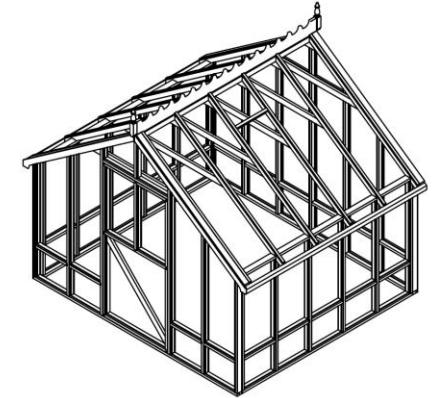


The DIY Floating-Panel Greenhouse



By,
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Introduction

Description, Photos & Materials List

This greenhouse was designed to follow a few simple principles.

- Keep the design and assembly simple, e.g. use templates instead of measuring repeated dimensions.
- Use as few fasteners as possible. Screws and nails are entry-points for weather and bugs, and thus deterioration.
- Make components replaceable, e.g. roof and wall panels are “floating,” captured by the vertical or horizontal boards.

To achieve this, I chose to dado (slot) all of the boards to “capture” the wood and polycarbonate panels, instead of using a separate piece of wood with screws to secure the panels. The result, no screws or glue needed for any of the panels! And because they “slide” into place, they can be easily replaced if/when they are damaged. I have provided several photos and CAD drawings to help you.

This greenhouse was designed and built in 5 days. With the right tools, an average woodworker could expect to complete this project in 3 weekends. Here are some tips:

- Always do a test assembly, prior to final assembly.
- If you are going to paint the greenhouse, do this step prior to installing the polycarbonate panels. You need to paint the dados (slots) to seal and protect the wood from moisture and rot.
- Do not use treated lumber for the greenhouse, as the chemicals will poison your plants! This is especially important if you want to grow edible plants (vegetables, fruits, etc.). You can use rot-resistant wood, e.g. cedar.
- To prevent rot at the base of the greenhouse, I suggest a single treated lumber (or cedar) board between the bottom rail and the ground.
- Be safe, especially when cutting the dados. Use ear and eye protection. Take your time.

Enjoy your new greenhouse!



Roof panels captured in slots cut into the wood, held with 1 screw.



Simple, manually operated, hinged roof vent.



Wall panels captured in slots cut into the wood, no nails or screws.



Cantilevered shelf and work bench for open floor space.



4 hand-operated vents placed on each wall.



Router detail on fascia boards.

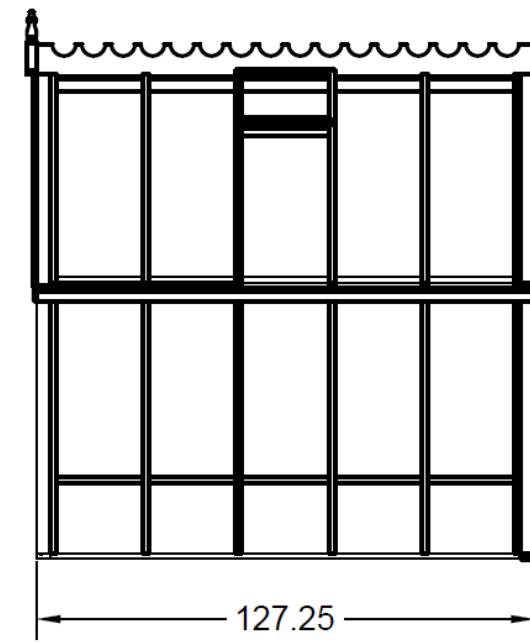
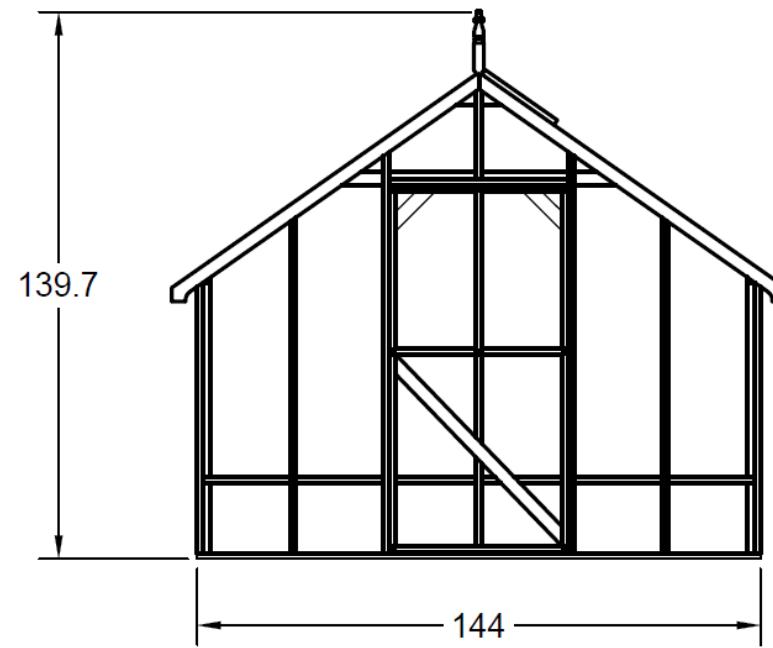
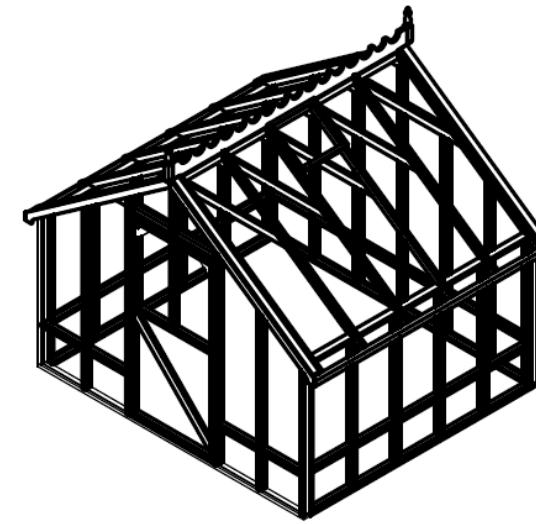
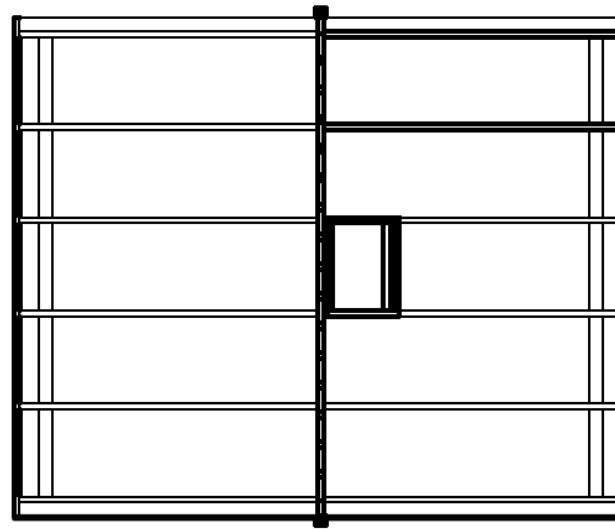


Fancy handle and latch.



Router detail on spine.

3-VIEW

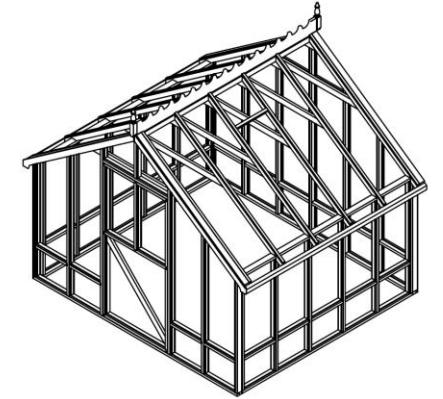


Materials	
Quantity	Dimensions & Description
55	2" x 4" x 8' Douglas Fir
4	2" x 4" x 10' Douglas Fir
9	2" x 4" x 12' Douglas Fir
1	2" x 12" x 12' Douglas Fir
2	1" x 8" x 12' Prime Pine
4	2" x 4" x 12' Pressure Treated Wood (direct-ground-contact wood)
3	0.344" x 48" x 96" Plywood Siding Plybead Panel
30	0.3125" x 24" x 96" Polycarbonate Clear Multiwall Roof Panel (made by Sunlite)
2	24" Table Legs
4	14" x 8" Wall/Ceiling Register with Adjustable Dampers
1	Set of 3 Door Hinges (Outdoor-Rated)
2	Door-latch (Outdoor-Rated)
1	Door Knob (Outdoor-Rated)
1	Set of 2" hinges (Outdoor-Rated)
1	Automatic greenhouse vent opener.
3	Tubes Pure Silicone Caulk (Outdoor-Rated)
4	Gallons Paint (Outdoor-Rated)
4	Boxes (100 count) #8, 3.5" Structural Screws (Deck Screws)
1	Bottle Green Tightbond Glue (green is outdoor-rated)
1	3' chain for door catch
3	Rolls of 3/4" weather seal
1	3"x 8' angled drip rail
1	Box galvanized screws for polycarbonate panels

Power Tools
Miter Saw
Table Saw, with Dado Blade & Rip Blade
Circular Saw
Jigsaw
Router, with 1/2" Roundover Bit
Power Drill, with 1/8" Drill Bit

Hand Tools
Hand Saw
Stanley #4 Hand-plane
Dead-Blow Hammer
Phillips Screw Driver
1" Chisel
Caulk gun
3" & 8" roller covers
3" & 8" roller handles
2" disposable paint brush

Optional Materials	
Quantity	Dimensions & Description
Heating & Cooling	
1	box fan
1	Electric oil-filled radiator portable space heater
1	thermostat
1	automatic vent opener
Sun-shade	
6	1" x 6' hardwood dowels
1	8'x20 sun screen fabric
2	Packs of 1/16" cable clamps (total of 4 clamps)
1	1/16" x 50' vinyl coated wire rope (96 lb working load limit)
2	Packs of #6 screw eyes (total of 6 eyes)
2	Packs of #210 screw eyes (total of 12 eyes)
3	7/32" x 6 1/4" turnbuckles (55 lb working load limit)
Workbench & Shelf	
12	2"x4"x8' studs
1	Box of 2" structural screws



Build Process

Templates

Preliminary Steps

Before building the greenhouse you will need some templates to assist in assembly, see Figure 1.

- (1) 4" x 4" Biscuit made from the plywood wall panel, make sure to chamfer the edges!
- (1) 22.25" template cut from 2" x 4" x 8' board.
- (1) 18" template cut from 2" x 4" x 8' board.

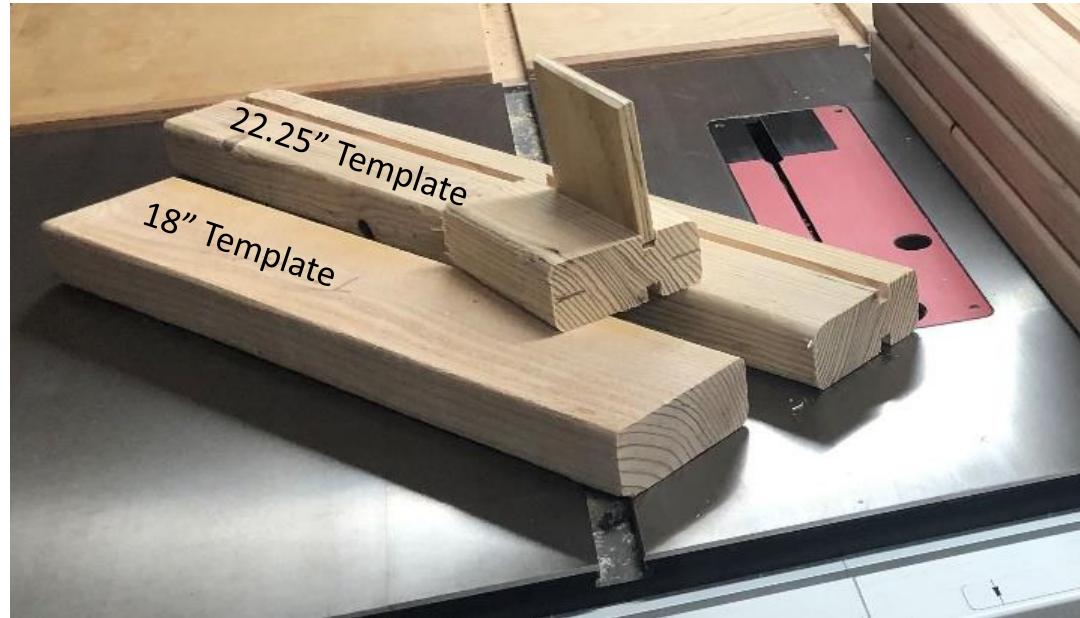
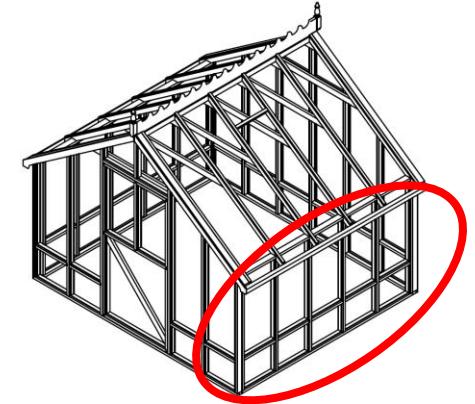


Figure 1



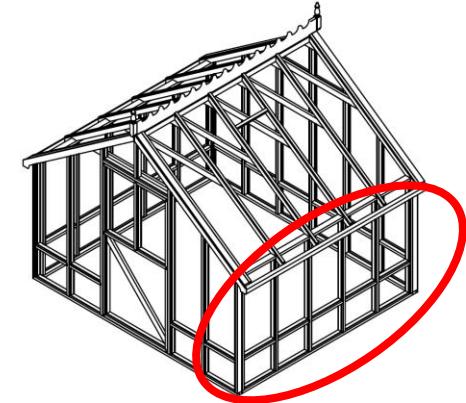
Build Process

Side Walls

Materials

For the side walls (see image to the right) you will need:

- (16) 2" x 4" x 8' boards
- (4) 2" x 4" x 12' boards
- (3) 4' x 8' plywood panels (note: should get 10 panels from one 4x8 sheet)
- (10) 2' x 8' polycarbonate panels



Steps

1. Cut wall panels as shown in Figure 2, to the sizes listed below.
 - (10) Plywood: width = 22.75", height 18.5"
 - (10) Polycarbonate: width = 22.75", height = 50"
2. Chamfer the edges of the plywood panels with a hand-plane. This will make assembly much easier.
3. Cut dados in each board as shown in Figures 3 & 4, also see Figures 9 & 10.
 - Dado: width = 3/8", depth = 3/8", distance from edge = 1"
 - **Note: the boards along the left/ right/ bottom/ top only need a dado on one side. All other boards need dados on both sides.**
4. Chamfer dado edges using a hand plane as shown in Figure 5. This will make assembly much easier.
5. Cut each board to the length shown in Figure 8.
6. Fasten the bottom rail to the vertical studs as shown in Figure 6 using the following steps:
 - Use the biscuit to align the bottom and vertical dados.
 - Drill 2 holes with a 3/16" bit.
 - Fasten rail to vertical with 2 structural screws.
 - Use 22.25" spacer to set distance between each vertical stud.
7. Slide plywood panels into place (you may need a hammer if the dados are tight) and secure top of each plywood panel with a 22.25" board using the 18" template to set the vertical spacing. Use pocket-hole fasteners to secure each 22.25" board to the vertical studs. See Figures 6 & 7.
8. Paint assembly, including dados for polycarbonate panels.
9. Slide polycarbonate panels into place, and secure top using a 120.25" board. See Figure 7.



Polycarbonate panels cut to size

Plywood panels cut to size

Figure 2



Dados (slots).

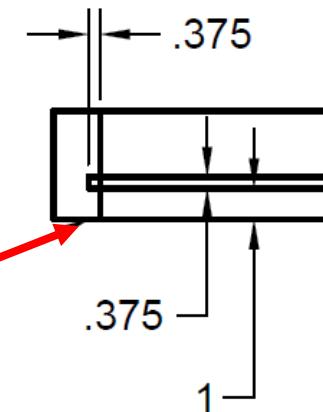
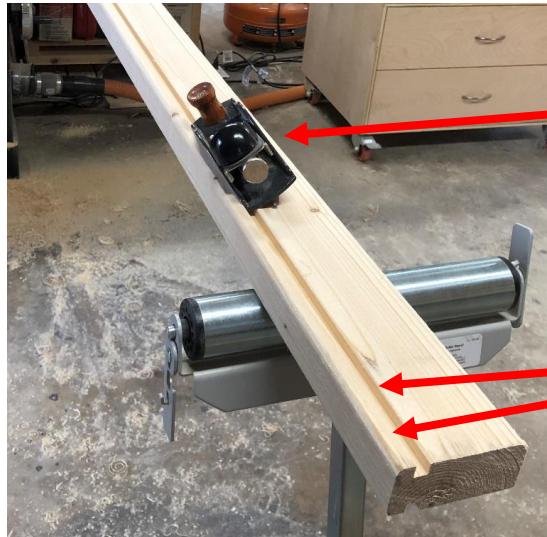


Figure 4

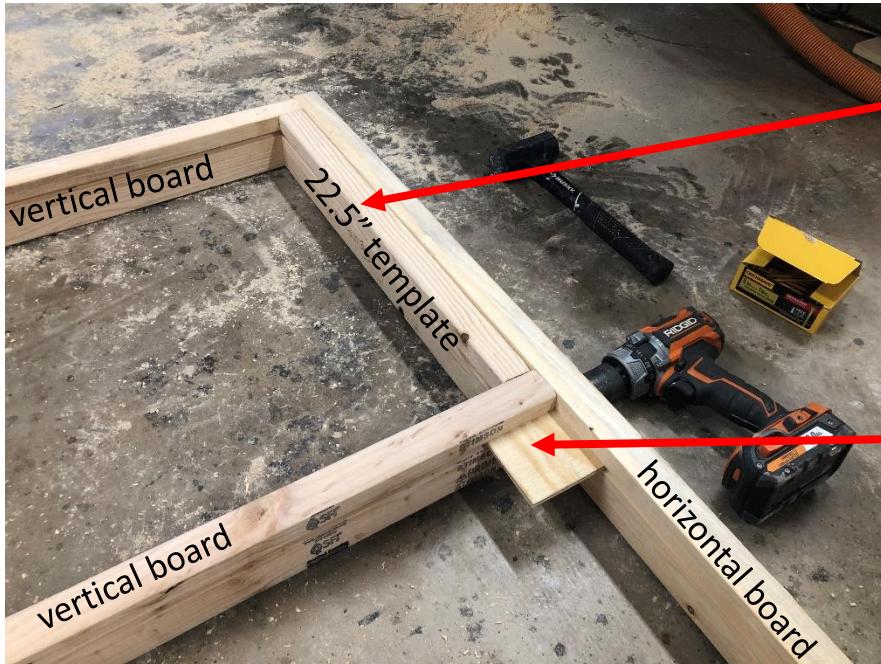
Figure 3



Stanley #4 hand-plane.

Chamfer both edges of dados.

Figure 5



Use 22.5" Template to maintain consistent spacing between vertical boards.

Biscuit inserted into dado to align both pieces.

Figure 6



Use 18" Template while securing horizontal boards with screws, to maintain consistent spacing between horizontal boards.

Repeat for each horizontal board.

This operation will “capture” the “floating” plywood panels in the dados.

Figure 7

SIDE WALL

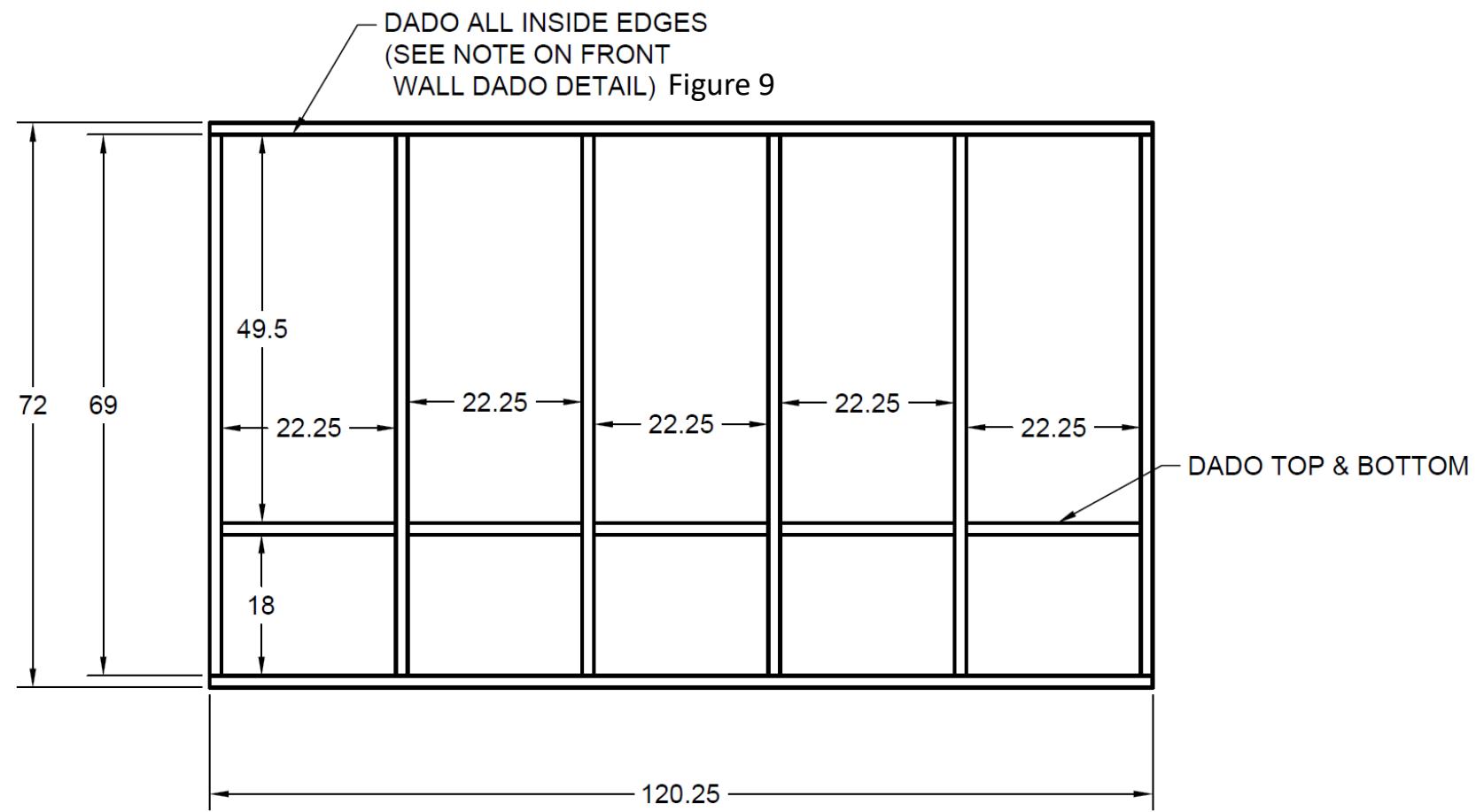


Figure 8

FRONT WALL DADO DETAIL

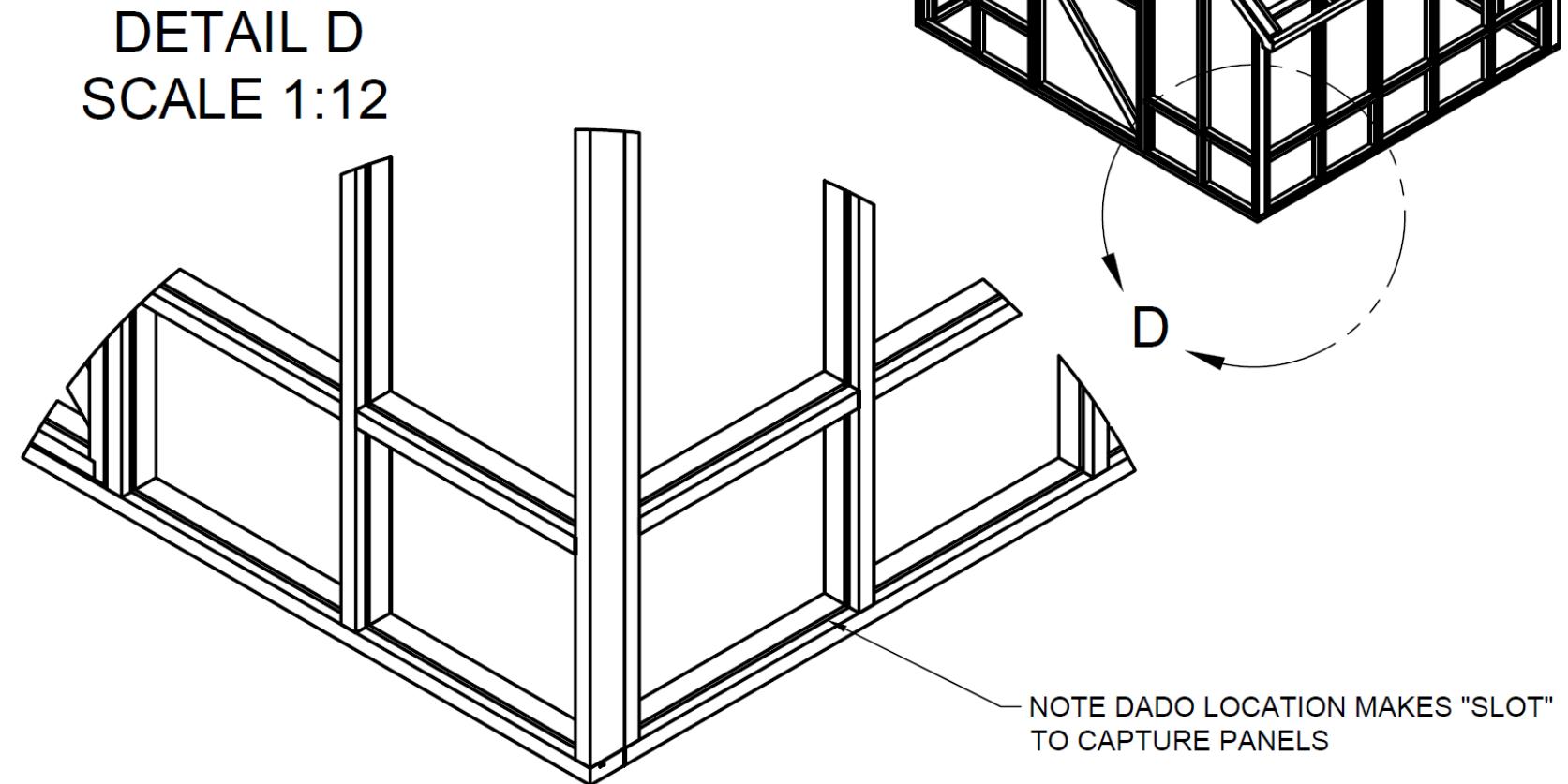


Figure 9

FRONT WALL DADO DETAIL

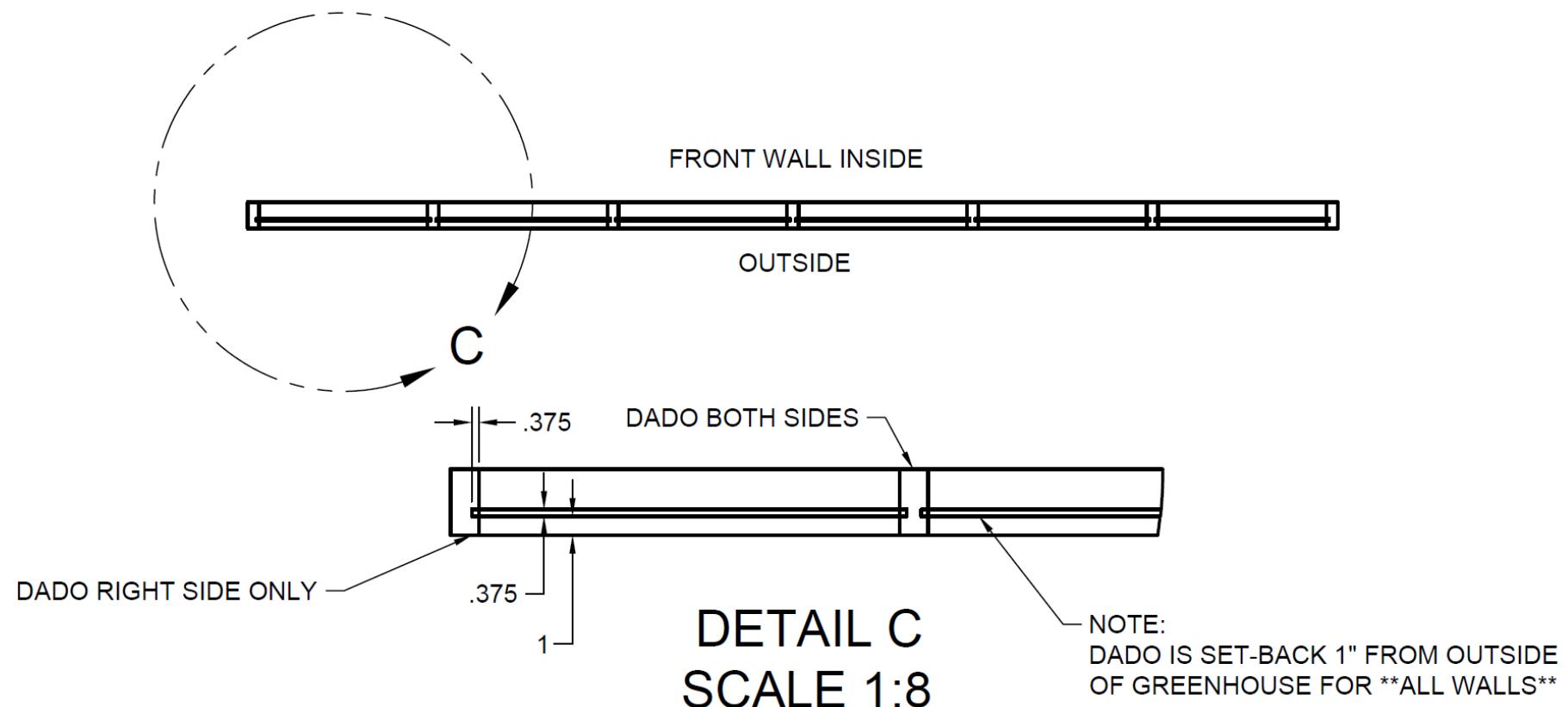
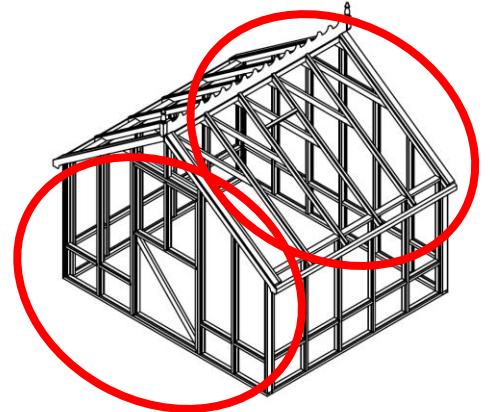


Figure 10



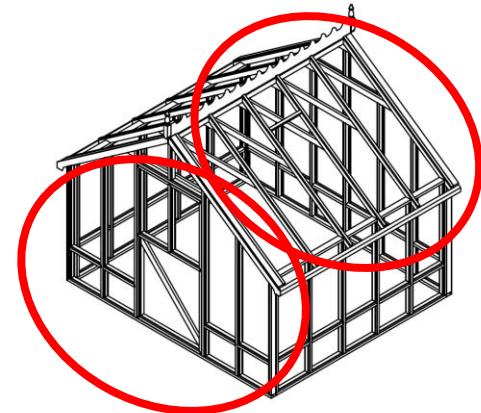
Build Process

Front and Back Walls

Materials

For the front and back wall (see image to the right) you will need:

- (16) 2" x 4" x 8' boards
- (4) 2" x 4" x 10' boards
- (3) 2" x 4" x 12' boards
- (1.5) 4' x 8' plywood panels (note: should get 10 panels from one 4x8 sheet)
- (12) 2' x 8' polycarbonate panels



Steps

The Front & Back walls follow the same process, and use the same templates and dado settings as the side walls.

1. Cut wall panels as shown in Figure 2, to the sizes listed below.

- (10) Plywood: width = 22.75", height 18.5"
- (12) Polycarbonate: width = 22.75", height = varies. Make sure you add 0.5" to your measurement before you cut the angles! This 0.5" will fit in the dado both top and bottom (0.25" in each).

Important Note: Measure and cut these after test assembly so that your panels are the correct size!

2. Dado each board as shown in Figures 3 & 4, also see Figures 9 & 10.

- Dado: width = 3/8", depth = 3/8", distance from edge = 1"
- **Note: the boards along the left/ right/ bottom/ top only need a dado on one side. All other boards need dados on both sides.**

3. Chamfer the dado edges using a hand plane as shown in Figure 5.

4. Cut each board to the length shown in Figures 12 & 13.

- **Important Note: Because the vertical boards have fractional measurements (e.g. 71.55"), it is recommended to assemble the bottom board with all vertical boards, then mark the cut with a straight-edge, then cut the angle for the roof-line. This will ensure that all vertical boards align with roof-line board.**

5. Fasten the bottom rail to the vertical studs as shown in Figure 6 using the following steps:

- Use the same steps as the side walls.

6. Slide plywood panels into place, and secure top of each plywood panel with a 22.25" board using the 18" template to set the vertical spacing. See Figures 11, 12, 13.

7. Paint assembly, including dados for polycarbonate panels.

8. Slide polycarbonate panels into place, and secure top using a 96" board (to be cut to length of 93.08" after assembly of entire greenhouse). See Figures 11, 12, 13.



Figure 11

Note: on the back wall these panels are not full-length. This is done so that the back matches the outline of the rafters.

See “Back Wall” CAD drawing.

BACK WALL

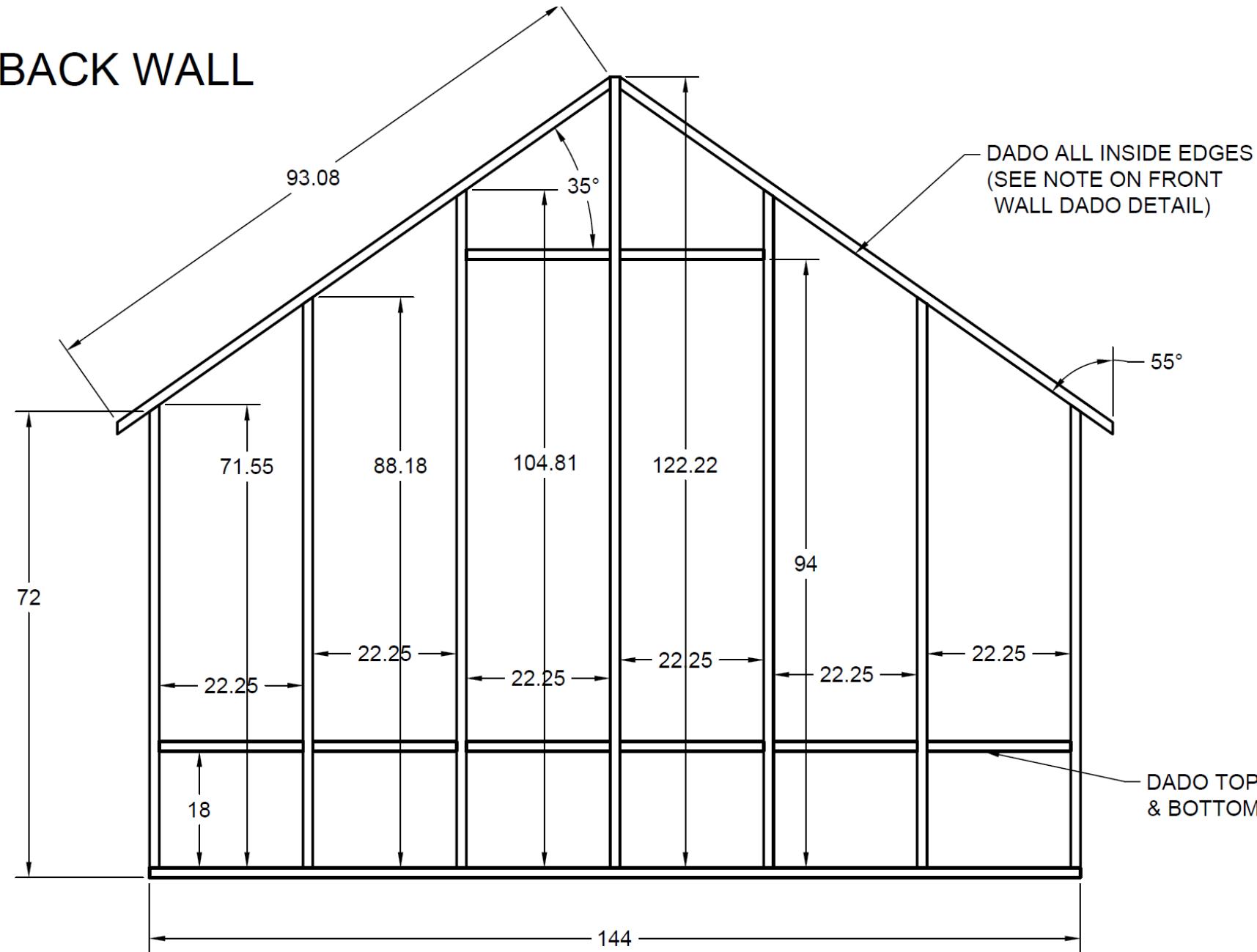


Figure 12

FRONT WALL

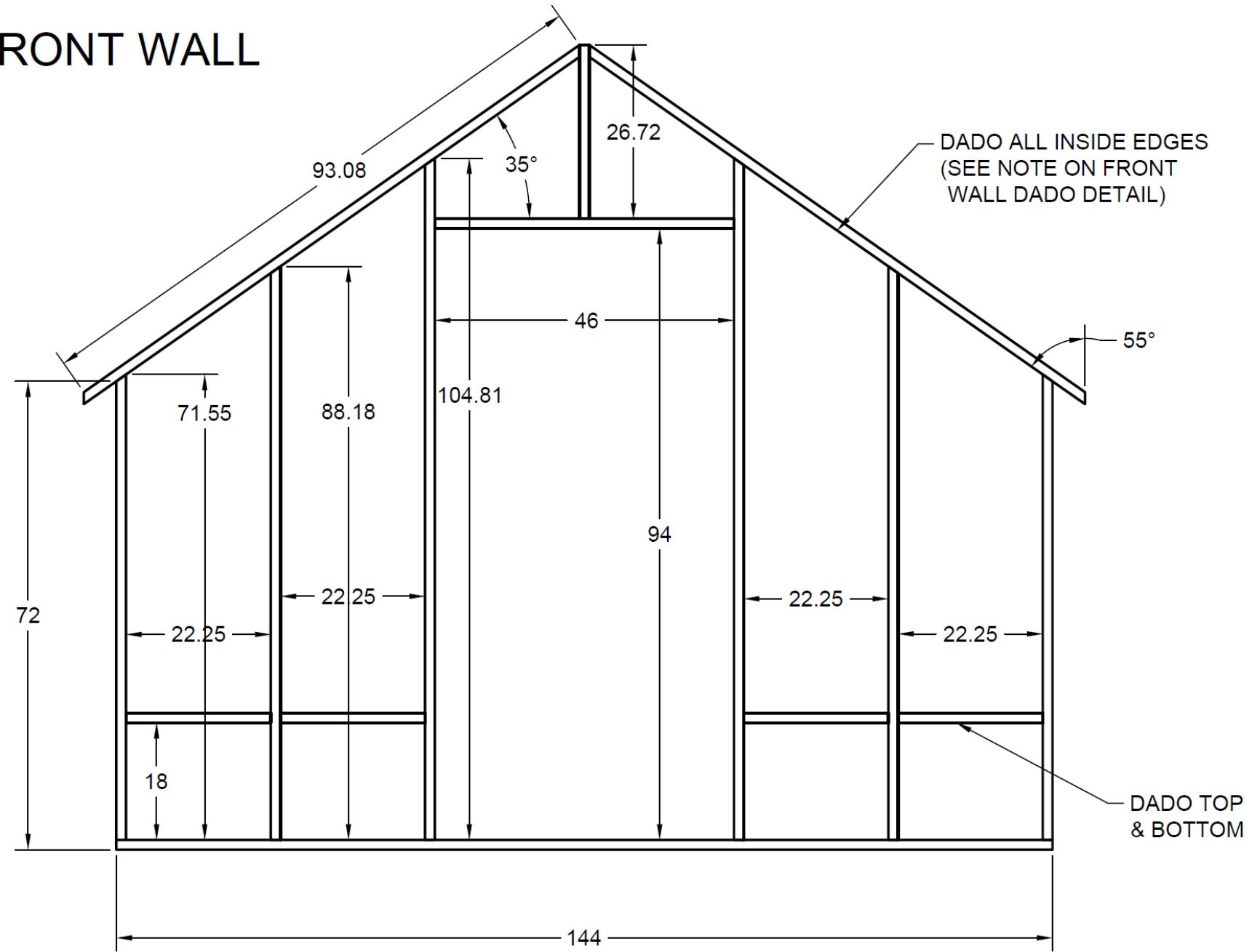
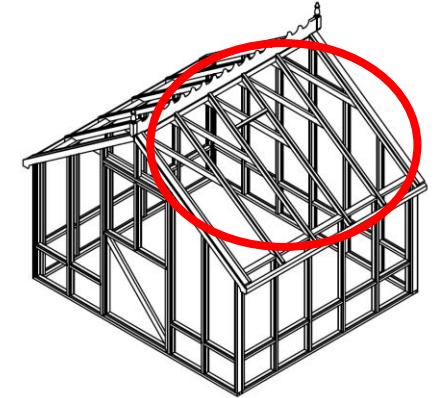


Figure 13



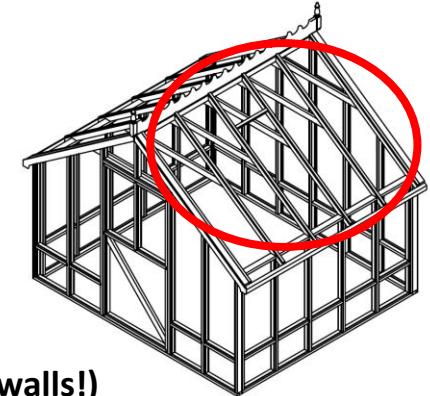
Build Process

Rafters

Materials

For the rafters (see image to the right) you will need:

- (18) 2" x 4" x 8' boards



Steps

The rafters are comprised of four (4) pieces each.

1. Dado each roof-line board as shown in Figure 14.
 - Dado: width = 3/8", depth = 3/8", **distance from edge = 0.5"** (**this is different than the walls!**)
 - **Note: dados on both sides.**
2. Chamfer the dado edges using a hand plane as shown in Figure 5.
3. Cut each board to the length shown in Figure 15.
4. Cut a 55° angle on the top of each rafter board, and the 35° angles on each of the top and middle braces, see Figure 15.
5. Measure and cut the 90° notch at the based of each rafter , see Figure 15.
6. Use the 18" Template on edge to set the 1.5" distance between the top of the 2 rafters.
7. Fasten the rafters to the top and middle braces using 2 structural screws at each attachment point, the result should look like Figures 14 & 15.
8. Paint assembly, including dados for polycarbonate panels

RAFTER DADO DETAILS

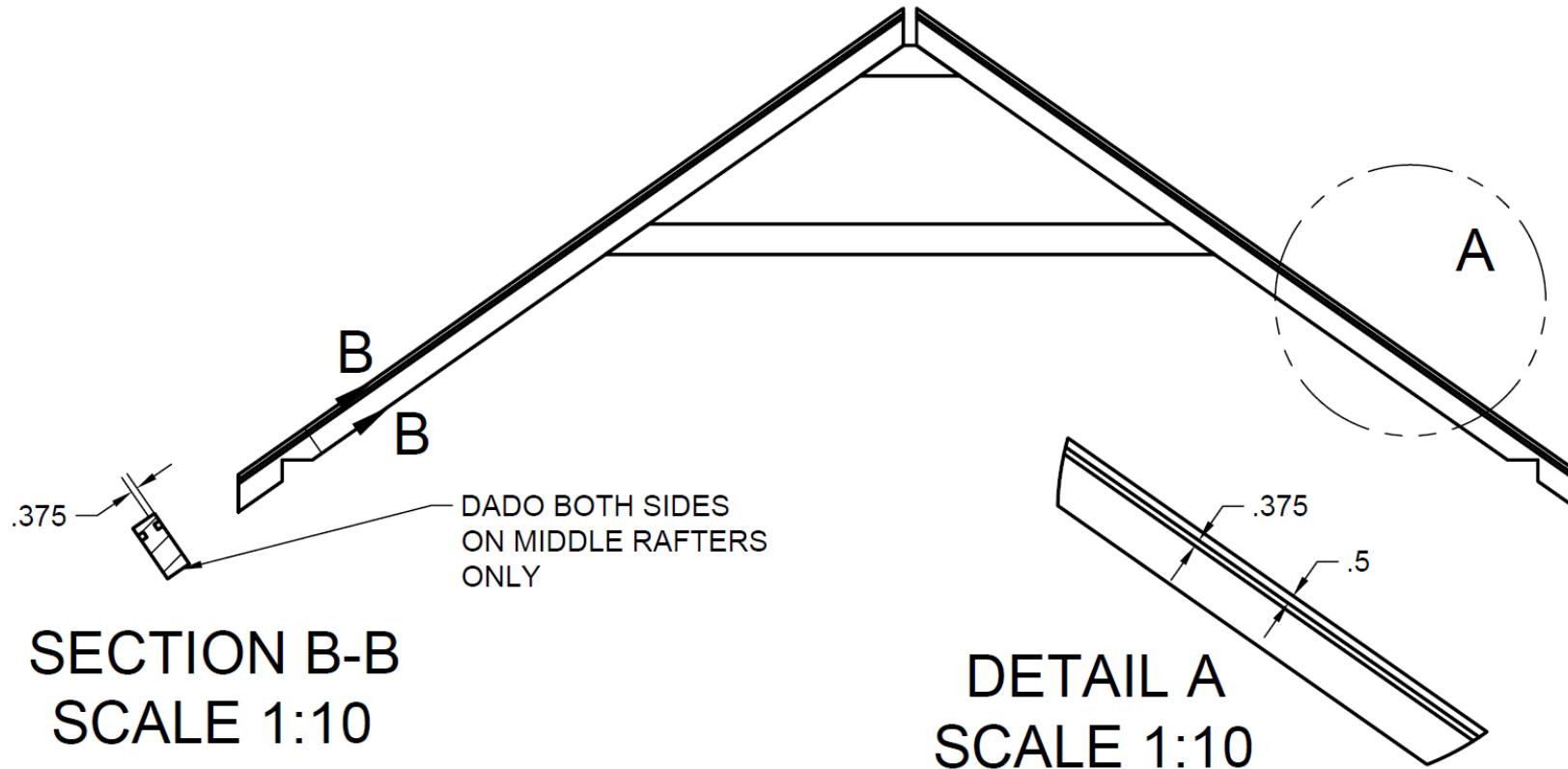


Figure 14

RAFTER

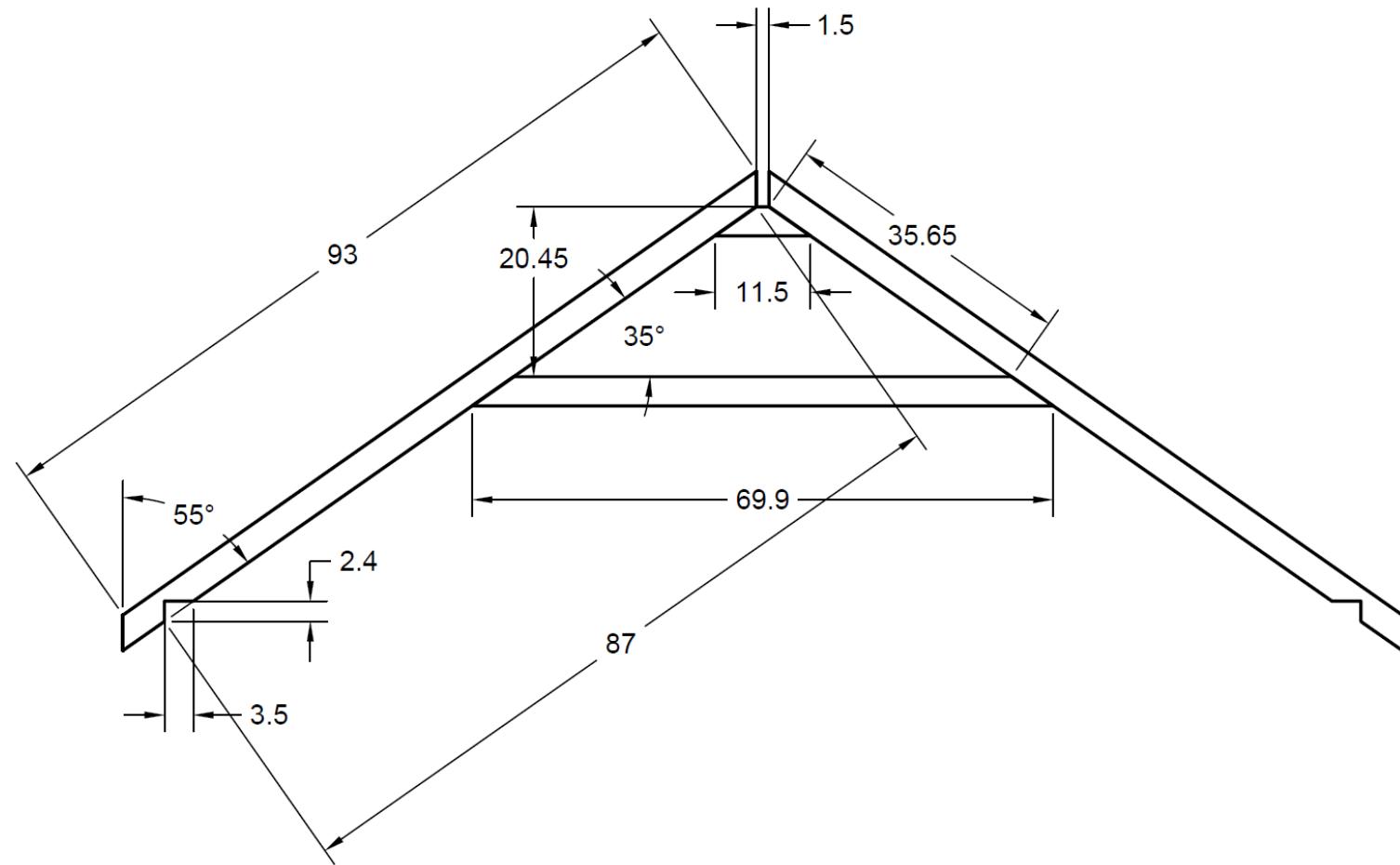
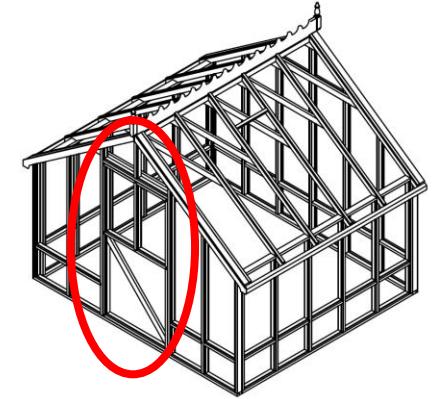


Figure 15



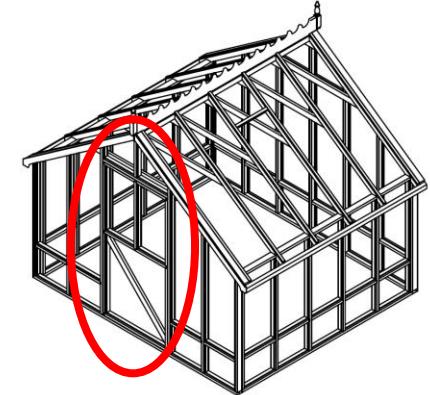
Build Process

Door

Materials

For the door (see image to the right) you will need:

- (4) 2" x 4" x 8' boards
- (0.5) 4' x 8' plywood panel (scrap from side walls)
- (1) 2' x 8' polycarbonate panel (scrap from side walls)



Steps

1. Cut door panels as shown in Figure 16, to the sizes listed below.
 - (1) Plywood: width = 43", height 49.5"
 - (2) Polycarbonate: width = 21", height = 40.5"
2. Dado each board as shown in Figure 16
 - Dado: width = 3/8", depth = 3/8", distance from edge = 1" (same depths/distances as the walls in Figures 9 & 10).
 - **Note: the boards along the left/ right/ bottom/ top only need a dado on one side. All other boards need dados on both sides.**
3. Chamfer the dado edges using a hand plane as shown in Figure 5.
4. Cut each board to the length shown in Figure 16.
5. Cut a rabbet¹ (notch) at the connection points as shown in Figure 16. This will add structural rigidity when assembled.
6. Cut 3 braces for the angled board as shown in Figure 16. These add structural rigidity.
 - Attached the lower brace so that it is flush with the lower plywood panel.
 - **Note: if you decide to put the hinges on the left side of the door, then you must flip (like a mirror) the orientation of the brace, as the “load-path” of the weight of the door is carried through the door in the direction from door handle to lower hinge.**
 - Attach the upper braces so that they are flush with the back of the door.
7. Test-fit the assembly, inserting the panels captured by the horizontal and vertical boards. Be sure to check the fit of the rabbets!
8. Paint assembly, including dados for polycarbonate panels.
9. Assemble using **Tightbond glue on the rabbets, and fasten with 3 structural screws at each attachment point.**
10. Install door hinges.
 - Note: hinges must be along the edge shown in Figure 16, so that the angled brace supports the door. If you want the door to open the other direction, you need to flip the angle of the brace.

DOOR

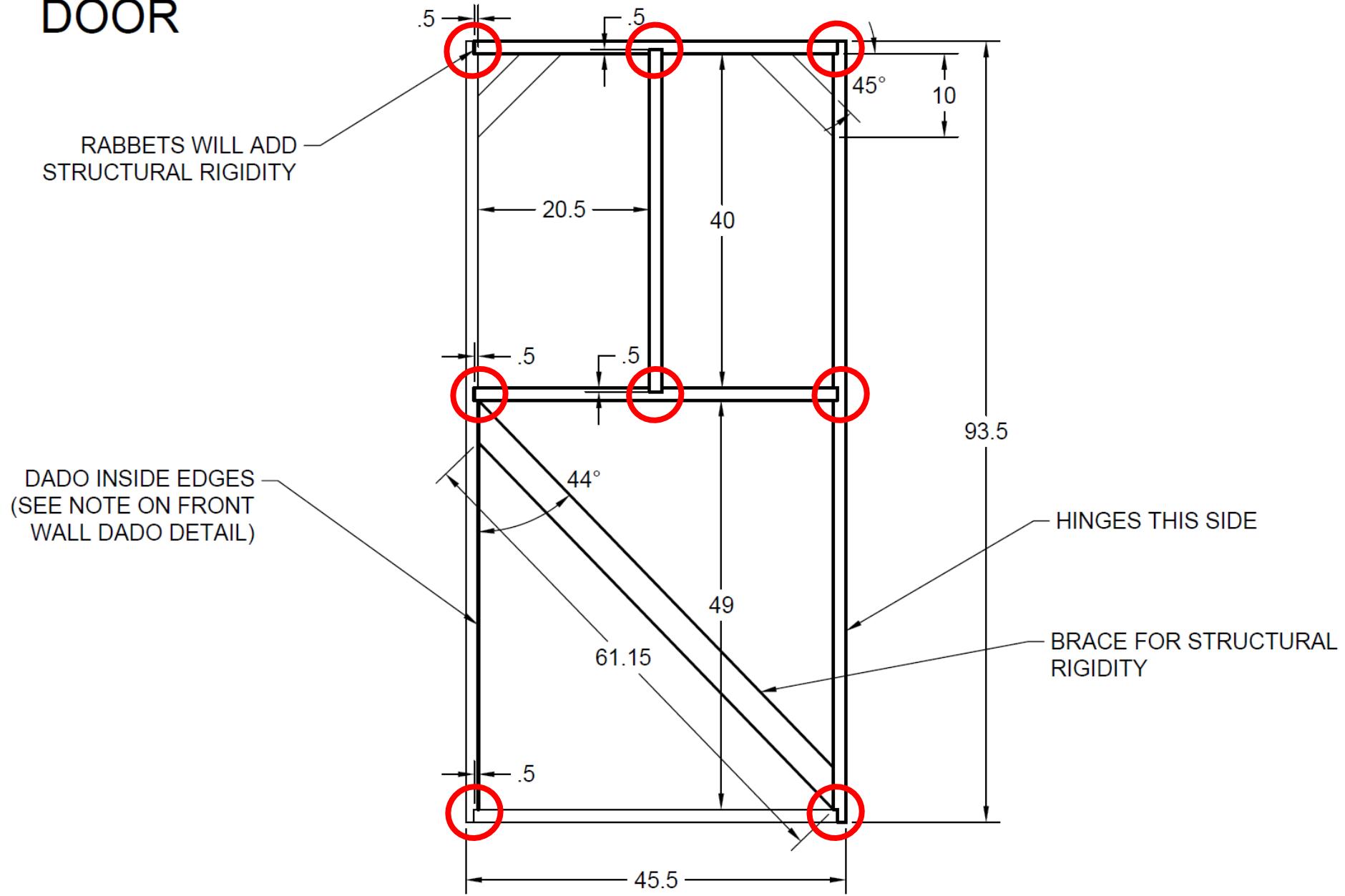
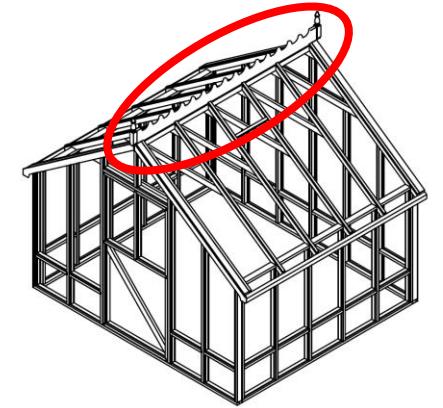


Figure 16



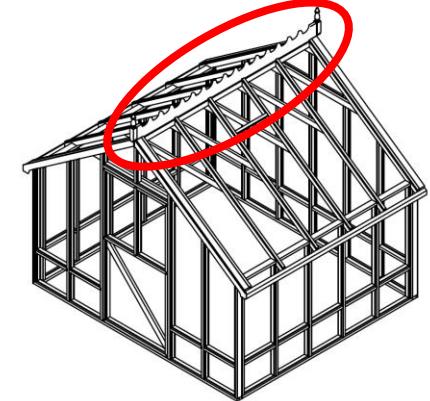
Build Process

Spine

Materials

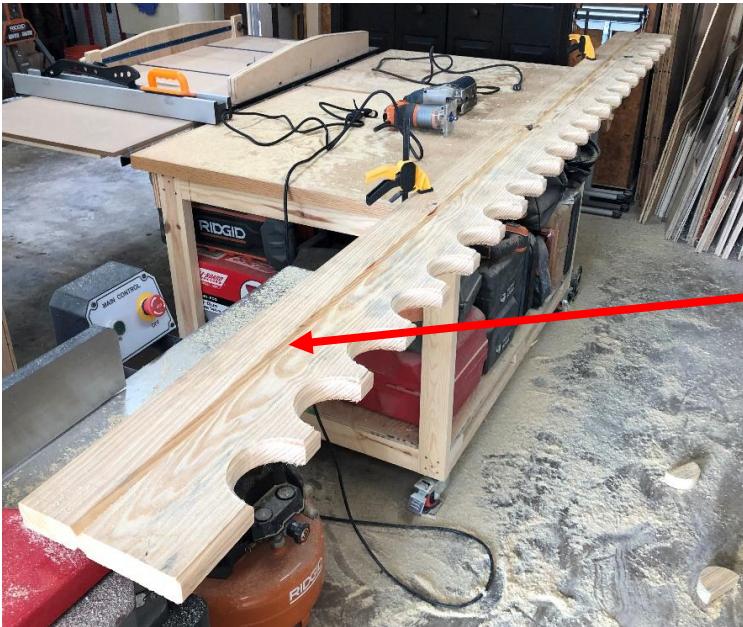
For the Spine (see image to the right) you will need:

- (1) 2" x 12" x 12' board



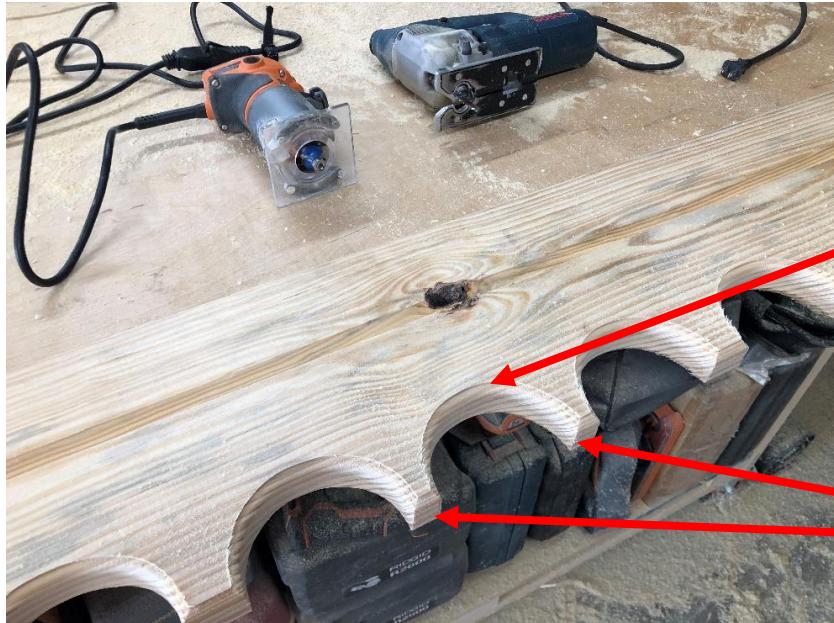
Steps

1. Cut a **35° angled dado** as shown in Figures 17 & 19.
 - Dado: width = 1/2", depth = 1/2", **distance from bottom edge = 3.125"**
 - **Note 1: dados on both sides with apposing angles (see Figure 19 lower detail).**
 - **Note 2: for a long dado, make sure you use "feather boards" on the table saw to keep the dado straight! Also enlist the help of someone to help guide the board through the feather boards.**
2. Chamfer the dado edges using a hand plane as shown in Figure 5.
3. Cut the board to length, as shown in Figure 19.
4. Cut the 3.5" x 4.25" end notches, as shown in Figure 19.
5. Cut 16 scallops with a 3" radius, as shown in Figure 19.
 - Note 1: Use a 3" radius template, so that all scallops will be the same.
 - Note 2: Trace 8 scallops from one end, then again from the other end, meeting in the middle. This way, any error in your measurement will make the middle scallop (or point) smaller/larger than the others, resulting in a symmetric appearance, see Figures 17 & 18.
6. With a router, and a $\frac{1}{2}$ " round-over bit, extended 1/8" past the round (to create a step in the wood), round over all scalloped edges as shown in Figures 17 & 18.
7. Paint spine, including dados for polycarbonate panels.



35° angled dado cut on
both sides

Figure 17



Notice “step” in round-over profile.
This is achieved by extending the bit
1/8” past the round-over part of the
bit.

Notice that a small measurement
error resulted in these 2 peaks to be
shorter in width than all of the
others. Because this is the middle,
the spine “looks” symmetric.

Figure 18

SPINE

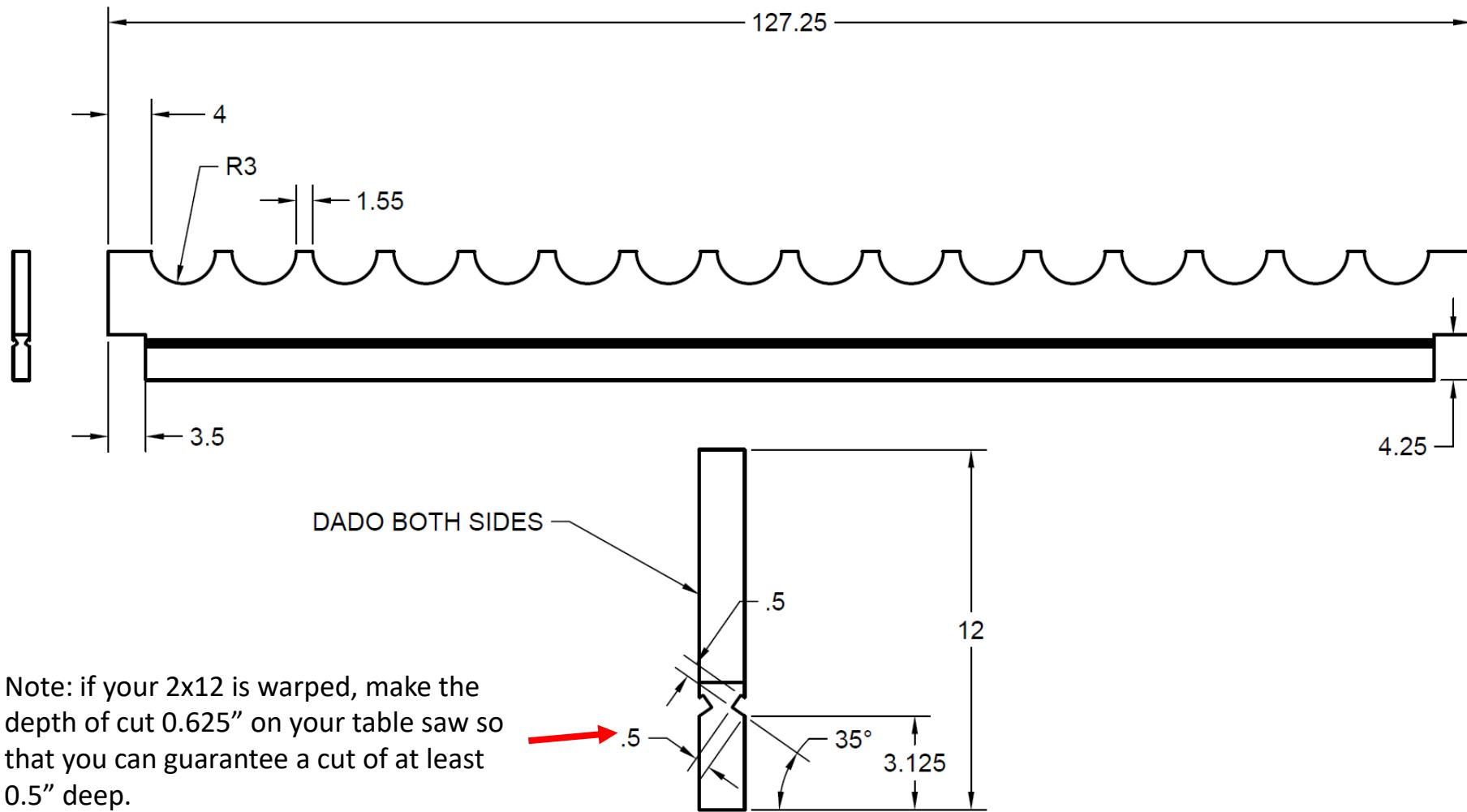
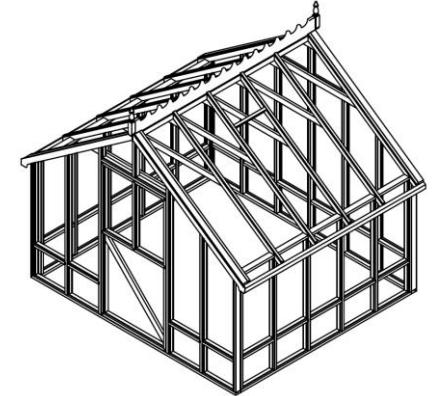


Figure 19



Build Process

Assembly: Walls, Door, Rafters & Spine

Job-site Preparation

Before you erect the walls of your greenhouse, do these prep tasks:

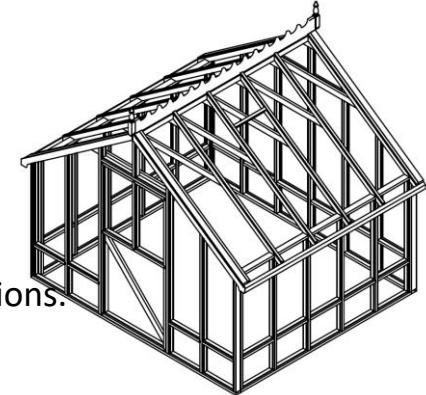
1. Level a pad for your greenhouse and add 2-3" of gravel for water irrigation and rodent suppression.
2. Install a treated lumber foundation frame, be sure to square this frame and secure it to the ground with stakes. This will ensure that the walls of the greenhouse are square.



Materials

For the assembly (see image to the right) you will need:

- 1 box #8, 3.5" structural screws



Steps

1. Fasten the side walls to the back wall, using structural screws in 4 equally spaced vertical locations.
 - **Note the wall-to-wall connection / orientation in Figure 9 Detail D.**
2. Fasten the front wall to the side walls.
 - **Note the wall-to-wall connection / orientation in Figure 9 Detail D.**
3. Place the rafter assemblies on the side walls, aligned with side wall vertical boards.
4. Place the spine, inserting it into the slot of each rafter assembly.
5. Fasten the rafter assemblies:
 1. Attach one rafter assembly to the back wall, and one to the front wall, using 6 structural screws along the roofline. See Figure 9.
 2. The remaining rafter assemblies are spaced so that they align with the side wall vertical boards.
 1. **Measure and adjust the separation at the top (at the spine) and bottom (at the wall) so that the distance for both are 22.25".**
 2. Fasten using 2 screws at the top (on both sides connecting to the spine) and 2 at the bottom (on both sides, connecting to the side walls).
6. Fasten fascia to base of rafters so that the top is flush with the lower line of the dado on the rafters; this will enable you to slide the roof panels into place and secure them with a single screw. Use a 2"x4"x10' stud, with a top cut at 35° to match the angle of the roof, see Figures 20 & 21.
7. Fasten fascia to front wall. Use 1"x6"x10' pine and secure with screws, see Figures 22 & 23.
8. Fasten decorative finials (table legs) to spine, see Figure 24.
9. Cut hole and install vents on front and back walls, see Figures 25 & 26.
10. Install door, see Figure 27. Note hinge locations, see Figure 25.
11. Install latch, see Figure 27.
12. Install door chain and eye-blots on the inside of the door, to limit door swing to roughly 135°, see Figure 28.
13. Install door stop, see Figures 29 & 30.



Figure 20



Figure 21

Side wall facia BOTH sides walls.

35° top angle on facia matches the angle of the roof.



Figure 22



Figure 23

Front wall fascia BOTH sides.

Use router to make a nice round-over and step detail.



Decorative finials.

Figure 24



Figure 25

Note hinge locations.

The vents are centered on the panel both FRONT wall and BACK wall.

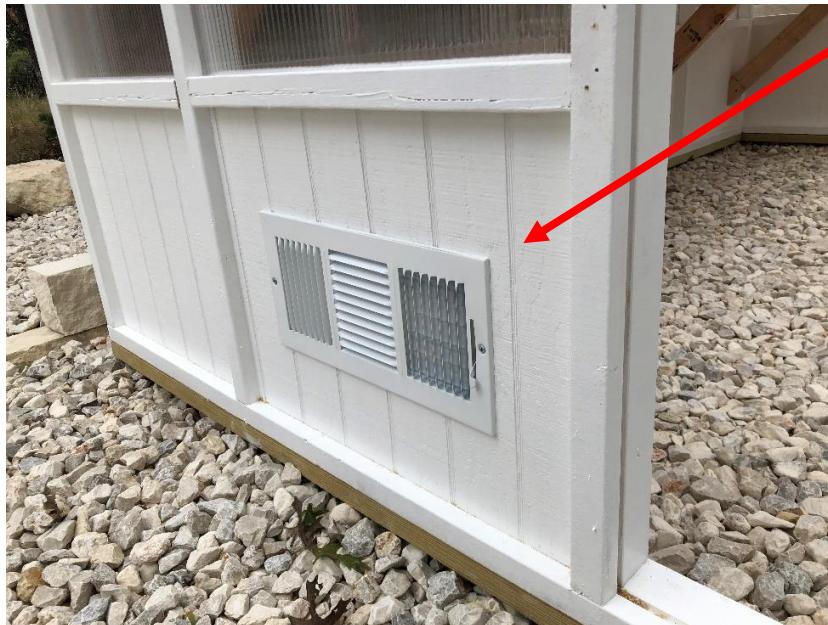
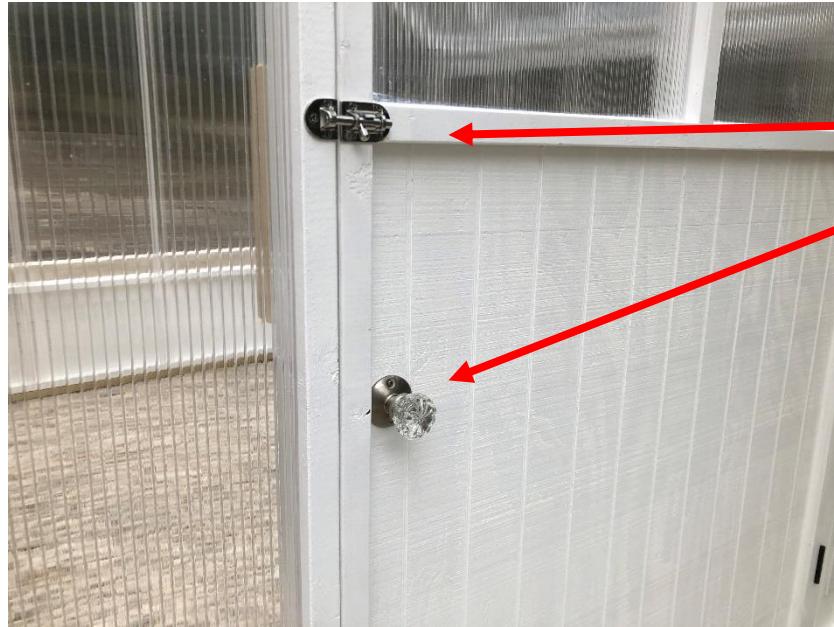


Figure 26



Latch and door handle.

Figure 27



Chain for door catch.

Figure 28

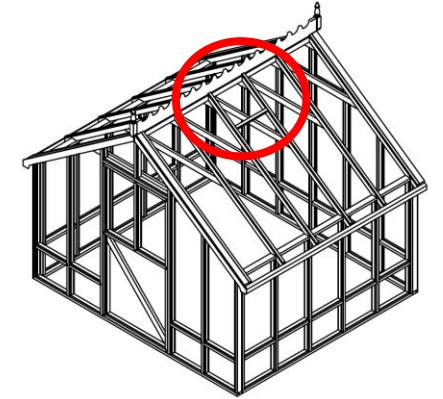


Figure 29

Top and Bottom door stop.



Figure 30



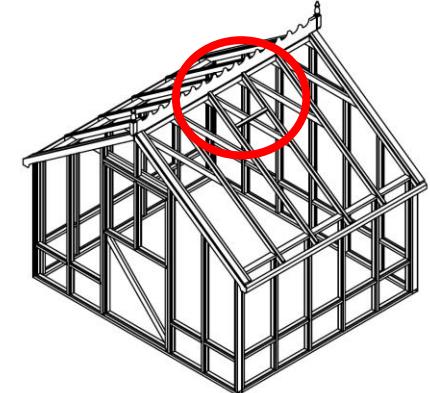
Build Process

Vent

Materials

For the vent (see image to the right) you will need:

- (1) 2" x 4" x 8' board (scrap from side walls)
- (1) 2' x 8' polycarbonate panel (scrap from side walls)



Steps

1. Cut vent panel as shown in Figure 34, to the size listed below.
 - (1) Polycarbonate: width = 22.75", height = 21.5"
2. Cut (4) 2"x4" boards to 2' length.
3. Dado each board, as shown in Figure 34
 - Dado: width = 3/8", depth = 3/8", **distance from edge = 0.5" (same distance as rafters)**
 - **Note: dados on both sides.**
4. Cut boards to thickness, as shown in Figure 34.
5. Cut boards to the length, as shown in Figure 34.
6. Cut mortise & tenon joints using a simple table saw jig, as shown in Figures 31 & 32.
 - Note: You can also use half-lap joints, but mortise and tenon joints are stronger.
7. Test-fit the assembly with the polycarbonate panel.
8. Paint assembly, including dados for polycarbonate panels.
9. Assemble using **Tightbond glue on the joints, and fasten with 2 structural screws at each attachment point.**
10. Cut and dado (1) 2"x4"x22.25" board. Dado should be same as rafter settings. Install roof brace for vent using vent to distance from spine, see Figure 33.
11. Install vent:
 1. Attach Vent to spine using 2 hinges placed 2" from ends of vent, see Figure 33.
 2. Attach springs to inside corners of vent and inside corners of roof, see Figure 33.
 3. Attach weather seal to roofline perimeter of vent opening , see Figure 33.
12. Install Drip Rail:
 1. Cut a 28" drip-rail
 2. Apply silicone caulk to back (this will prevent water from leaking between the drip rail and spine)
 3. Center above installed vent and fasten to spine with 3 screws, see Figure 33.

Mortise & Tennon table saw jig made from scrap material.

This jig holds the boards vertical, while cutting the “tenon shoulder” or “mortise pocket” with consecutive passes through the saw blade.



Figure 31

Resulting Mortise & Tenon Joints

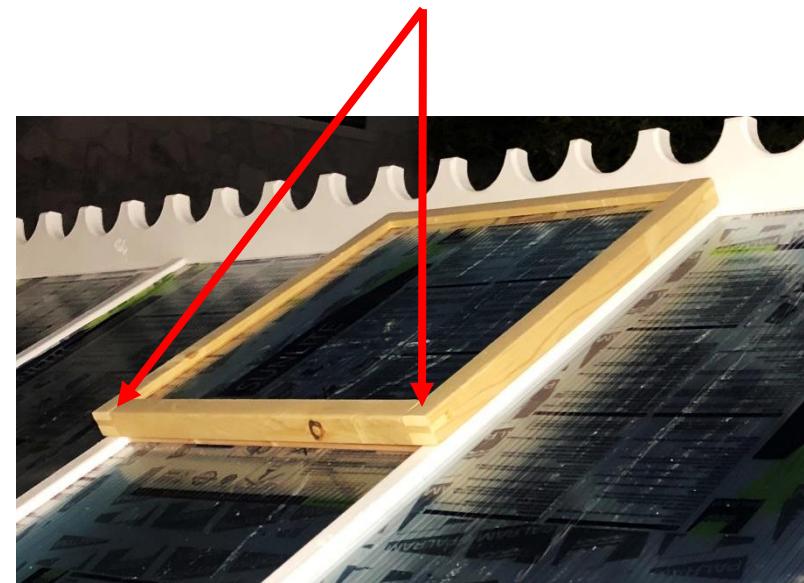


Figure 32

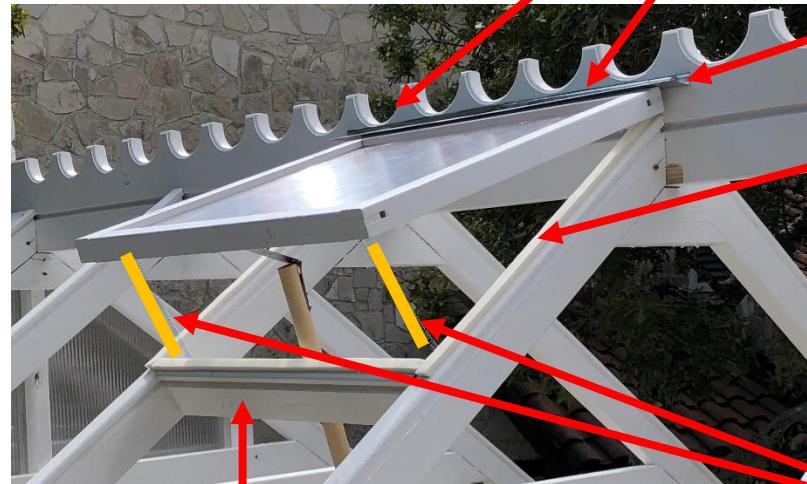


Figure 33
Roof brace for vent.

Hinges

Drip rail

Weather strip around perimeter of vent

Springs attached at inside corners using eye-bolts

VENT

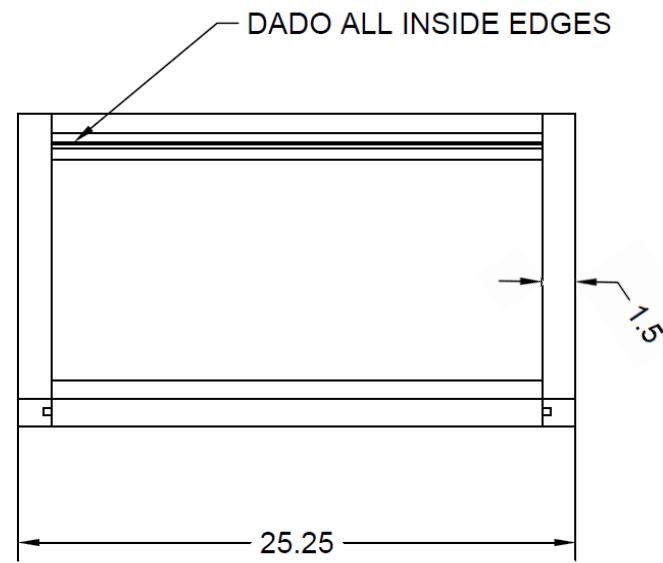
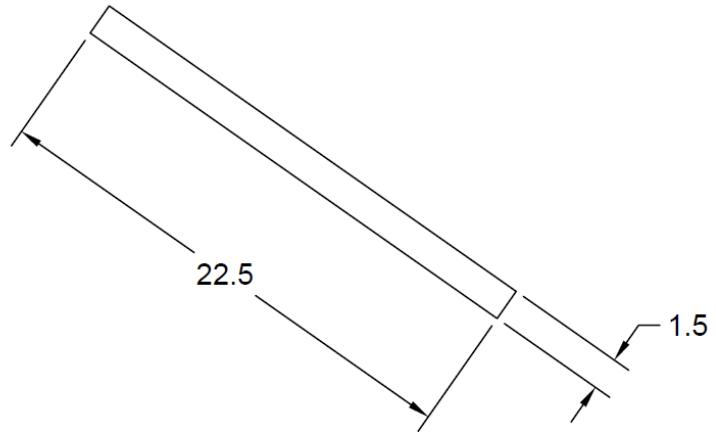
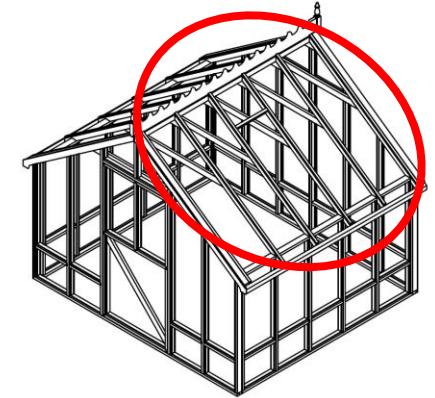


Figure 34



Build Process

Roof Panels

Materials

For the roof panels (see image to the right) you will need:

- (10) 2' x 8' polycarbonate panels

Steps

1. Cut roof panels to the sizes listed below.
 - (9) Polycarbonate: width = 22.75", height = 94.5".
 - (1) Polycarbonate: width = 22.75", height = 72.25".
2. Slide polycarbonate panels into place, and secure bottom with galvanized steel screw.
See Figures 35 & 36.

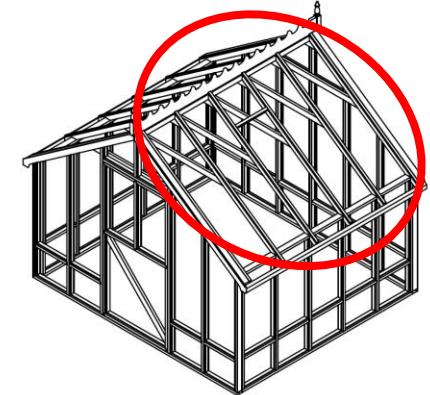




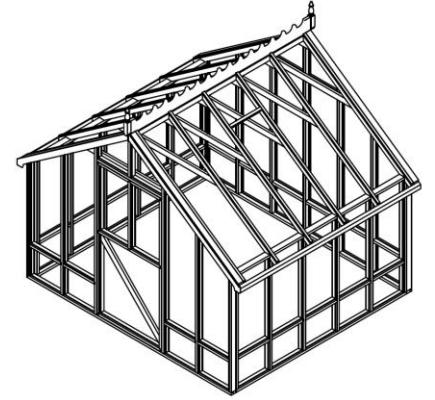
Figure 35

The short panel is installed along the vent.



Only 1 retainer screw for each panel.

Figure 36



Build Process

Final touches

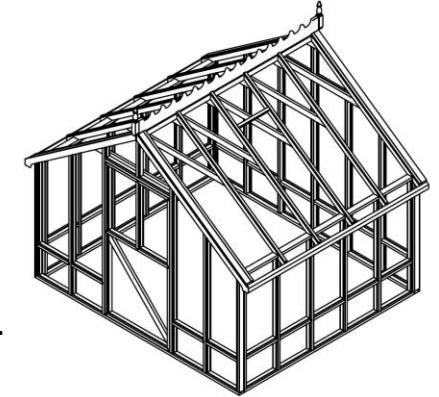
Materials

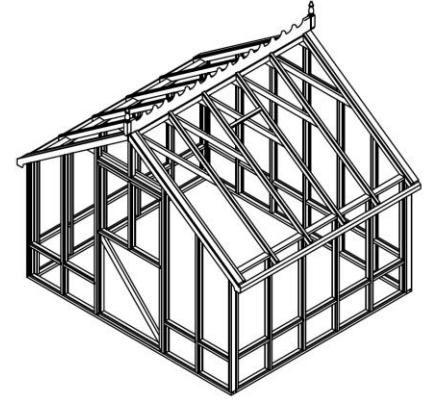
For the final step you will need:

- Silicone caulk

Steps

1. Caulk all top edges (at the spine) of polycarbonate roof & vent panels.
 - This can be done by installing the roof panels one-at-a-time, and caulking the top edge.
 - This is to prevent leaking during rain.
2. Caulk all exterior edges of polycarbonate wall & door panels.
 - This is to prevent moisture and rot in the dados.

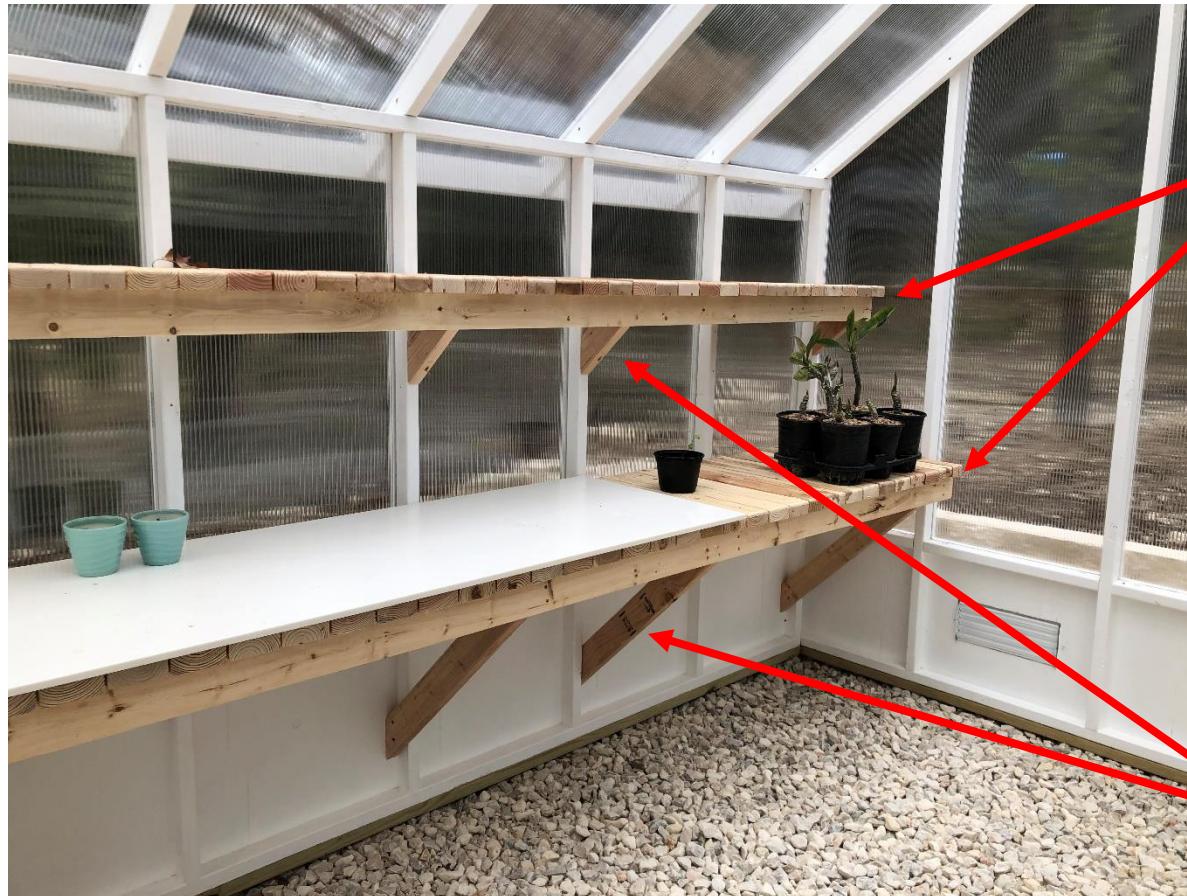




Additional Ideas

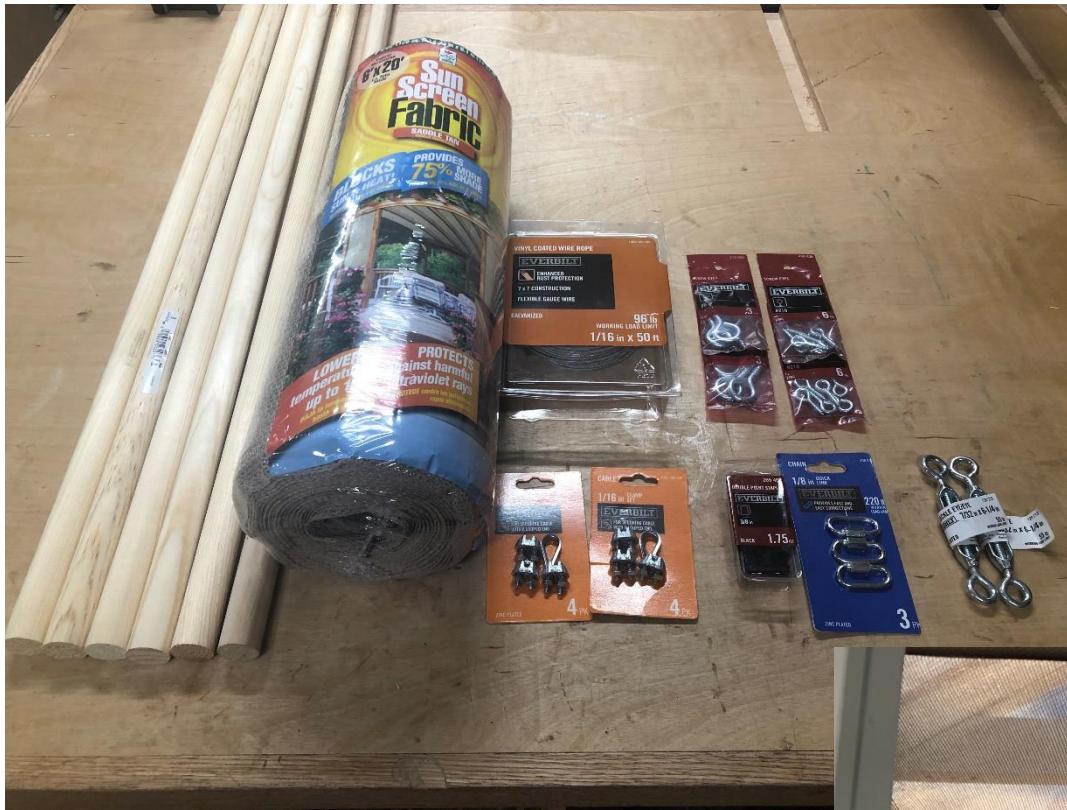
Final touches

Workbench & Shelf



Install a 18" deep workbench and 8" deep shelf.

Secure bench and braces (legs) to the wall studs so that the floor is unobstructed.



Sun Shade

Install a sliding sun-shade for hot summer climates.

Attach eye-bolts to the front and back A-frame, then attach the wire and turn-buckles to tighten the wire.



Automated Heating & Cooling

Install a box-fan (shown) and floor heater (not shown) with a thermostat to regulate temperature.

Install an automatic vent opener.



Enjoy your new greenhouse!

