

# Request for Expressions of Interest

## Four-Season Greenhouse Construction

**Issue Date: January 11, 2022**

**Closing Date: January 18, 2022 at 4:00:00pm NDT**

*econext* is soliciting Expressions of Interest for the possible construction of a four-season greenhouse. The greenhouse is intended to be constructed generally following the attached drawings and specifications from the University of Minnesota. Some modifications may be necessary to accommodate solar panels and ground conditions on site.

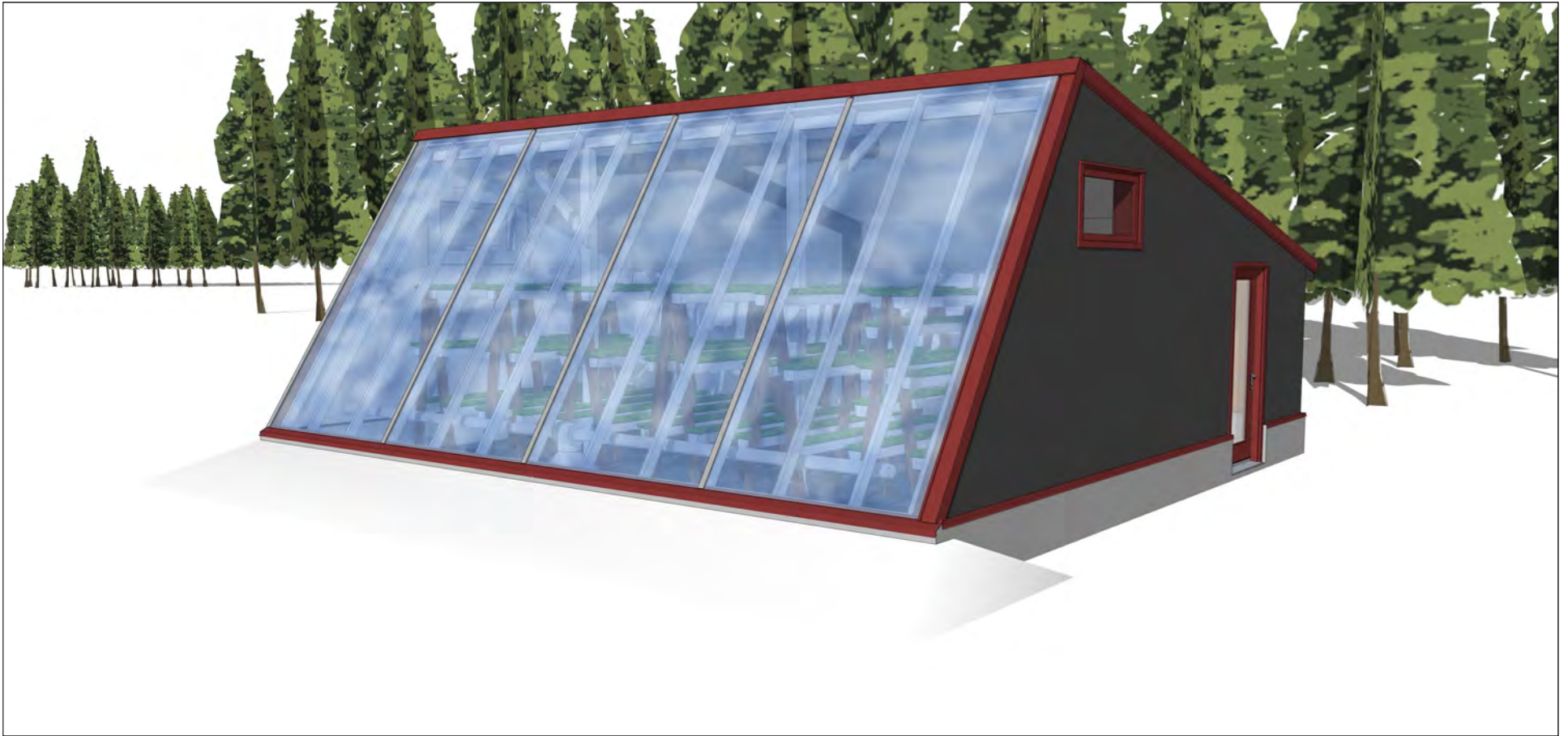
*econext* is seeking a contractor who has experience with four-season greenhouses in the Newfoundland and Labrador context and can demonstrate successful completion and satisfied clients.

Interested parties are asked to submit a letter expressing their interest to work with *econext* to explore building the greenhouse.

Responses should contain the following information:

- Company name and primary contact person.
- Short company description with outline of experience building four-season greenhouses in Newfoundland and Labrador, including pictures or other project details if available.
- Written confirmation of ability to provide insurance certificate and a letter of good standing with WorkplaceNL (actual documents will be requested from the successful applicant prior to finalizing an agreement).
- Two references from previous clients, at least one of which must be a four-season greenhouse.

Please submit the letter expression interest to Kieran Hanley, Executive Director of *econext* at [kieran@econext.ca](mailto:kieran@econext.ca).



## Deep Winter Greenhouse v2.2

Published May 18, 2017

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**NB: This design is the product of research at the University of Minnesota and performance has not been thoroughly tested. The University of Minnesota offers the design as-is and without warranty. Please see Section 5 – Disclaimer of Warranties and Limitation of Liability in the Creative Commons Attribution-ShareAlike 4.0 International License for details.**

## Deep Winter Greenhouse Prototype v2.2

Published May 18, 2017

Please note that this design is subject to change, and the most updated documents can be found on the U of MN Extension website:

<http://www.extension.umn.edu/rsdp/statewide/deep-winter-greenhouse/>

### NOTES:

#### **Introduction:**

This Deep Winter Greenhouse is designed to allow users in cold climates to produce crops throughout winter with minimal use of external inputs for heat. It works by allowing solar radiation to pass through the steeply sloped polycarbonate glazing wall and using a small fan to move that heat into an underground rock bed thermal mass. When the ambient space cools at night, the underground heat is available to keep crops warm enough to grow. The reverse happens in the daytime, as the rock bed can act as a heat sink that cools the growing area when temperatures climb while the sun is shining.

As the name implies, this greenhouse is optimized for use in the coldest, darkest months of the year. It is not intended to be used year round for growing crops, and modifications would be needed to do so.

#### **Field Testing, and Considerations:**

The Regional Sustainable Development Partnerships are working with five producer partners throughout Minnesota, one in each of the five RSDP regions, who will build the greenhouse to these design specifications. Throughout this process, researchers will continuously tweak the building design to increase performance, lower cost, and respond to various complications that arise during the building process. As a result, this document may be updated periodically in the future.

#### **Reasoning and Rationale:**

Each aspect of the design has been considered with regard to building performance, energy efficiency, structural longevity, moisture management, ease of construction, material availability, and material cost.

#### **Humidity and Moisture:**

This is a greenhouse, and we can expect high and widely varying amounts of humidity. Condensation is also expected, so we attempt to control exactly where it occurs. In the greenhouse, we can expect condensation primarily in two areas: 1) On the interior of the glazing wall; and 2) in the rock bed. Latent heat is released into the rocks as condensation occurs and excess water is allowed to drain through the bottom of the rock bed. The glazing wall is detailed with sealant and a canted sill to prevent condensation from seeping into or sitting on structural members.

The vapor barrier of the stud walls is very important to managing moisture: The vapor barrier should always be placed on the *warm* side of the wall. Any seams should be overlapped and taped, and any ends should be sealed to the structure to maintain airtightness. As a general rule of operation, irrigation should be precise in order to avoid wasted water and unnecessary humidity.

#### **Containers and Growing Media**

In general, we recommend growing in containers in this DWG. Because of the seasonal use of the structure and the expected speed of crop cycles, containerized growing allows better use of the growing space. Many growers use modified rain gutters or conventional flats in a hanging or rack support system.

Containerized growing can help avoid wasted water, reduce unproductive soil surfaces, and provide better control of growing media in the event of a pest infestation.

(cont. next page)



## NOTES (continued):

### Materials and Cost:

Materials required to build the greenhouse should be available from a combination of local hardware stores, specialty lumber yards, and greenhouse supply companies. Other local specialty construction companies may have some of the materials at better prices. Our estimated cost of the materials required for the greenhouse (compiled from online retail sites) is approximately \$14,000, however availability and price of items can vary from location to location. It is advisable to consult multiple vendors to find the correct materials at the best prices. Total construction costs will depend heavily on your personal skills, abilities, and capacity to perform some or all of the building yourself. Total price considerations will depend on local material cost and availability, and quality of labor. People in remote locations might expect to pay considerably more for delivery charges, labor, and materials. A common rule of thumb is that labor costs are roughly equal to materials costs, although this will not always be the case.

### Substitution Materials:

Many prospective DWG builders or materials estimators may feel the need to substitute materials on the list for other materials. Many of the materials are chosen to perform specific building performance functions, and substitutions may have detrimental consequences. It is advised that no material substitutions be made without first consulting with the Deep Winter Producers Association on the Facebook group available here (you will have to request acceptance from the group's administrators, which will be granted): <https://tinyurl.com/DWGFBgroup>

Often, participants on this forum have experience with DWG operation and construction and can provide reasoned explanations for why some materials can or cannot be substituted.

### Lessons Learned:

The door between the growing room and the packing shed should be kept closed unless the packing shed is kept at a similar temperature as the greenhouse. Excess heat or humidity should be exhausted through the ventilation windows. The humidity and temperature differential between the greenhouse and this room create optimal conditions for condensation that could lead to mold growth. Thus, it is not advisable to use wood paneling for the walls in the north packing shed: MgO or fibercement panels are preferred.

Based on infrared imaging of the first completed DWG, most conductive heat loss occurs through the exposed portion of the foundation wall. Additional insulation could be helpful at this location, such as a layer of straw bales placed around the exterior perimeter.

### Questions:

If you have any questions about DWGs, construction, design, etc, please join the Facebook Deep Winter Producers Association group (you will have to request acceptance from the group's administrators, which will be granted). Questions addressed to this group will be answered by UMN DWG researchers as well as a network of DWG producers throughout North America (and the world)

<https://tinyurl.com/DWGFBgroup>



## Estimated Materials List

Function	Item	Unit	Qty
Foundation	8"x8"x16" CMU		737
Footing	Concrete	yd3	4
pier formwork	8" Sonotube		2
Fdtn insulation	R-10 XPS	4x8 sheets	16
Insulation protection	FRP	4x8 sheets	6
rock bed ducting	Perforated drain tile (Prinsco 08GF20NP)	8"x20'	3
rock bed ducting	duct tees (Prinsco GFT0808)		2
rock bed ducting	end caps (Prinsco EC08-GF)	8"	4
intake ducting	solid wall metal or plastic pipe	8" dia. x 5'	6
intake ducting	pipe tee	8"	1
intake ducting	pipe adj. elbow	8"	1
thermal mass	1-1/2" washed crushed stone #3 NO FINES	yd3	48
greenhouse interior	1/2" Fibercement backer board	4x8 sheets	22
pack shed interior	1/2" MR gypboard	4x8 sheets	18
glazing	16mm tri-pane polycarbonate	5' 11-1/4" x12' sheets	4
sheathing	25/32" BildRite Sheathing	4x8 sheets	16
roof deck	1/2 OSB roof sheathing	4x8	15
vapor barrier	6 mil poly	10'x100' roll	2
WRB	Tyvek weather barrier	9'x100'	2
sill/fdtn waterproofing	Bituthene 4000	200sf roll	4
	foam sill seal	5-1/2" x 50'	2
cladding	LP SmartSide 76 Series Smooth Panel 25930 Dk. Grey		18
gable trim	Metal Sales Red Gable trim	10'-6" length	7
ridge cap	Metal Sales Red Outside corner	10'-6" length	3
ridge vent	Pro-Rib ridge vent or equivalent	20'	2
roofing	Steel roofing panel	20' length	8
furring strips	1x2	8' strip	
rainscreen venting screen	Mongoose ridge vent or equivalent	20'	3
roof insulation	7-1/4"x 23" R-30 Rockwool Roxul 169102	30sf	15
Side wall insulation	5-1/2"x 23" R-23 Rockwool Roxul 169094	37.5sf	12

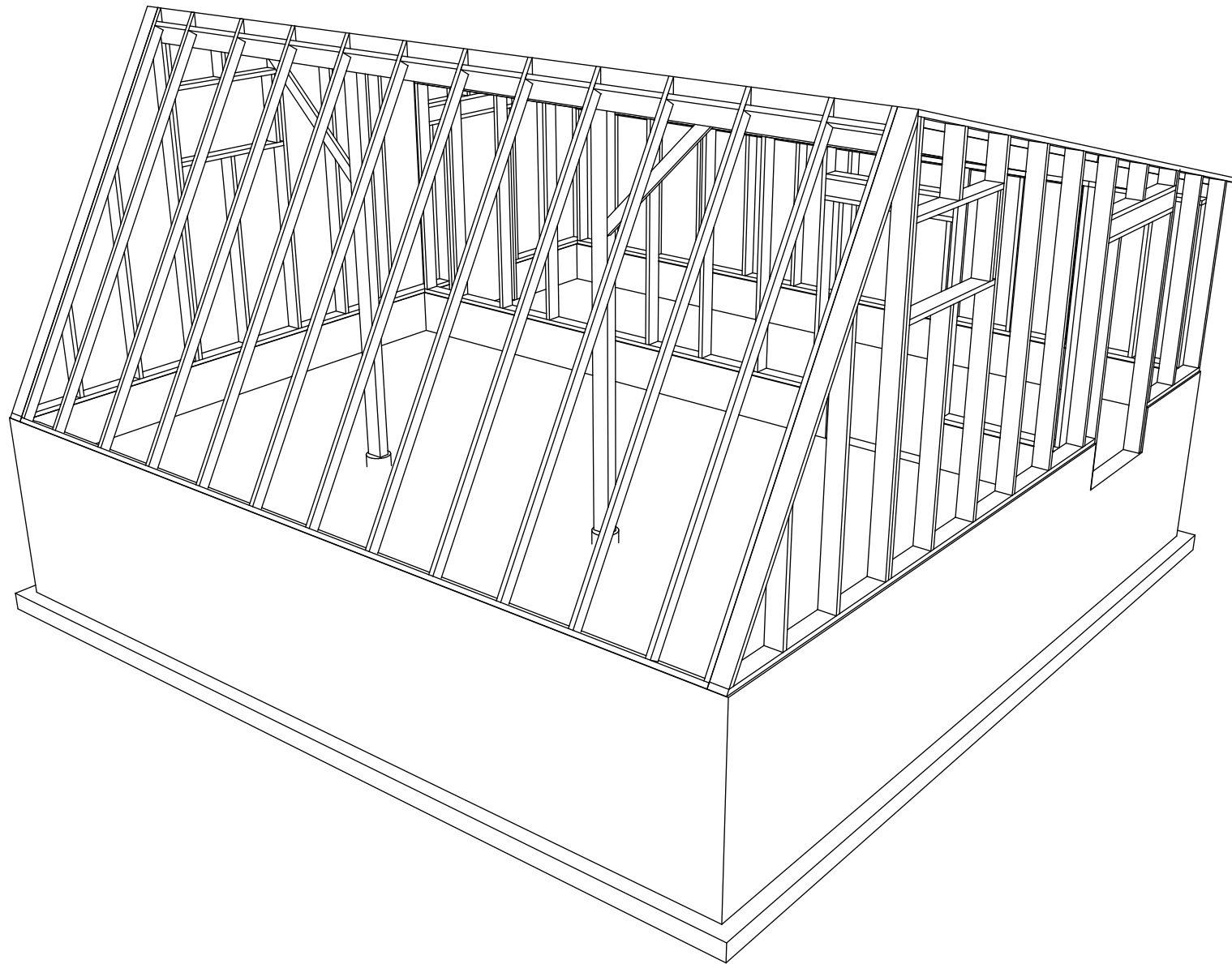
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**Estimated Materials List (cont.)**

Function	Item	Unit	Qty.
post	4x6 post	12' length	2
ridge beam	2x12	8' length	6
bracing	2x4	10' length	2
elastomeric paint	687 EnviroWhite coating	5 gal bucket	1
sidewall	2x6	12' length	2
sidewall	2x6	10' length	16
sidewall	2x6	8' length	24
sidewall	2x6 treated	10' length	3
partition wall	2x6	8' length	21
partition wall	2x8	12' length	2
partition wall	2x6 treated	12' length	2
glazing wall	2x4	12' length	13
glazing wall	2x4	8' length	3
glazing wall	2x8 treated	12' length	2
north wall	2x6	10' length	10
north wall	2x6	12' length	2
north wall	2x6 treated	12' length	2
roof rafters	2x10 (could subst. 20' 9-1/2" TJI)	10' length	22
roof rafters	2x4	10' length	4
sealant	POLYCARBONATE COMPATIBLE		
fasteners			
glazing screws	AmeriLux Int'l MultiLite 2" screw	2lbs	
straps and hangers			
doors	insulated steel		3
windows	Marvin Integrity double-glazed w/auto operator		2
vent openers	Orbeteknik Megavent		2
glazing retention	Growers' Supply 111604Z144 Roof mullion cap	12'	5
mullion gasket	Growers' Supply 112000 EPDM gasket		60
2-stage thermostat controller	Growers' Supply CR2031		2
Centrifugal duct fan	Growers' Supply CF1410 (Fantech FR200)	8"	



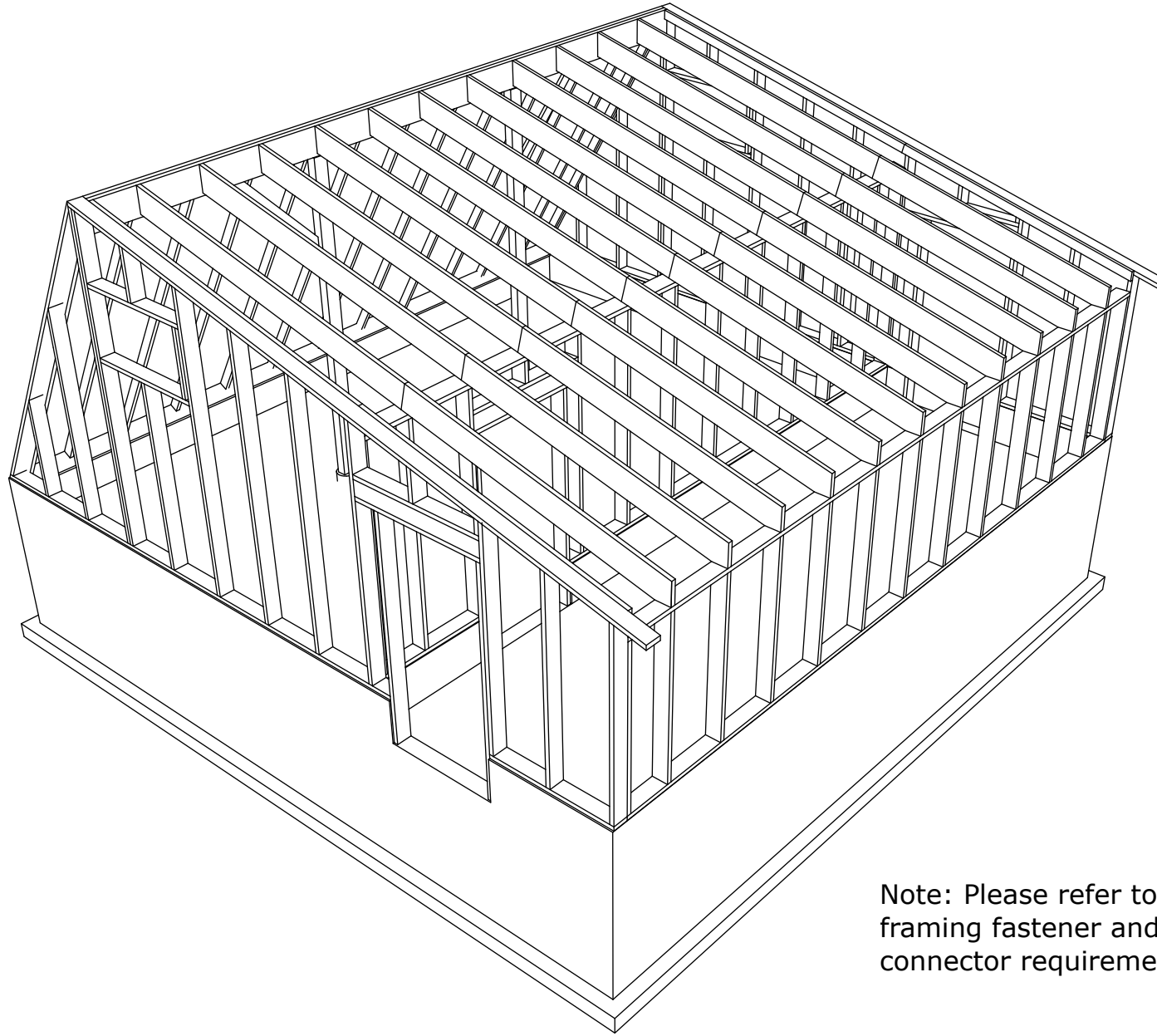


# A.01

## Perspective of framing from SE

Deep Winter Greenhouse v2.2  
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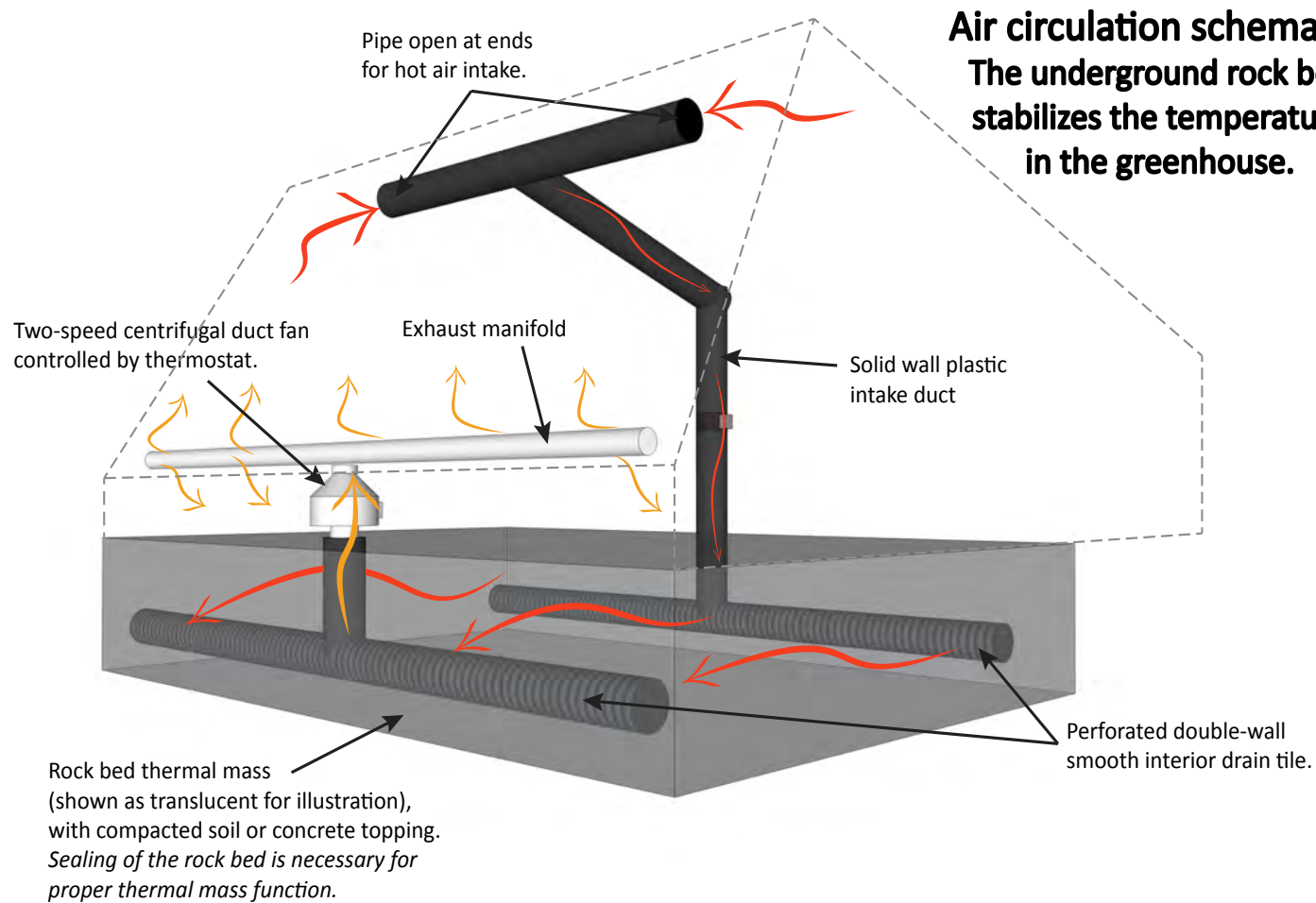




Note: Please refer to S1.0 for framing fastener and connector requirements.

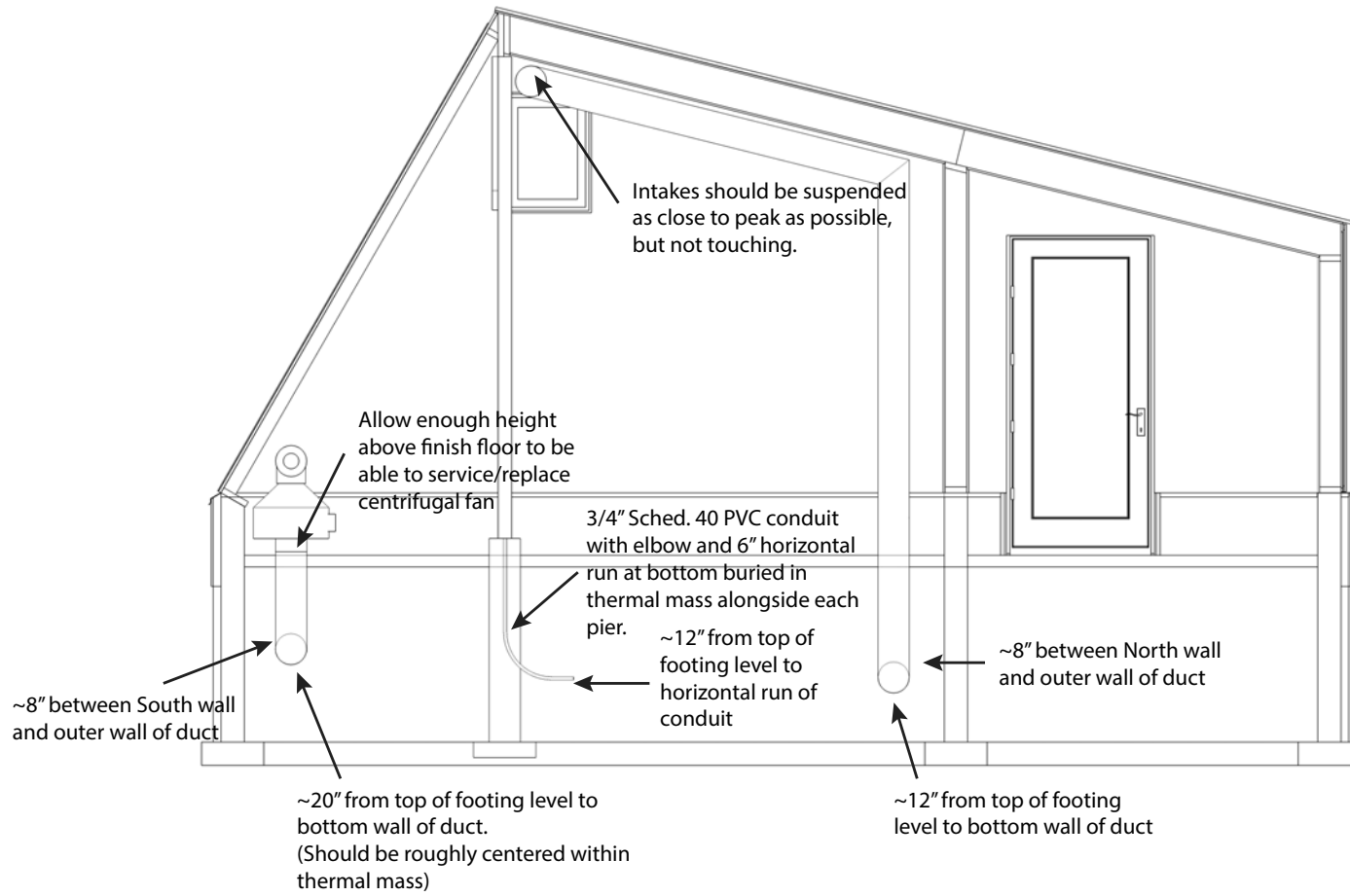




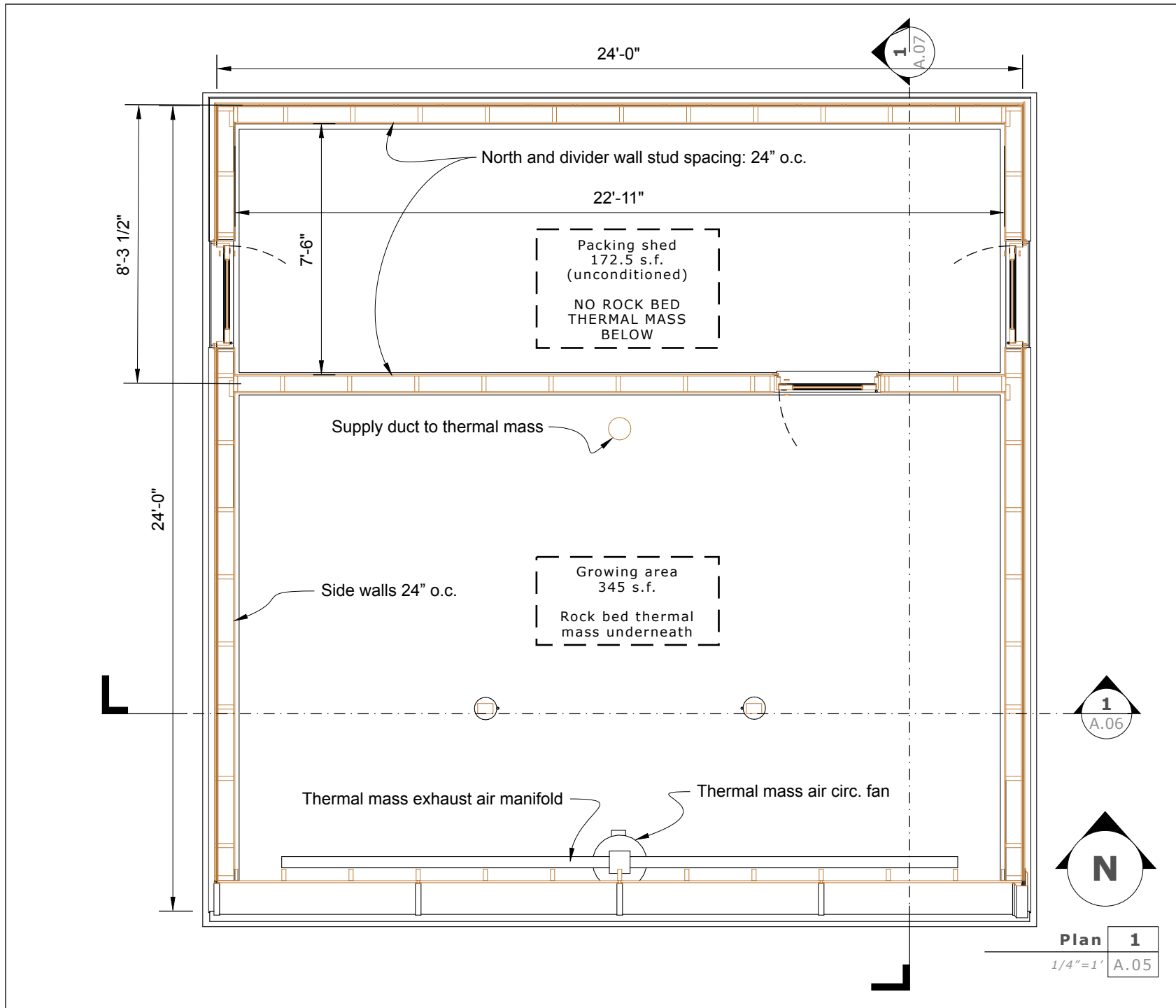


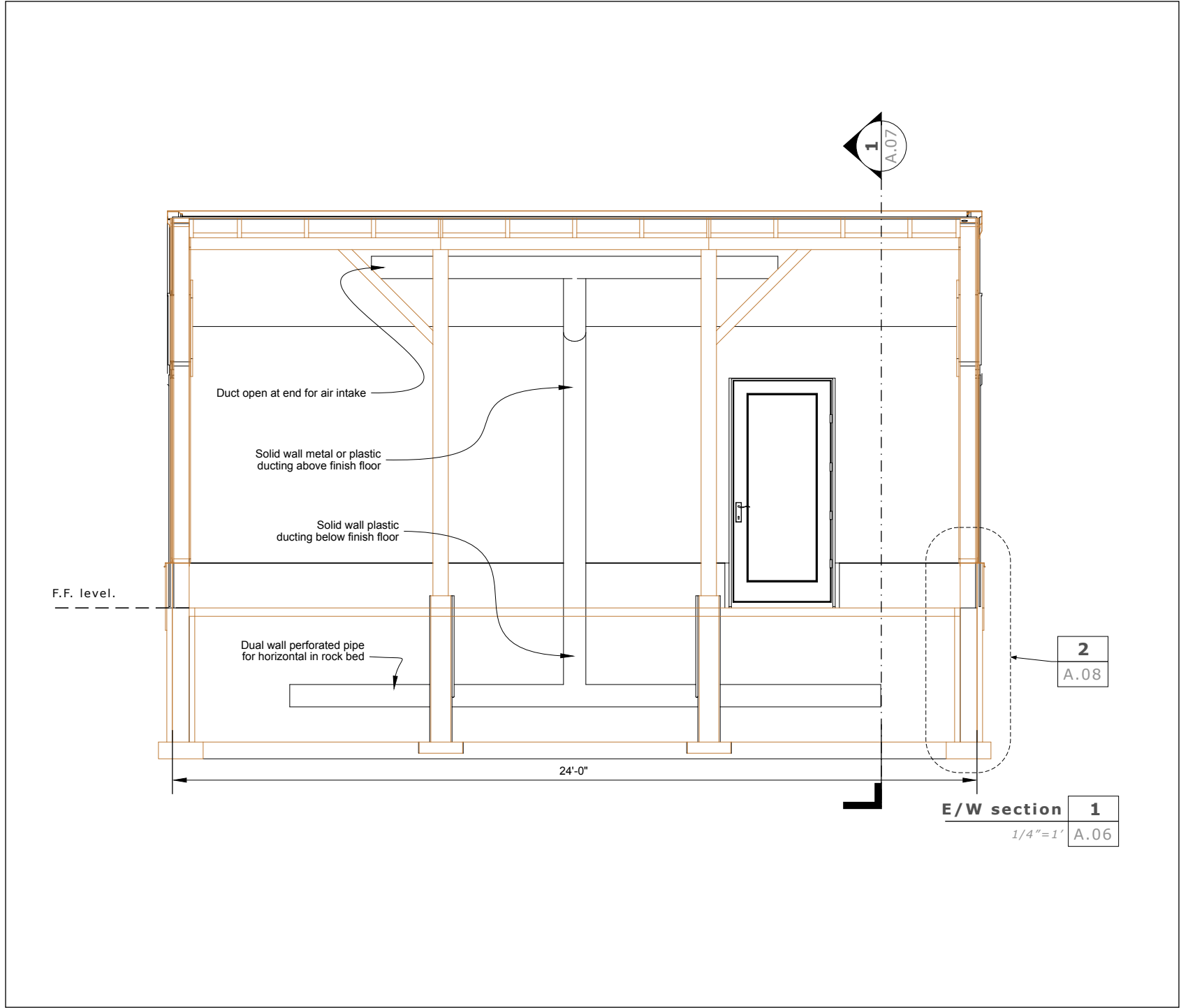
**Air circulation schematic:  
The underground rock bed stabilizes the temperature in the greenhouse.**



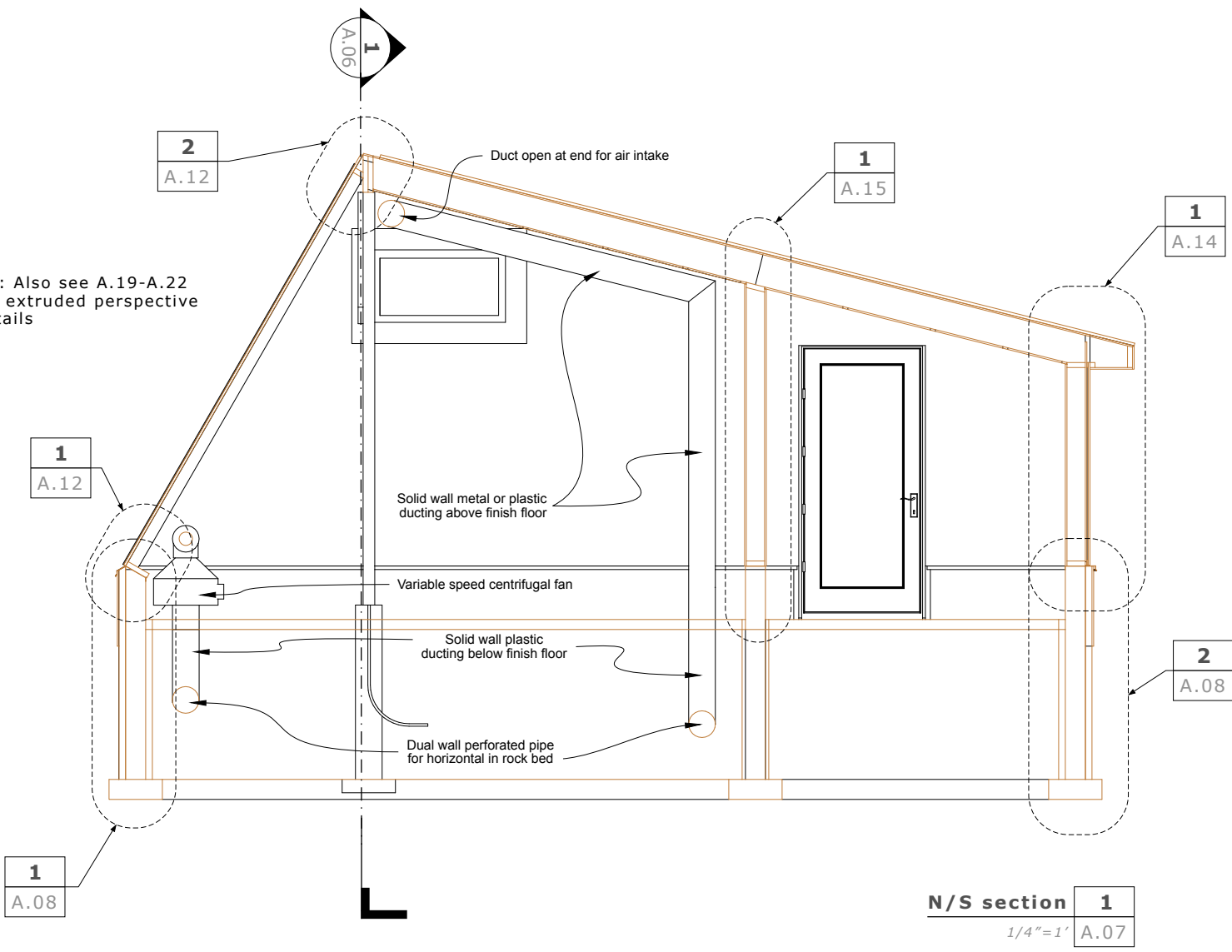


Ductwork layout



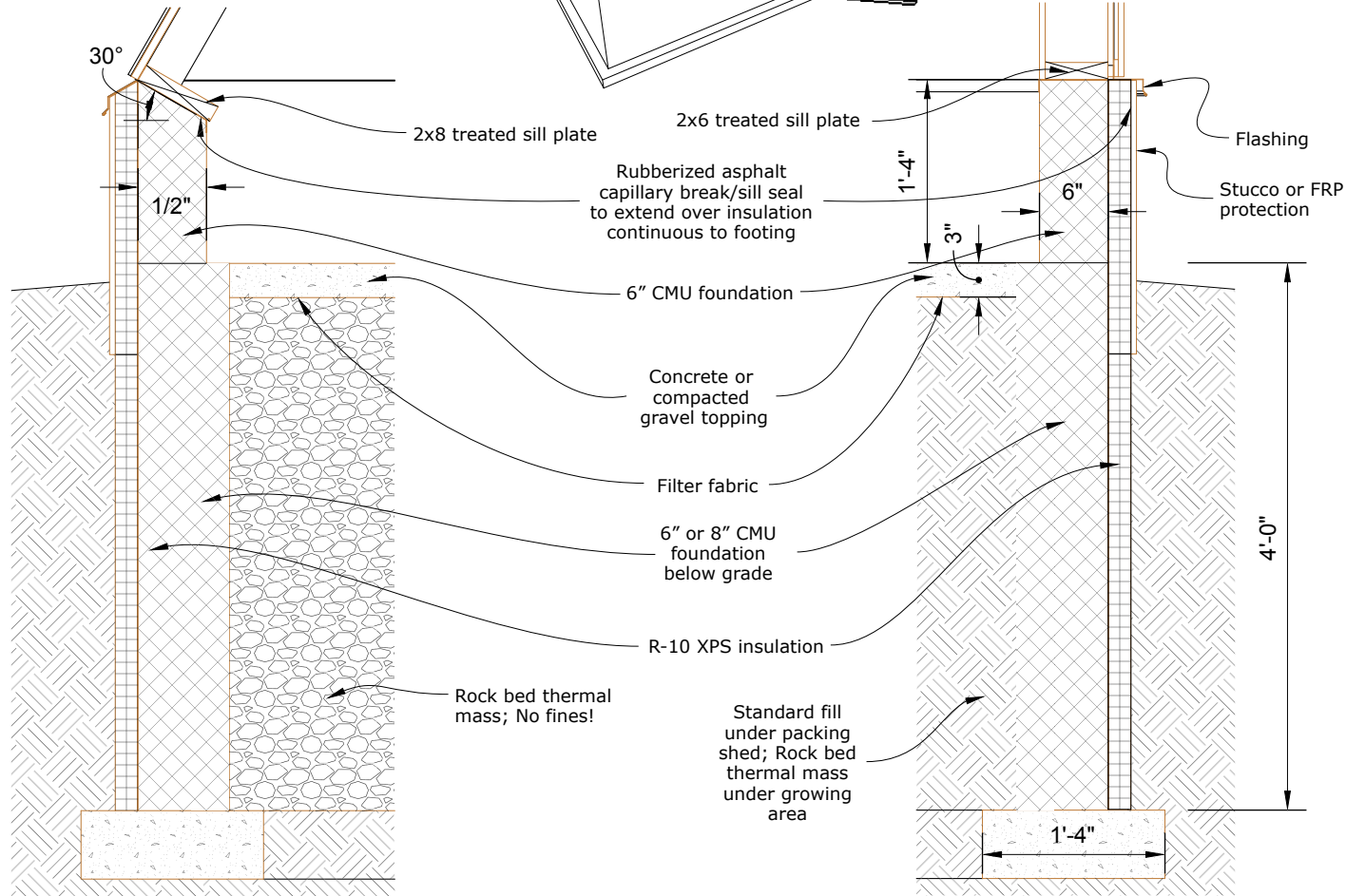
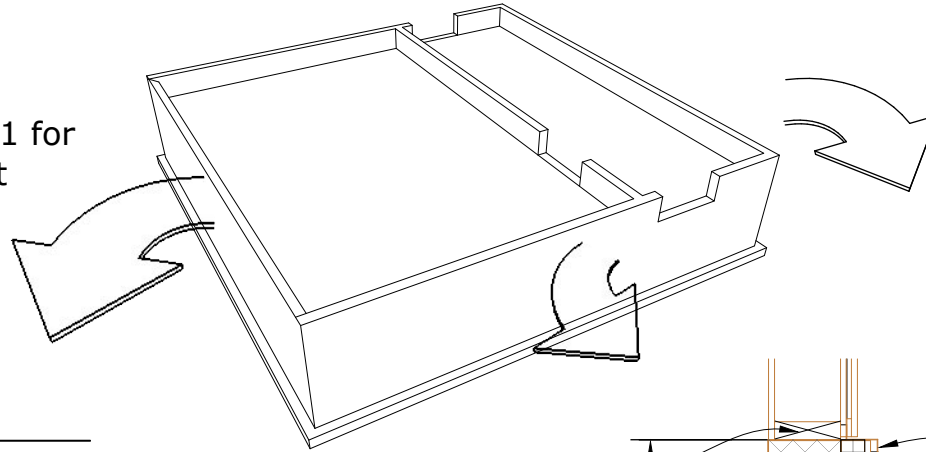


NB: Also see A.19-A.22 for extruded perspective details



North/South section elevation

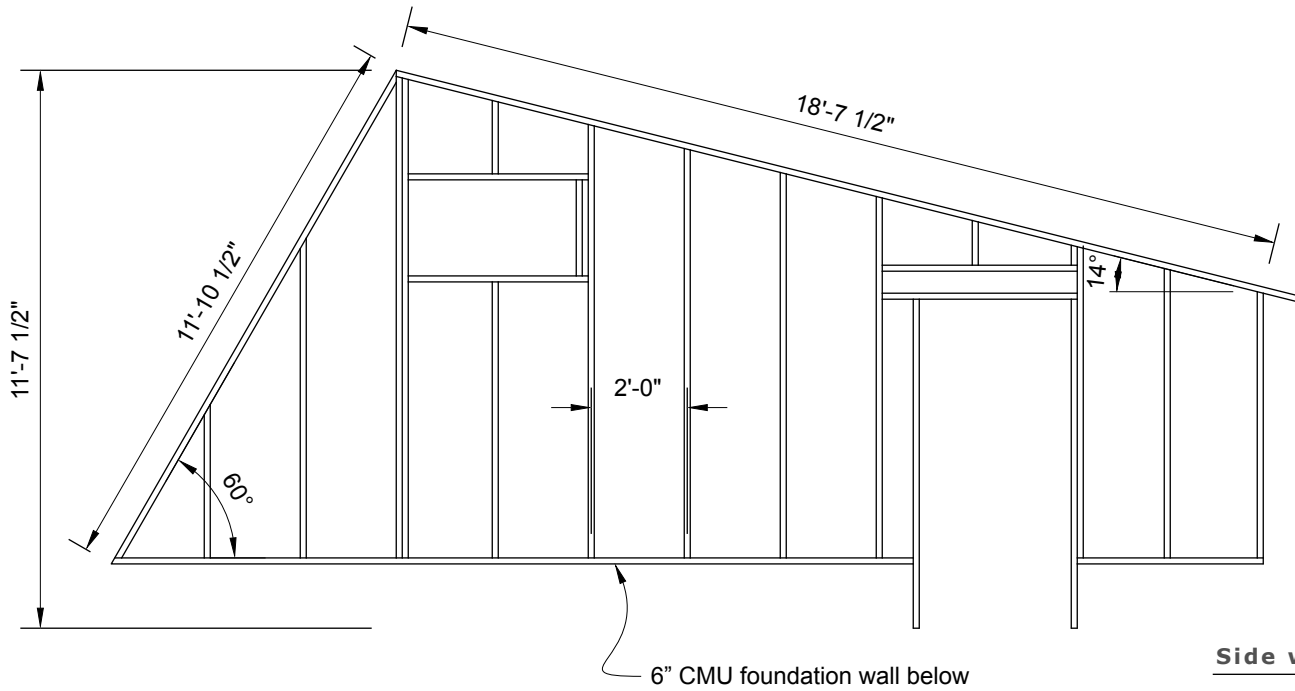
Note: Please refer to S1.1 for foundation reinforcement requirements!



**South foundation 1**  
3/4"=1' A.08

**North and side foundation 2**  
3/4"=1' A.08





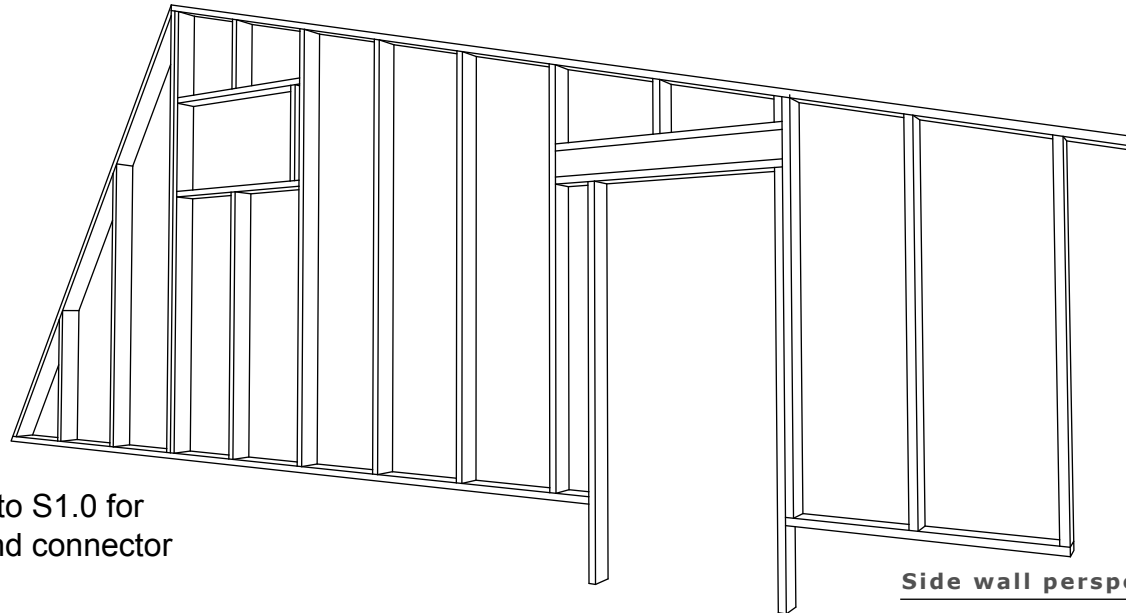
Side wall framing 

1
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 1/4" = 1' 

A.09
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Note: All studs are spaced to minimize material cutoff waste.



Side wall perspective 

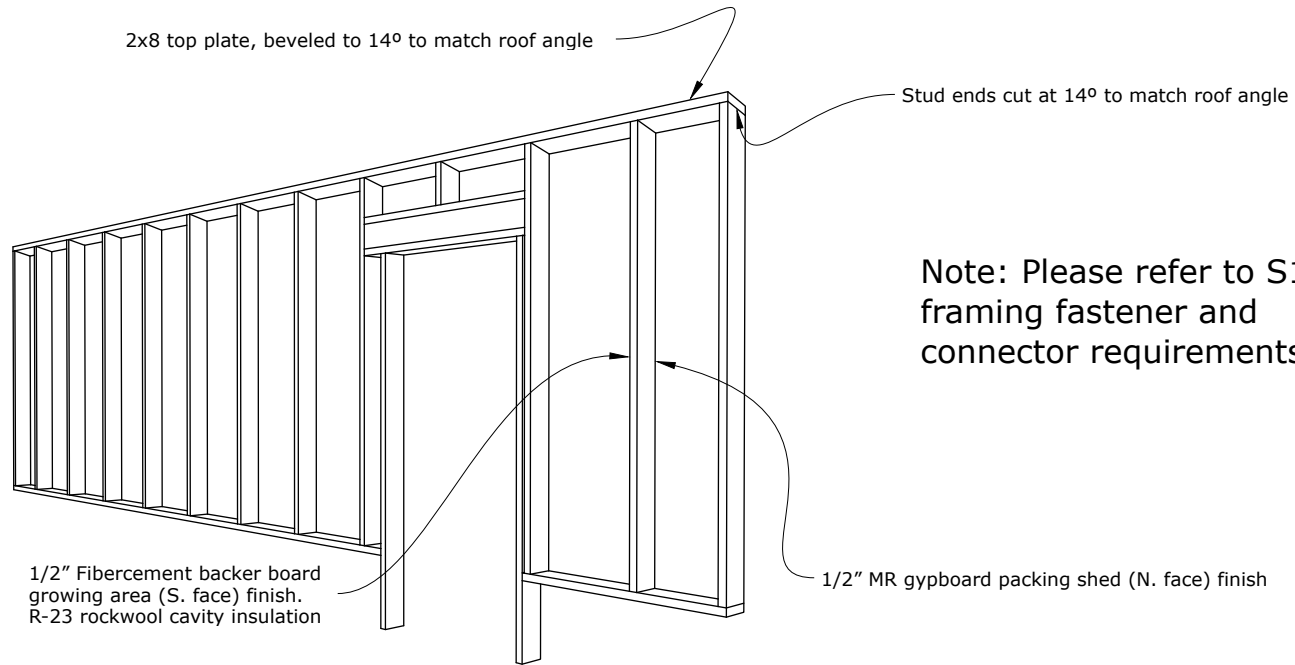
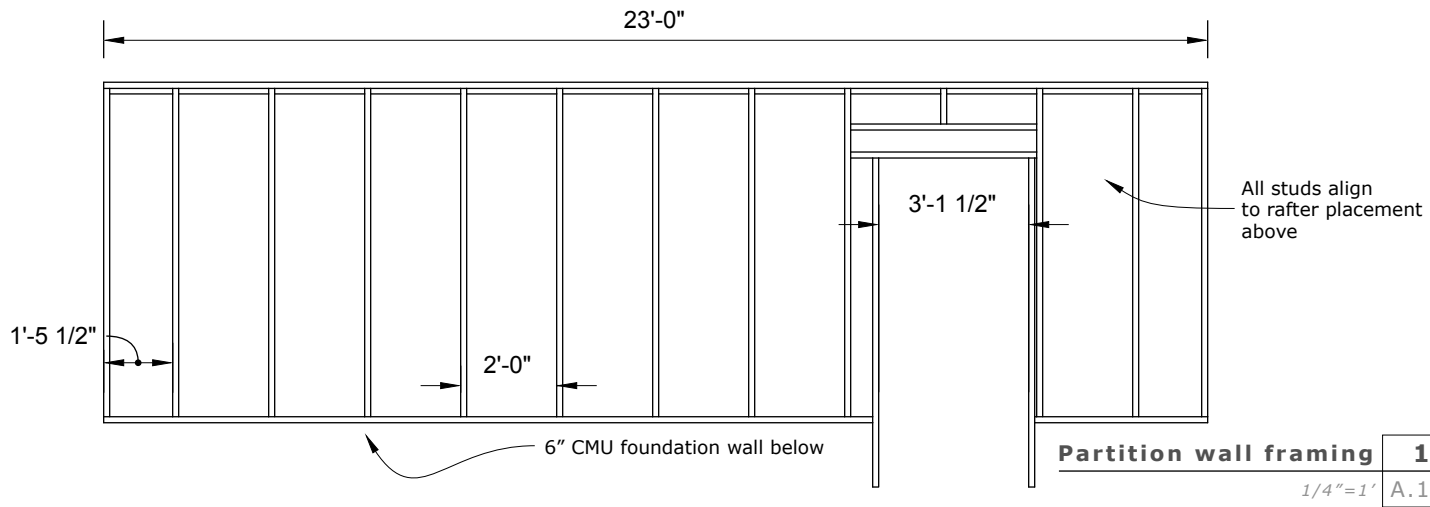
2
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 nts 

A.09
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Note: Please refer to S1.0 for framing fastener and connector requirements.



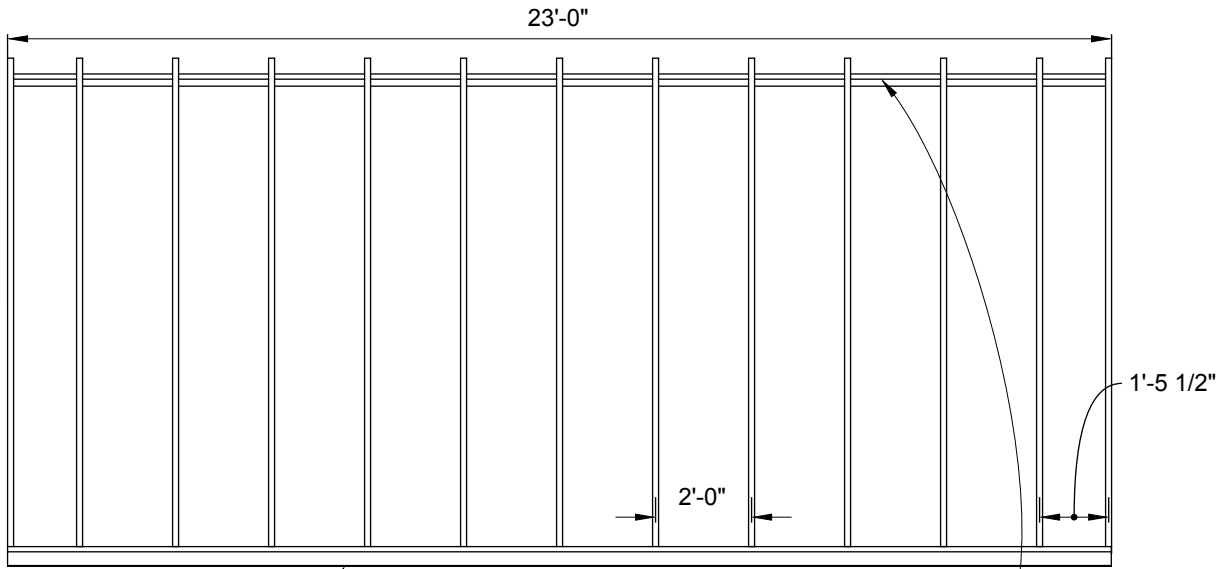


**Partition wall perspective 2**

*nts* A.10



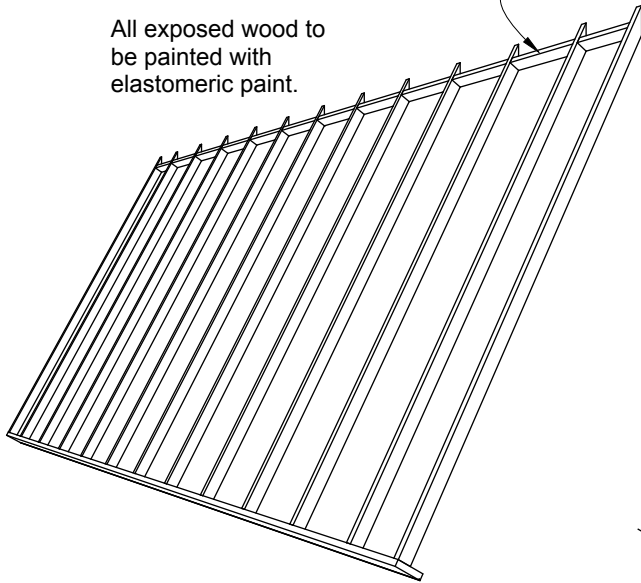




2x8 treated sill plate  
(elastomeric coating)

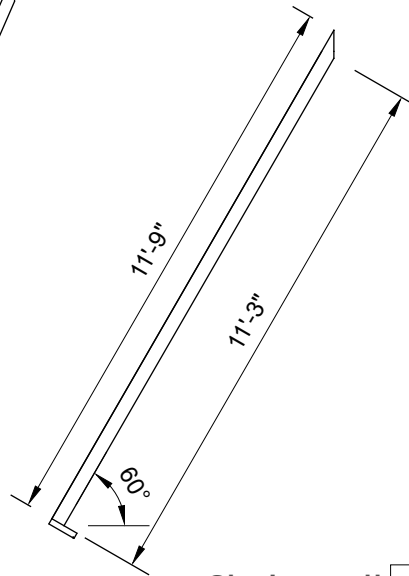
**Glazing wall 1**  
1/4"=1' A.11

All exposed wood to  
be painted with  
elastomeric paint.



**Glazing wall persp. 2**  
nts A.11

Blocking at peak for airsealing

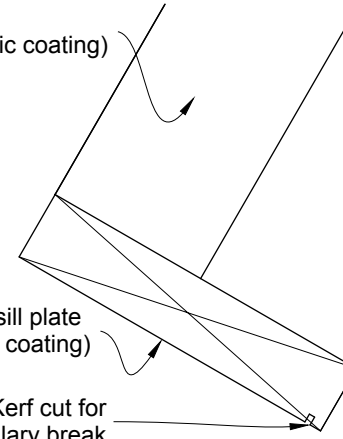


**Glazing wall 3**  
1/4"=1' A.11

2x4 rafter  
(elastomeric coating)

2x8 treated sill plate  
(elastomeric coating)

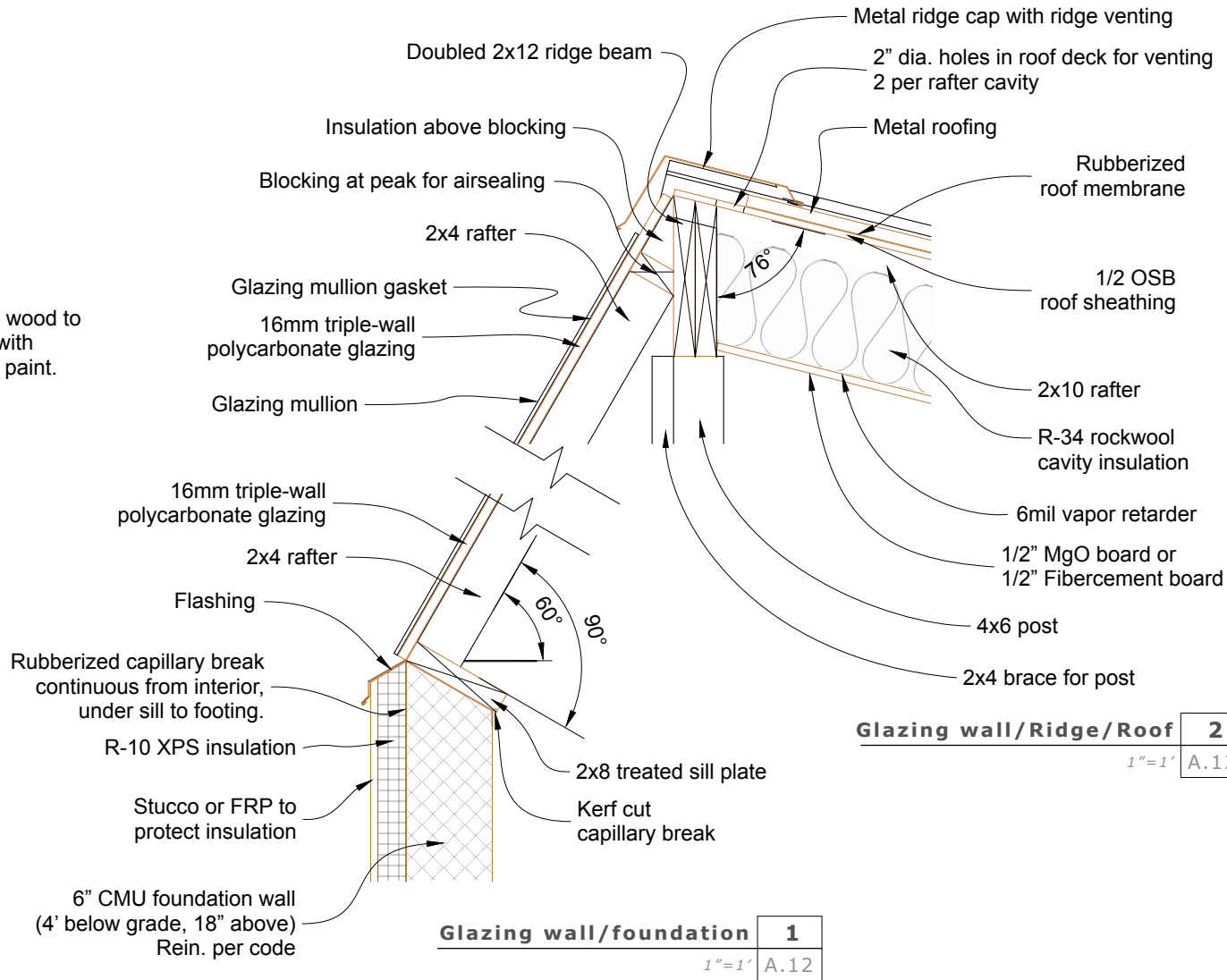
Kerf cut for  
capillary break

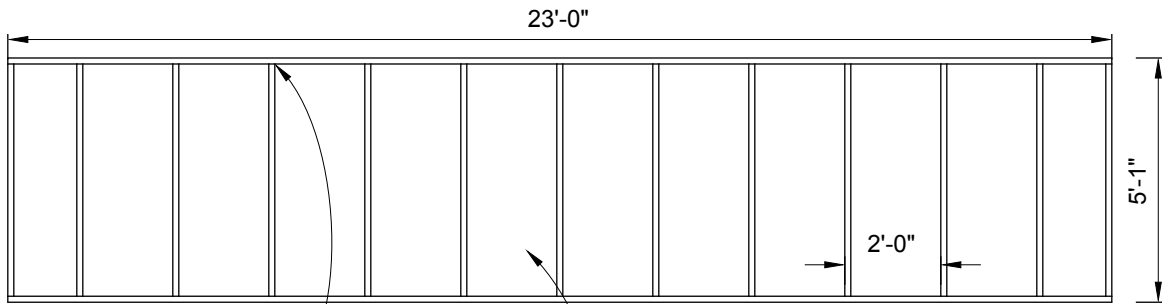


**Glazing wall 4**  
3"=1' A.11



All exposed wood to be painted with elastomeric paint.



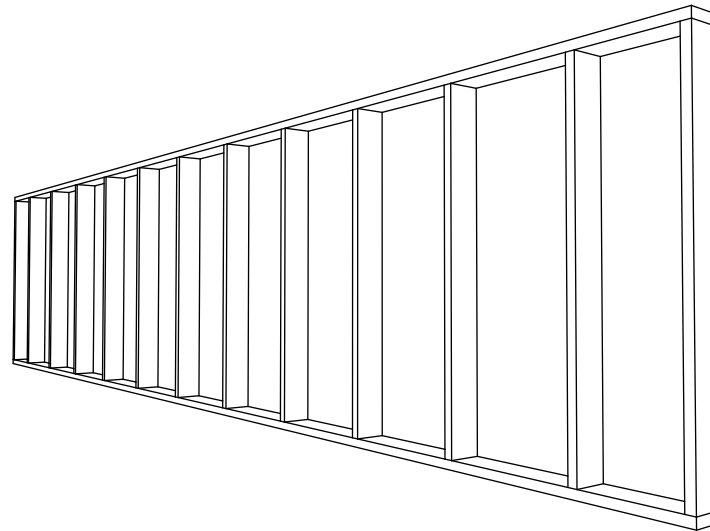


All studs align directly below rafter placement above

R-23 mineral wool insulation in cavities

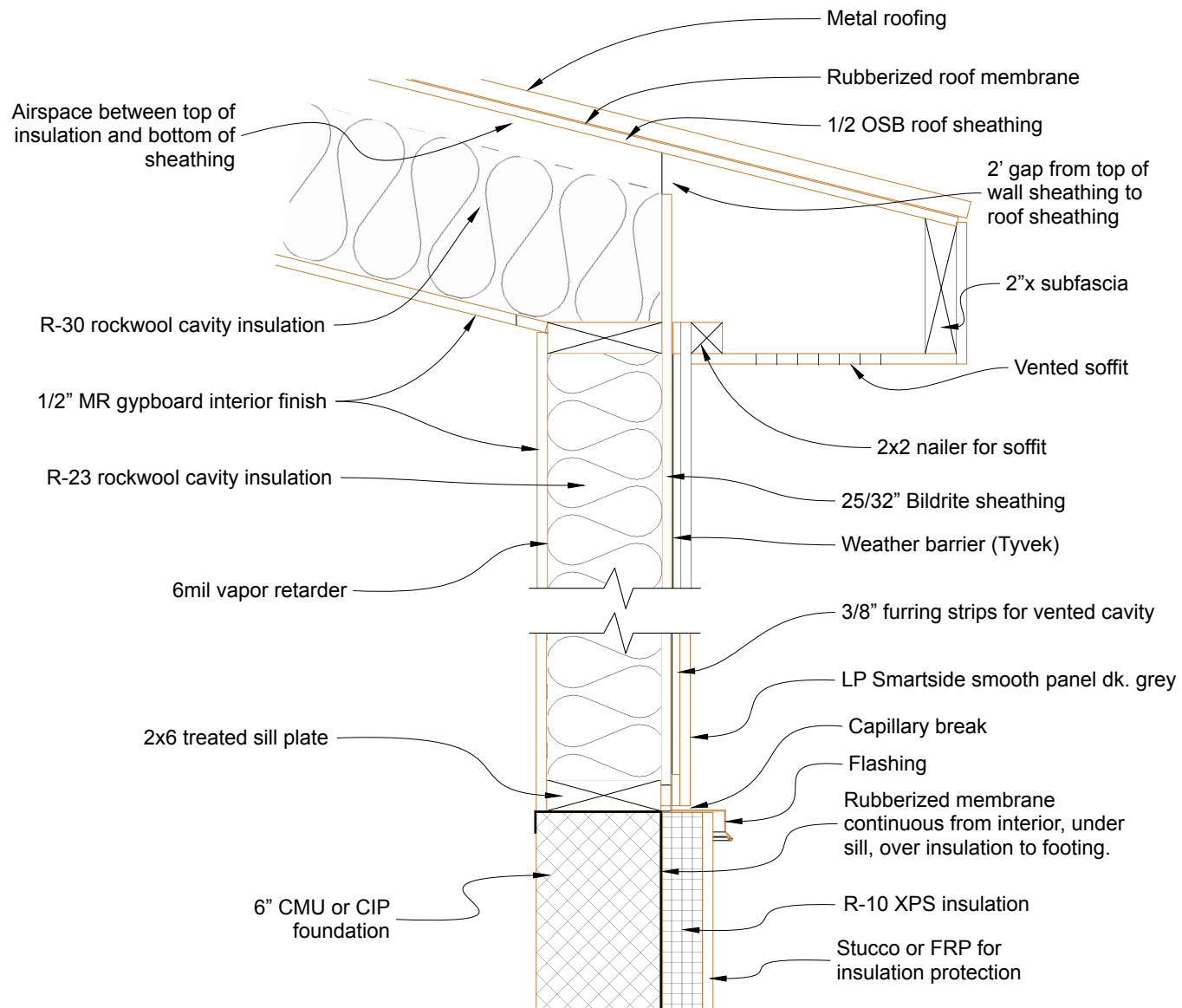
**North wall framing** 1  
*scale: 1/4"=1'* A.13

Note: Please refer to S1.0 for framing fastener and connector requirements.



**North wall framing persp.** 2  
*nts* A.13

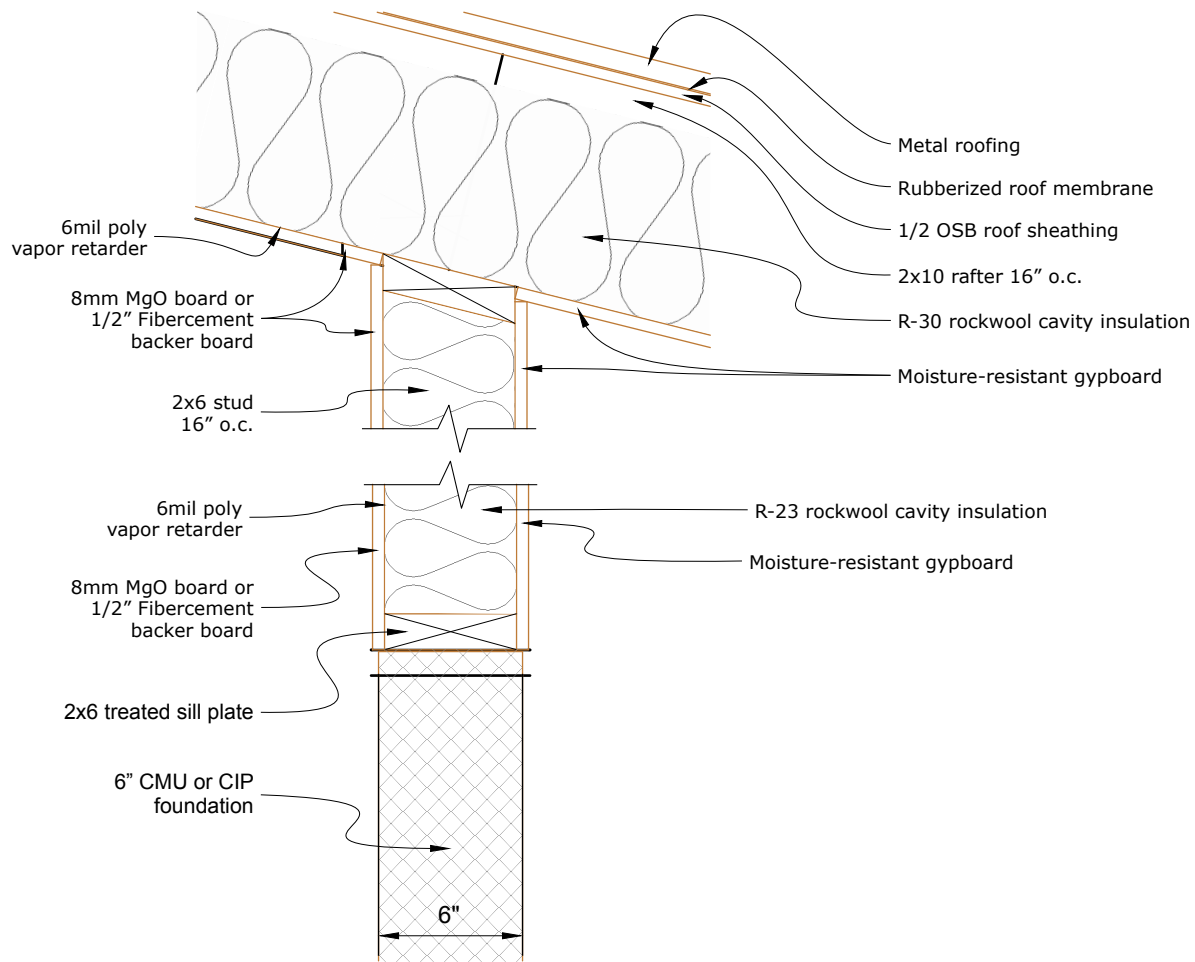




Note: Please refer to S1.0 for framing fastener and connector requirements.

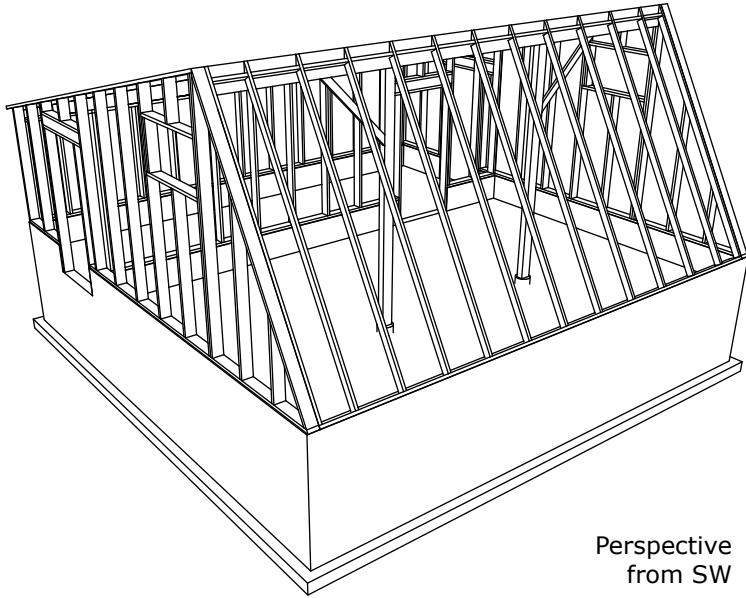
**North wall/foundation 1**  
 scale: 1-1/2"=1' A.14



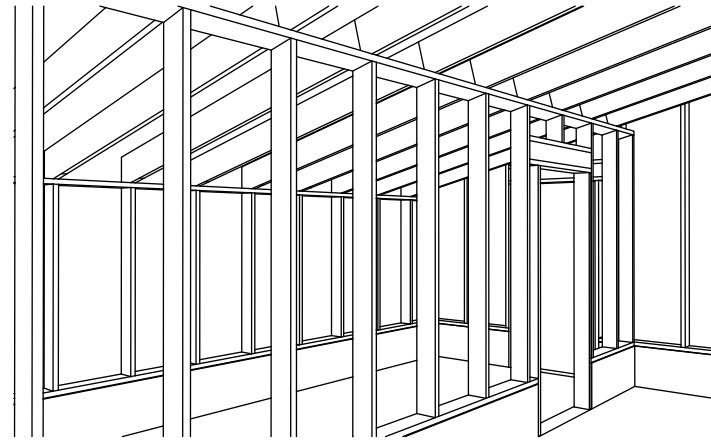


**Partition wall/roof 1**  
 1-1/2"=1' A.15

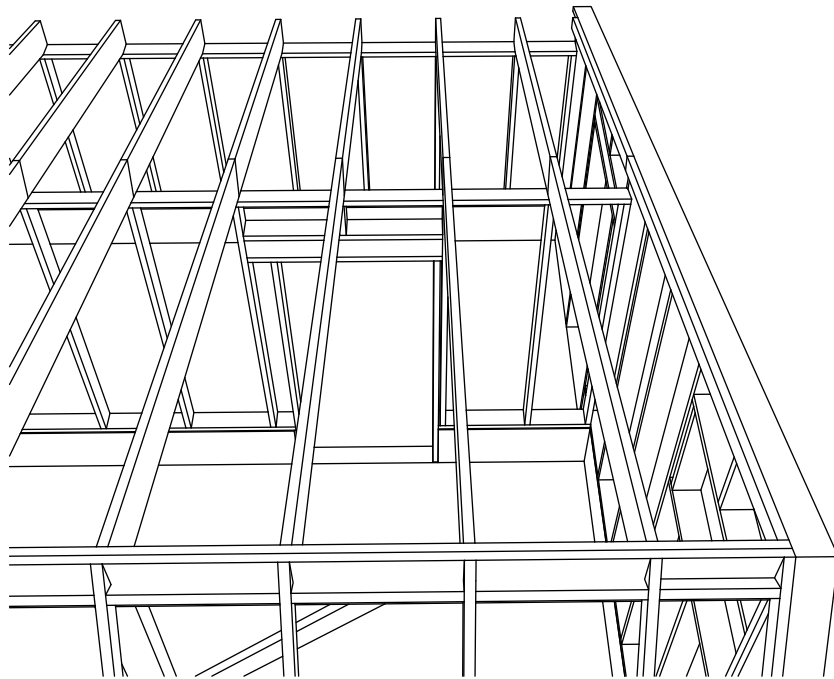




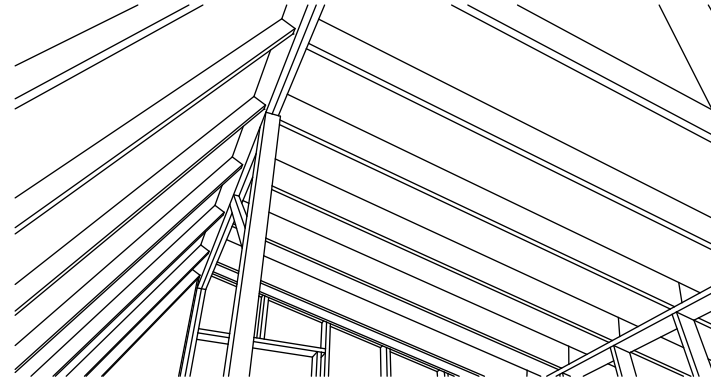
Perspective  
from SW



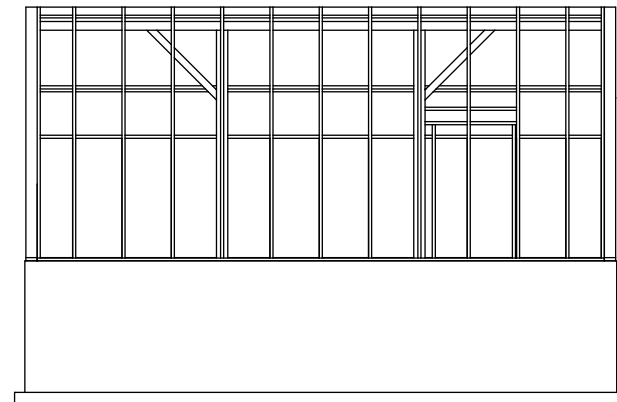
Partition wall



Ridge and roof

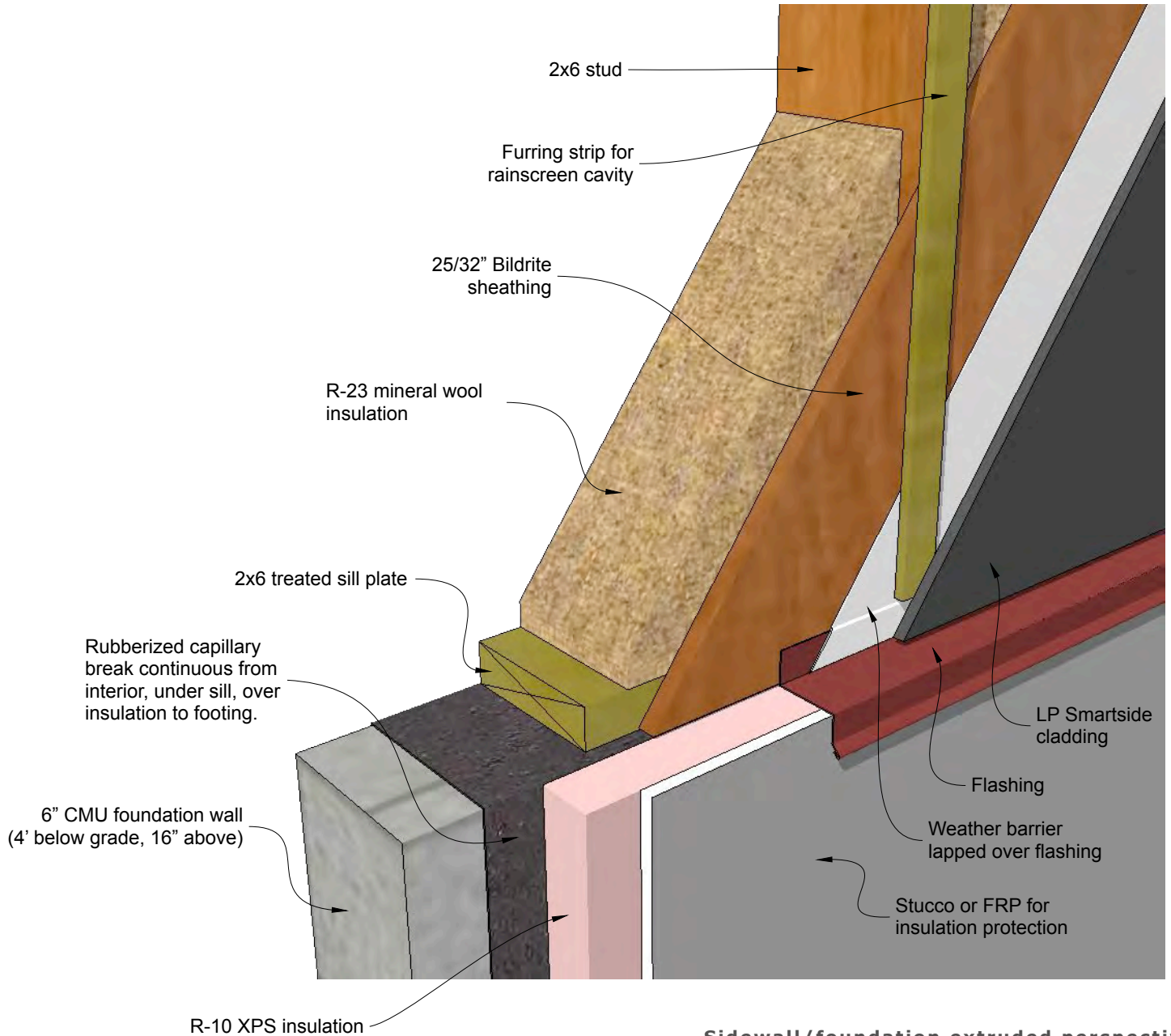


Ridge beam



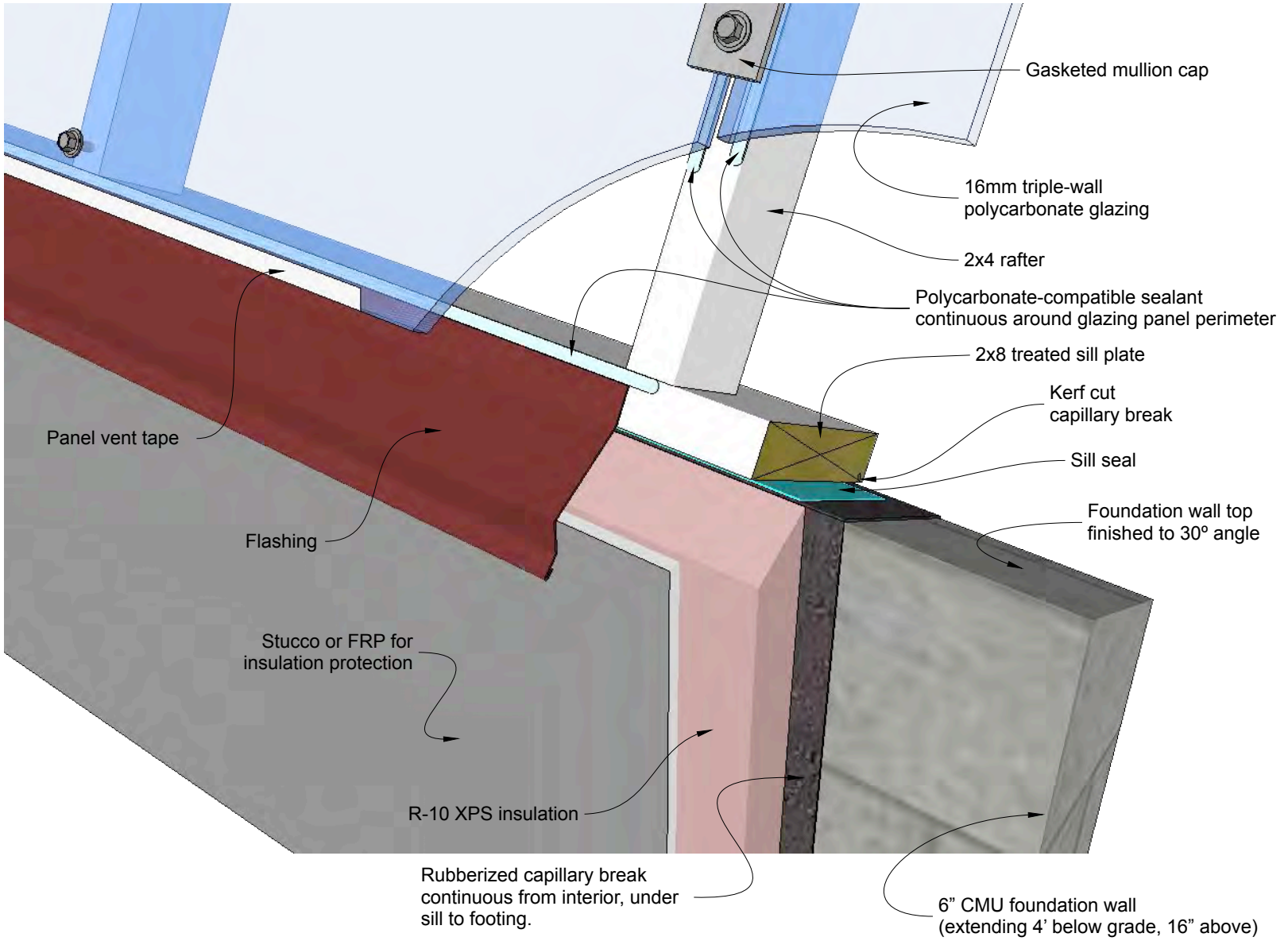
South Elevation





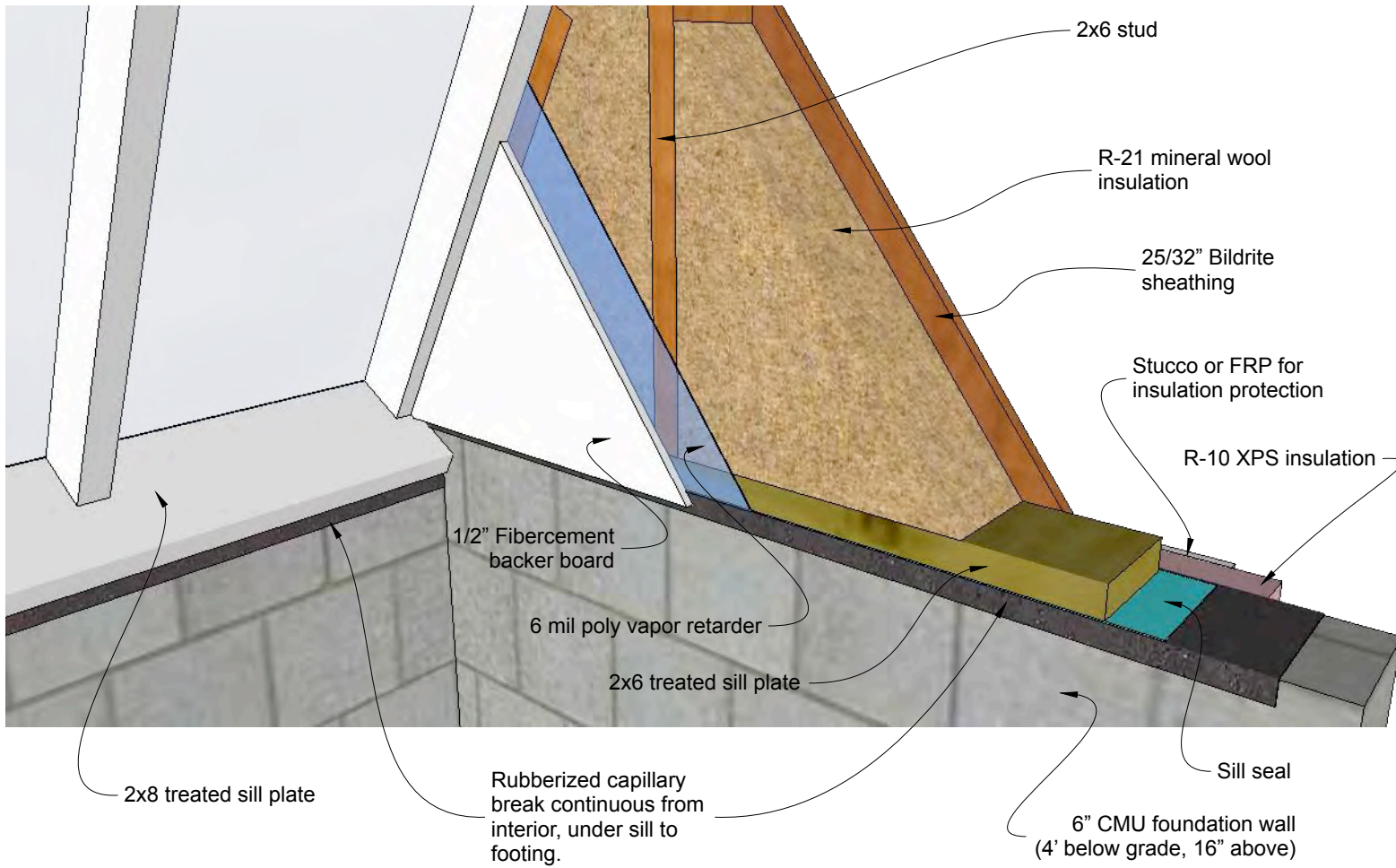
Sidewall/foundation extruded perspective **1**

n.t.s. A.17



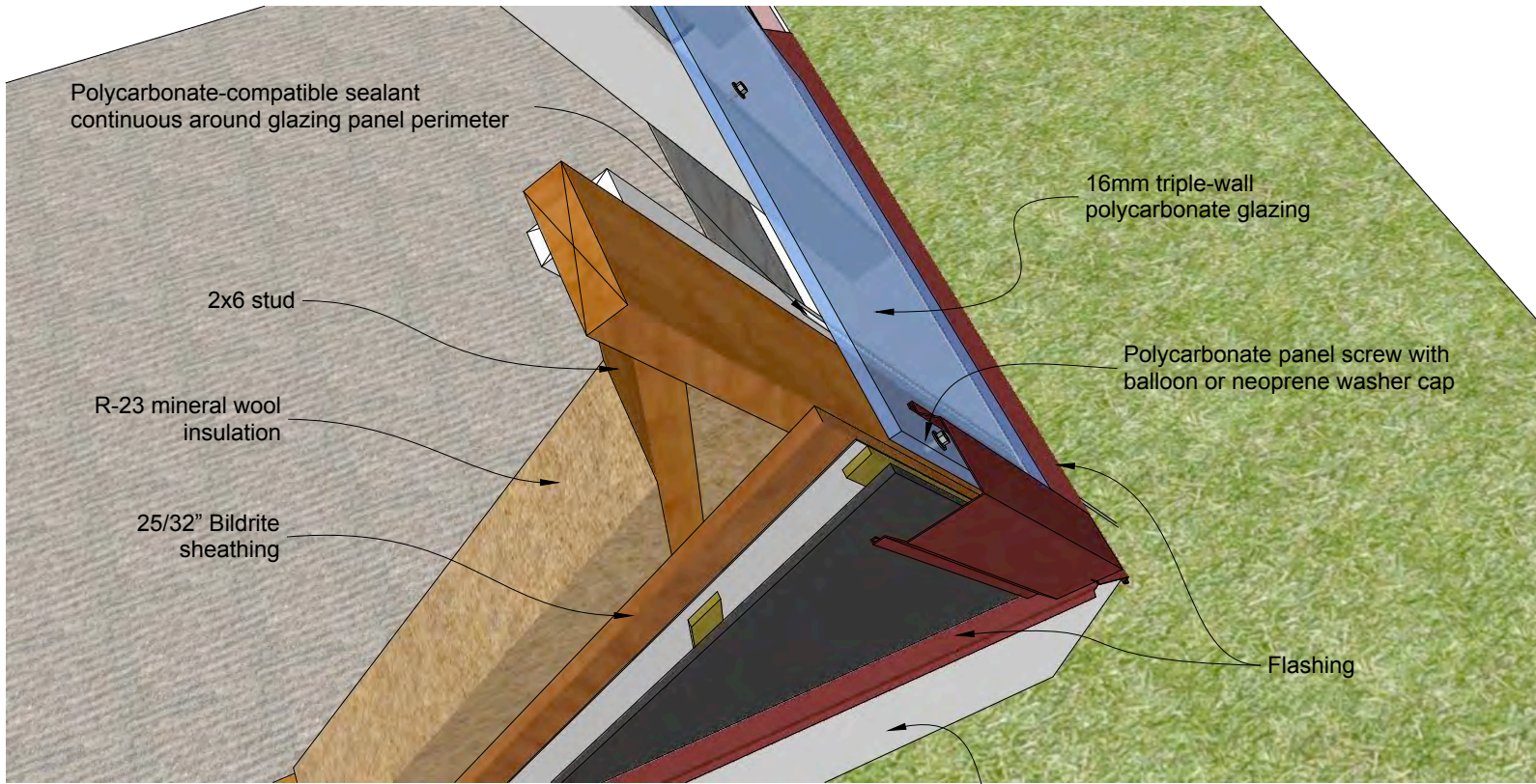
**Glazing wall/foundation knee wall extruded perspective** 1  
*n.t.s.* A.18





**Glazing wall/sidewall/foundation extruded perspective 1**

*n.t.s.* A.19

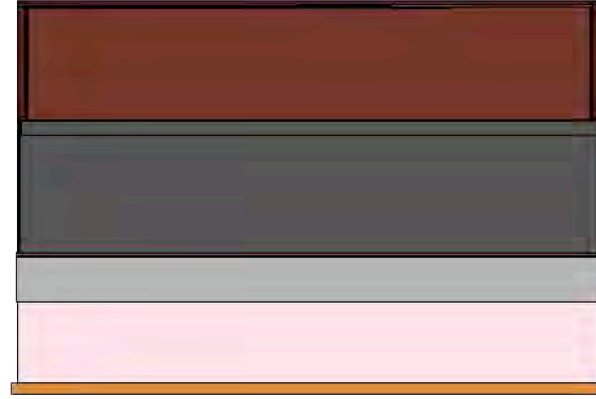


**Glazing wall/sidewall extruded perspective** 1  
*n.t.s.* A.20

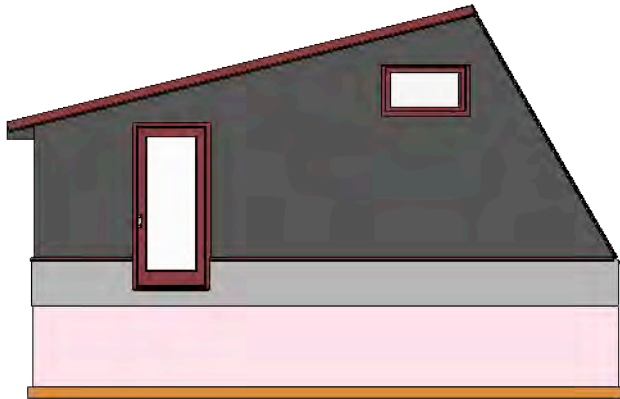




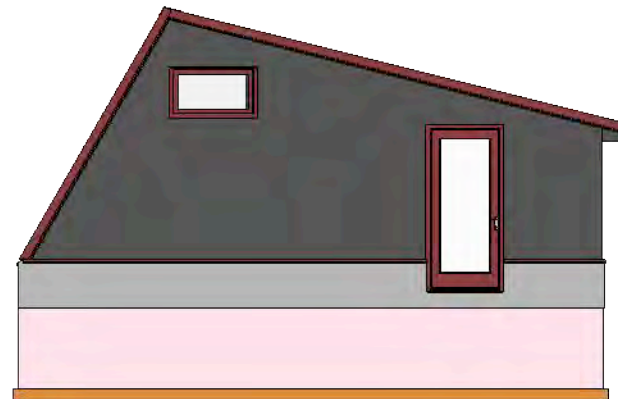
South Elevation



North Elevation

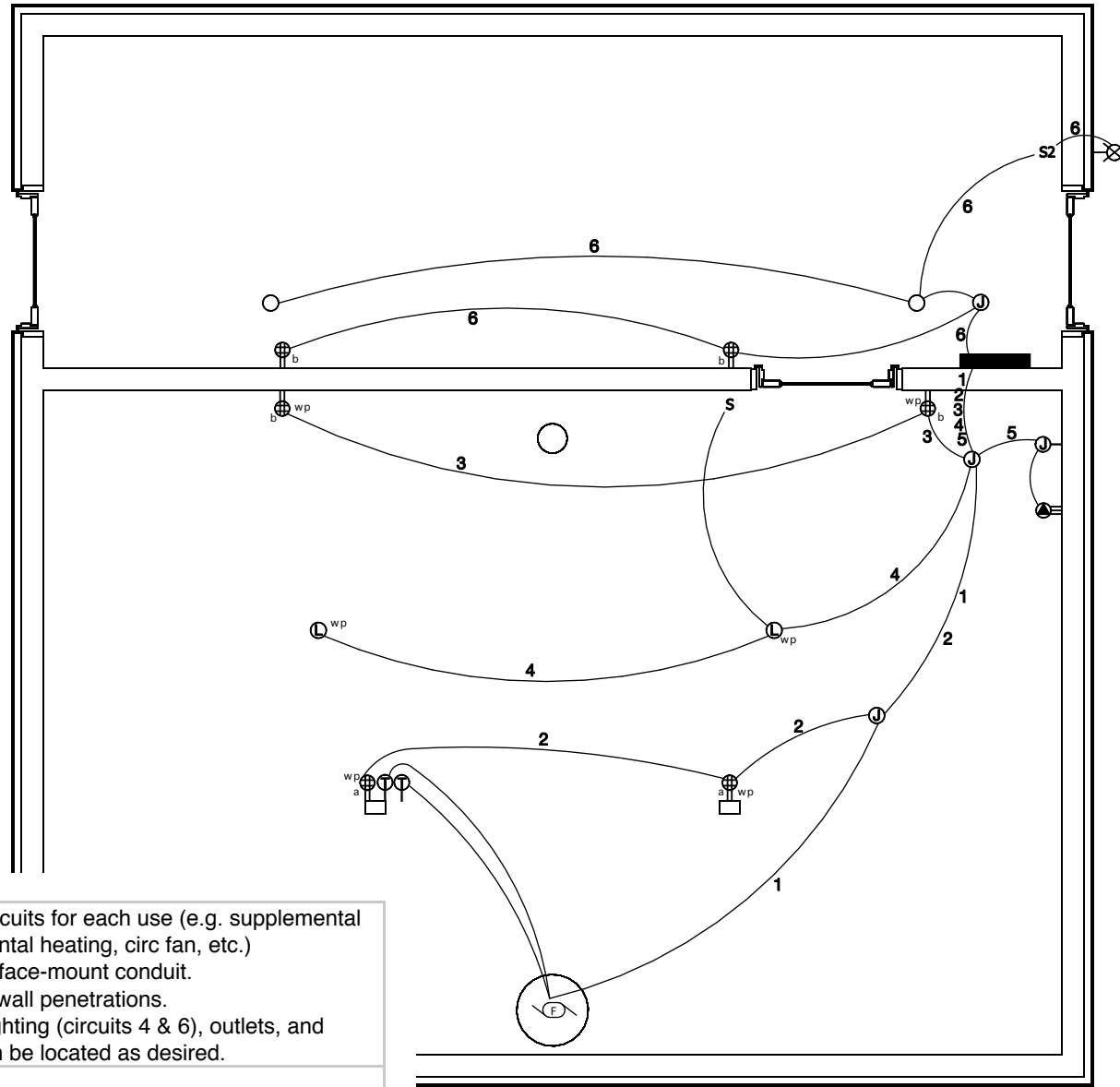


West Elevation



East Elevation





Notes:	Install separate circuits for each use (e.g. supplemental lighting, supplemental heating, circ fan, etc.) All electrical in surface-mount conduit. Minimize through-wall penetrations. Task and safety lighting (circuits 4 & 6), outlets, and junction boxes can be located as desired.
F	Fantech FR200
T	2@ Growers' Supply CR2031 mounted below (a)
▲	240v Heater: King KB2407-1-B2-ECO
a	mounted 8' high on post
b	mounted 4' high on wall

Electrical Plan 1  
1/4"=1' E.01



ROOF SHEATHING TO BE 1/2" APA RATED PANELS. NAIL TO SUPPORTING MEMBERS WITH 6d NAILS SPACED 6" ON CENTER AT PANEL EDGES AND 12" ON CENTER AT PANEL INTERIOR.

2x10 @ 24" ROOF RAFTERS  
CONNECT EACH JOIST TO BRG WALL TOP PLATE AT LOW END WITH SIMPSON TYPE H2.5 FRAMING ANCHOR. CONNECT TO RIDGE BEAM WITH SIMPSON TYPE LRU28Z RAFTER HANGER.

SPACING CHANGED TO 24" 2

2x10 @ 24" ROOF RAFTERS  
CONNECT EACH JOIST TO BRG WALL TOP PLATE EACH END WITH SIMPSON TYPE H2.5 FRAMING ANCHOR.

SPACING CHANGED TO 24" 2

REAR BEARING WALL:  
2x6 @ 24" WALL STUDS. SINGLE 2x6 TOP PLATE AND SINGLE 2x6 BOTTOM PLATE. ALIGN STUDS WITH RAFTERS ABOVE. 5/8" DIAM x 12" ANCHOR BOLTS TO FOUNDATION WALL. PLACE WITHIN 8" OF EACH END OF WALL AND 48" ON CENTER MAX BETWEEN ENDS.

SPACING CHANGED TO 24" 2

SHEATH EXTERIOR WALLS WITH 25/32" FIBERBOARD SHEATHING. NAIL TO STUDS AND PLATES WITH 11 GA. GALVANIZED ROOFING NAIL, 1 1/2" LONG, 1/8" HEAD SPACED 4" ON CENTER AT PANEL EDGES AND 6" ON CENTER AT PANEL INTERIOR.

CHANGED TO 25/32" FIBERBOARD 2

INTERIOR BEARING WALL:  
2x6 @ 24" WALL STUDS. SINGLE 2x6 TOP PLATE AND SINGLE 2x6 BOTTOM PLATE. ALIGN STUDS WITH RAFTERS ABOVE. 5/8" DIAM x 12" ANCHOR BOLTS TO FOUNDATION WALL. PLACE WITHIN 8" OF EACH END OF WALL AND 48" ON CENTER MAX BETWEEN ENDS. PROVIDE 2 - 2x6 HEADER OVER DOOR OPENING. MIN 1 - 2x TRIMMER STUD EACH JAMB. SHEATH EACH FACE OF INTERIOR WALL WITH 1/2" SHEETROCK. NAIL TO STUDS AND PLATES WITH 6d COOLER OR WALLBOARD NAILS (ALT #6 x 1 1/4" SCREWS) SPACED 7" ON CENTER AT ALL SUPPORTING MEMBERS.

SPACING CHANGED TO 24" 2

SIDE WALL (NEAR SIDE AND FAR SIDE):  
2x6 @ 24" WALL STUDS. SINGLE 2x6 TOP PLATE AND SINGLE 2x6 BOTTOM PLATE. 5/8" DIAM x 12" ANCHOR BOLTS TO FOUNDATION WALL. PLACE WITHIN 8" OF EACH END OF WALL AND WITHIN 8" OF DOOR JAMBS. SPACE 48" ON CENTER MAX BETWEEN ENDS. PROVIDE 2 - 2x6 HEADER OVER DOOR OPENING. MIN 1 - 2x TRIMMER STUD EACH JAMB.

SPACING CHANGED TO 24" 1

1 ROOF AND WALL FRAMING  
S1.0 NT5

2 4/19/17  
1 9/14/16

Project No. 16433  
Date 8/1/16  
Drawn By dhm

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.  
*David H. Macdonald*  
David H. Macdonald P.E.  
Date: 14751 License No.: 811/16

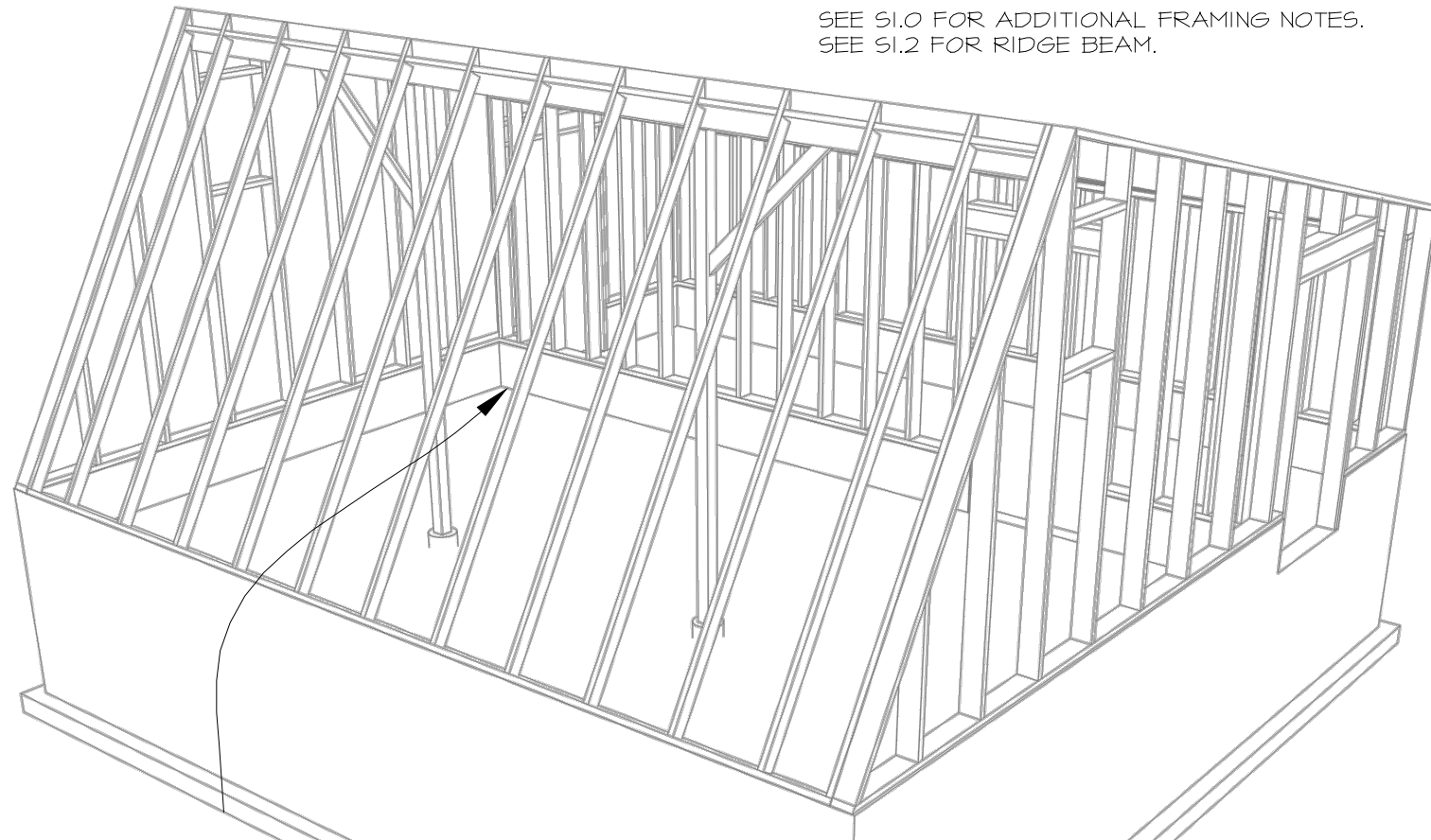
Mattison Macdonald Young  
**structural engineers**  
Bassett Creek Business Center  
901 North 3rd Street, Suite 100  
Minneapolis, MN 55401  
612-827-7825 voice  
612-827-0805 fax



Deep Winter Greenhouse  
Structural Requirements

Framing

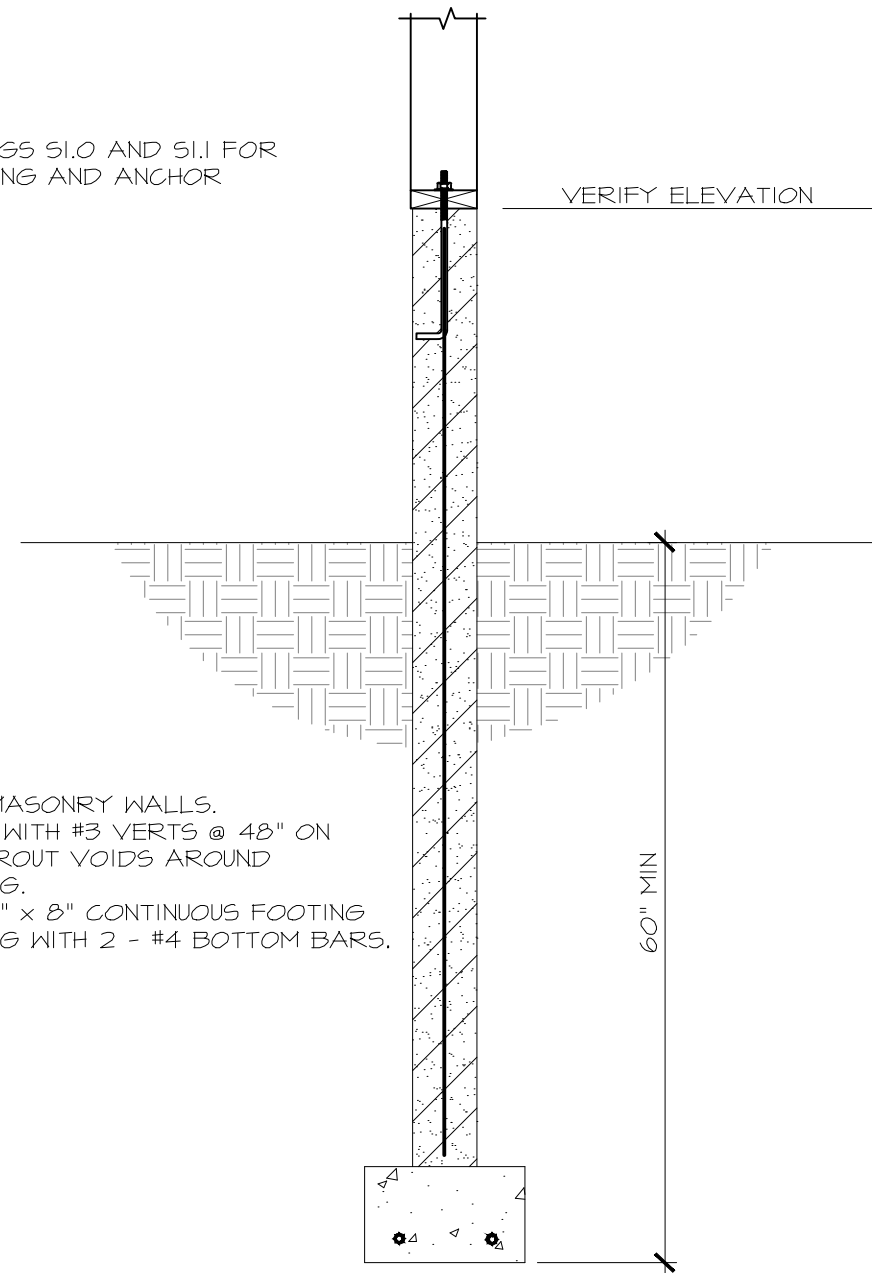
S1.0



SEE S1.0 FOR ADDITIONAL FRAMING NOTES.  
SEE S1.2 FOR RIDGE BEAM.

FRONT WALL FRAMING:  
2x4 RAFTERS @ 24" ON CENTER MAX.  
ANCHOR TO SILL PLATE WITH 4 - 10d TOE NAILS  
ANCHOR TO RIDGE BEAM WITH SIMPSON TYPE LRU26Z RAFTER HANGER.  
ANCHOR SILL PLATE TO FOUNDATION WALL WITH 5/8" DIAM x 12" ANCHOR BOLTS. PLACE ONE BOLT WITHIN 8" OF END OF WALL, 48" ON CENTER BETWEEN ENDS.

SEE DRAWINGS S1.0 AND S1.1 FOR WALL FRAMING AND ANCHOR BOLTS.



6" BLOCK MASONRY WALLS.  
REINFORCE WITH #3 VERTS @ 48" ON CENTER. GROUT VOIDS AROUND REINFORCING.  
PROVIDE 14" x 8" CONTINUOUS FOOTING REINFORCING WITH 2 - #4 BOTTOM BARS.

VERIFY ELEVATION

60" MIN

1 ROOF AND WALL FRAMING  
S1.1 NTS

2 TYPICAL FOUNDATION WALL  
S1.1 3/4" = 1'-0"

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I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

*David H. Macdonald*

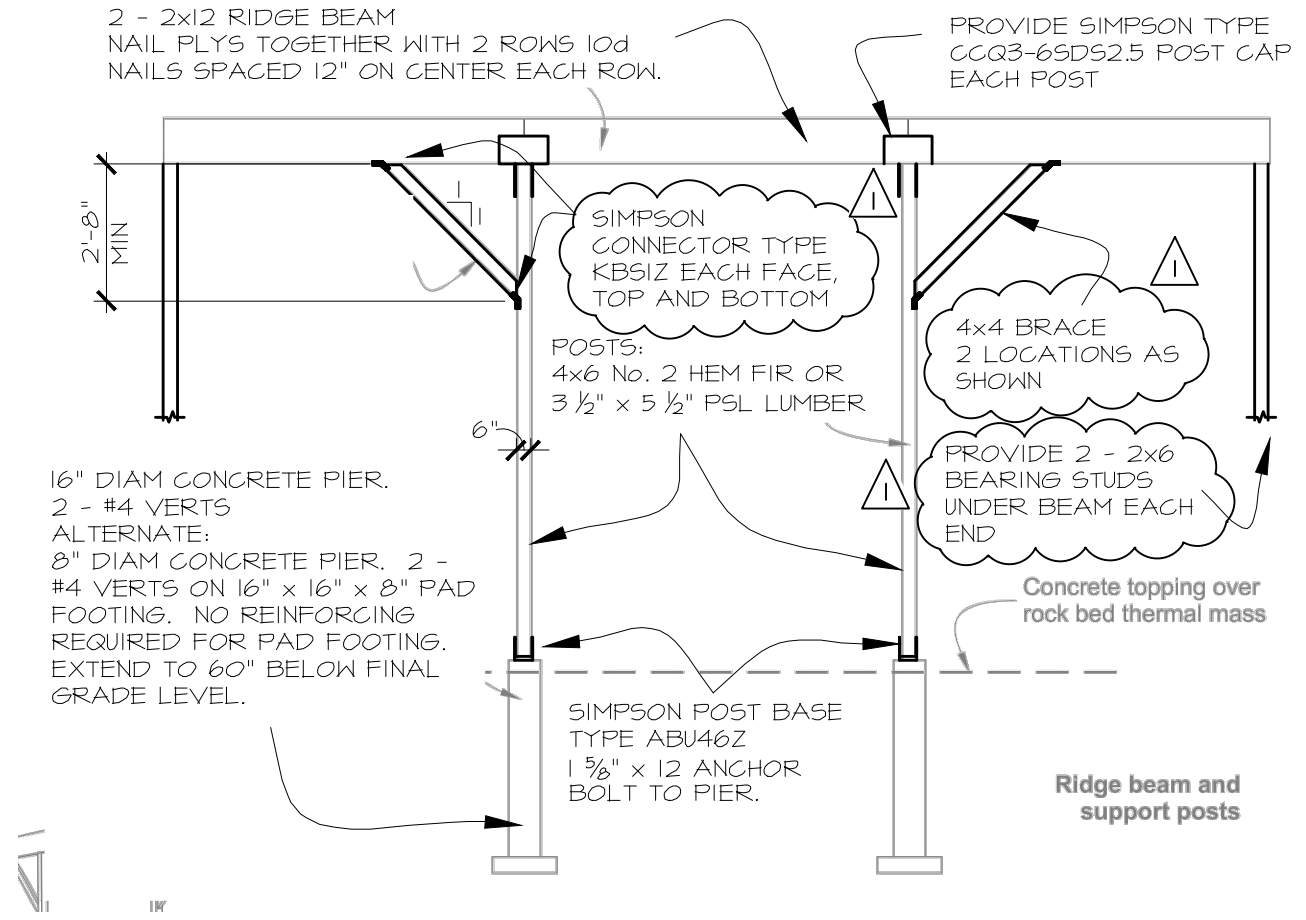
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Project No. 16433  
Date 8/1/16  
Drawn By dhm

Deep Winter Greenhouse  
Structural Requirements

Framing

S1.1



2 - 2x12 RIDGE BEAM  
 NAIL PLYS TOGETHER WITH 2 ROWS 10d  
 NAILS SPACED 12" ON CENTER EACH ROW.

PROVIDE SIMPSON TYPE  
 CCQ3-6SDS2.5 POST CAP  
 EACH POST

SIMPSON  
 CONNECTOR TYPE  
 KBS1Z EACH FACE,  
 TOP AND BOTTOM

POSTS:  
 4x6 No. 2 HEM FIR OR  
 3 1/2" x 5 1/2" PSL LUMBER

4x4 BRACE  
 2 LOCATIONS AS  
 SHOWN

PROVIDE 2 - 2x6  
 BEARING STUDS  
 UNDER BEAM EACH  
 END

16" DIAM CONCRETE PIER.  
 2 - #4 VERTS  
 ALTERNATE:  
 8" DIAM CONCRETE PIER. 2 -  
 #4 VERTS ON 16" x 16" x 8" PAD  
 FOOTING. NO REINFORCING  
 REQUIRED FOR PAD FOOTING.  
 EXTEND TO 60" BELOW FINAL  
 GRADE LEVEL.

SIMPSON POST BASE  
 TYPE ABU46Z  
 1 5/8" x 12 ANCHOR  
 BOLT TO PIER.

Concrete topping over  
 rock bed thermal mass

Ridge beam and  
 support posts

1 RIDGE BEAM AND POSTS  
 S1.2 NTS

Project No. 16433  
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 Drawn By dhm

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Deep Winter Greenhouse  
 Structural Requirements

Framing

1 9/14/16

S1.2