.
FOR CANTILEVERED CEILING JOISTS

✓

TYPICAL FLOOR JOIST



$D: 14psf \left(\frac{16in}{12in}\right) = 19plf$

$L: 20psf \left(\frac{16in}{12}\right) = 27plf$

LOAD COMBINATIONS

① $D + L = 14 plf + 27 plf = 46 plf$

DEMANDS

$M = \frac{(46 plf)(12 FT)^2}{8} = 828^{FT\,lbs}$

$V = \frac{(46 plf)(12 FT)}{2} = 276^{lbs}$

$EI = \frac{5(46 plf / 12 in)[(12 FT)(12 in)]^3 (240)}{384} = 1.87 \times 10^6 \; lb \cdot in^2$

$I_{REQ} = \frac{1.87 \times 10^6 \; lb\,in^2}{1.60 \times 10^6 \; PSI} = 1.17 in^4$

*TRY 2×6 DF-L #2

$I_{xx} = 20.80 in^4$
$S_{xx} = 7.56 in^3$
$A = 8.25 in^2$

$F_b' =$ SEE PREVIOUS $= 1682 psi$

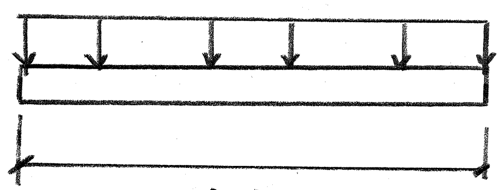
$M_{MAX} =$ SEE PREVIOUS $= 1060^{FT\,lbs} \geq 828^{FT\,lbs}$ ✓

$V_{MAX} =$ SEE PREVIOUS $= 1238 lbs \geq 276^{lbs}$ ✓

$\boxed{\text{∴ USE 2×6 DF-L \#2 @16" o.c. FLOOR JOISTS}}$

✓

FLOOR BEAM



$A_T = (15FT)(12FT) = 180\ FT^2$

$D: (14psF)(12FT) = 168\ pLF$

$L: (20psF)(12FT) = 240\ pLF$

LOAD COMBINATIONS

② $D + L = 168\ pLF + 240\ pLF \qquad = 408\ pLF$

DEMANDS:

$M = (408\ pLF)(12FT)^2/8 \qquad = 7.3^{KIP\ FT}$

$V = (408\ pLF)(12FT)/2 \qquad = 2.5\ KIPS$

$$EI = \frac{5(408\ pLF/12)[(12FT)(12FT)]^3(240)}{384} \qquad = 620 \times 10^6\ lb\ in^2$$

$$I_{REQ} = \frac{620 \times 10^6\ lb\ in^2}{1.6 \times 10^6\ psi} \qquad = 387^{in^4}$$

CAPACITY:

* TRY 4×12 DF-L #2 $\quad I_{xx} = 415.3^{in^4}$
$S_x = 73.15\ in^3$
$A = 39.38\ in^2$

$F_b' = (900psi)(1.25)(1.1)(1.15) \qquad = 1423\ psi$

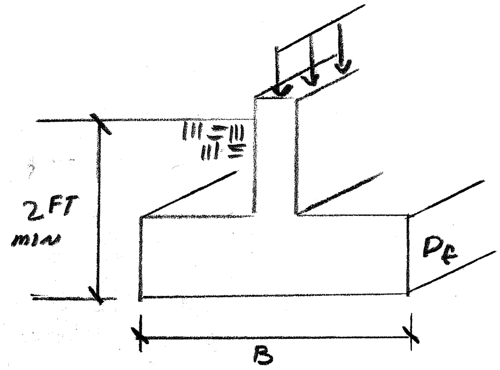
$M = (1423psi)(73.15\ in^3) \qquad = 8.68^{KIP\ FT} \geq 7.3^{KIP\ FT}$ ✓

$F_v' = (1.80)(1.25) \qquad = 225\ psi$

$V = (225psi)(39.38\ in^2)/1.5 \qquad = 5.9\ KIPS \geq 2.5\ KIPS$ ✓

$\therefore$ USE 4×12 DF-L #2 FLOOR BEAMS

CONTINUOUS WALL FOOTING



D_R: 23.1 psf (6 FT) = 139 plf

L_R: 20 psf (6 FT) = 120 plf

D_F = 23.1 psf (6 FT) = 139 plf

L_F = 20 psf (6 FT) = 120 plf

DEMANDS:

w = 139 plf + 120 plf = 259 plf

IBC 2015
T. 1806.2

ASSUMPTIONS: SEDIMENTARY + FOLIATED ROCK

VERTICAL FOUNDATION PRESSURE = 1500 psf

LATERAL BEARING PRESSURE = 100 psf / FT BELOW GRADE

COEFFICIENT OF FRICTION = 0.25

EFFECTIVE UNIT WEIGHT, γ = 156 pcf (WORST CASE)

SIZE SELECTION:

$$b = \frac{(139\text{ plf} + 120\text{ plf})\,2}{1500\text{ psf}} = 0.35\text{ FT}$$

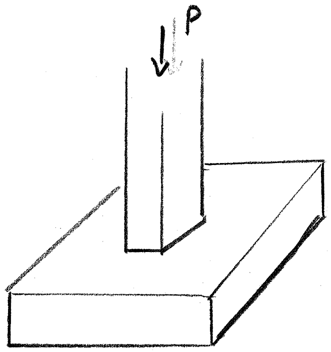
$\boxed{\text{USE 1 FT WIDE, 2 FT DEEP FOOTING}}$

REBAR

$$A_{s\,min} = 0.0018(12\text{ IN})(24\text{ IN}) = 0.518\text{ IN}^2$$

$\boxed{\text{USE (2) \#5 BARS} \quad A_s = 0.62\text{ IN}^2}$

PAD FOOTING



$A_T = (12FT)(12FT) = 144FT^2$

$P = (35psf + 32psf)144FT^2 = 9.65KIPS$

SIZE SELECTION

$A = \frac{P}{f_b} = \frac{9.65KIPS}{1.5KSF} = 6.43FT^2$

$\boxed{\therefore \text{ USE } 2.5FT \times 2.5FT \times 2FT \text{ PAD FOOTING}}$

REBAR:

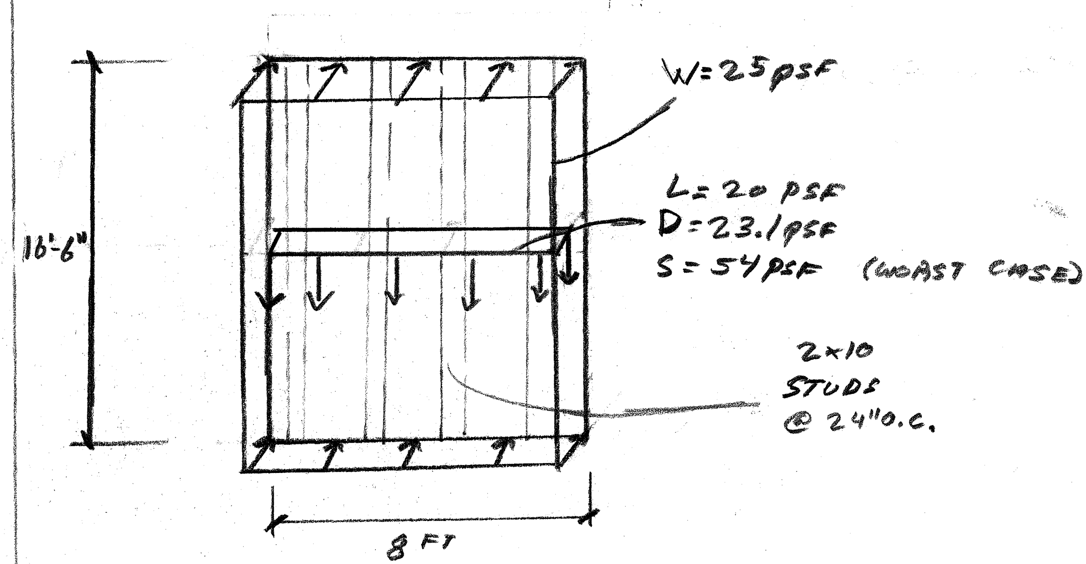
$A_{S\,min} = 0.0018(720 IN^2) = 1.30 IN^2$

$\boxed{\therefore \text{ USE (2) \#8 BARS E.W. } A_S = 1.6 IN^2}$

CHECK IBC 2015 1809.4 + T. 1809.7
MINIMUM REQUIREMENTS

D = 12" min ≤ 2 FT ✓
B = 12" min ≤ 2'-6" ✓
T = 6" min ≤ 12" ✓

EXTERIOR STUD WALL - OUT OF PLANE LOADING



LOAD COMBINATIONS

(6a) $D + 0.75L + 0.75S$

$= (2FT)(5FT)[(23.1psf) + (0.75)(20psf) + 0.75(54psf)] = 786$ lbs

$0.75(0.6)W = 0.75(0.6)(25psf)(2FT) = 22.5$ plf

DEMANDS:

$M = (22.5plf)(16.5FT)^2/8 = 783$ lb FT

$V = (22.5plf)(16.5FT)^2/2 = 186$ lbs

P = SEE LOAD COMBO ABOVE = 786 lbs

CAPACITY:

* TRY 2x10 DF-L #2 @ 24in o.c.

$F_c = \frac{P}{A} = (786 lbs)/(13.875 in^2) = 56.65$ psi

$F_{CE} = \frac{0.822 E'_{min}}{(\ell/d)^2} = \frac{0.822(0.58 \times 10^6 psi)}{(198in/9.25in)^2} = 1041$ psi

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

$F_{cE}/F_c^* = \dfrac{1041\,psi}{2376\,psi}$ $= 0.438$

$C_p = \dfrac{1+(0.438)}{1.6} - \sqrt{\left[\dfrac{1+(0.438)}{1.6}\right]^2 - \dfrac{(0.438)}{0.8}}$ $= 0.389$

$F_c' = (2376\,psi)(0.389)$ $= 923\,psi$

$F_c/F_c' = \dfrac{56.65\,psi}{923\,psi}$ $= 0.061$ ≤ 1.0 ✓

$F_b = \dfrac{783\,lb\,ft\,(12\,in)}{21.56\,in^3}$ $= 436\,psi$

$F_b' = (900\,psi)(1.6)(1.3)(1.0)(1.15)$ $= 2152.8\,psi$

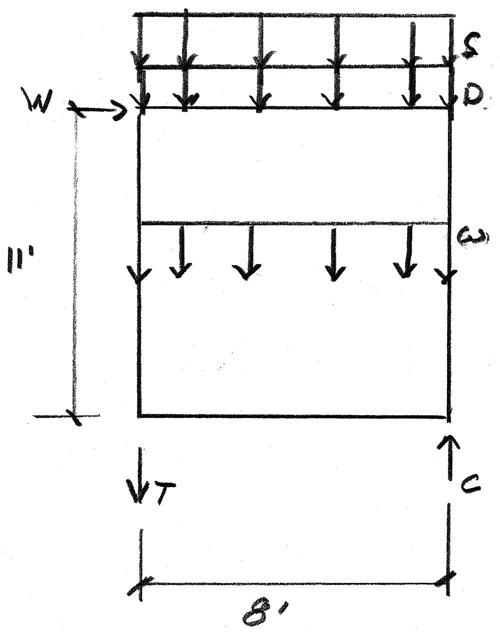
$F_b/F_b' = \dfrac{436\,psi}{2152.8\,psi}$ $= 0.20$ $\ngtr 1.0$ ✓

COMBINED LOADING:

$$\left(\frac{F_c}{F_c'}\right)^2 + \frac{F_b}{F_b'\left(1-\frac{F_c}{F_{cE}}\right)} = (0.061)^2 + \frac{(436\,psi)}{2153\,psi\left(1-\frac{56.65}{1041}\right)} = 0.22 \leq 1.0 \checkmark$$

$$\boxed{\text{2x10 DF-L \#2 @ 16" o.c. ARE ADEQUATE}}$$

TYPICAL SHEAR WALL DESIGN



NOTE: N-S WALLS ARE WORST CASE

$\omega = 23.1\,psf\,(11\,FT) = 254.1\,plf$

$W = 25\,psf\,(11\,FT)(\frac{41\,FT}{2}) = 5.6\,kips$

$D = 20\,psf\,(41FT/2) = 410\,plf$

$S = 60\,psf\,(41FT/2) = 1230\,plf$

$L = 20\,psf\,(41FT/2) = 410\,plf$

LOAD COMBINATIONS

(6a) $D + 0.75L + 0.75(0.6W) + 0.75S$

$\therefore\ \omega = 254.1\,plf + 410\,plf + 0.75(410\,plf) + 0.75(1230\,plf) = 1.90\,klf$ GRAVITY

$\therefore\ W = 0.75(0.6)(5.6\,kips) = 2.52\,kips$ LATERAL

→ FOR HOLD DOWNS

$+\circlearrowleft \Sigma m_T = 0 = -(2.52\,kips)(11\,FT) - (1.90\,klf)(8\,FT)(8\,FT)/2 + C\,(8\,FT)$

$C = 88.52\,k\,FT / 8\,FT = 11.1\,kips$ (comp)

$+\uparrow \Sigma F_y = 0 = (1.90\,klf)(8\,FT) - T + 11.1\,kips = 4.1\,kips$ (TENSION)

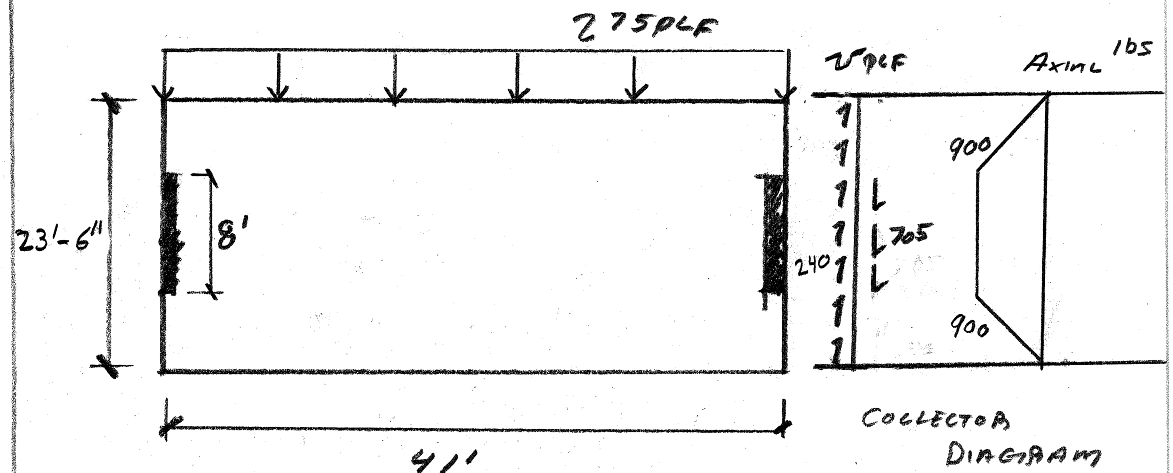
∴ USE SIMPSON HHDQ11-SDS2.5 T = 11.8 kips

→ FOR SHEAR PANEL

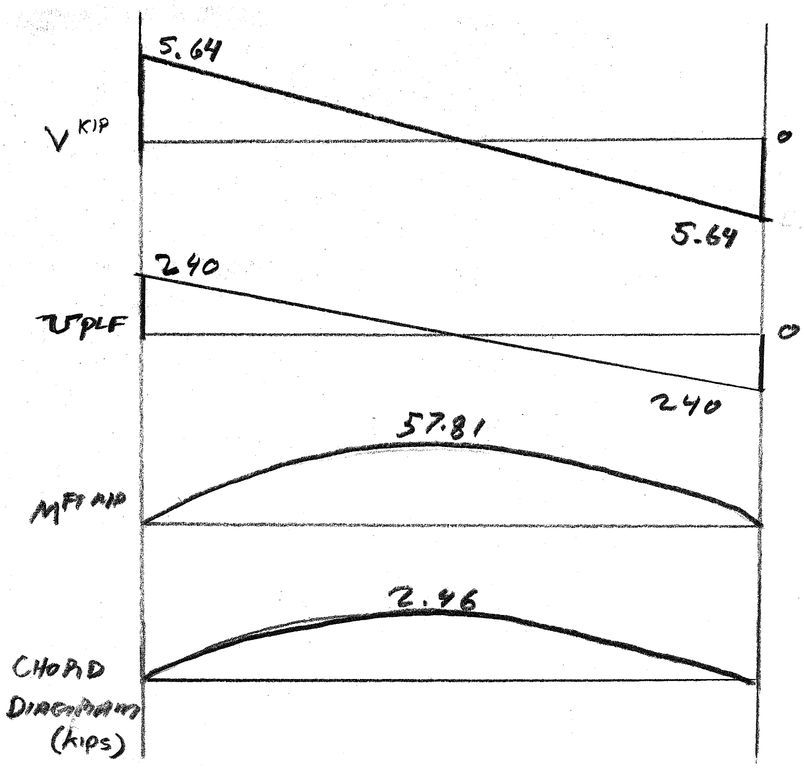
$2v = 2W / l_{eff} = 2(2.52\,kips)/7.1\,FT = 710\,plf$

∴ USE 15/32 STRUCTURAL 1 W/ 10d @ 6" O.C. (C = 950 plf)

N-S ROOF DIAPHRAGM



DEMANDS:



→ FOR DIAPHRAGM SHEATHING

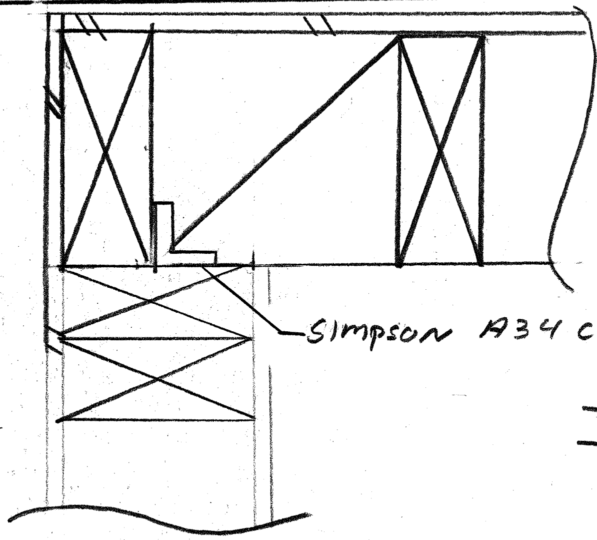
CASE 1 + CASE 2

$v = 705$ PLF

USE 10d @ 6/6/12 W 1/2" SHEATHING C = 910 PLF

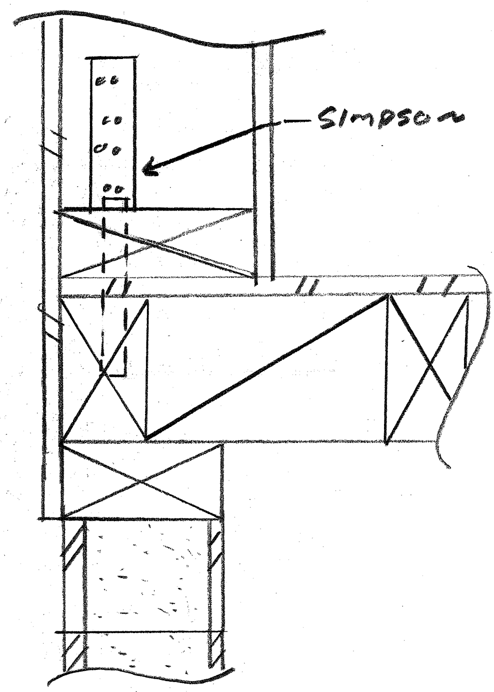
CONNECTION DESIGN

SHEAR FLOW FOR TYPICAL SHEAR WALL (N-S)



SIMPSON A34 CLIP

→ DEMAND = 355 PLF
→ CAPACITY = 695 PLF
→ SPACING = 695/355 = 1.95
USE 2 FT SPACING



SIMPSON HHDQ11 - SDS2.5

ANCHOR BOLT DESIGN FOR TYPICAL WALL

$v = w / l_{EFF} = 2.52\text{ KIPS} / 7.1\text{ FT}$ $= 355\text{ PLF}$

* TRY 1/2" Ø ANCHOR BOLTS

$Z\perp' = 650\text{ lbs}\,(1.6)$ $= 1040\text{ lbs}$

SPACING: $C/_{v} = 1040\text{ lbs} / 355\text{ PLF}$ $= 2.93\text{ FT} \leq 4\text{ FT}$ ✓

$\boxed{\text{USE } 1/2\text{" Ø ANCHOR BOLTS @ 3 FT O.C.}}$

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.

STEEL

20. STRUCTURAL STEEL DESIGN, FABRICATION, AND ERECTION SHALL BE BASED ON THE LATEST EDITIONS OF THE A.I.S.C. SPECIFICATIONS AND CODES:

21. ALL A-325 CONNECTION BOLTS SHALL BE INSTALLED TO THE SNUG-TIGHT CONDITION PER A.I.S.C. SPECIFICATIONS. IN STRICT ACCORDANCE WITH THE MANUFACTURER'S PUBLISHED RECOMMENDATIONS.

WOOD

22. 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. 2 MINIMUM BASE VALUE, F_b = 900 PSI
BEAM AND STRINGERS: (INCLUDING 6 X AND LARGER MEMBERS)	DOUGLAS FIR NO. 2 MINIMUM BASIC DESIGN STRESS, F_b = 900 PSI
POSTS AND TIMBERS:	DOUGLAS FIR NO. 2 MINIMUM BASIC DESIGN STRESS, F_C = 1,350 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

23. 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.

24. 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.

25. 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.

26. 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).

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)	100 PSF

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 SAN LUIS OBISPO 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.

GENERAL STRUCTURAL NOTES

(The following apply unless shown 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 INTERNATIONAL BUILDING CODE.

2. DESIGN LOADING CRITERIA

DEAD LOADS	
ROOF	51 PSF
FLOOR	52 PSF
LIVE LOADS	
ROOF LIVE LOAD	20 PSF
FLOOR LIVE LOAD (RESIDENTIAL)	20 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=5 (SPECIAL REINFORCED MASONRY WALL) Vb (N-S)=15.65K, Vb (E-W)=15.65K Cs (N-S)=0.09138, Cs (E-W)=0.09138

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 COMPENENTS 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),
PREFABRICATED WALL ASSEMBLIES
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.

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- PASSIVE HOME DESIGNER

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- ADMINISTRATION

SERGIO VERGARA

- CONSTRUCTABILITY
- COST ESTIMATOR

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WEED HOUSING DEVELOPMENT

GENERAL NOTES

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27. 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.

28. 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 4'-0" AT JOINTS AND PROVIDE SIX 16d NAILS AT 4" O.C. 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.

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- CONSTRUCTABILITY
- COST ESTIMATOR

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WEED HOUSING DEVELOPMENT

GENERAL NOTES

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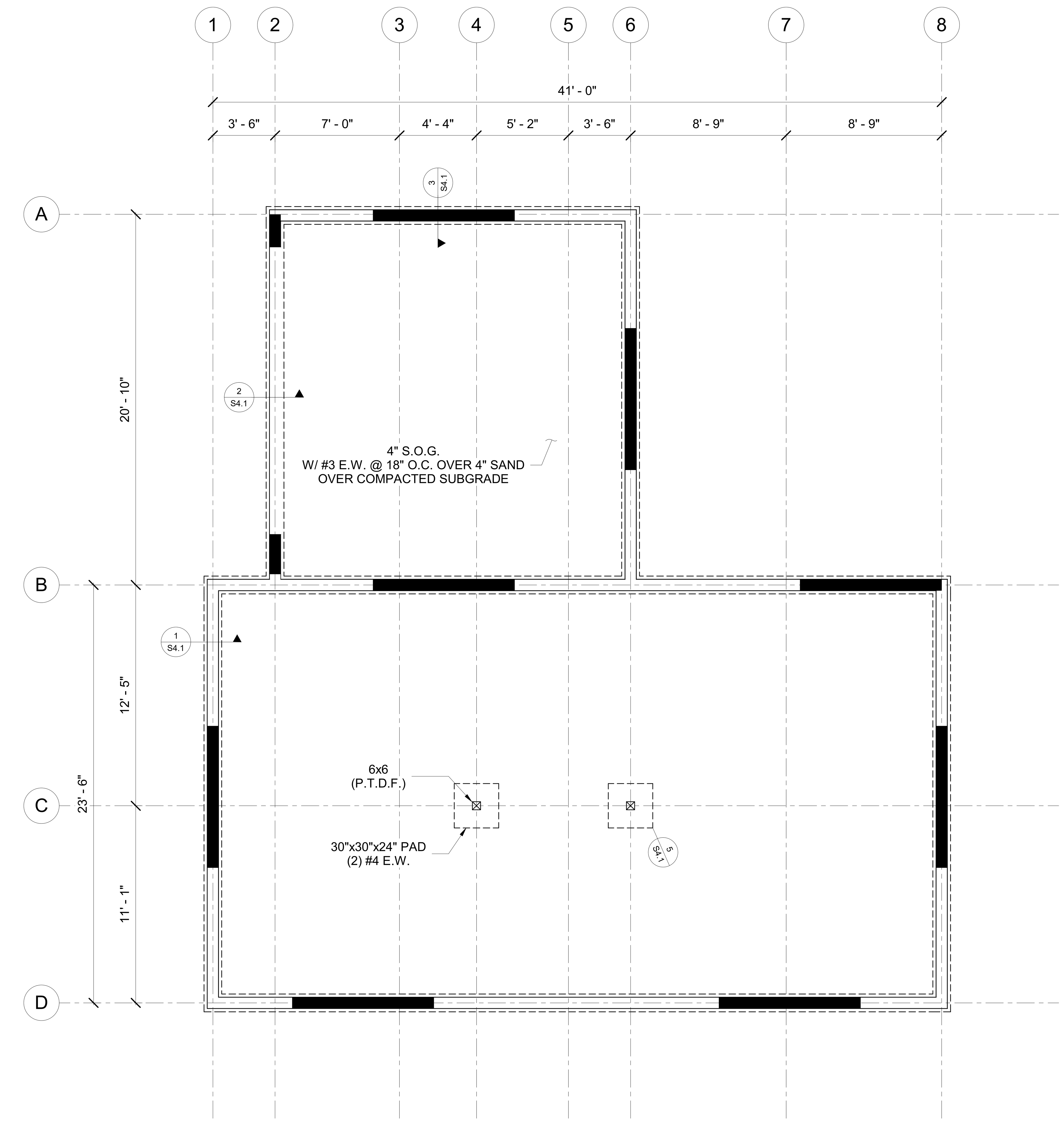
Scale	



1 FOUNDATION PLAN
1/4" = 1'-0"

FOUNDATION NOTES

1. IT IS THE CONTRACTORS RESPONSIBILITY TO VERIFY ALL DIMENSIONS WITH THE ARCHITECTURAL FLOOR PLAN AND NOTIFY THE ARCHITECT AND ENGINEER OF ANY DISCREPANCIES PRIOR TO STARTING WORK.
2. THE GENERAL CONDITIONS, SPECIFICATIONS, GENERAL NOTES ON SHEET S1.0, GENERAL STRUCTRAL DETAILS AND THE FOLLOWING APPLY TO THE WORK OF THE FOUNDATION.
3. SUB-GRADE PREPARATIONS WILL CONFORM TO THE REQUIREMENTS OF THE SOILS REPORT AND WILL BE PREFORMED UNDER THE SUPERVISION OF THE SOILS ENGINEER.
4. FOOTINGS ARE TO BE EXAMINED AND CERTIFIED IN WRITING BY THE PROJECT SOILS ENGINEER PRIOR TO PLACEMENT OF CONCRETE.
5. ALL SLAB REINFORCEMENT SHOULD BE SUPPORTED ON CHAIRS TO PROVIDE PLACEMENT AT MID DEPTH OF SLAB.
6. FOUNDATION SYSTEM WILL BE BASED UPON THE REQUIREMENTS OF THE SOILS REPORT. THE ENGINEER OF RECORD MUST BE NOTIFIED OF ANY DISCREPANCIES OR UPDATES OF THE SOIL INFORMATION.
7. AN APPROVED WATER AND VAPOR PROOF BARRIER MUST BE INSTALLED UNDER THE CONCRETE FOUNDATION SYSTEM SO THAT WATER AND VAPOR CANNOT ENTER INTO THE STRUCTURE. REFER TO THE ARCHITECTS OR OWNERS DOCUMENT AND GEOTECHNICAL ENGINEERS RECOMMENDATION FOR DETAILED REQUIREMENTS.

LEGEND

00 Z.00	DETAIL CALL OUT
	SHEAR WALL
	HIDDEN LINE
	GRID LINE
P.T.D.F.	PRESSURE TREATED DOUGLAS FIR
TYP.	TYPICAL MEMBER
E.W.	EACH WAY
S.O.G.	SLAB ON GRADE
O.C	ON CENTER

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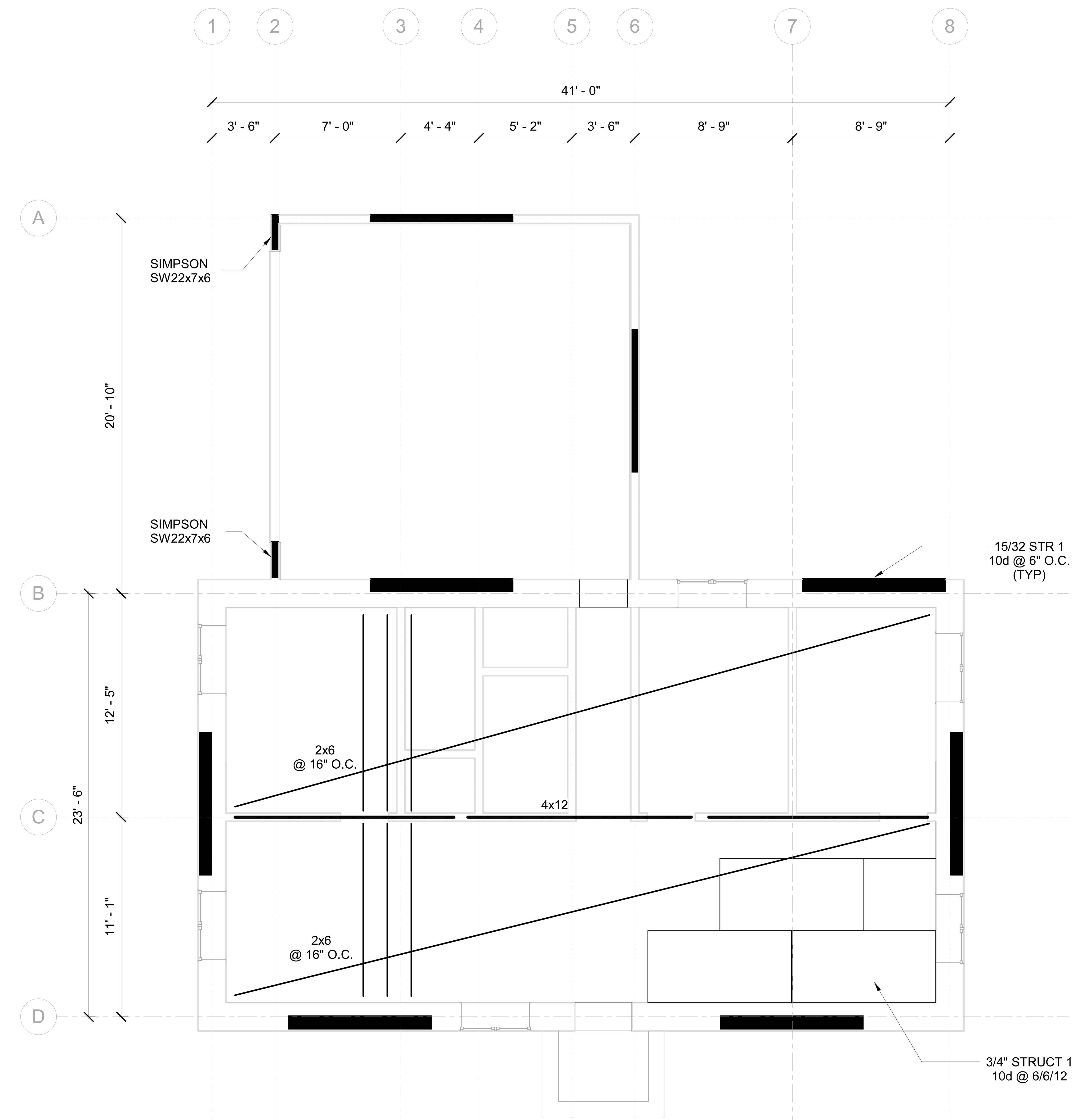
FOUNDATION PLAN

Project Number	
Date	NOV. 17.2017
Drawn By	TRENT PICHEL
Checked By	DENNIS BASHAW
	S2.0
Scale	1/4" = 1'-0"



1 FLOOR FRAMING PLAN
1/4" = 1'-0"

FLOOR FRAMING NOTES

1. THE GENERAL CONDITIONS, SPECIFICATIONS, GENERAL NOTES ON SHEET S1.0, GENERAL STRUCTRAL DTAILS AND THE FOLLOWING APPLY TO THE WORK OF THE FLOOR FRAMING NOTES.
2. THE CONTRACTOR WILL CHECK FLOOR FRAMING DIMENSIONS AGAINST THE ARCHITECTURAL PLAN AND NOTIFIY THE ARCHITECT AND ENGINEER OF RECORD OF ANY OMISSIONS AND DISCREPENCIES BEFORE STARTING WORK.
3. ALL WALLS AT THE FLOOR FRAMING LEVEL ARE TO BE 2X6 STUDS @ 16" O.C. AND 2X10 STUDS @ 24" O.C. FOR INSIDE AND OUTSIDE WALLS, RESPECTFULLY.
4. SEE ARCHITECTURAL PLANS FOR LOCATIONS OF PLUMBING WALLS.
5. BEARING HEADERS SPANNING 6'-0" OR MORE SHALL HAVE AT LEAST (2) 2X TRIMMER CONTINUOUS TO THE SILL PLATE, UNLESS NOTED OTHERWISE.
6. ALL SHEAR CONNECTORS AND BLOCKING MUST BE INSTALLED PRIOR TO THE INSTALLATION OF FLOOR SHEATHING.
7. USE SIMSPON HANGERS FOR FLOOR JOIST TO FLUSH BEAM CONNECTIONS, UNLESS OTHERWISE NOTED.
8. CARRY ALL MULTIPLE STUDS OR POSTS FROM SECOND FLOOR DOWN TO FIRST FLOOR OR BEAM BELOW. PROVIDE 4X SOLID BLOCKING @ FLOOR LEVEL.
9. SHEAR PANELS MAY BE INSTALL ON EITHER SIDE OF THE WALL.

LEGEND

00 Z.00	DETAIL CALL OUT
	SHEAR WALL
	HIDDEN LINE
	GRID LINE
P.T.D.F.	PRESSURE TREATED DOUGLAS FIR
TYP.	TYPICAL MEMBER
E.W.	EACH WAY
S.O.G.	SLAB ON GRADE
O.C	ON CENTER

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FLOOR FRAMING PLAN

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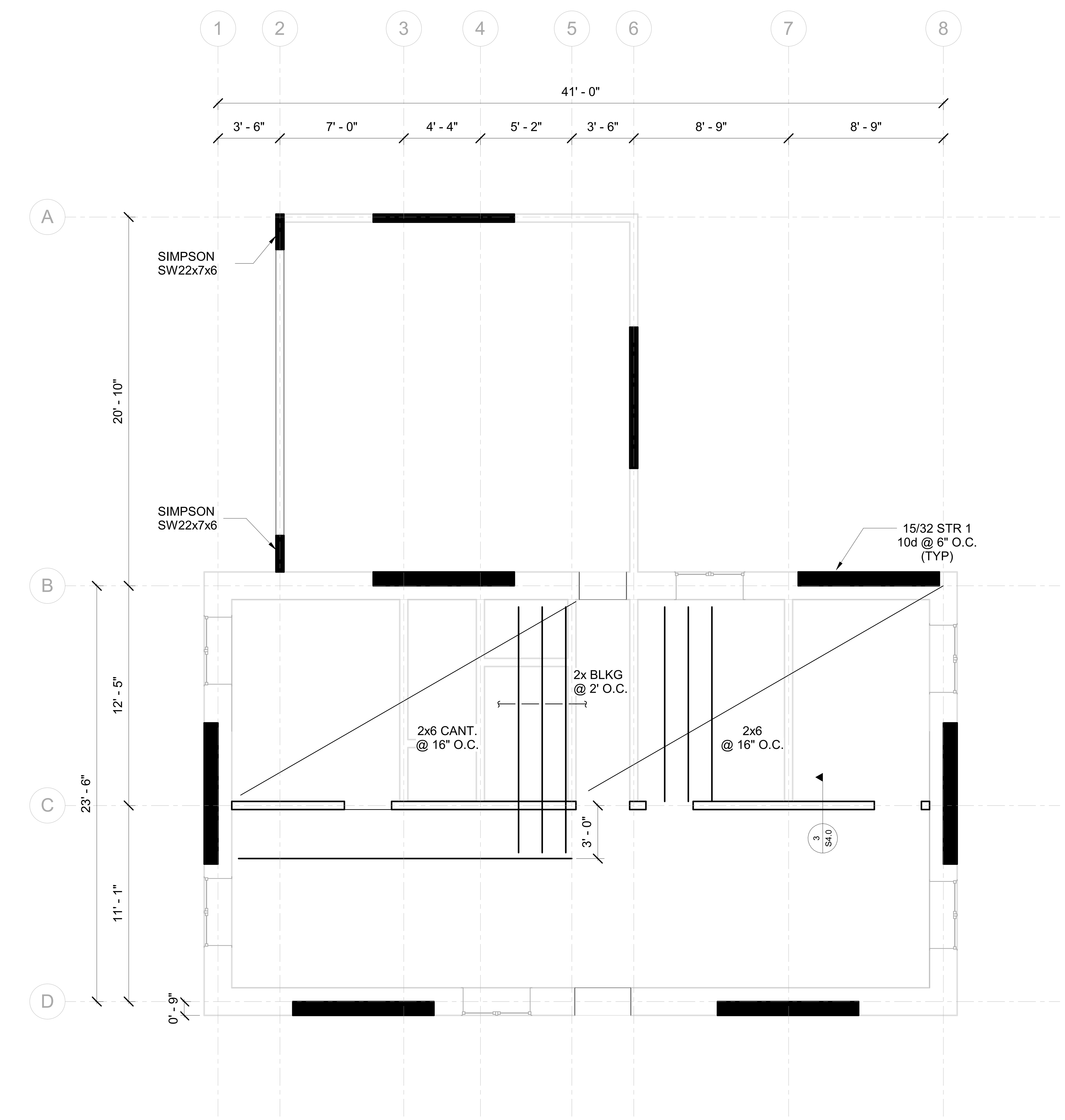
	S2.1
Scale	As indicated



1 CEILING FRAMING PLAN
1/4" = 1'-0"

CEILING FRAMING NOTES

1. THE GENERAL CONDITIONS, SPECIFICATIONS, GENERAL NOTES ON SHEET S1.0, GENERAL STRUCTRAL DTAILS AND THE FOLLOWING APPLY TO THE WORK OF THE FLOOR FRAMING NOTES.
2. THE CONTRACTOR WILL CHECK FLOOR FRAMING DIMENSIONS AGAINST THE ARCHITECTURAL PLAN AND NOTIFIY THE ARCHITECT AND ENGINEER OF RECORD OF ANY OMISSIONS AND DISCREPENCIES BEFORE STARTING WORK.
3. ALL WALLS AT THE FLOOR FRAMING LEVEL ARE TO BE 2X6 STUDS @ 16" O.C. AND 2X10 STUDS @ 24" O.C. FOR INSIDE AND OUTSIDE WALLS, RESPECTFULLY.
4. SEE ARCHITECTURAL PLANS FOR LOCATIONS OF PLUMBING WALLS.
5. BEARING HEADERS SPANNING 6'-0" OR MORE SHALL HAVE AT LEAST (2) 2X TRIMMER CONTINUOUS TO THE SILL PLATE, UNLESS NOTED OTHERWISE.
6. ALL SHEAR CONNECTORS AND BLOCKING MUST BE INSTALLED PRIOR TO THE INSTALLATION OF FLOOR SHEATHING.
7. USE SIMSPON HANGERS FOR FLOOR JOIST TO FLUSH BEAM CONNECTIONS, UNLESS OTHERWISE NOTED.
8. CARRY ALL MULTIPLE STUDS OR POSTS FROM SECOND FLOOR DOWN TO FIRST FLOOR OR BEAM BELOW. PROVIDE 4X SOLID BLOCKING @ FLOOR LEVEL.
9. SHEAR PANELS MAY BE INSTALL ON EITHER SIDE OF THE WALL.

LEGEND

00 Z.00	DETAIL CALL OUT
	SHEAR WALL
	HIDDEN LINE
	GRID LINE
P.T.D.F.	PRESSURE TREATED DOUGLAS FIR
TYP.	TYPICAL MEMBER
E.W.	EACH WAY
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O.C	ON CENTER

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CEILING FRAMING PLAN

Project Number	
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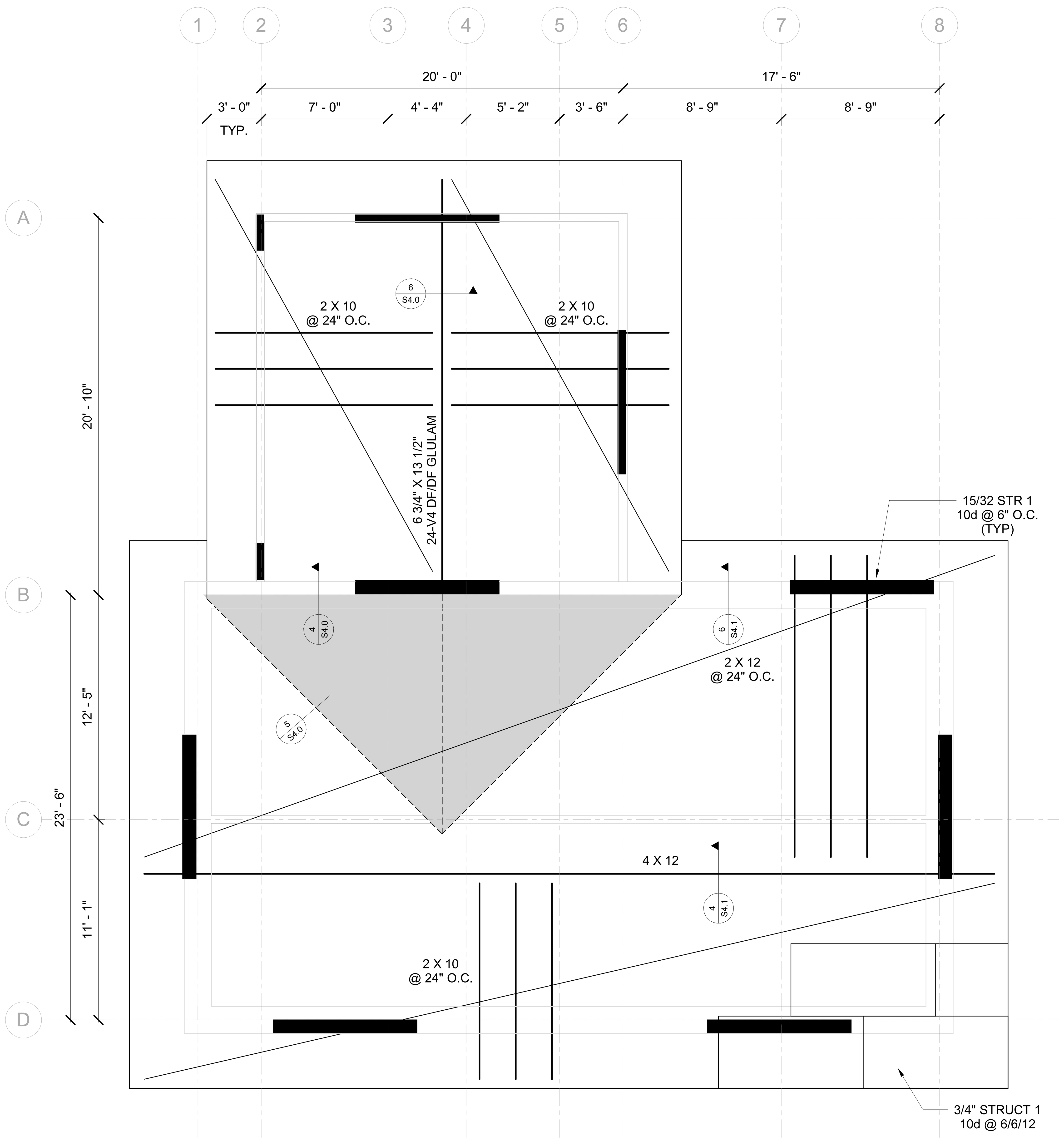

1 ROOF FRAMING PLAN
1/4" = 1'-0"

ROOF FRAMING NOTES

1. THE GENERAL CONDITIONS, SPECIFICATIONS, GENERAL NOTES ON SHEET S1.0, GENERAL STRUCTRAL DTAILS AND THE FOLLOWING APPLY TO THE WORK OF THE ROOF FRAMING NOTES.
2. THE CONTRACTOR WILL CHECK ROOF FRAMING DIMENSIONS AGAINST THE ARCHITECTURAL PLAN AND NOTIFIY THE ARCHITECT AND ENGINEER OF RECORD OF ANY OMISSIONS AND DISCREPENCIES BEFORE STARTING WORK.
3. ALL WALLS ARE TO BE 2X6 STUDS @ 16" O.C. AND 2X10 STUDS @ 24" O.C. FOR INSIDE AND OUTSIDE WALLS, RESPECTFULLY.
4. HEADERS SUPPORTING ROOF LOADS SHALL HAVE AT LEAST ONE 2X TRIMMER CONTINUOUS TO THE SILL PLATE, UNLESS OTHERWISE NOTED.
5. HEADERS SPANNING 8'-0" OR MORE SHALL HAVE AT LEAST (2) 2X TRIMMERS CONTINUOUS TO THE SILL PLATE AND (2) 2X KING STUDS, UNLESS OTHERWISE NOTED.
6. ALL SHEAR CONNECTORS AND BLOCKING MUST BE INSTALLED PRIOR TO THE INSTALLATION OF ROOF SHEATHING.
7. INTERIOR NON-BEAING WALL TOP PLATE MAY BE 1X4 OVER 2X4 MEMBERS.
8. SEE DETAIL ON SHEET S4.1 FOR CALIFORNIA FRAMING REQUIREMENTS.
9. SHEAR PANELS MAY BE INSTALLED ON EITHER SIDE OF THE WALL.

LEGEND

00 / Z.00	DETAIL CALL OUT
	SHEAR WALL
	HIDDEN LINE
	GRID LINE
P.T.D.F.	PRESSURE TREATED DOUGLAS FIR
TYP.	TYPICAL MEMBER
E.W.	EACH WAY
S.O.G.	SLAB ON GRADE
O.C	ON CENTER

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ROOF FRAMING PLAN

Project Number	
Date	NOV. 17.2017
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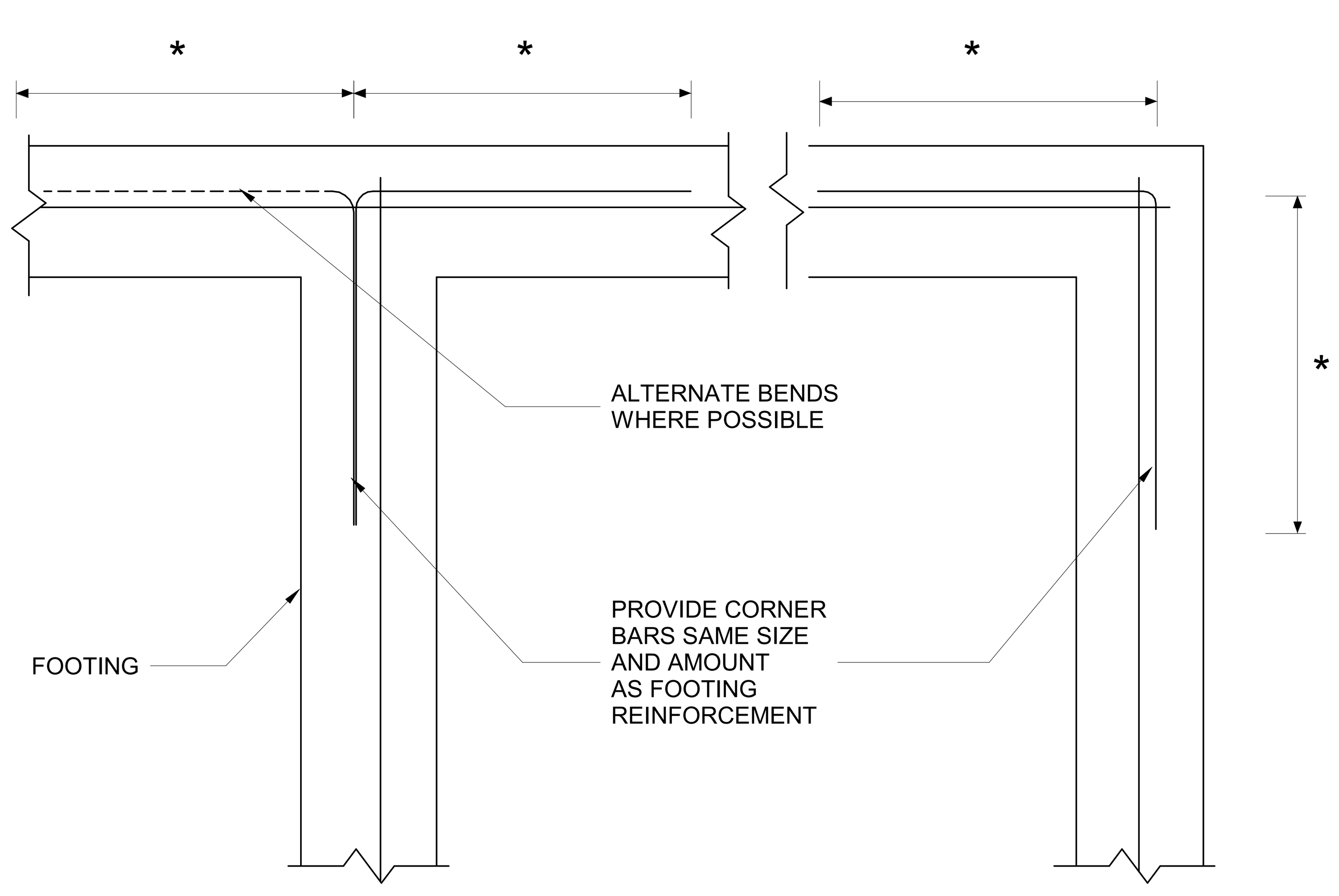
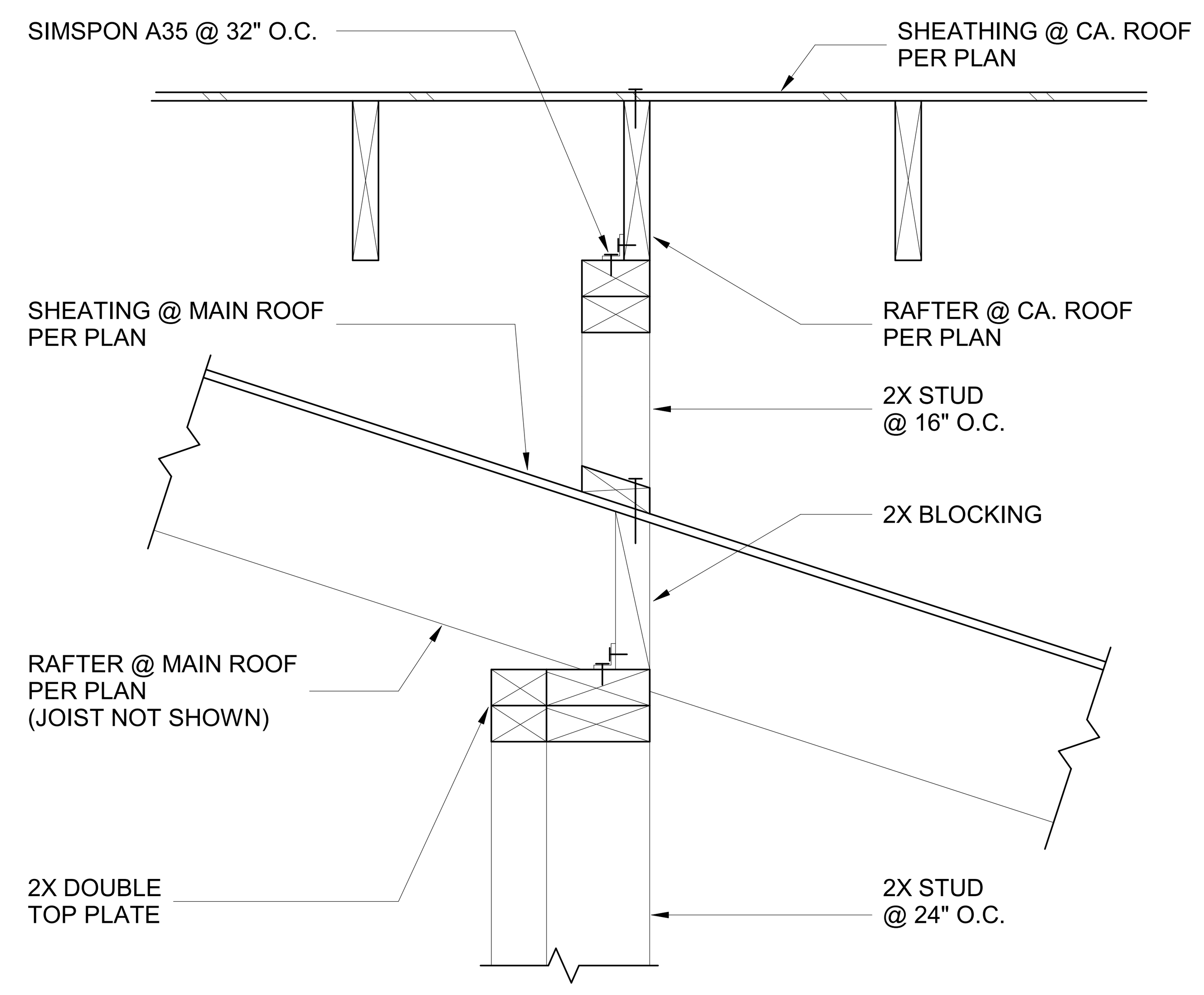
Scale	As indicated

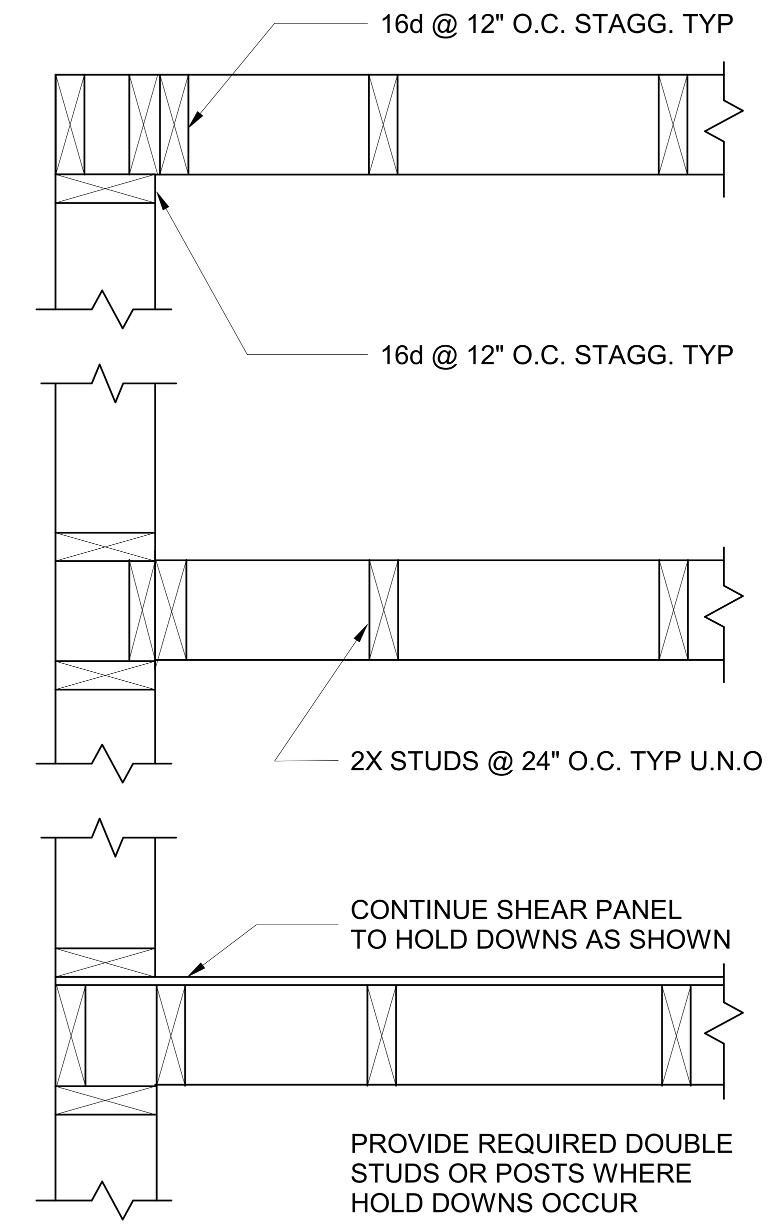


* LAP 48d U.N.O
(2' - 6" MIN.)

7 FOOTING REINFORCING AT INTERSECTION
1 1/2" = 1'-0"

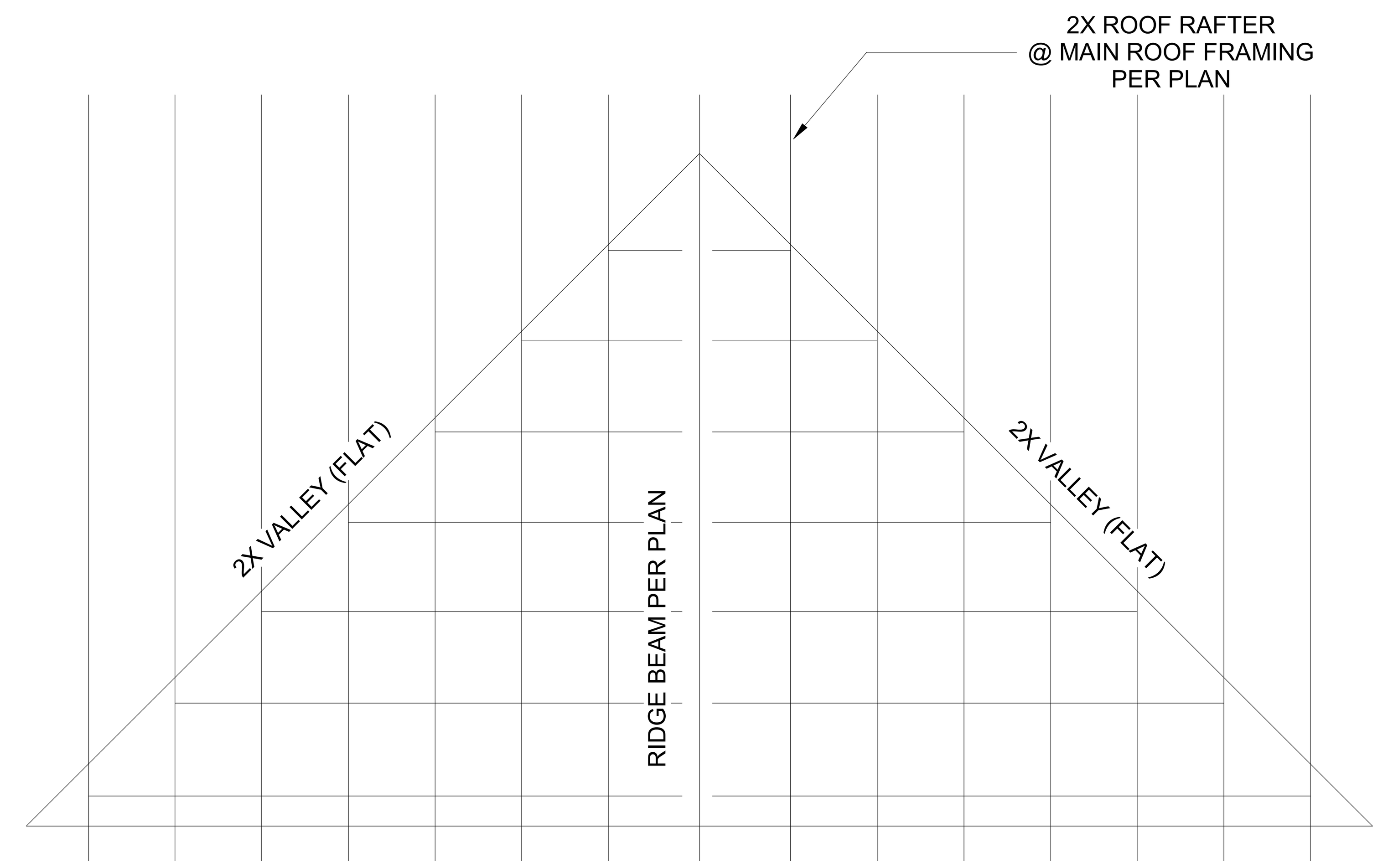


4 CALIFORNIA ROOF SECTION
1 1/2" = 1'-0"

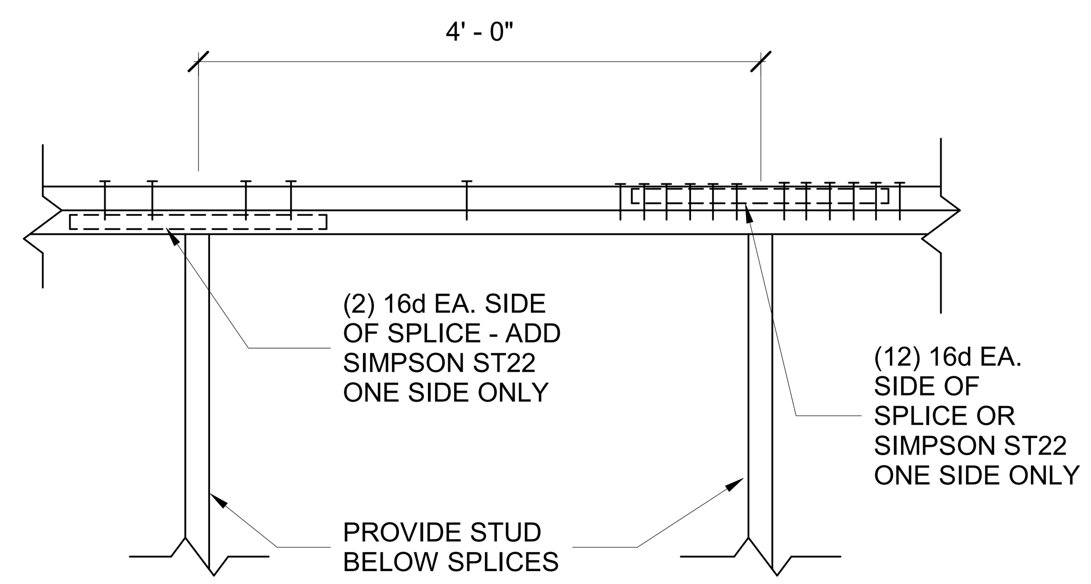


1 STUD WALL INTERSECTIONS
1 1/2" = 1'-0"

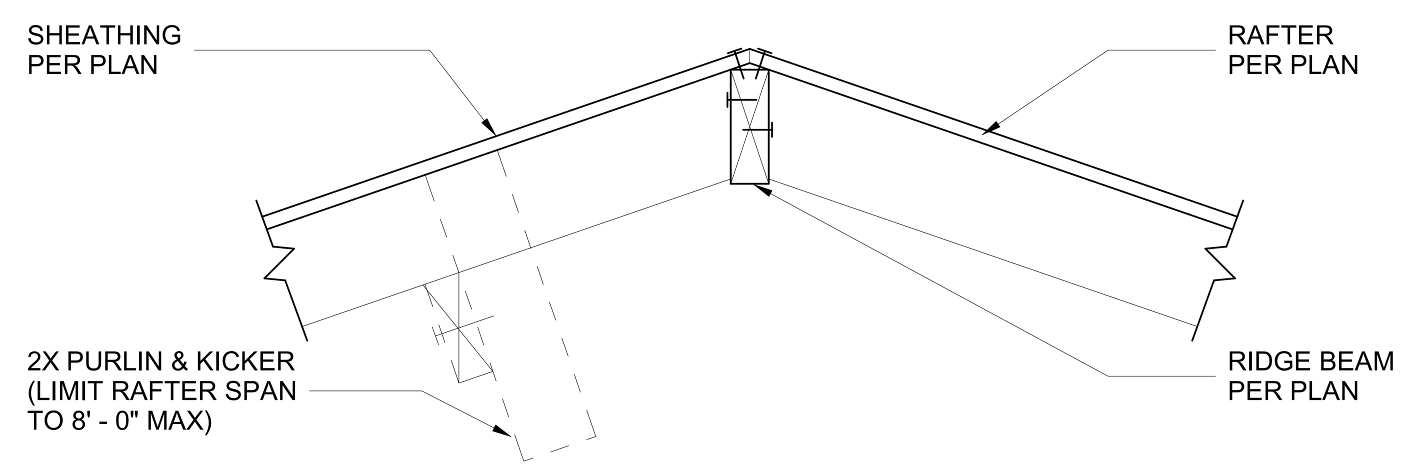
INTENTIONALLY LEFT BLANK



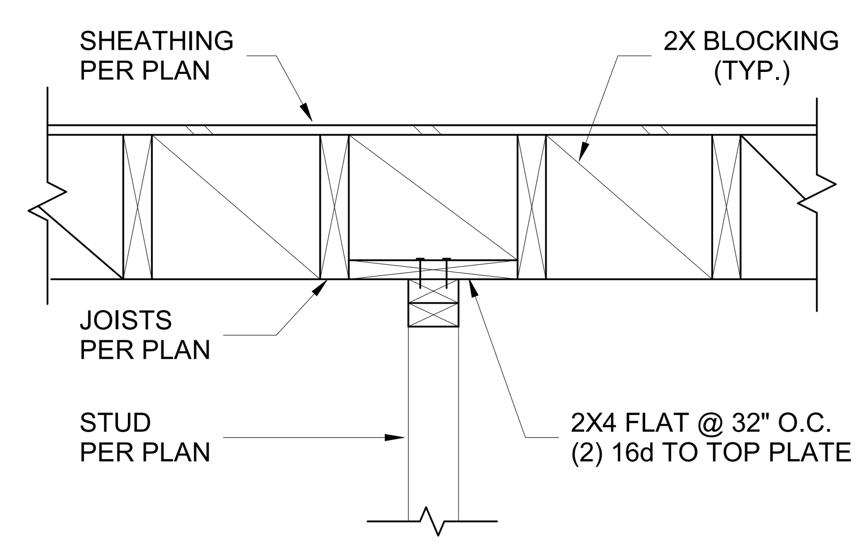
5 CALIFORNIA ROOF FRAMING
1 1/2" = 1'-0"



2 MINIMUM PLATE SPLICE
1 1/2" = 1'-0"



6 CALIFORNIA ROOF RIDGE FRAMING
1 1/2" = 1'-0"



3 NON BEARING INTERIOR WALL
1 1/2" = 1'-0"

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TYPICAL DETAILS

Project Number	
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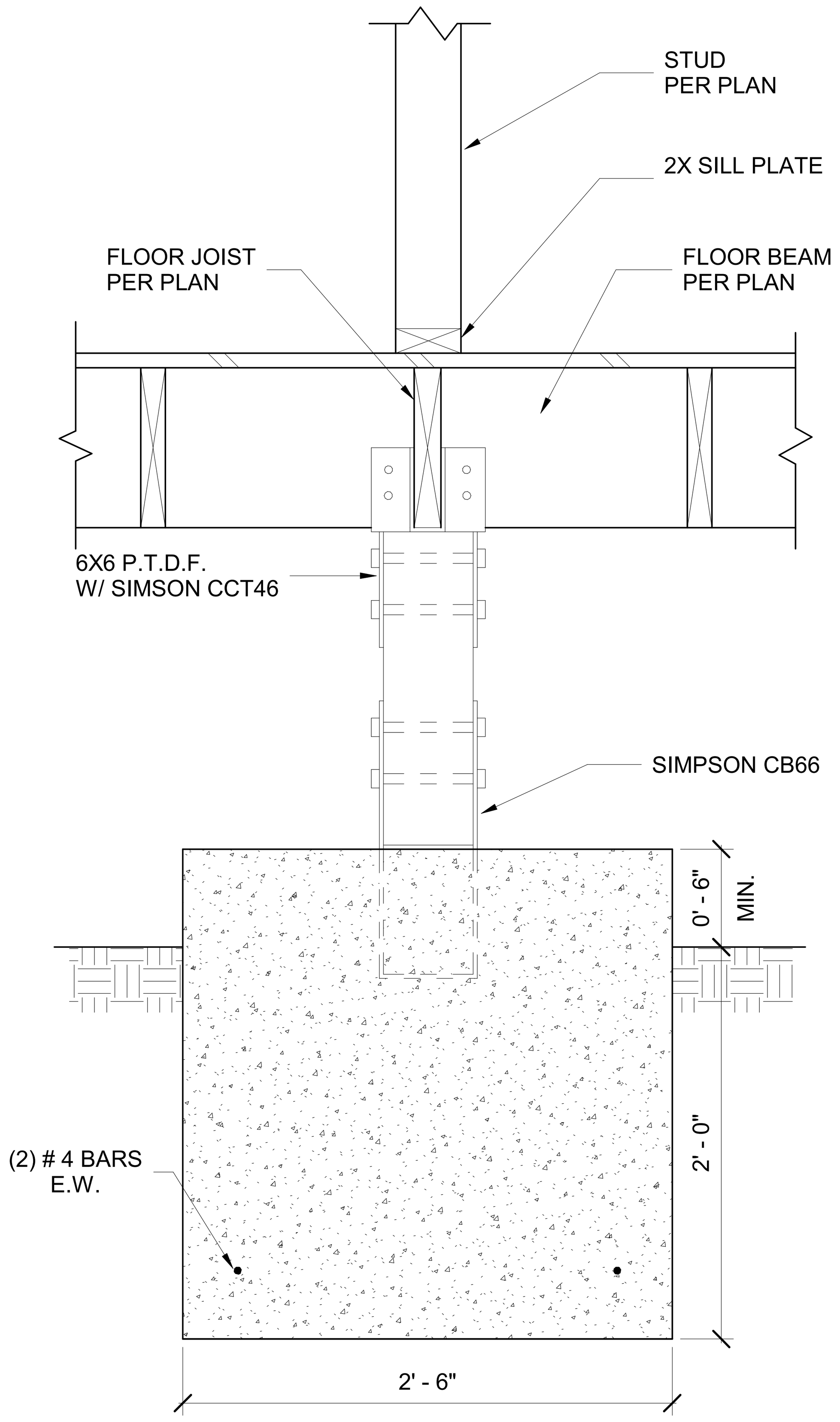
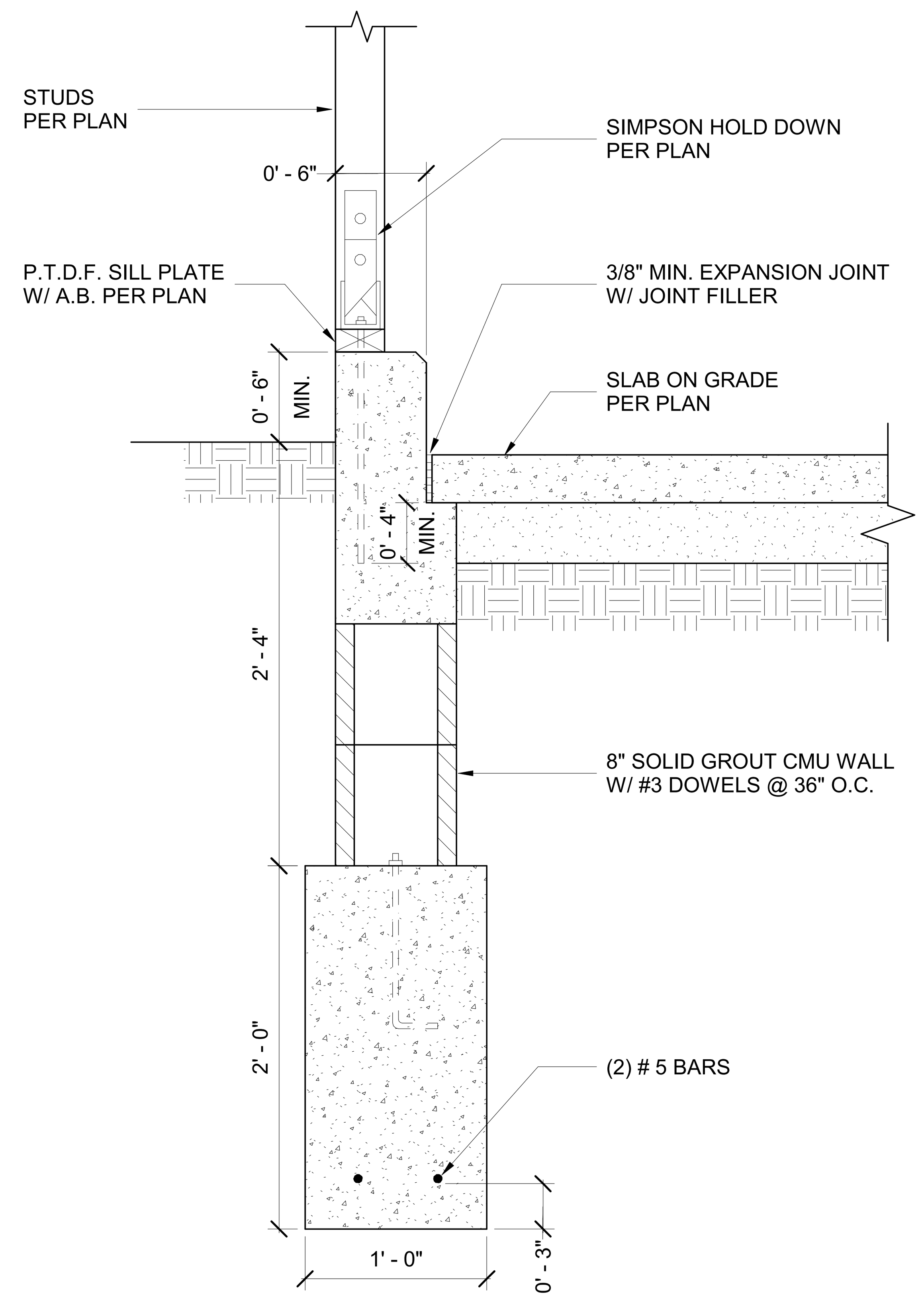
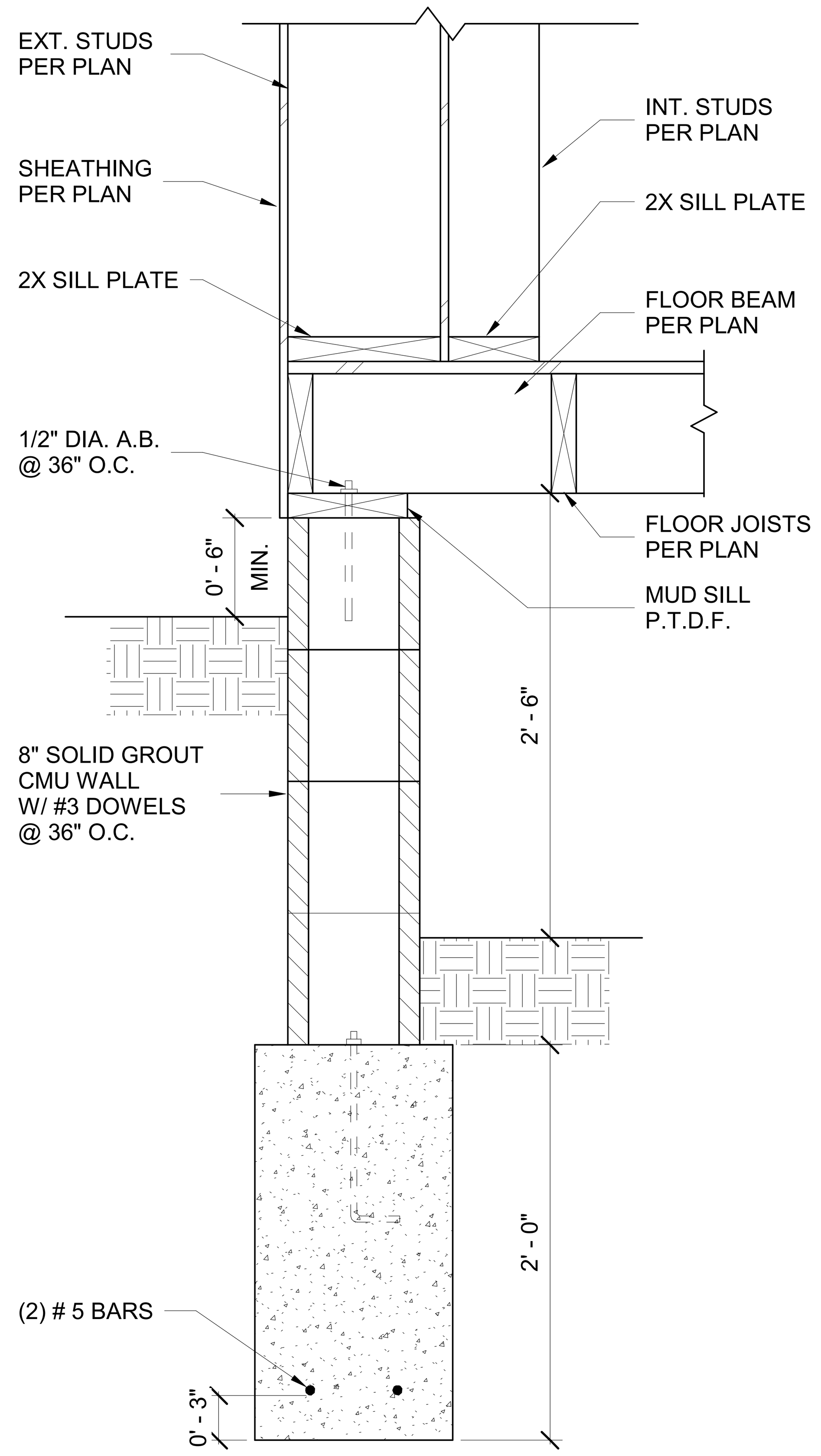
	S4.0
Scale	1 1/2" = 1'-0"



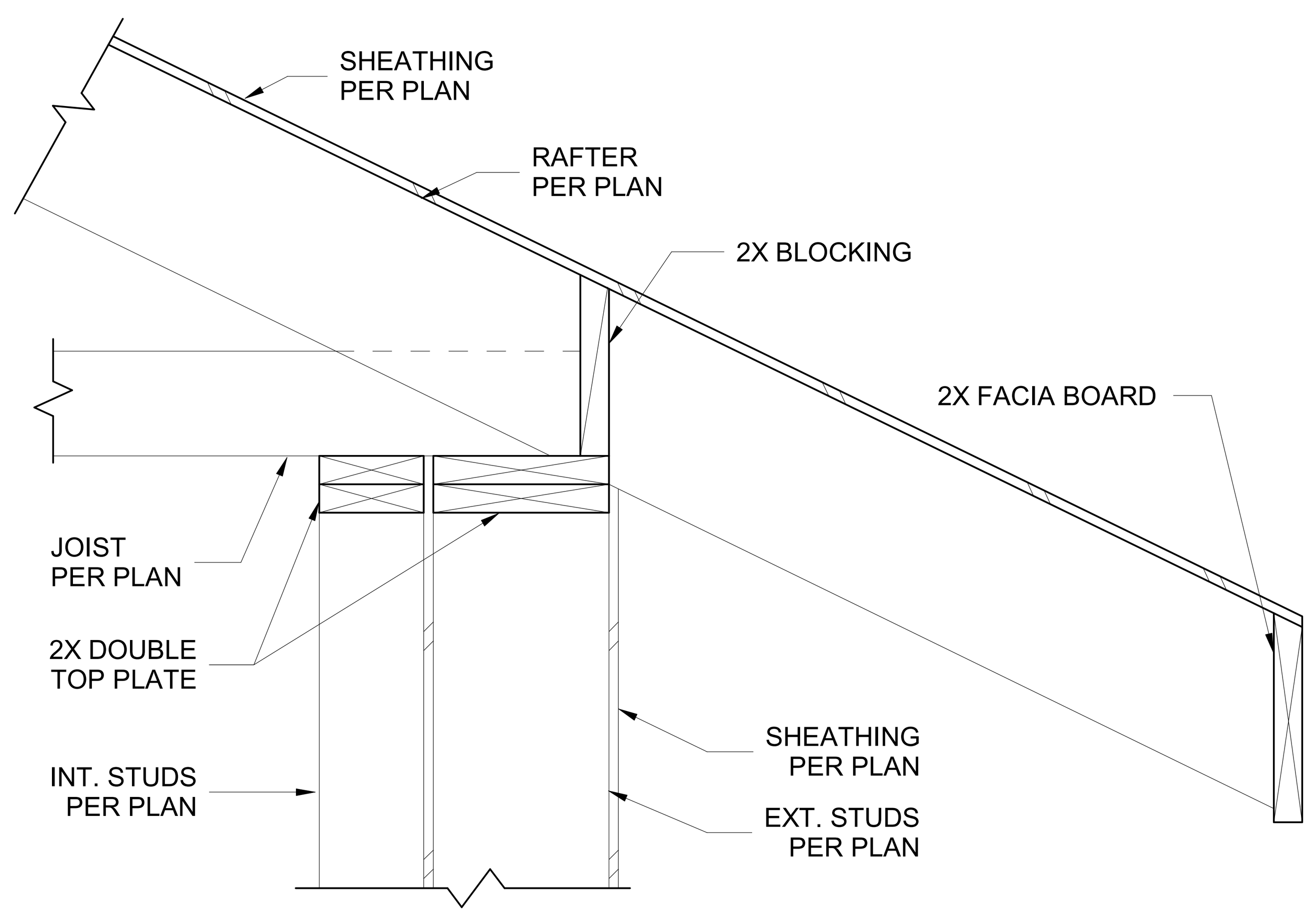
5 ISOLATED PAD FOOTING
1 1/2" = 1'-0"



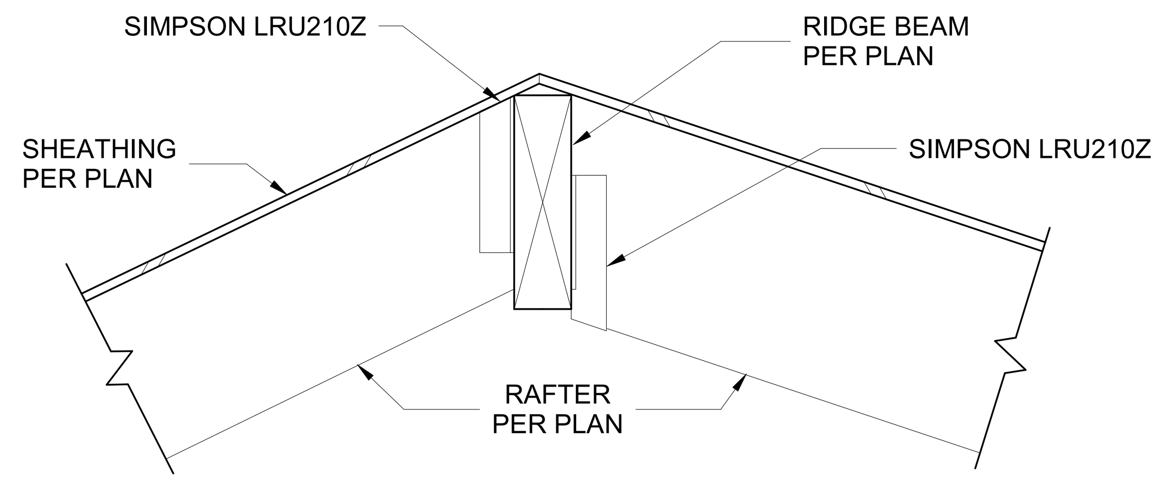
3 GARAGE SHEARWALL FOOTING
1 1/2" = 1'-0"



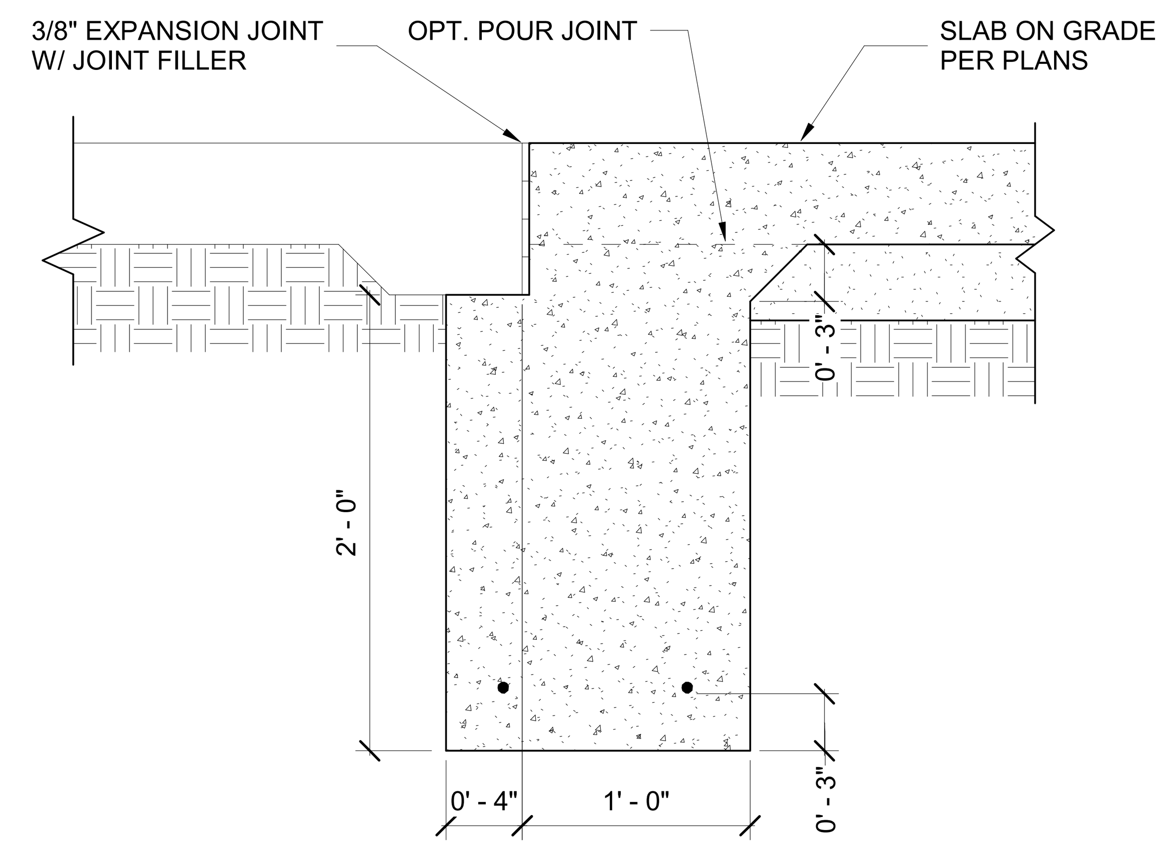
1 EXTERIOR FOOTING
1 1/2" = 1'-0"



6 WALL TO ROOF DETAIL
1 1/2" = 1'-0"



4 MAIN ROOF RIDGE BEAM
1 1/2" = 1'-0"



2 FOOTING @ GARAGE OPENING
1 1/2" = 1'-0"

Happy
Homes

FRANZISKA BECK
- ARCHITECTURURAL DESIGNER
- PASSIVE HOME DESIGNER

BRAIN LEE
- ARCHITECTURAL DESIGNER

MEGAN LUNDHAL
- ARCHITECTURAL DESIGNER

TRENT PICHEL
- STRUCTURAL DESIGNER
- ADMINISTRATION

SERGIO VERGARA
- CONSTRUCTABILITY
- COST ESTIMATOR

GREAT NORTHERN SERVICES
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WEED HOUSING DEVELOPMENT

DETAILS

Project Number	
Date	NOV. 17.2017
Drawn By	Author
Checked By	Checker
	S4.1
Scale	1 1/2" = 1'-0"