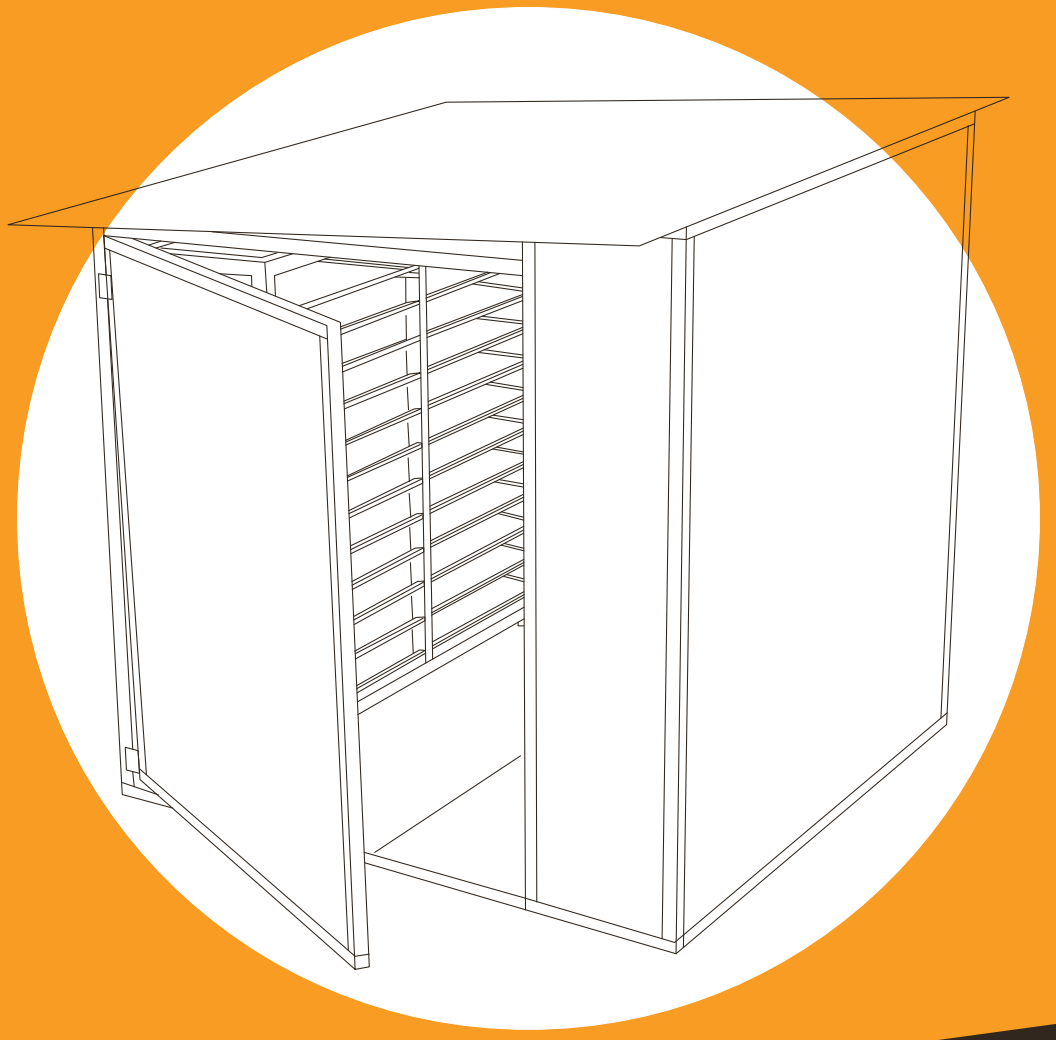
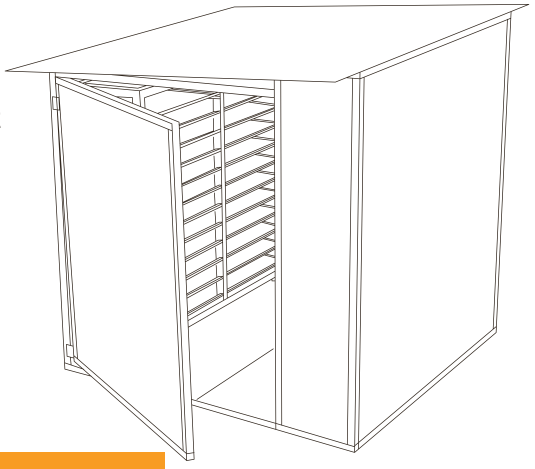
»HOW TO BUILD YOUR OWN SOLAR DRYER



»KOPERNIK
FINDING WHAT WORKS

THE SOLAR DRYING METHOD



Drying agricultural produce can prevent crops from spoilage. This process reduces the moisture in the produce so that bacteria, yeast and mould can't grow and the produce can then be stored, either for consumption or for transportation to sell.

Solar dryers aimed at smallholder farmers are not readily available. Kopernik has therefore designed a simple, small-scale solar dryer using locally available and affordable materials. This small-scale solar dryer has a size of 2m x 2m x 2m and an average capacity of 300 kg, depending on the commodity.

Please note that this particular design has only been tested to dry cashews, therefore, users need to conduct further testing for other commodities' drying processes and results.

HOW THE SOLAR DRYER WORKS

This solar dryer works by absorbing and trapping the sunlight to heat the air inside the dryer. The increase in air temperature reduces the moisture level inside the produce, enhancing the water evaporation process. Kopernik's design also has gravel in the base of the dryer to further store heat and increase the temperature.

DRYING TECHNOLOGY

The benefits of a solar dryer, listed in Kopernik's Unmet Needs Report are:
1. **Protection** from dust, insects, birds and animals;
2. **Reduction in risk of spoilage** by microorganisms due to a high temperature;
3. **Greater control over timing and duration** of the drying process, particularly in bad weather;
4. **Greater efficiency** as the dryer is enclosed and waterproof and the produce does not have to be moved or covered when it rains;
5. **Decrease in labour** as the produce does not need to be turned or moved;
6. **More robust drying results** leading to better storage and a reduction in overall produce loss.

TOOLS

1. Grinding machine
2. Welding machine
3. Drilling machine with 8mm drill bit for steel
4. Wood saw
5. Wood chisel
6. Wrench no. 11
7. Hammer
8. Paint brush
9. Cutter
10. Scissors
11. Tape Measure

MATERIALS

1. Square-shaped iron supports
   a. 200cm x 4cm x 4cm, 6 pcs
   b. 192cm x 4cm x 4cm, 5 pcs
   c. 46cm x 4cm x 4cm, 12 pcs
   d. 204cm x 4cm x 4cm, 2 pcs
   e. 206cm x 4cm x 4cm, 2 pcs
   f. 210cm x 4cm x 4cm, 2 pcs
2. Iron sheeting (2.4m x 1.2m, 2 pcs)
3. Polycarbonate sheeting (11.40m x 2.1m x 5mm, 1 sheet)
4. Hexagon nuts and bolts (M8)
5. Nails (7cm, 3cm, 2cm, 1 box each)
6. Fishing net (mesh size: 0.5cm x 0.5cm, 25m x 1m, 1pc)
7. Paint for wood (clear color)
8. Paint for iron (black color)
9. Metal grinding disc, 20pc
10. Flap grinding disc, 2pcs
11. Door hinges (3" x 1", 4 pairs)
12. Filler/welding rod (diameter 2.4mm, 1 pc)
13. Thumb tacks (All size, 1000pcs)
14. Gravel (diameter 5cm, 300 kg)
15. Wooden blocks
    a. 4.5cm x 4.5cm x 400cm, 16 pcs
    b. 2cm x 2cm x 400cm, 50 pcs
    c. 1.35cm x 1.35cm x 400cm, 100 pcs

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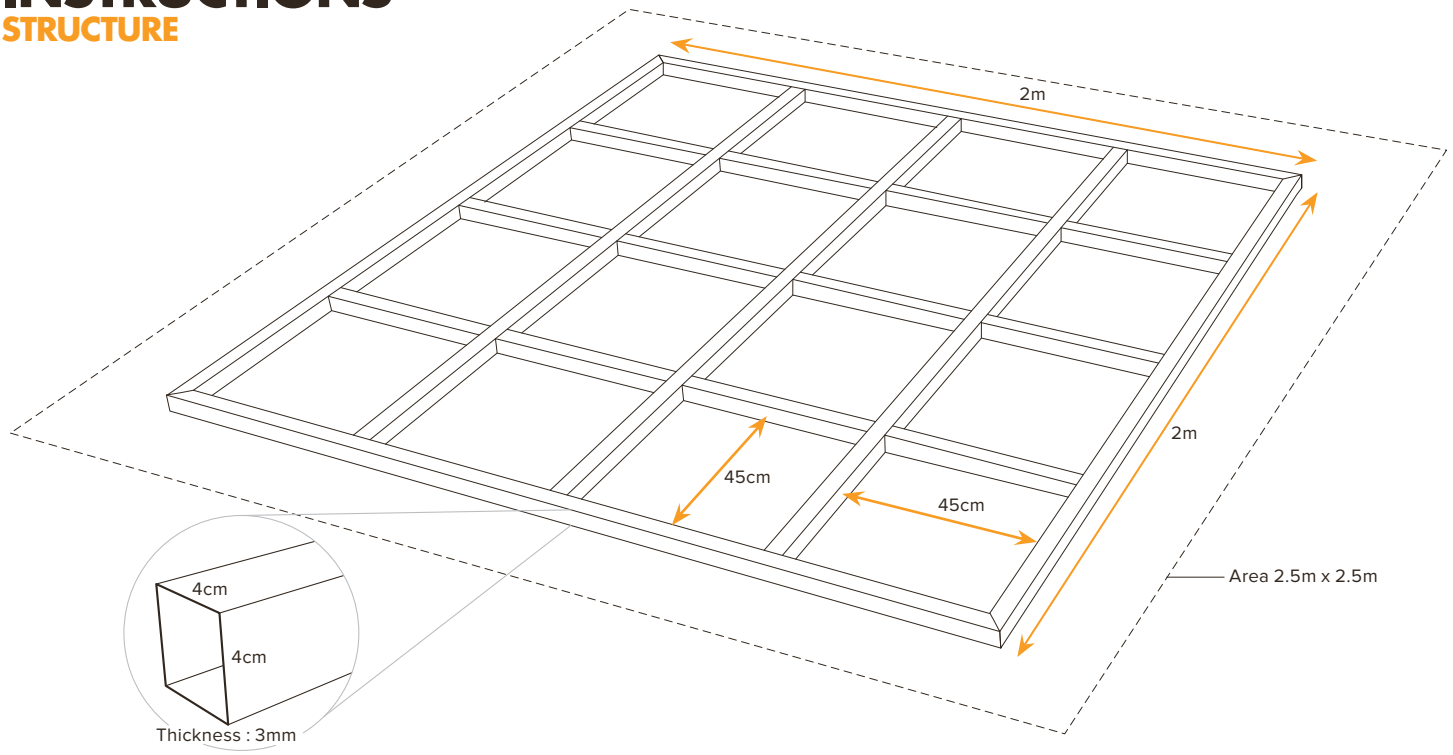
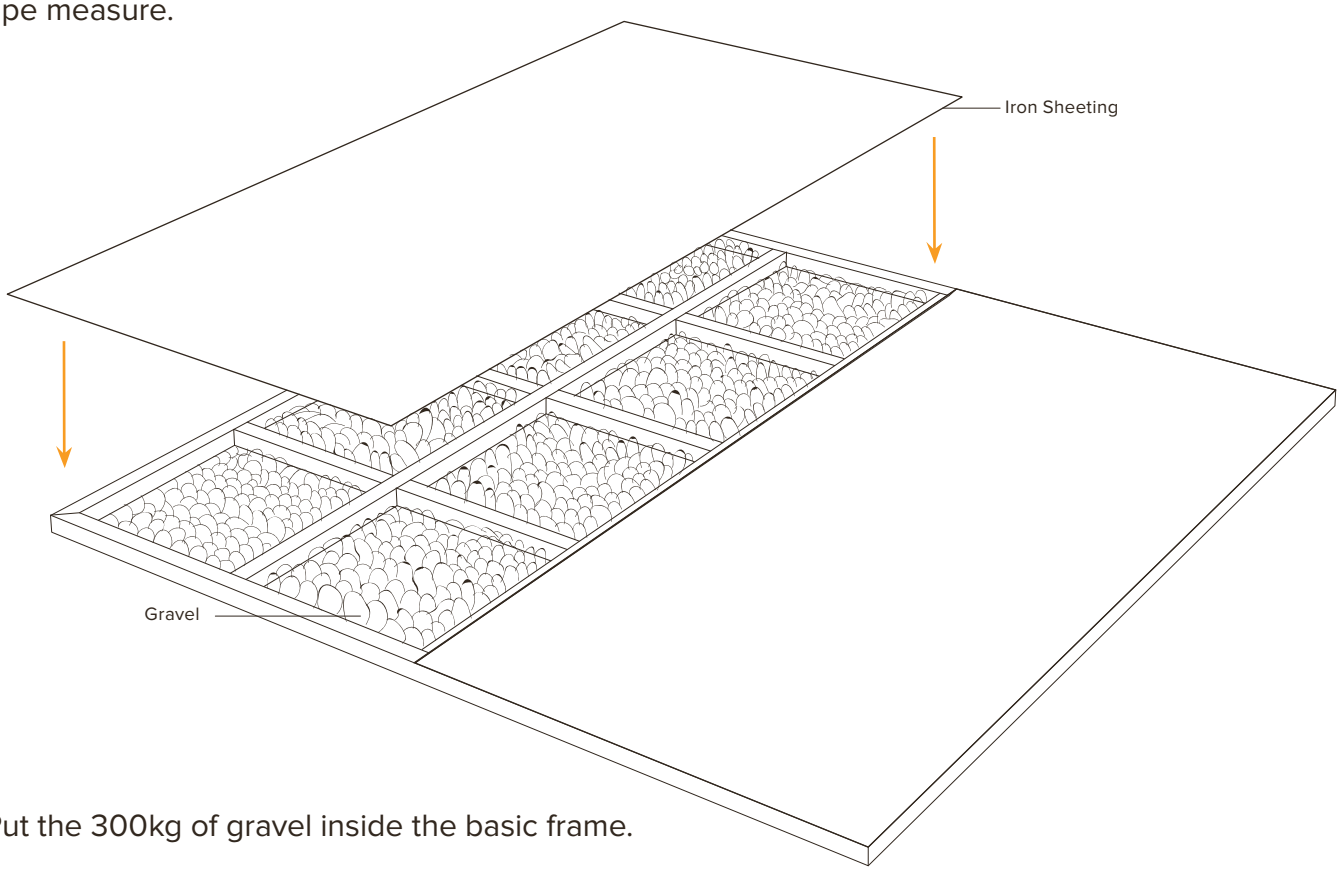
INSTRUCTIONS
STRUCTURE



1. Prepare an area of 2.5mx2.5m. Ensure that the area is flat by using a split level and is free from rocks and grass.

2. Build the basic frame of the building by welding the iron supports in the same structure as the example pictured above. Ensure that the distance between each iron support inside the frame is 45cm using a tape measure.



3. Put the 300kg of gravel inside the basic frame.

4. Weld the iron sheeting to the basic frame.

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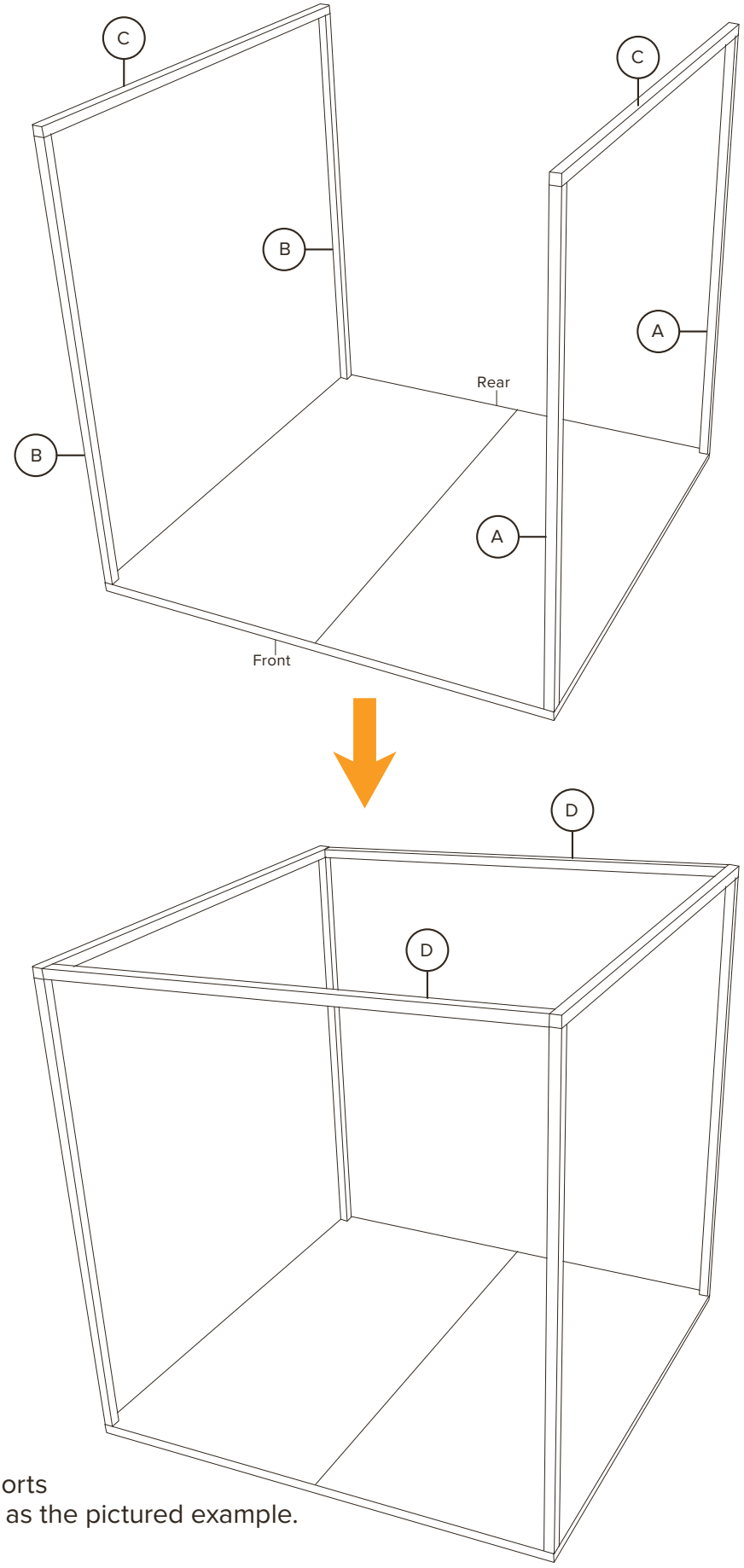

5. Weld the iron supports
in the same structure as the pictured example.

A : 202cm x 2 pcs
B : 192cm x 2 pcs
C : 200cm x 2 pcs
D : 192cm x 2 pcs

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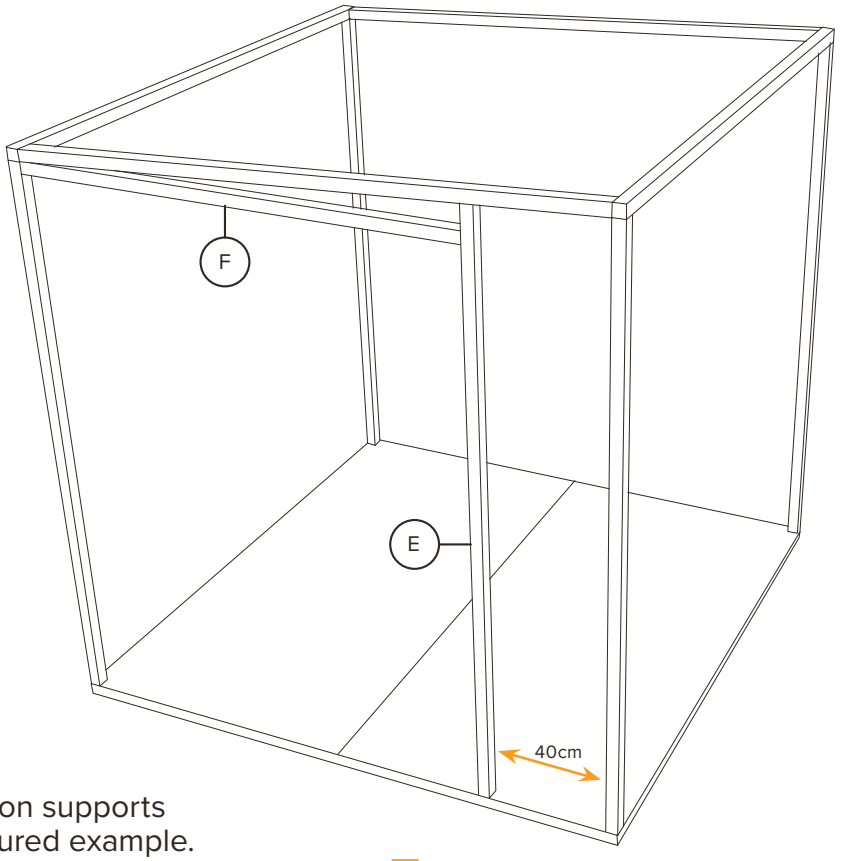
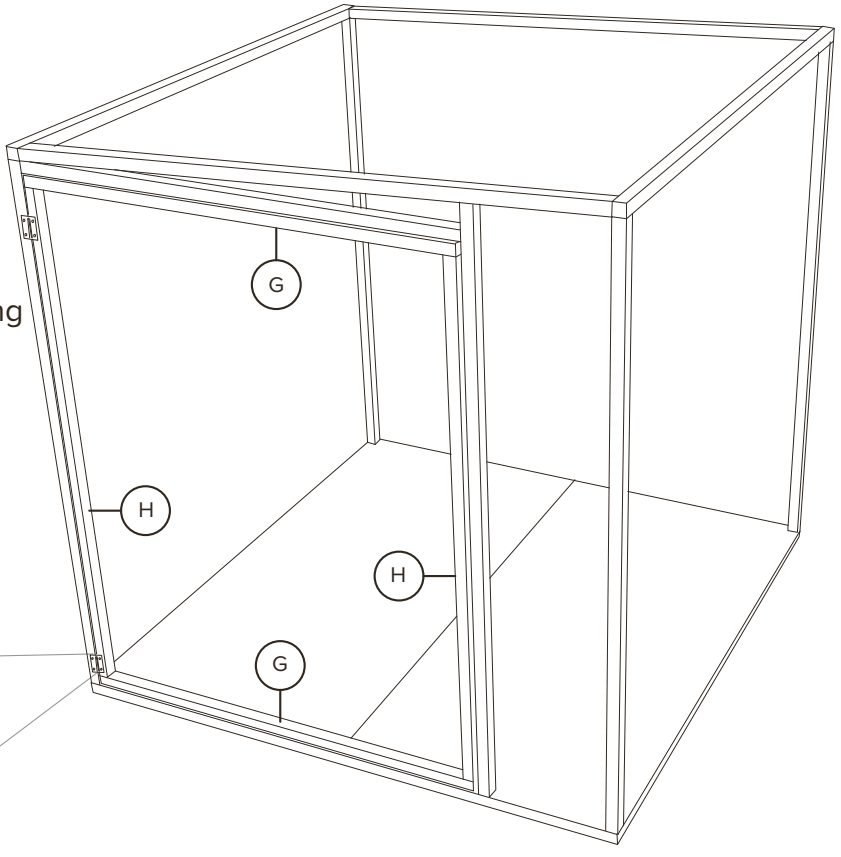


6. Make a door by welding the iron supports in the same structure as the pictured example.

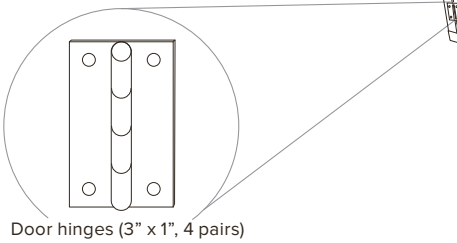
E : 200cm x 1 piece
F : 148cm x 1 piece



7. Attach the door hinges by using a welding machine or screws.

8. Prepare the polycarbonate sheeting as pictured in the example. This sheeting will cover the iron supports.

G : 146.5cm x 2 pcs
H : 179.5cm x 2 pcs



Door hinges (3” x 1”, 4 pairs)

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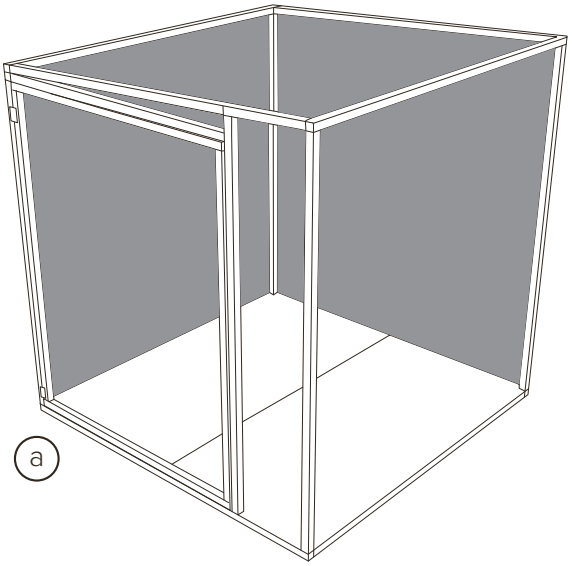

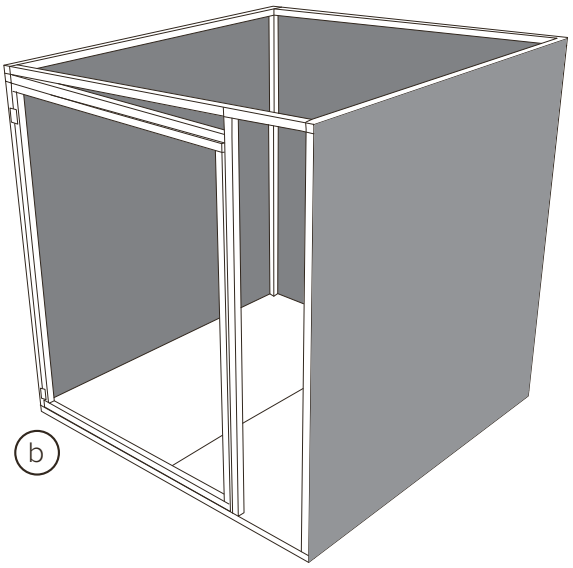

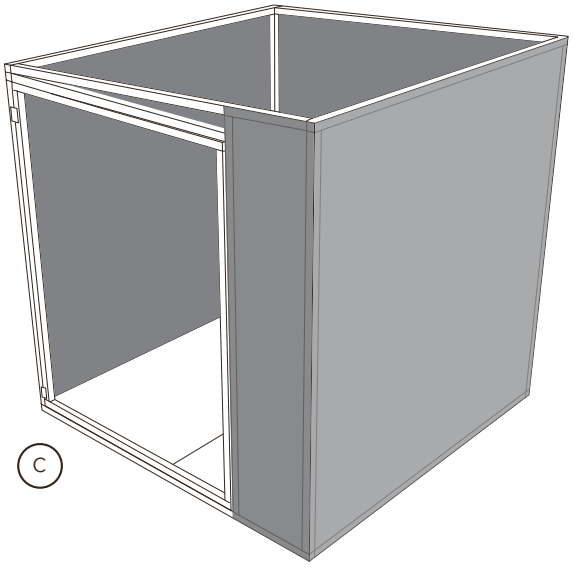

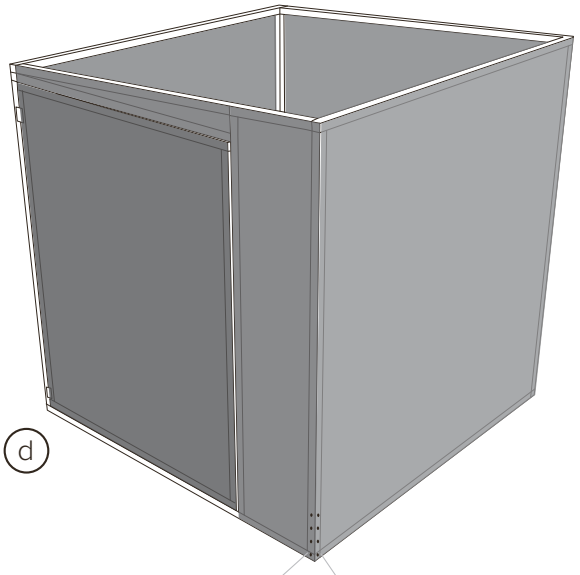

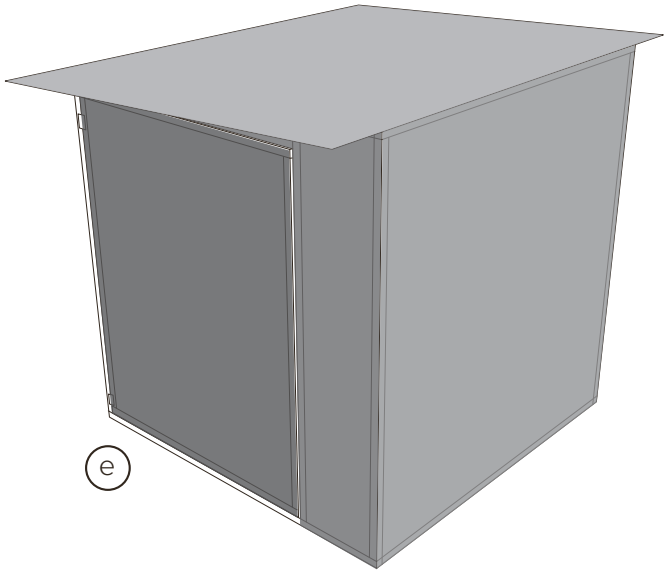

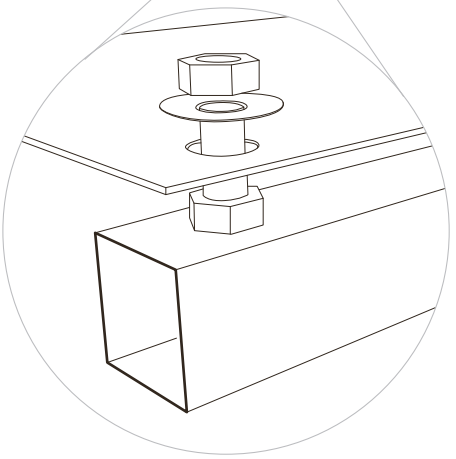

9. Weld bolts onto the surface of the iron supports as pictured in the example, with an 18cm space between each bolt.

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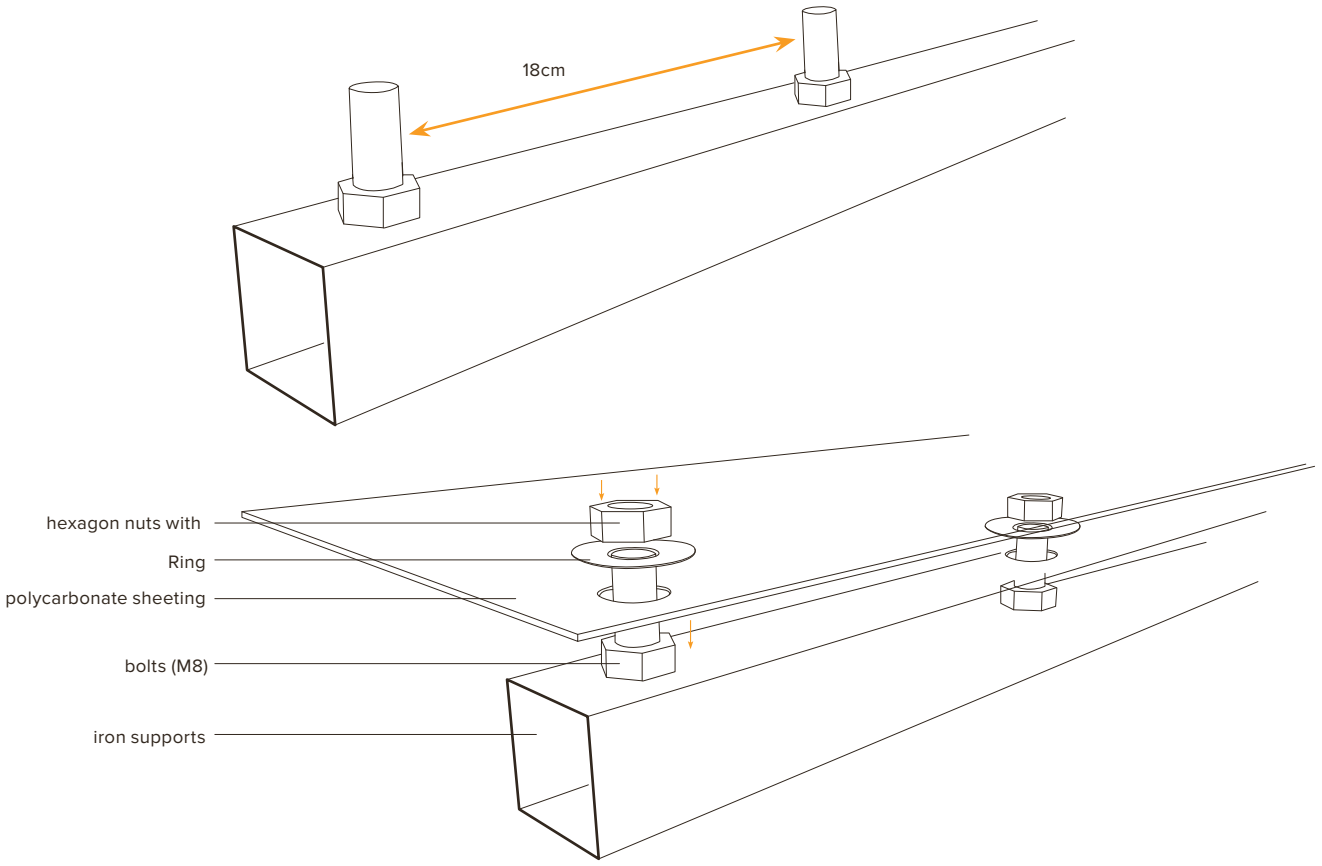
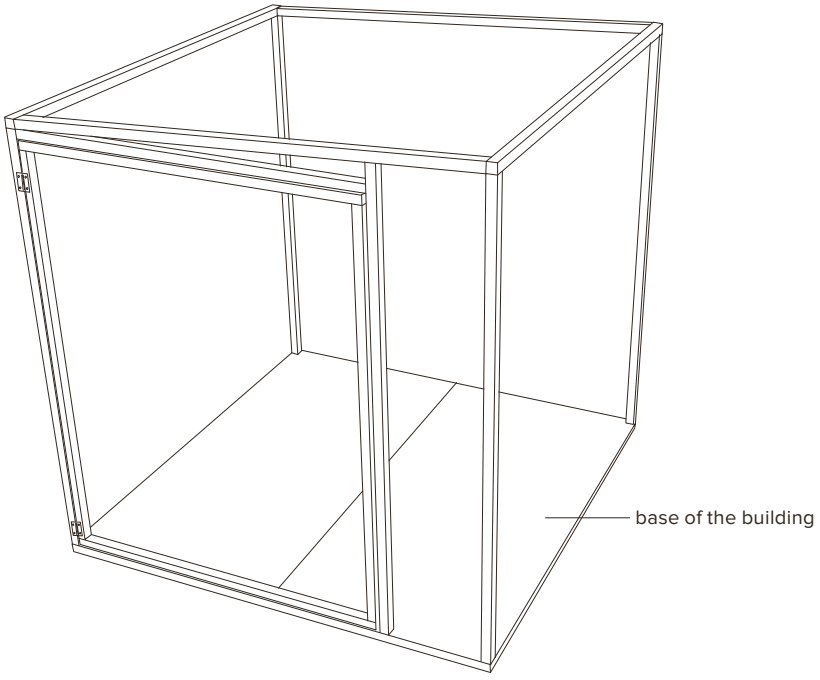
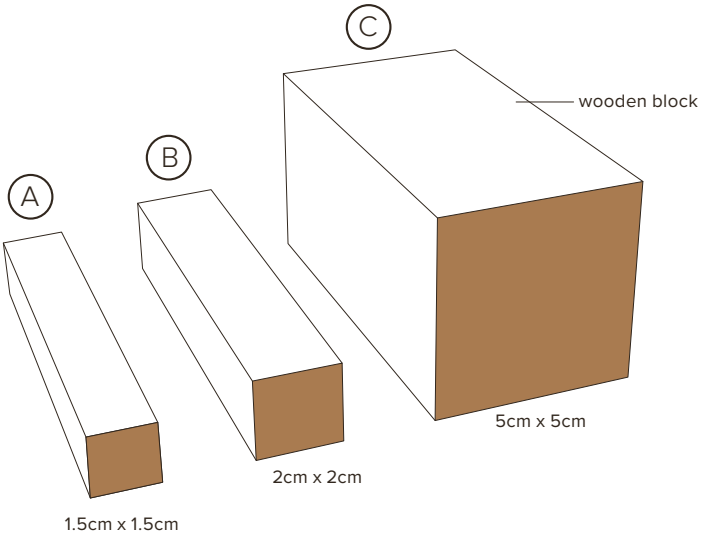


10. Attach the polycarbonate sheeting on to the iron supports, then lock it in place with the hexagon nuts and bolts (M8). The polycarbonate sheeting needs to be securely attached to the frame.



11. After the building is finished, paint the base of the building with black metal paint. While waiting for it to dry, start building the shelves.

INSTRUCTIONS
SHELVES



A container

A1 — 50cm x 1.5cm x 1.5cm (96pcs)

A2 — 81cm x 1.5cm x 1.5cm (96pcs)

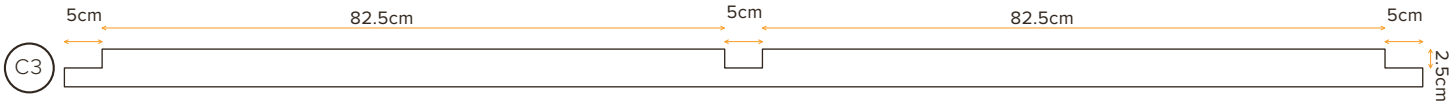
B rail

B1 — 50cm x 2cm x 2cm (96pcs)

C shelve

C1 — 180cm x 5cm x 5cm (8pcs)

C2 — 165cm x 5cm x 5cm (4pcs)



C3 — 180cm x 5cm x 5cm (8pcs)

C4 — 40cm x 5cm x 5cm (12pcs)

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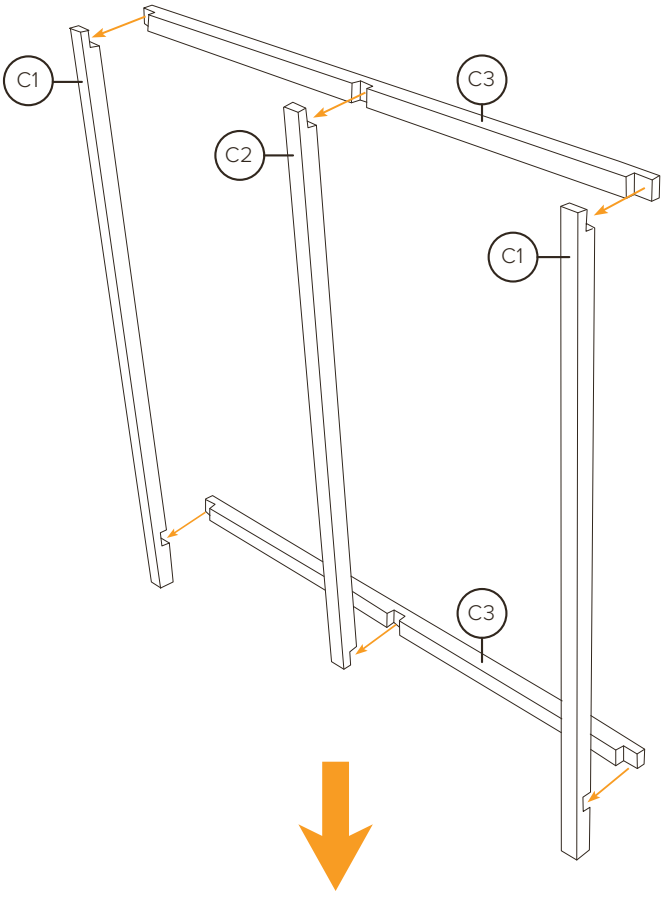
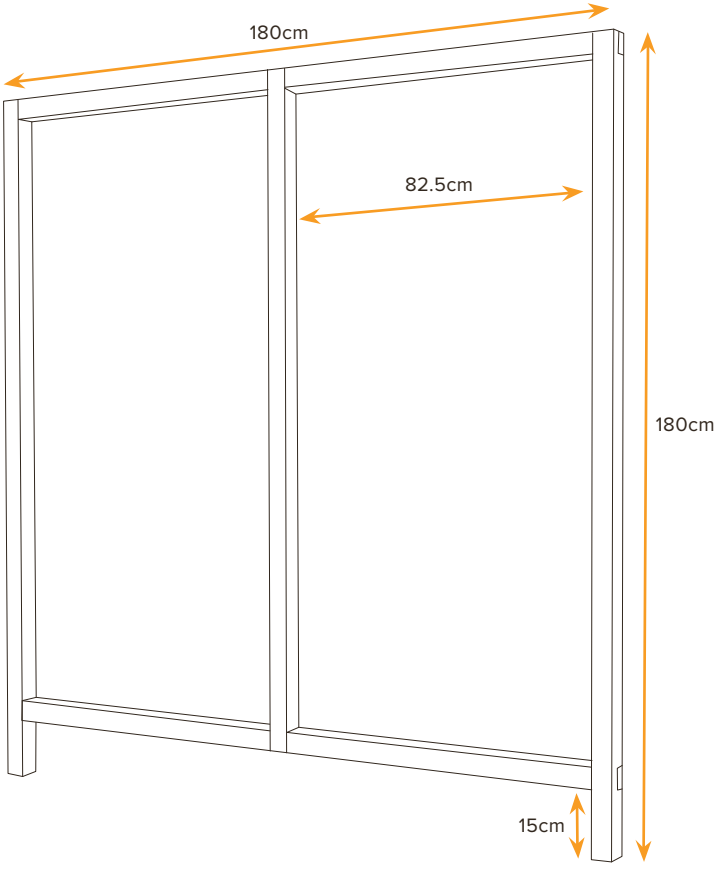
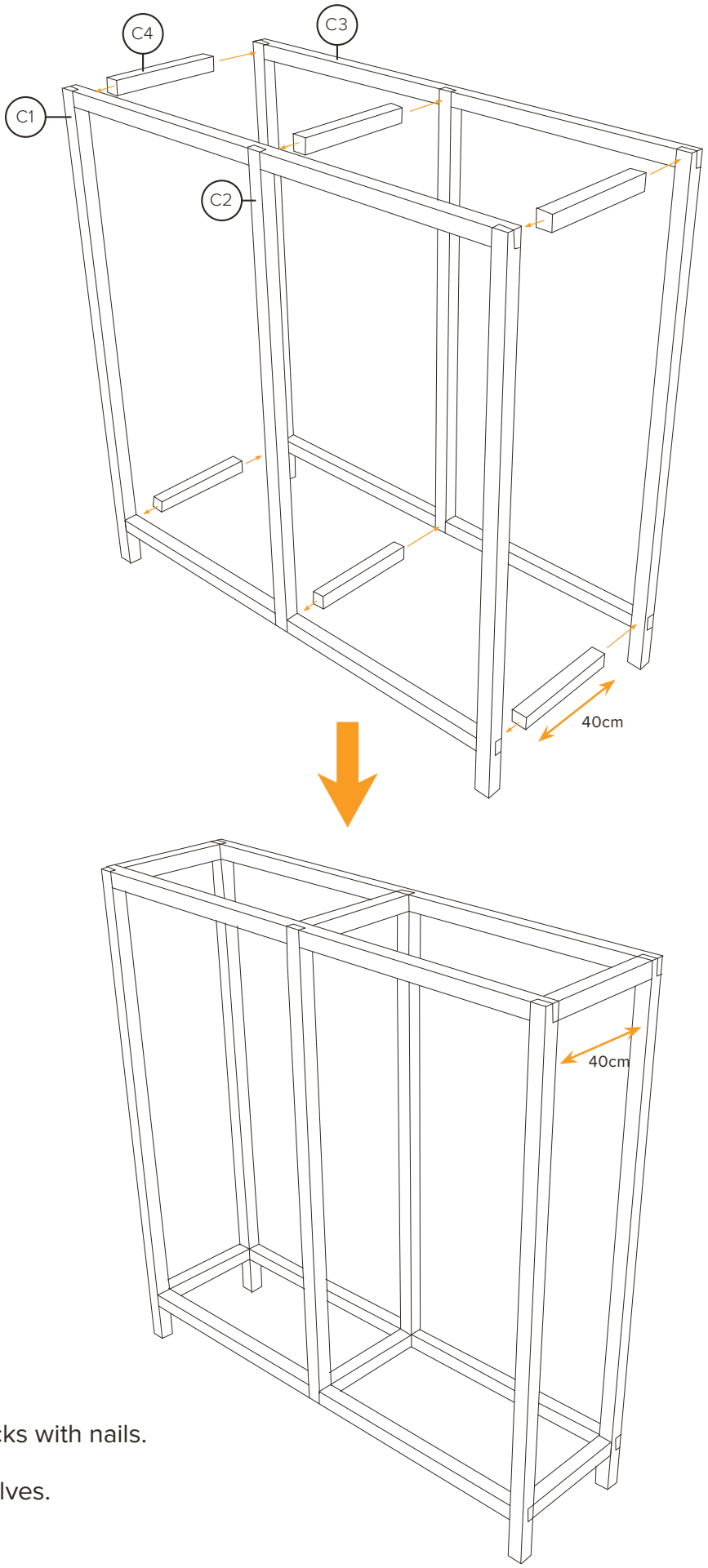




1. Build the first part of the shelves as pictured in the example. Make four.

Note: the most efficient process (time wise) to build these shelves requires 4 people.



2. Attach all blocks with nails.

3. Make two shelves.

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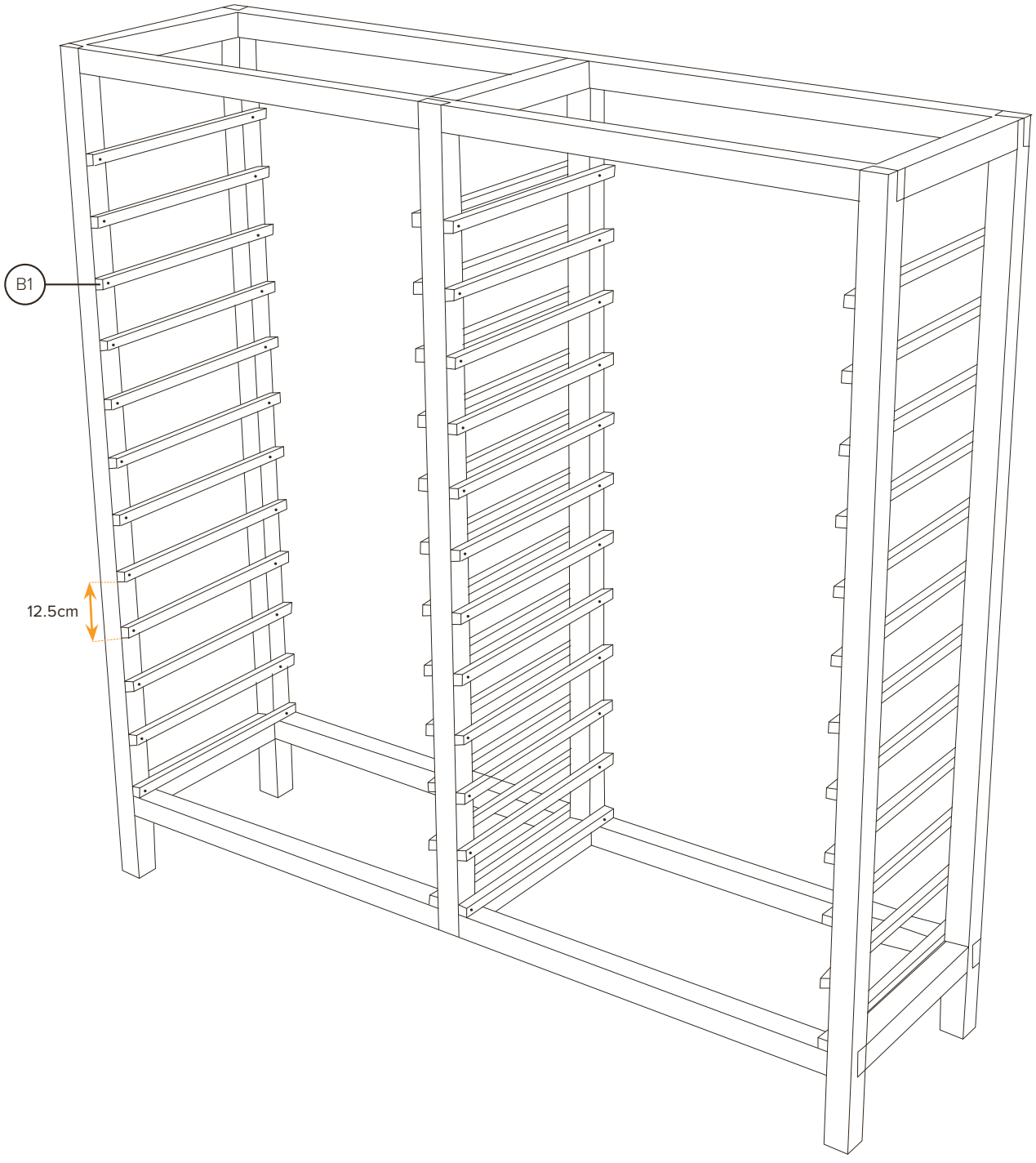
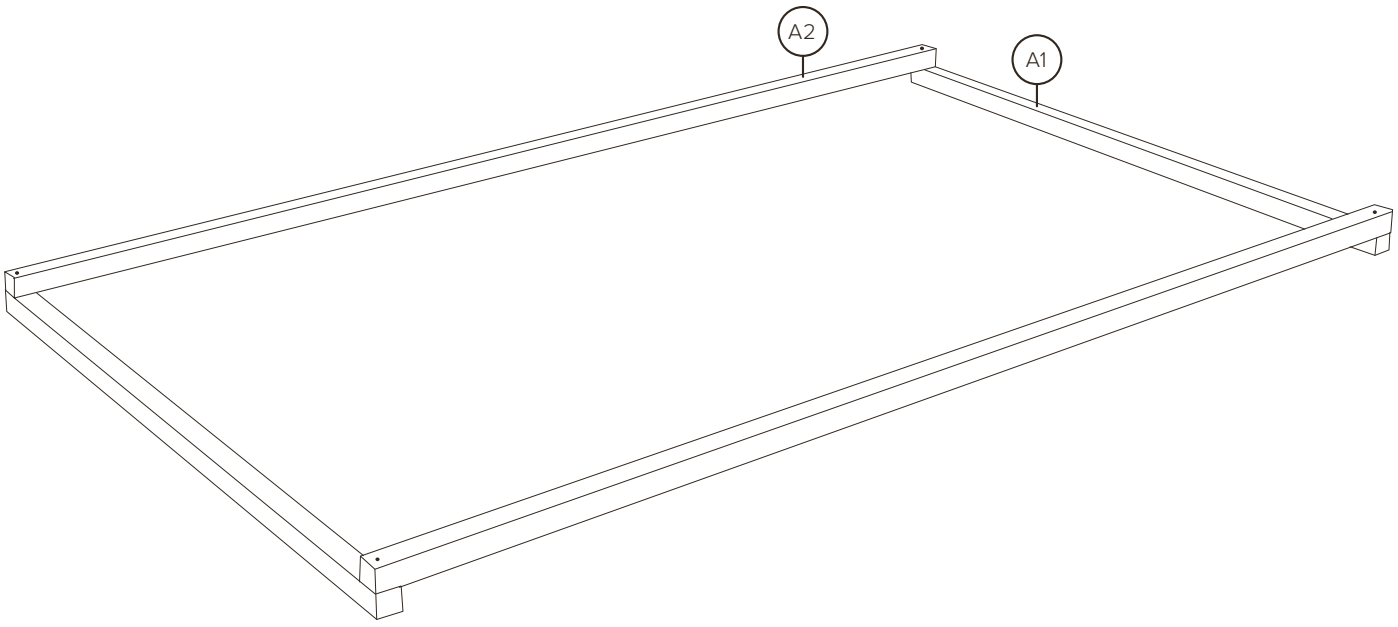
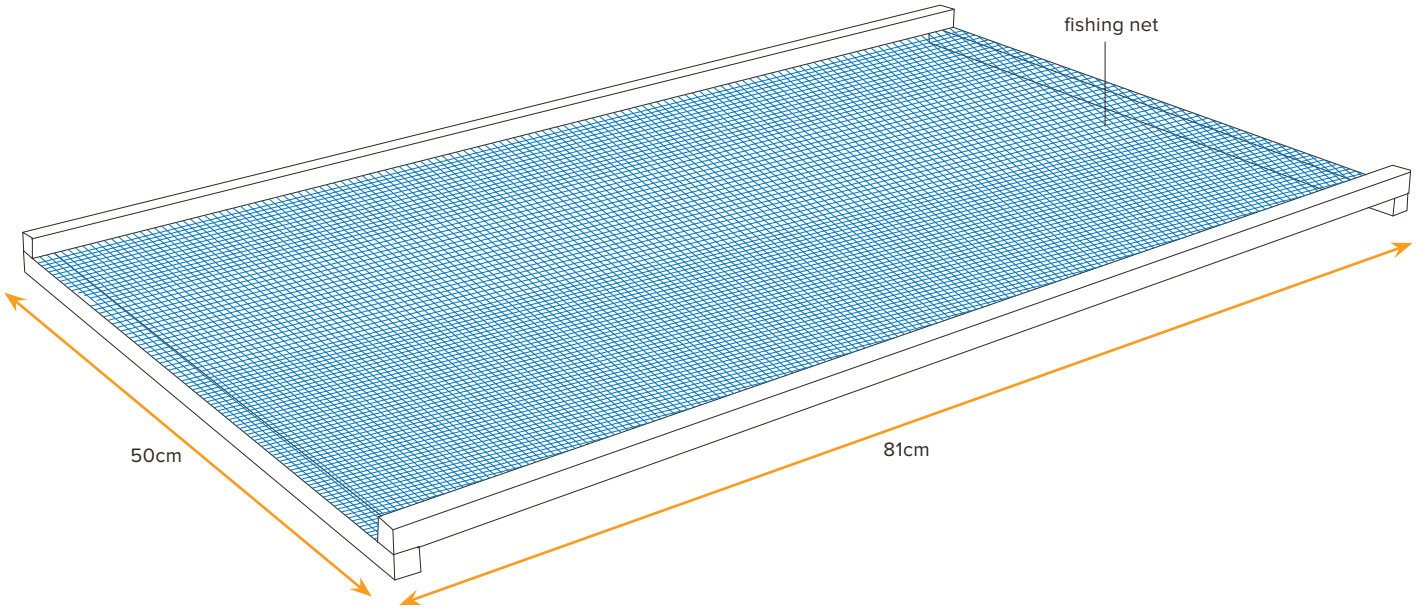


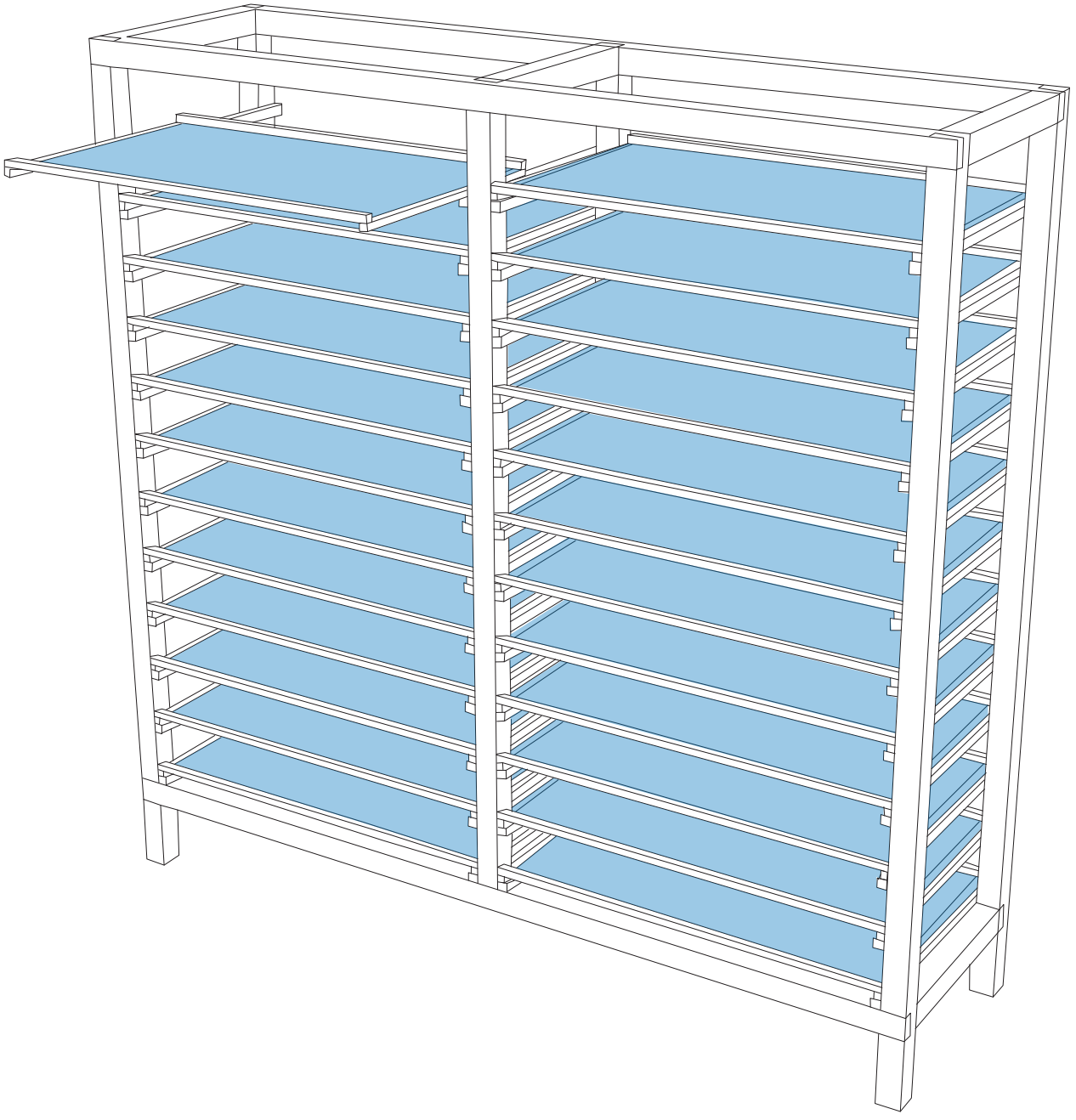
4. Attach the wooden blocks with nails in the same way as the pictured example.

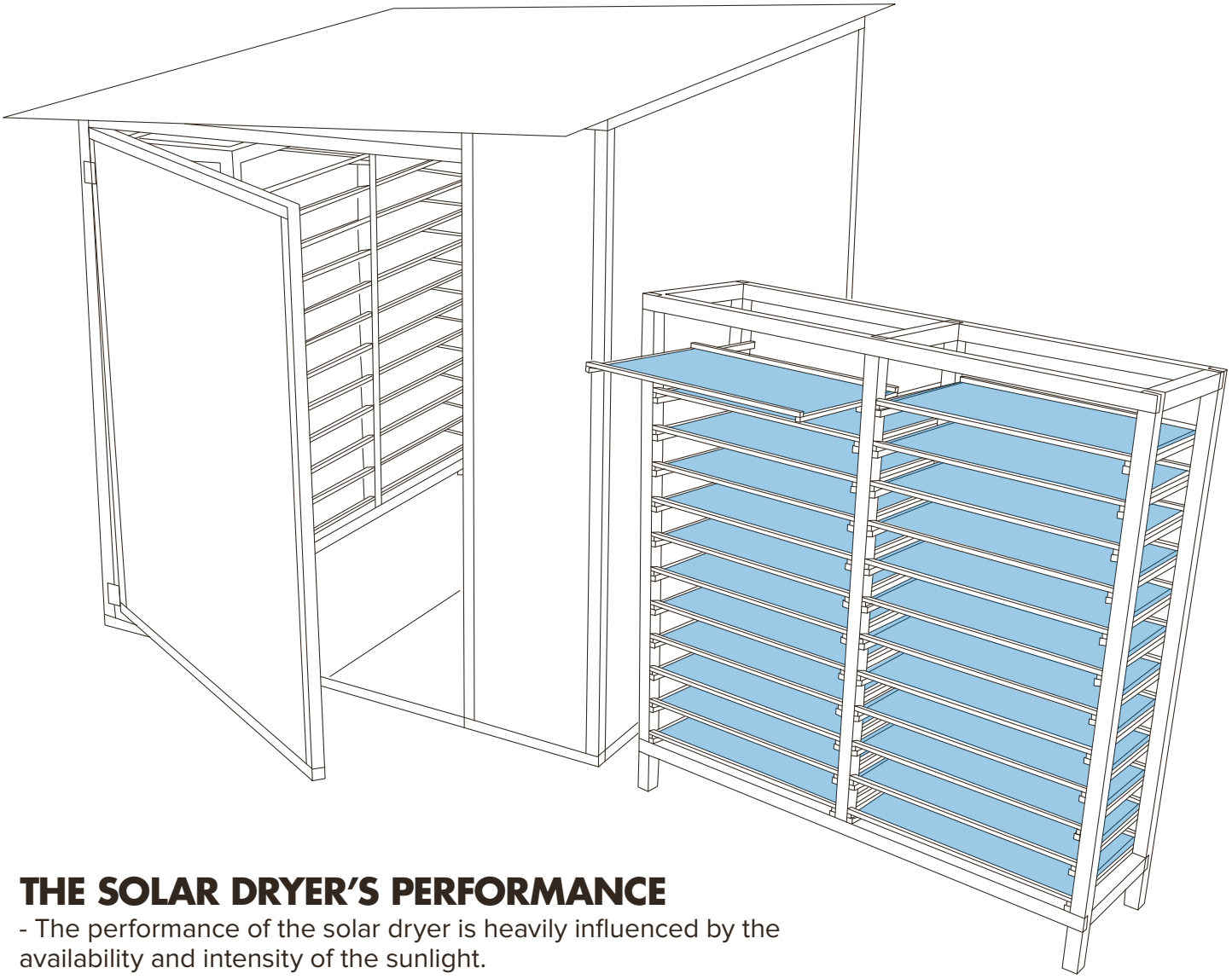


5. Attach the wooden blocks with nails in the same way as the pictured example.



6. Attach the fishing net to the shelf frame with thumb tacks in the same way as the pictured example.





THE SOLAR DRYER'S PERFORMANCE

- The performance of the solar dryer is heavily influenced by the availability and intensity of the sunlight.

- Control the dried products' moisture content by opening the door three times a day: at 8 AM, 1 PM, and 5PM.

KOPERNIK'S OTHER SOLAR DRYING PROJECTS

Learn more about Kopernik's solar drying experiments:

1. Increasing Farmer Incomes: Solar Drying Solutions Phase One
2. Increasing Farmer Incomes: Solar Drying Solutions Phase Two
3. Improving Processing Technologies: Cacao Beans Phase One
4. Improving Processing Technologies: Cacao Beans Phase Two

ESTIMATED COST

No	Item	Size	Qty	Estimated Price per Unit*	Subtotal	Note
BUILDING						
1	Square-shaped iron supports	200cm x 4cm x 4cm	6	US$ 5.61	US$ 33.67	Can be substituted with grade II wooden beams (eg. mahogany, albizia, or black wattle)
2	Square-shaped iron supports	192cm x 4cm x 4cm	5	US$ 5.61	US$ 28.06	Can be substituted with grade II wooden beams (eg. mahogany, albizia, or black wattle)
3	Square-shaped iron supports	46cm x 4cm x 4cm	12	US$ 5.61	US$ 67.34	Can be substituted with grade II wooden beams (eg. mahogany, albizia, or black wattle)
4	Square-shaped iron supports	204cm x 4cm x 4cm	2	US$ 5.61	US$ 11.22	Can be substituted with grade II wooden beams (eg. mahogany, albizia, or black wattle)
5	Square-shaped iron supports	206cm x 4cm x 4cm	2	US$ 5.61	US$ 11.22	Can be substituted with grade II wooden beams (eg. mahogany, albizia, or black wattle)
6	Square-shaped iron supports	210cm x 4cm x 4cm	2	US$ 5.61	US$ 11.22	Can be substituted with grade II wooden beams (eg. mahogany, albizia, or black wattle)
7	Iron sheeting	2.4m x 1.2m x 1.6ml	2	US$ 30.89	US$ 61.77	Can be replaced with zinc plate, **with the same thickness**. It will function as a heat reflector
8	Polycarbonate sheeting	11.40m x 2.1m x 5mm	1	US$ 120.53	US$ 120.53	
9	Hexagon nut and bolts (in pair)	M8	200	US$ 0.08	US$ 15.07	
10	Metal paint, black	1kg	1	US$ 3.77	US$ 3.77	Better in black color because it absorbs heat
11	Paint thinner	1ltr	1	US$ 2.82	US$ 2.82	
12	Door hinges (in pair)	Size: 3”x 1”	4	US$ 2.26	US$ 9.04	
13	Metal grinding disc	Any size	20	US$ 1.43	US$ 28.63	
14	Flap grinding disc	Any size	2	US$ 1.51	US$ 3.01	
15	Welding machine	900 watt	1	US$ 112.99	US$ 112.99	
16	Welding rod	Box	1	US$ 4.52	US$ 4.52	
17	Gravel stone	All size	1	US$ 15.07	US$ 15.07	Can’t be replaced with another stone because of its heat retention characteristic
SHELVES						
18	Wooden blocks	190cm x 5cm x 5cm	20	US$ 2.45	US$ 48.96	
19	Wooden blocks	60cm x 5cm x 5cm	12	US$ 2.45	US$ 29.38	
20	Wooden blocks	60cm x 2cm x 2cm	104	US$ 1.41	US$ 146.89	
21	Wooden blocks	87.5cm x 2cm x 2cm	104	US$ 1.41	US$ 146.89	
22	Wooden blocks	60cm x 2cm x 2cm	52	US$ 1.41	US$ 73.45	
23	Fishing Net (mesh size: 0.5cmx0.5cm)	25m x 1m	1	US$ 0.30	US$ 0.30	Can be replaced with wire mesh 2mmx2mm
24	Thumb tacks	Small box	50	US$ 0.23	US$ 11.30	
25	Nail	7cm, 1kg	1	US$ 0.75	US$ 0.75	
26	Nail	3cm, 1kg	1	US$ 0.38	US$ 0.38	
27	Nail	2cm, 1kg	1	US$ 0.23	US$ 0.23	
OTHERS (Optional)						
	Labor		10	US$ 5.65	US$ 56.50	
TOTAL ESTIMATED COST					US$ 1,054.99	

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