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SOLAR DRYING SOLUTIONS FOR NUTMEG AND SEAWEED IN WEST PAPUA

FIELD REPORT: NUTMEG AND SEAWEED SOLAR DRYERS - CONSTRUCTION GUIDELINE

For:



31 May 2020

Table of contents

Commodity

NUTMEG



- ☐ Overview
- ☐ Construction guideline
- ☐ Budget estimation

SEAWEED



- ☐ Overview
- ☐ Construction guideline
- ☐ Budget estimation

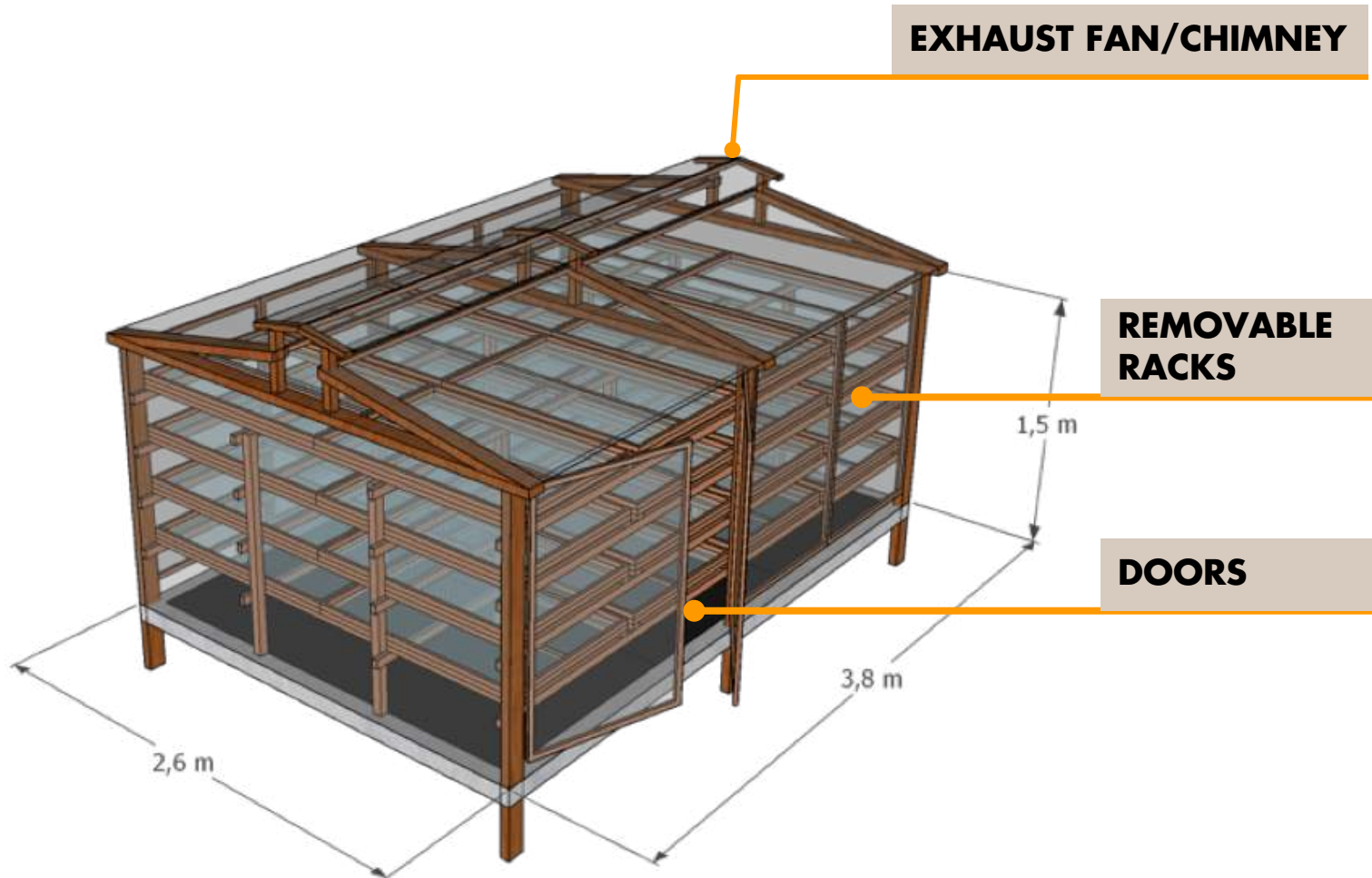




NUTMEG SOLAR DRYER

The nutmeg solar dryer has three main features including exhaust fans, removable racks and lateral doors to maximize drying efficiency

Nutmeg solar dryer model



Main advantages

- The solar dryer is equipped with a chimney to increase air circulation for passive drying and heat distribution. A more expensive (but optional) alternative is to use an automatic exhaust fan to force air out of the drying – active drying.
- Removable racks are installed to ease the mixing of nutmegs.
- Doors are built to easily spread out the nutmeg on the racks and inspect the drying process, while maximizing the available space.

The list below includes the materials needed to build the solar dryer

PURPOSE	ITEM	SIZE	QUANTITY
Frame	Ironwood	5 cm x 10 cm – 185 cm	6 units
		5 cm x 5 cm – 280 cm	3 units
		5 cm x 5 cm – 122 cm	6 units
		5 cm x 5 cm – 32 cm	6 units
		3 cm x 5 cm – 60 cm	6 units
Binder structure	Ironwood	3 cm x 5 cm – 380 cm	8 units
	Kaso wood	2 cm x 3 cm – 183 cm	12 units
Floor	Ironwood	3 cm x 5 cm – 360 cm	5 units
	Ironwood	3 cm x 5 cm – 240 cm	5 units
Rack	Ironwood	5 cm x 5 cm – 145 cm	10 units
	Ironwood	3 cm x 5 cm – 380 cm	8 units
Rail	Ironwood	2 cm x 5 cm – 240 cm	32 units
Door	Kaso wood	2 cm x 3 cm – 150 cm	16 units
		2 cm x 3 cm – 85 cm	16 units
Tray	Kaso wood	2 cm x 3 cm – 120 cm	128 units
		2 cm x 3 cm – 84 cm	128 units
		2 cm x 3 cm – 116 cm	32 units
	Net	130 cm x 100 cm	32 sheets

Step 1: Build the main frame (3x) as the structure of the solar dryer

Series of main frames

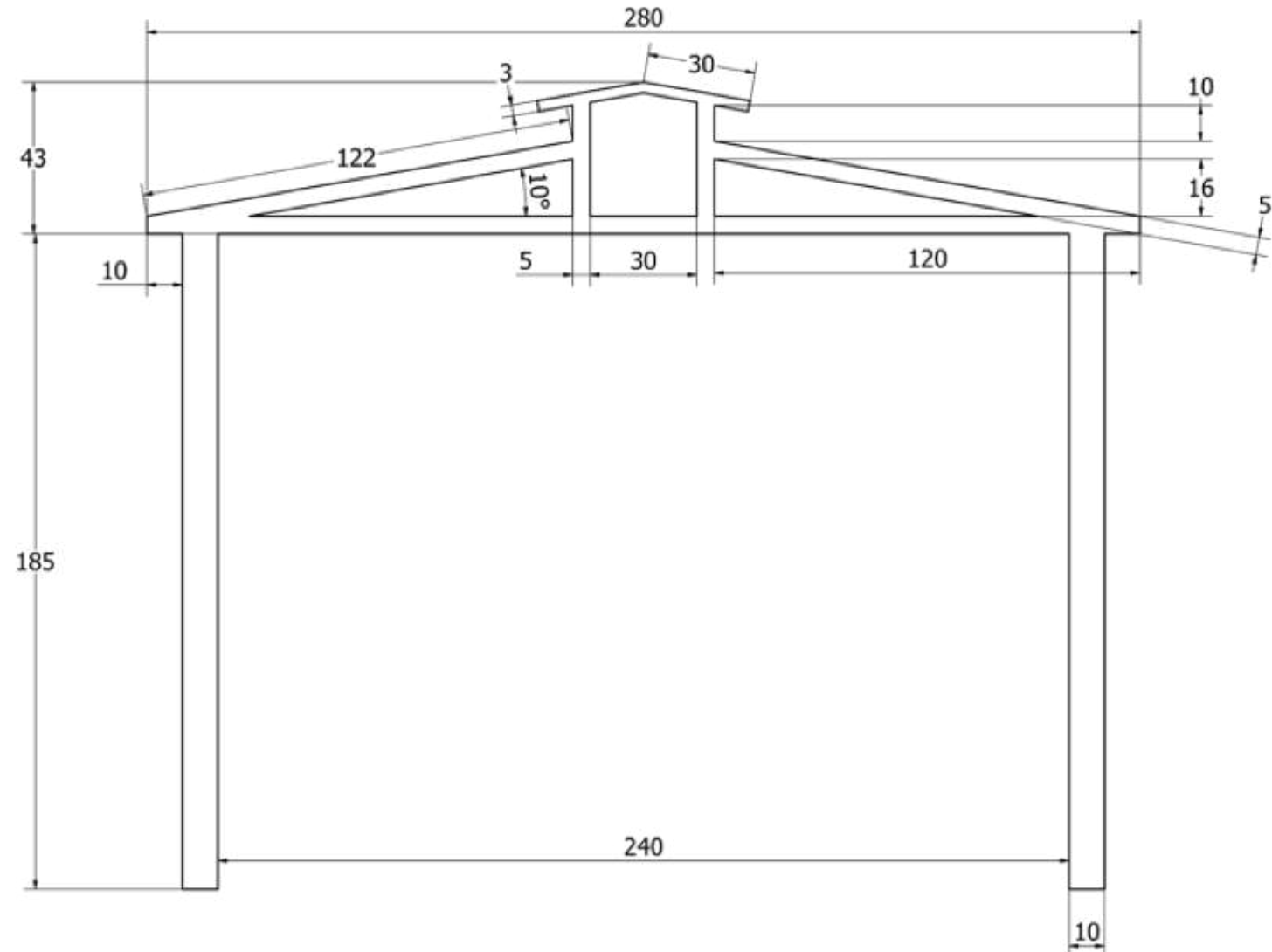
Roof section

- There are two levels 10 cm apart that function as air outlet;
- The angle of both roofs is 10° .

Poles

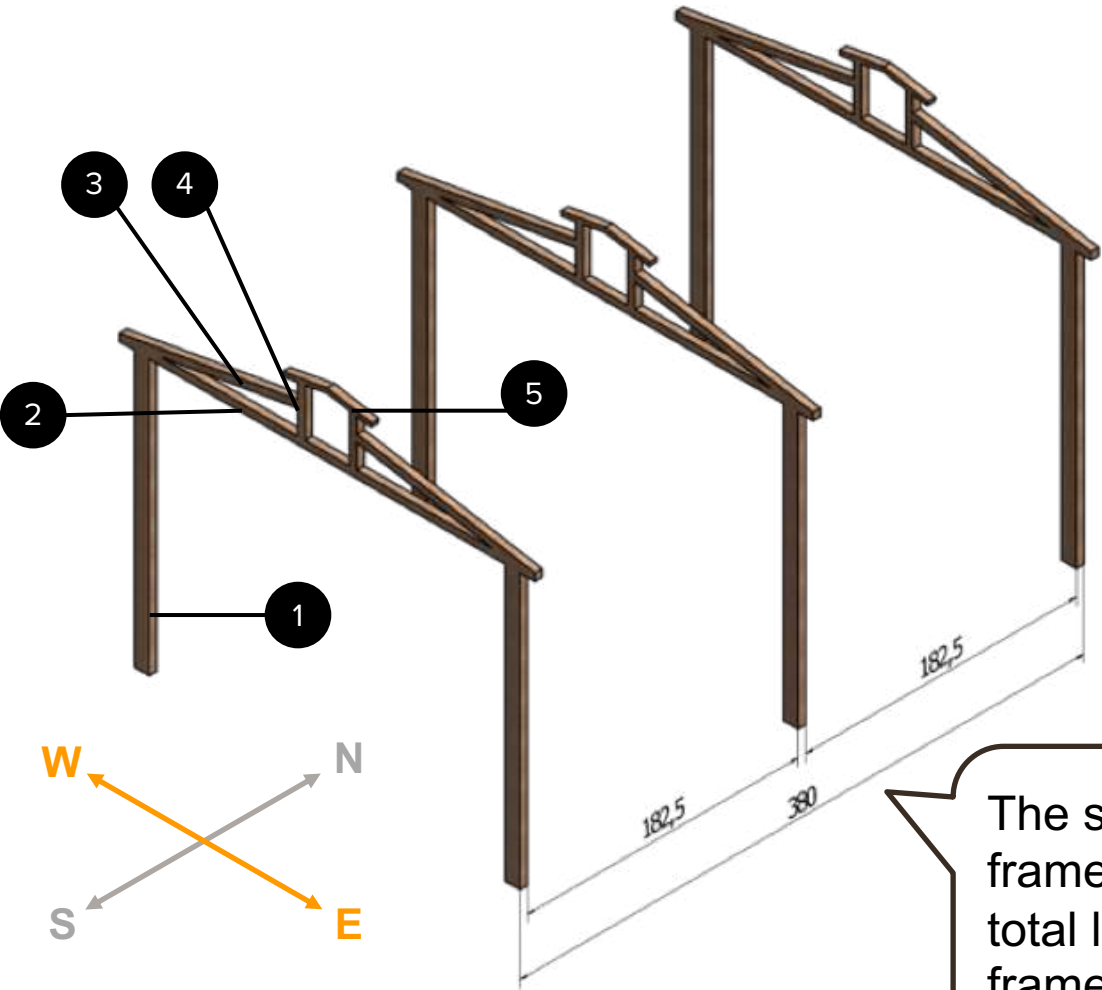
- The Poles are embedded 20 cm deep;
- The embedded part is covered with stones and tightened with concrete.

Detailed size (cm)



Step 2: Arrangement of three main frames with roof section facing east-west.

Series of frame sections with spacing (cm)



List of materials for the main frame

No	Material	Qty.
1	Ironwood 5 cm x 10 cm – 185 cm	6 units
2	Ironwood 5 cm x 5 cm – 280 cm	3 units
3	Ironwood 5 cm x 5 cm – 122 cm	6 units
4	Ironwood 5 cm x 5 cm – 32 cm	6 units
5	Ironwood 3 cm x 5 cm – 60 cm	6 units

The spacing between each frame is 182,5 cm and the total length for three main frames is 380 cm

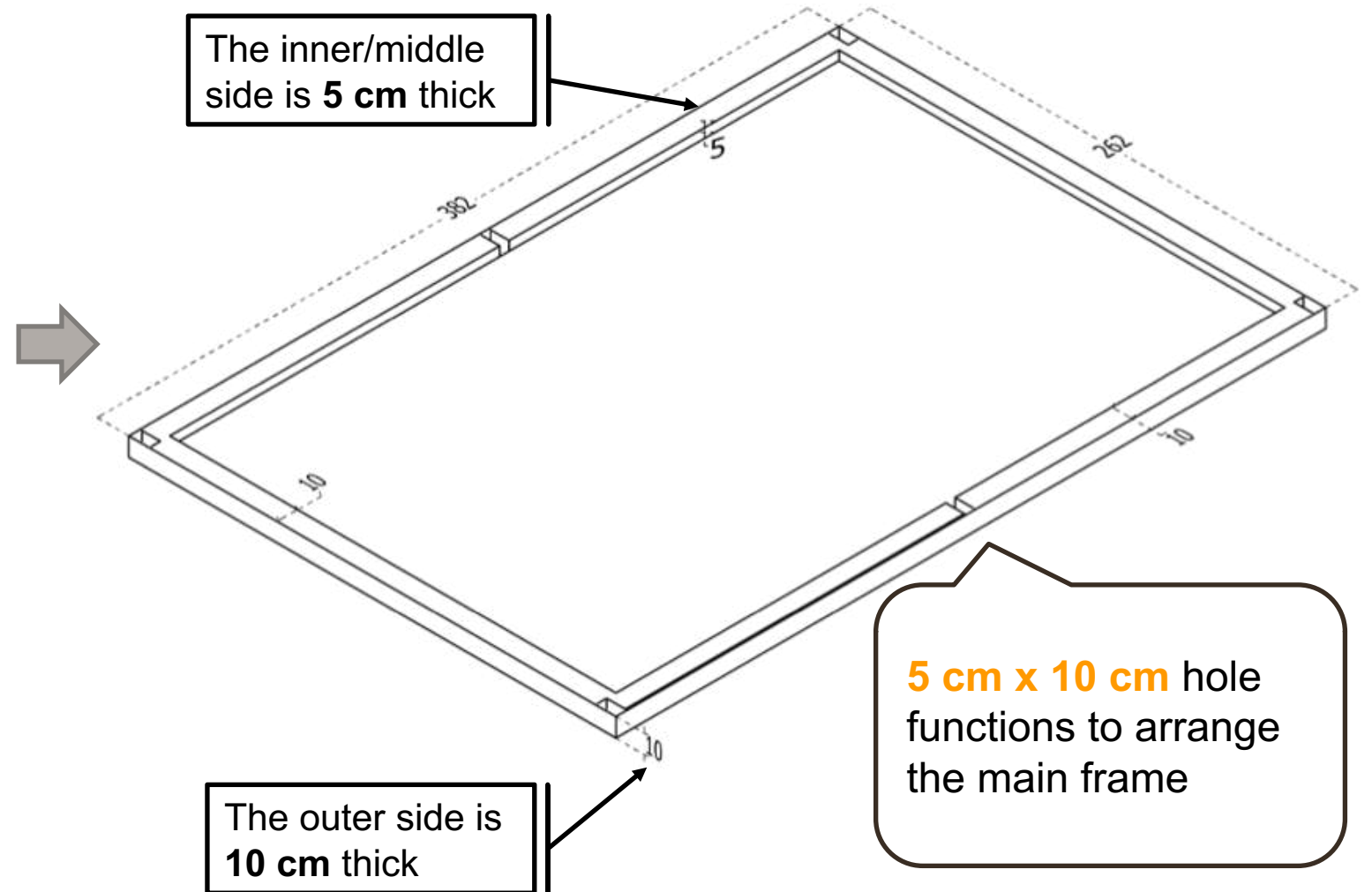
Step 3: Floor casting

Series of base pieces for casting

Floor section

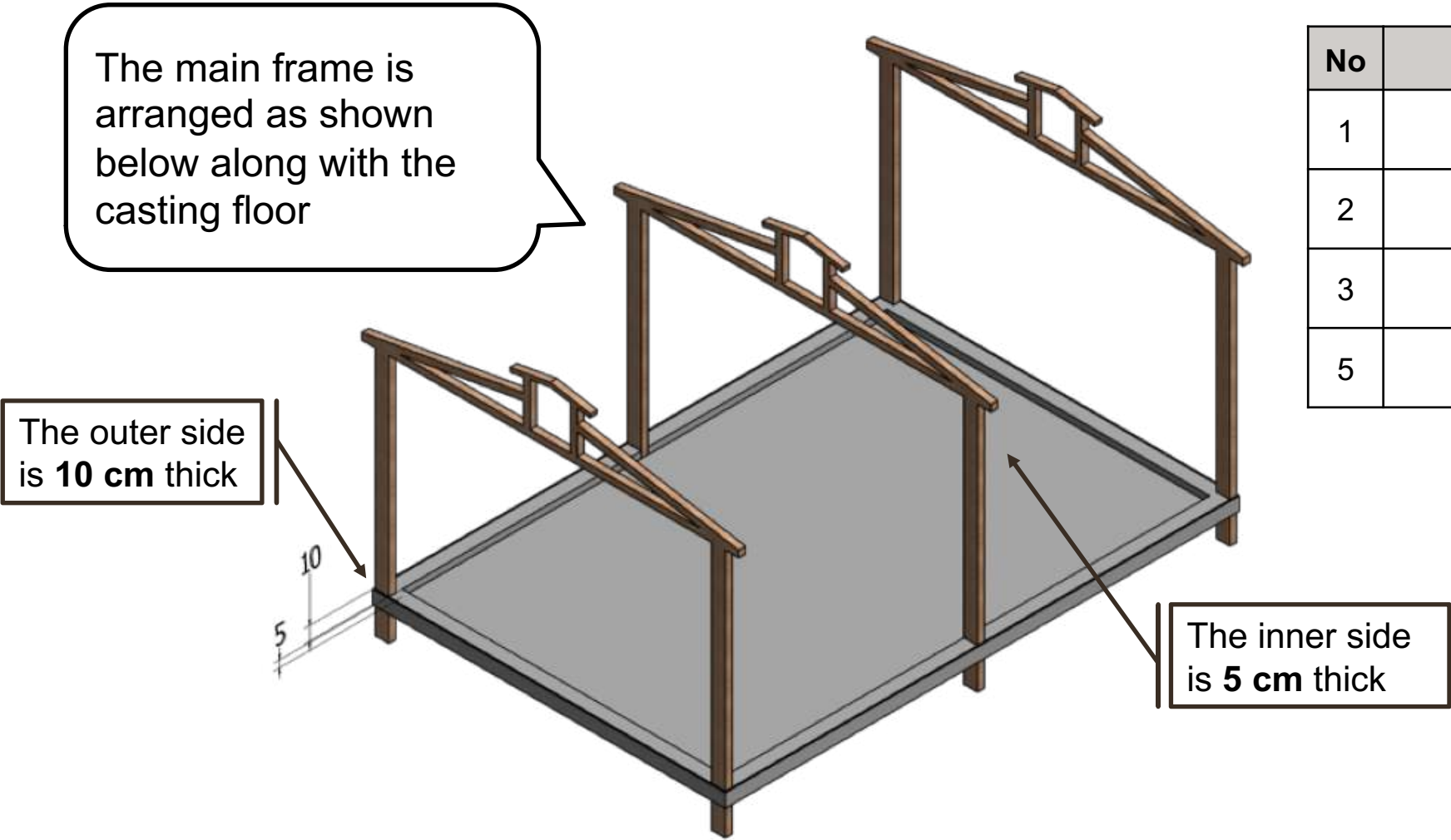
- The outer side is flattened with the width of the wood (10 cm);
- Concrete bricks are placed on the outer side and embedded in the ground;
- The outer side is 5 cm higher than the middle one;
- A mixture of concrete and construction sand without gravel is used for the base.

Detailed size (cm)



Step 4: Floor and main frame casting

Illustration of floor and main frame casting

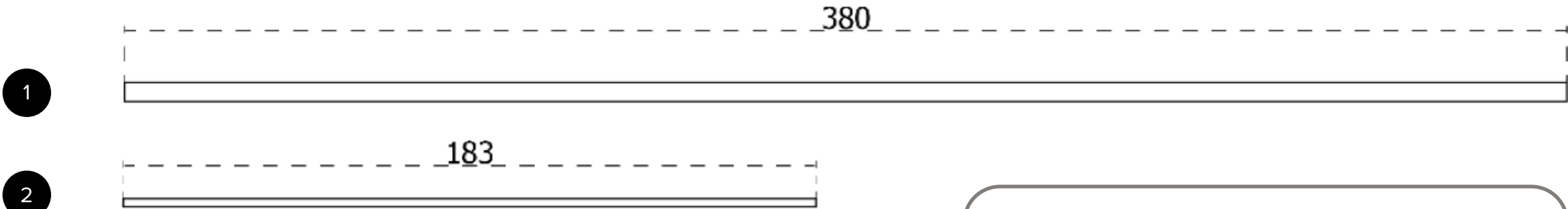


List of materials for floor casting

No	Material	Qty.
1	Sand	1 m ³
2	Cement	4 sacks
3	Nail	8 units
5	Yarn	30 m

Step 5: Building of wooden frame as binding media to support the shelves and roof

Size of binding wood (cm)



- 1 Placed on the wall as a main frame binder and shelf support structure;
- 2 Support for roof section.

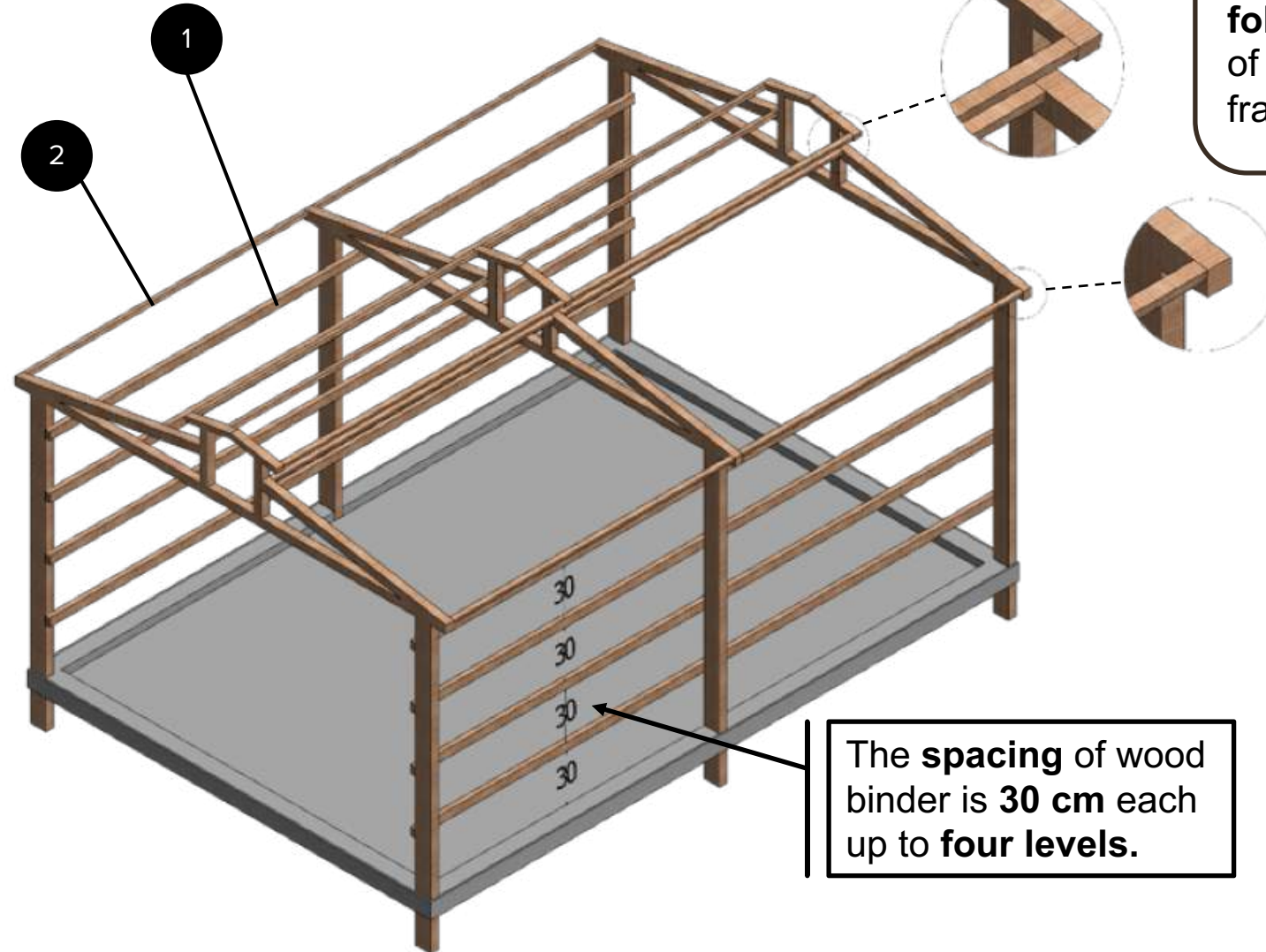
List of materials

No	Material	Qty.
1	Ironwood 3 cm x 5 cm – 380 cm	8 units
2	Kaso wood 2 cm x 3 cm – 183 cm	12 units

Step 6: Installation of binding wood with four levels 30 cm apart

Installation of wood binders

1. Wood binder on the wall as a main frame and shelf support;
2. Support roof section.

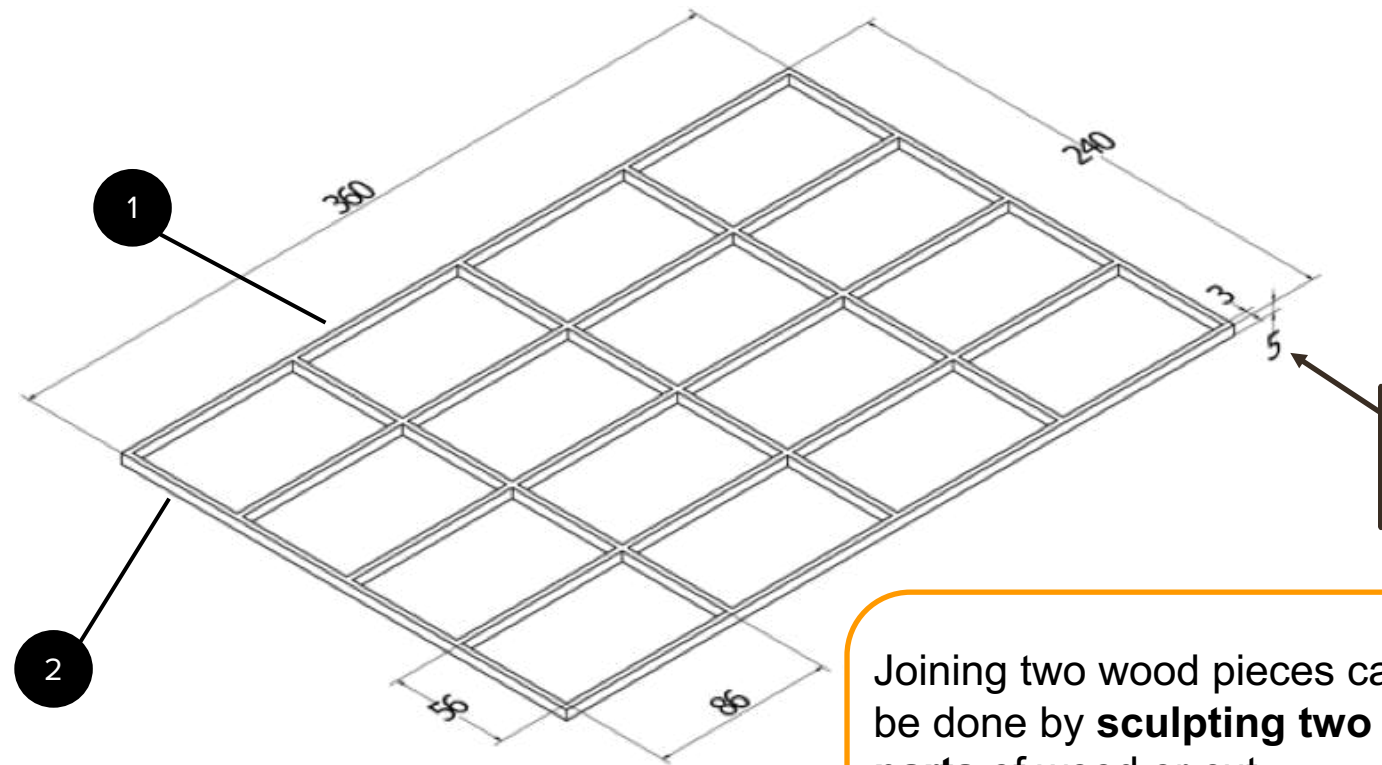


Wood binder installation **follow the slope** of the main frame

The **spacing** of wood binder is **30 cm** each up to **four levels**.

Step 7: Series of wood pieces for the dryer base

Series of wood pieces for base (cm)



List of materials for base

No	Material	Qty.
1	Ironwood 3 cm x 5 cm – 360 cm	5 units
2	Ironwood 3 cm x 5 cm – 240 cm	5 units

The height of the base is **5 cm**

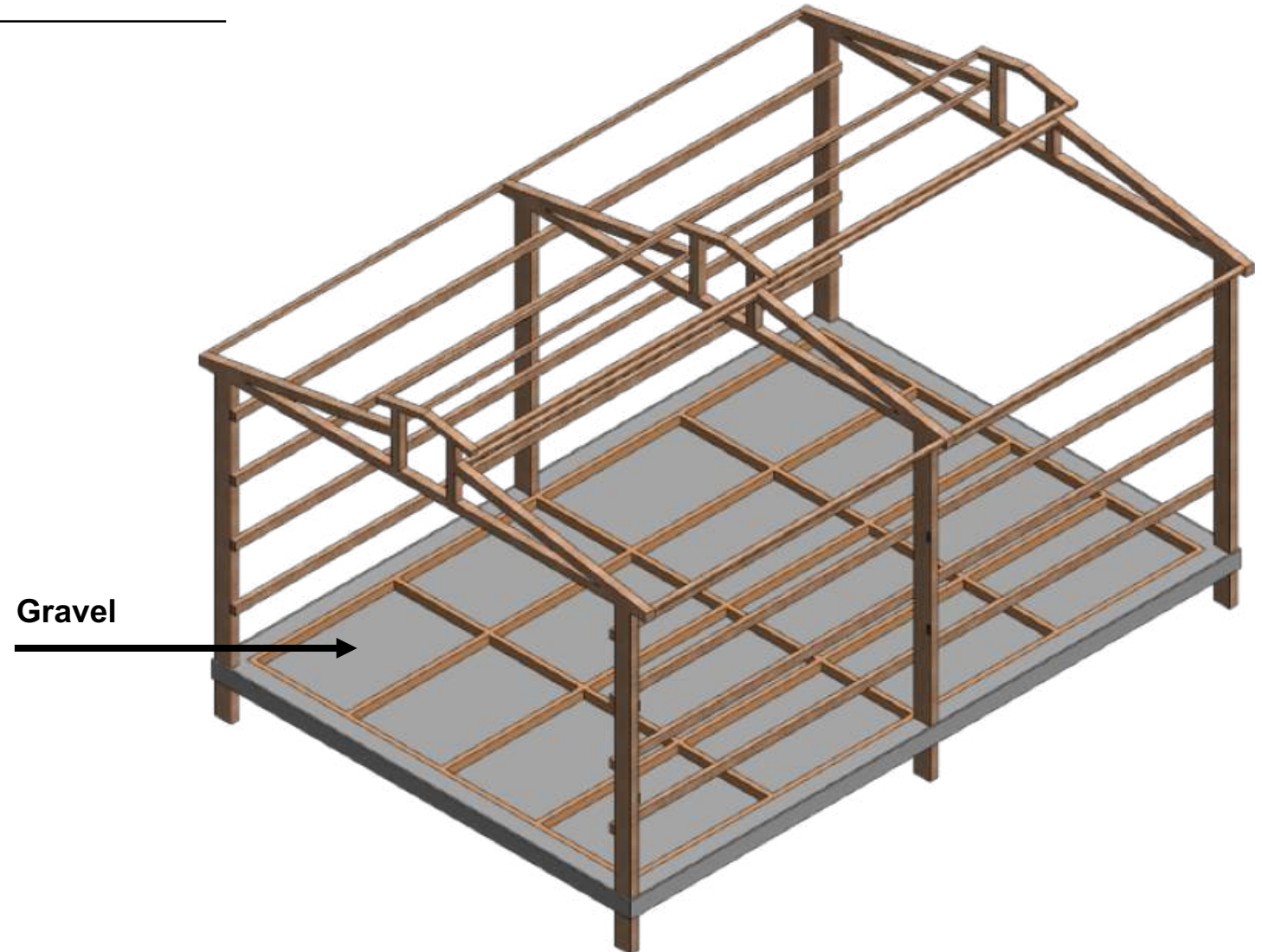
Joining two wood pieces can be done by **sculpting two parts** of wood or cut according to the size of **56 cm x 86 cm**.

Step 8: Base installation is followed by placing gravel in the cavities up to 5 cm or flat to the surface.

Wood base installation and gravel

Series of wood pieces and base section

- Floor section is filled with gravel until it is flat with the surface or 5 cm

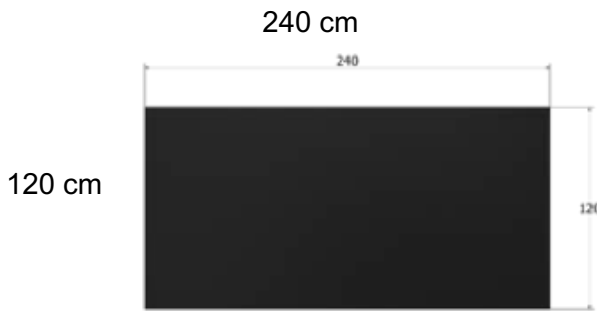


Step 9: Iron plate is used as the floor for the solar dryer.

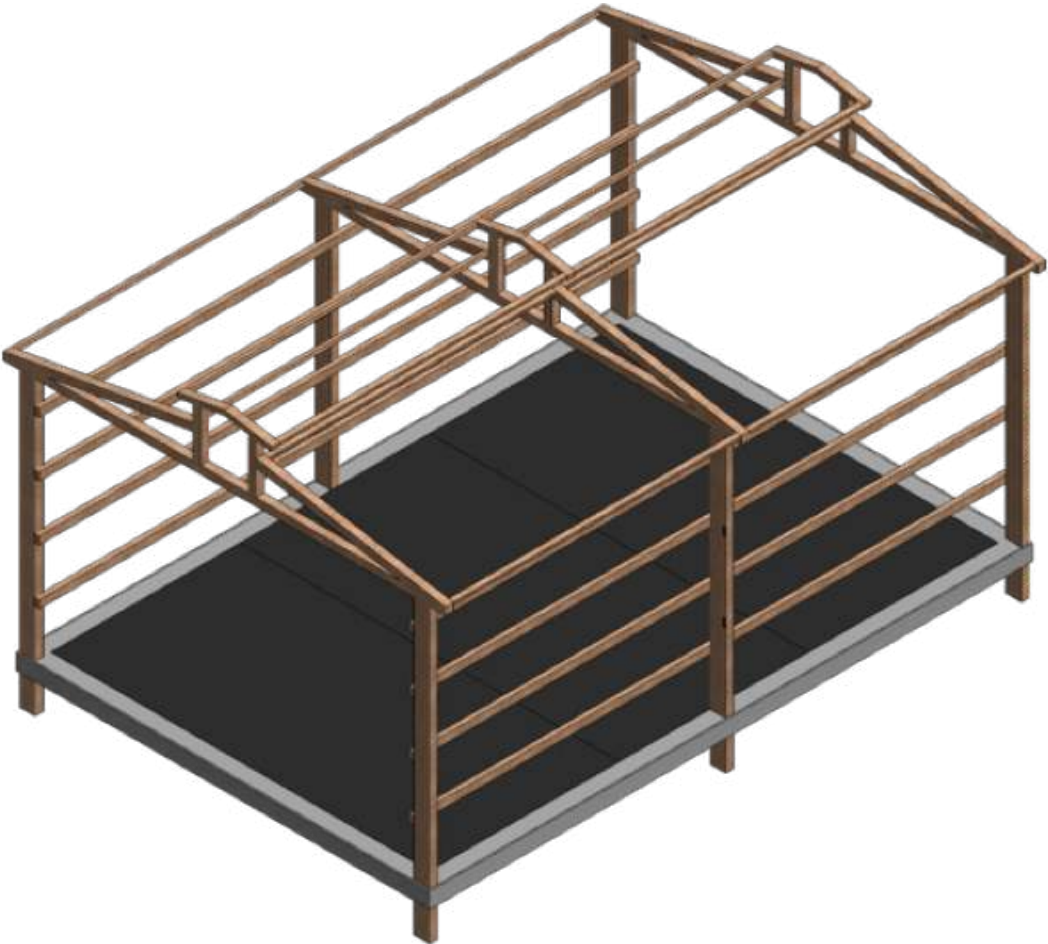
Iron plate as floor

Iron plate

Fastened to the series of wood (step 7) using nuts with the drill



Iron sheet size 240 cm x 120 cm

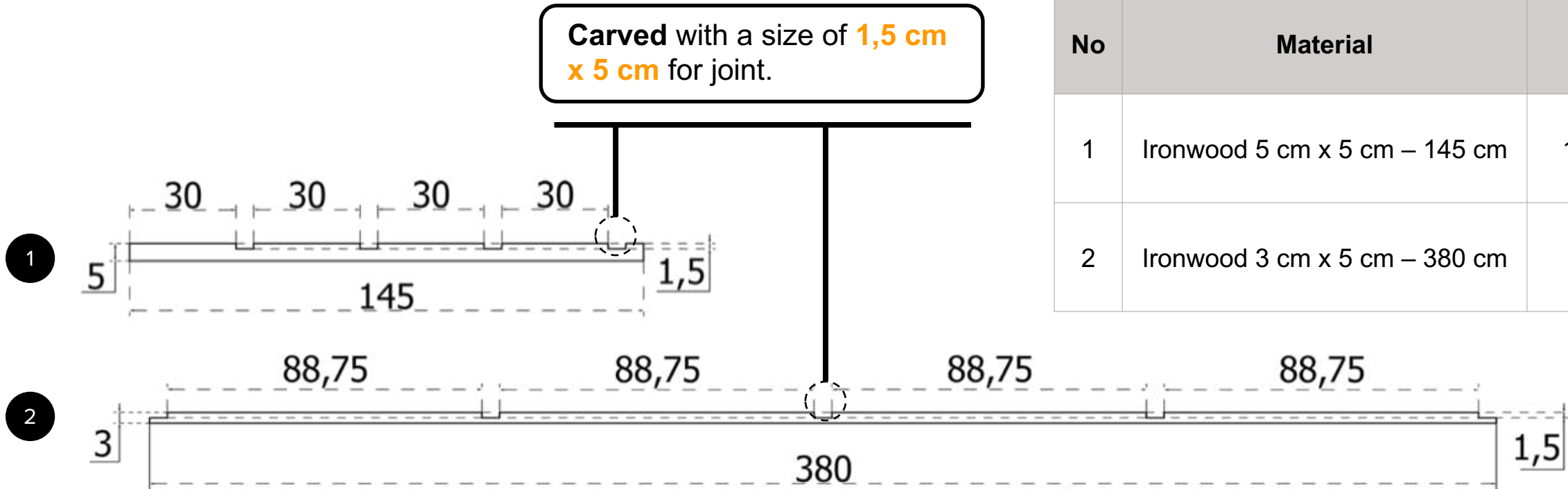


List of materials for floor

No	Material	Qty.
1	Iron plate (240 cm x 120 cm x 1.5 mm)	3 sheets
2	Nut M8	50 units

Step 10: Wooden leg and horizontal frame are carved for rack frame.

Wooden rack size (cm)

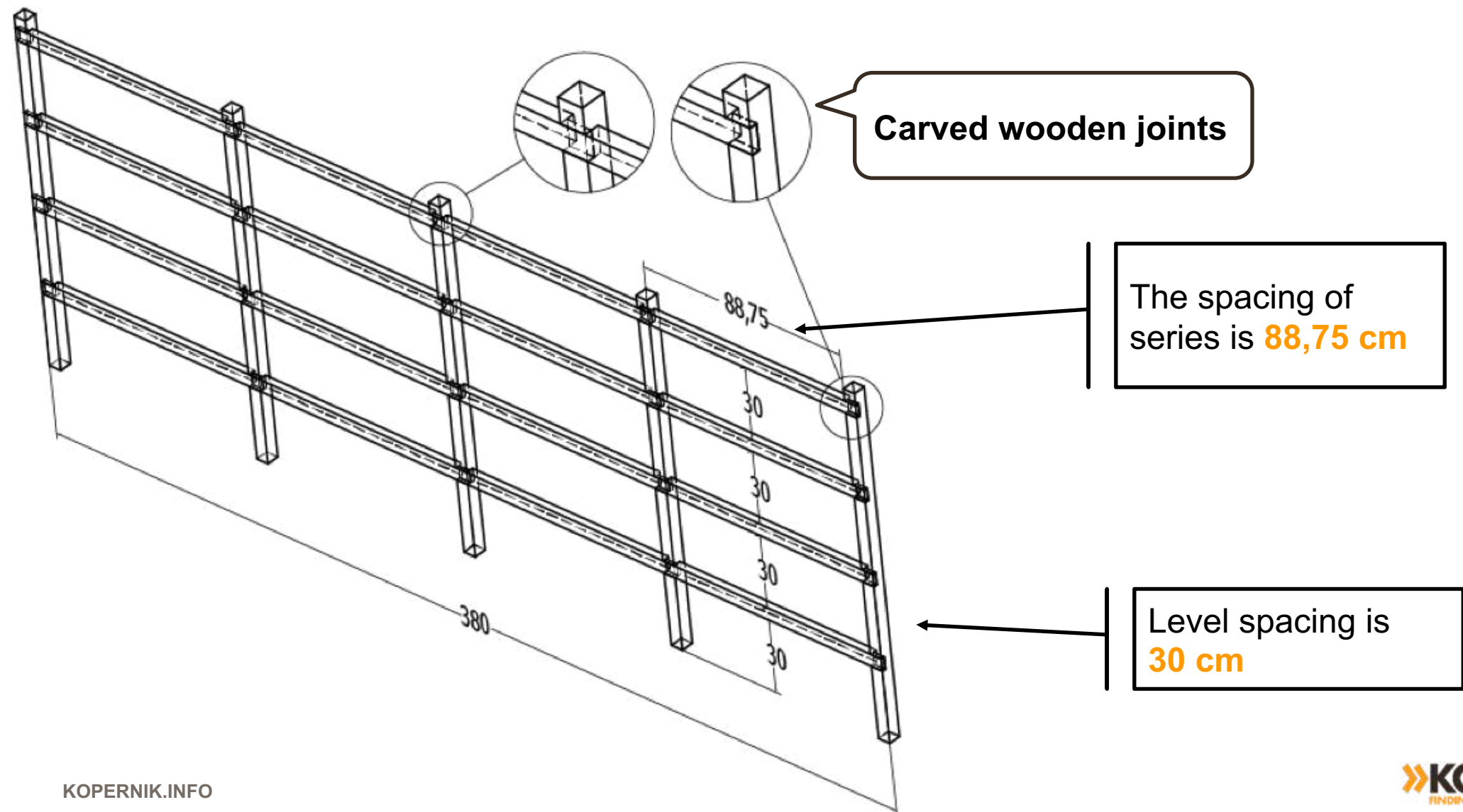


List of materials for rack frame

No	Material	Qty.
1	Ironwood 5 cm x 5 cm – 145 cm	10 units
2	Ironwood 3 cm x 5 cm – 380 cm	8 units

Step 11: Two rack units assembly

Wooden rack size (cm)



Step 12: Arrangement of two rack units in the dryer

Rack arrangement dimensions (cm)

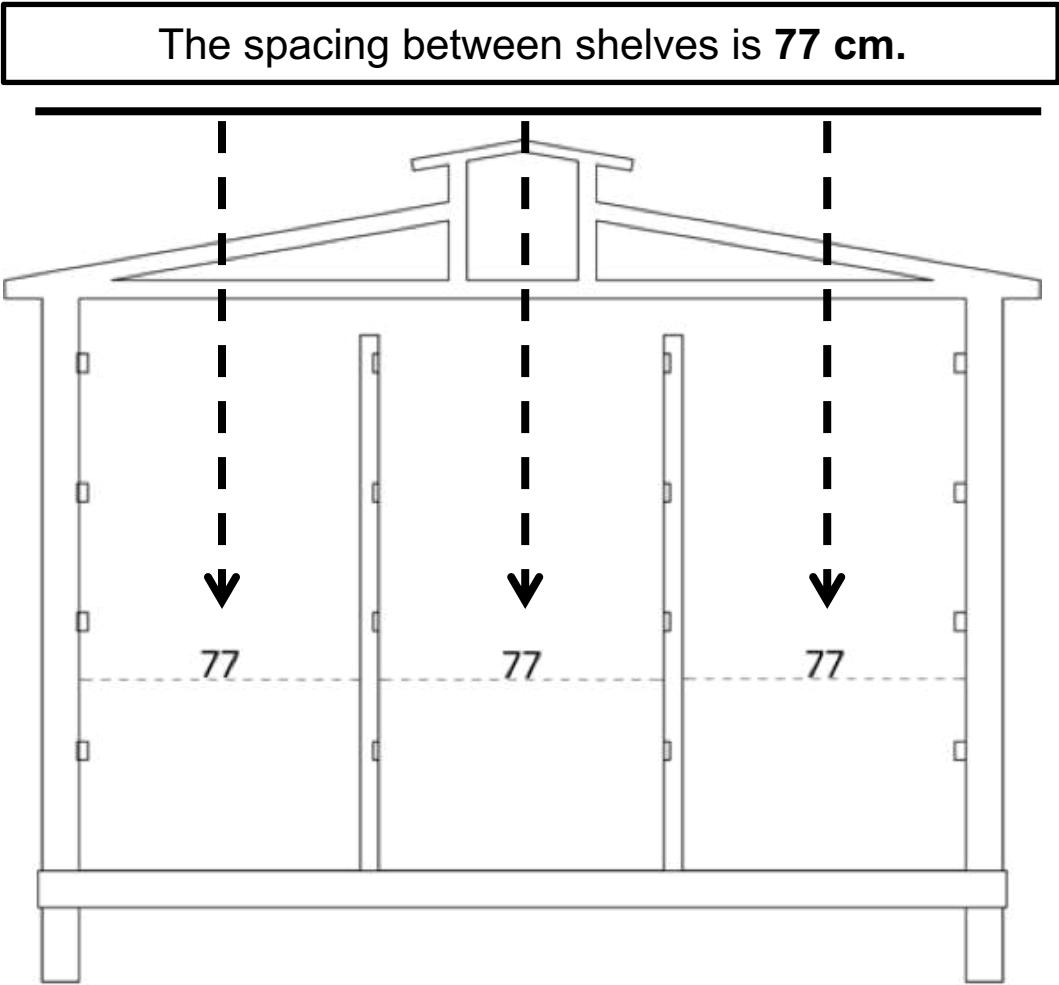
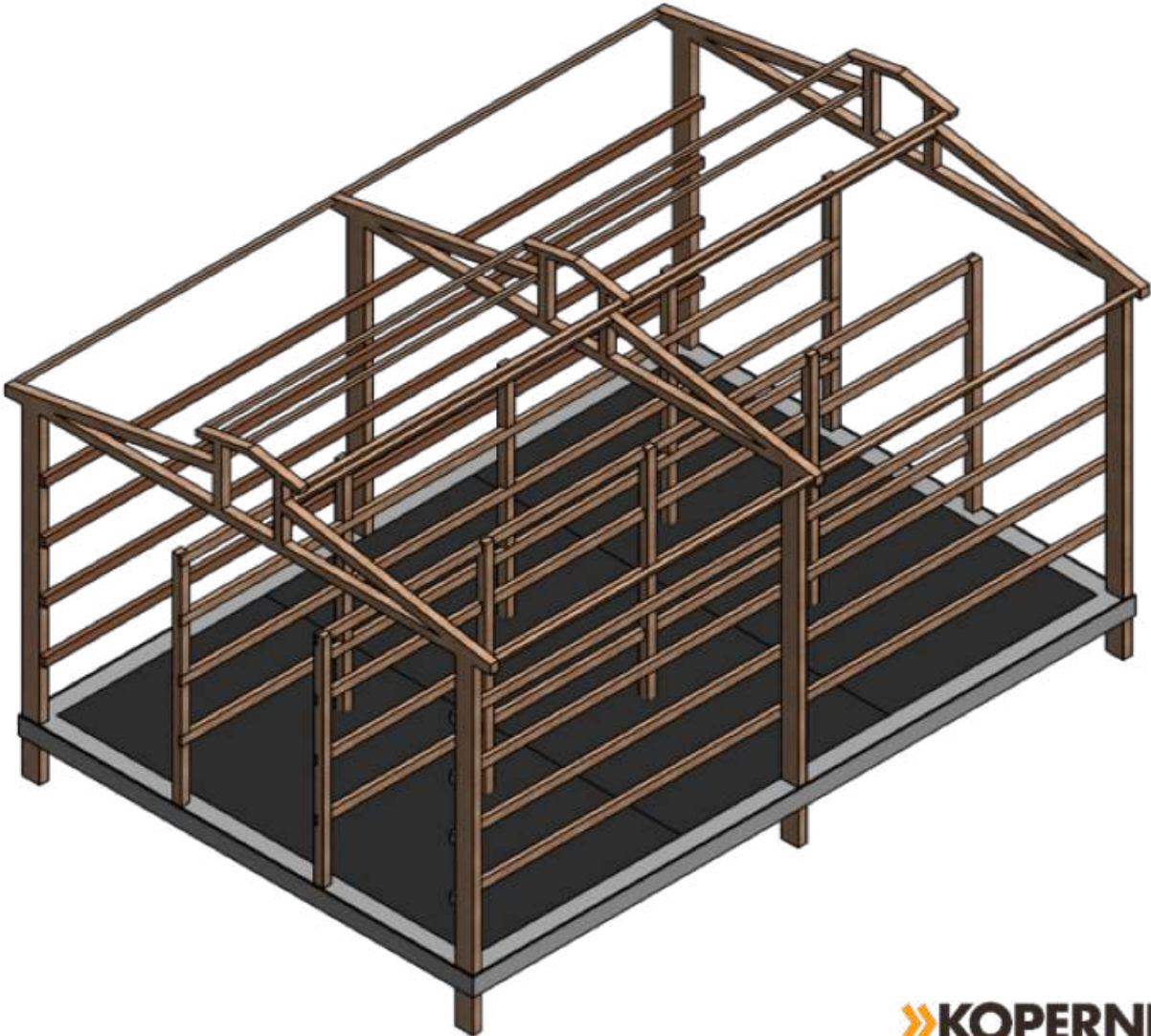
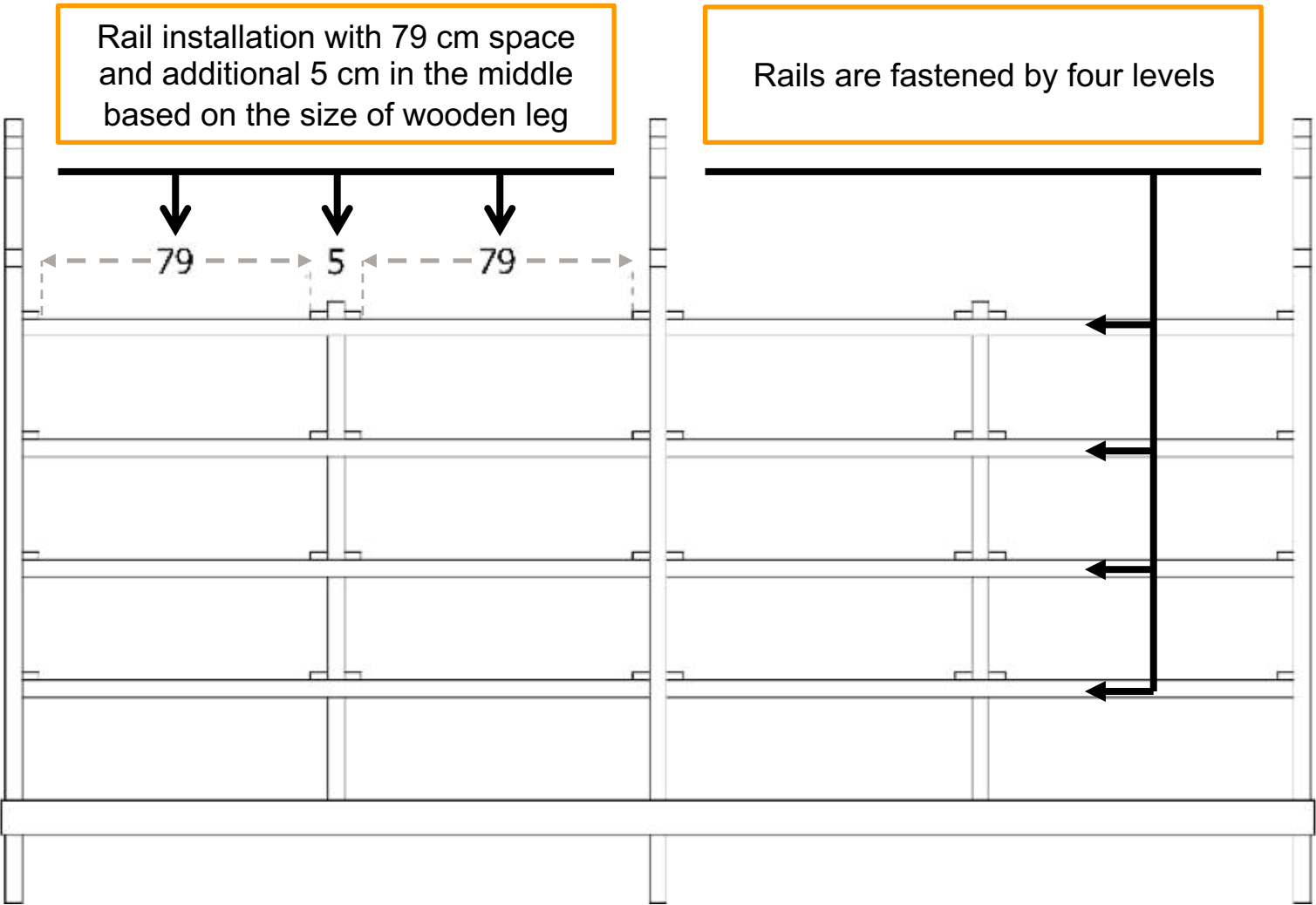


Illustration of rack arrangement

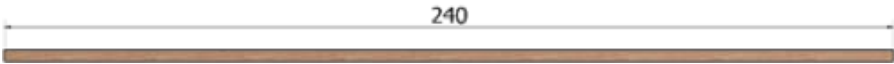


Step 13: Installation of rails as wood binder for rack and support for tray

Spacing of rail installation



List of materials

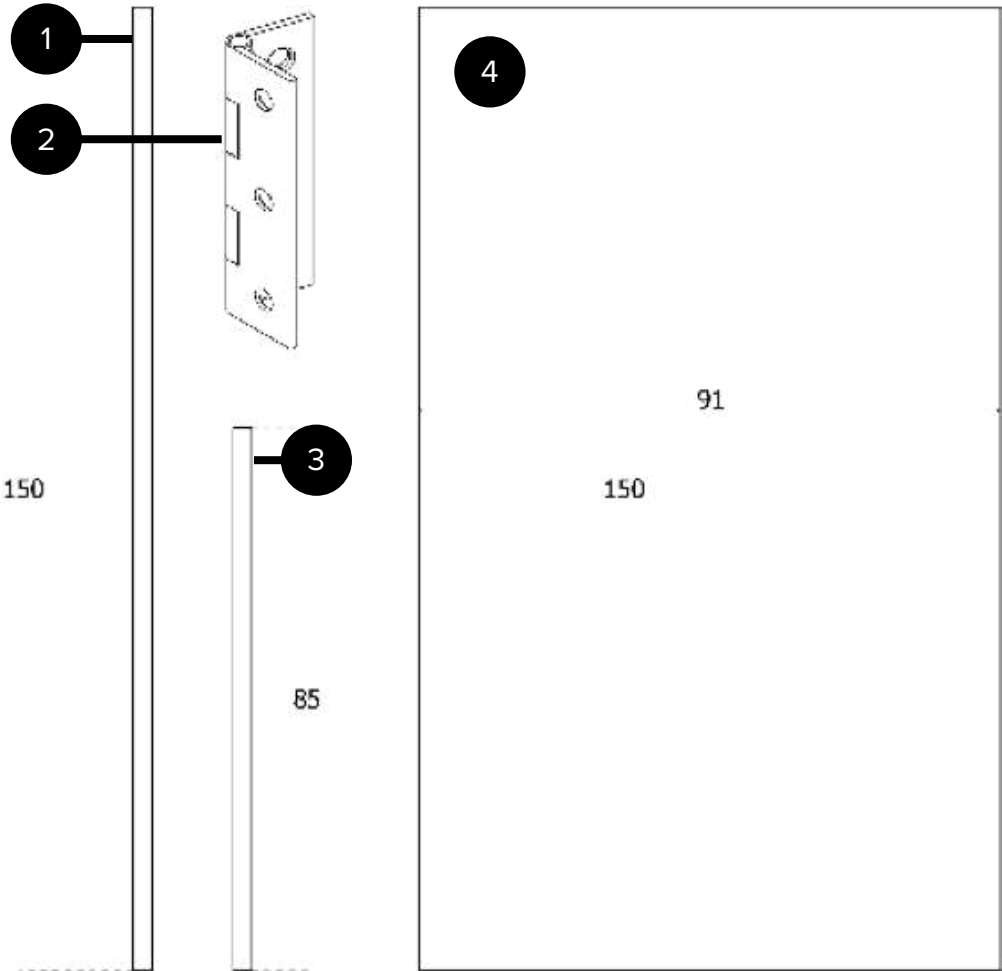


2 cm x 5 cm wood with a length of 240 cm

No	Material	Qty.
1	Ironwood 2 cm x 5 cm – 240 cm	10 units
2	Nail 3 cm	128 units

Step 14: Door frame assembly

Detailed size of door frame (cm)

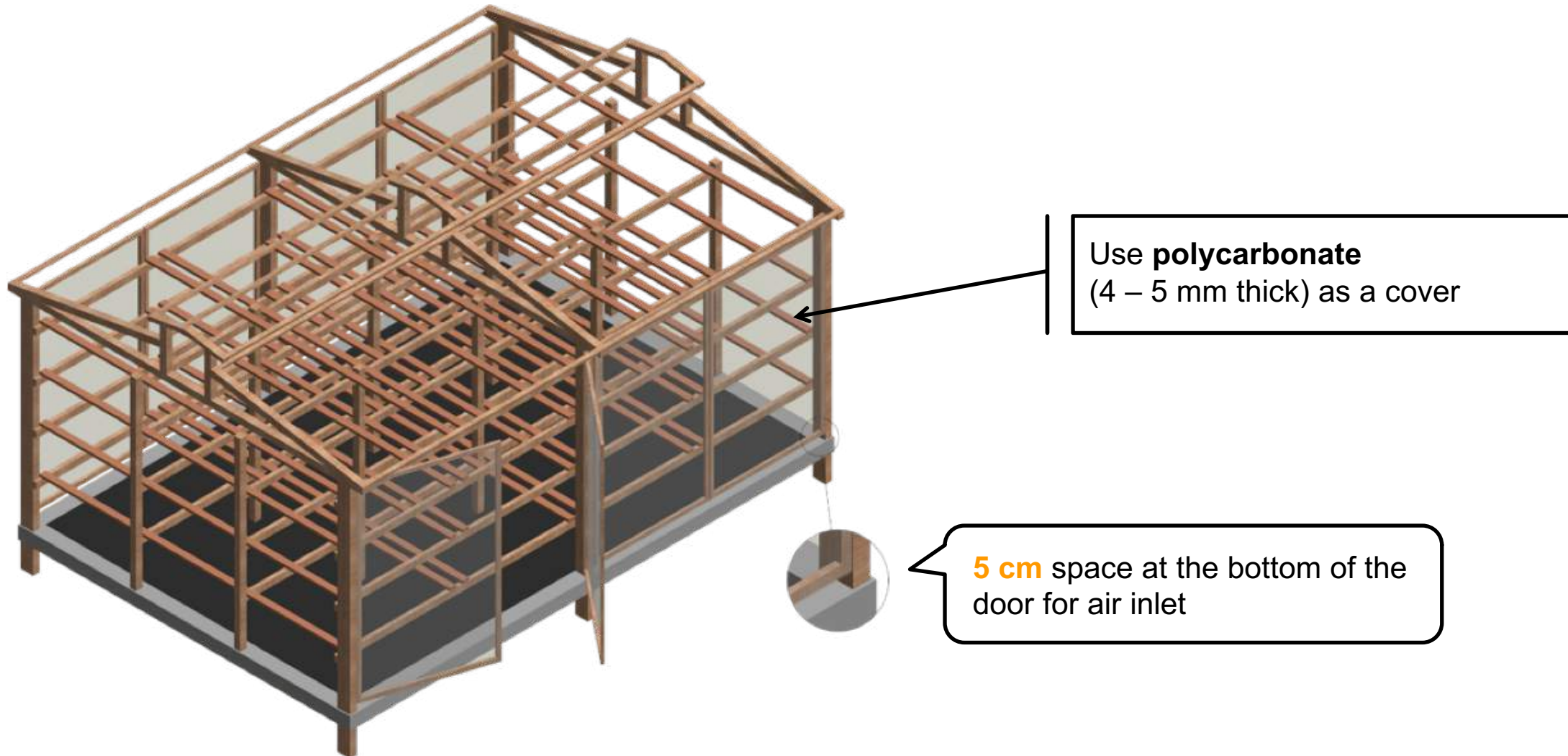


List of materials for installing door frames

No	Material	Qty.
1	Kaso wood 2 cm x 3 cm – 150 cm	16 units
2	Door hinges	8 pairs
3	Kaso wood 2 cm x 3 cm – 85 cm	16 units
4	Polycarbonate - 91 cm x 150 cm	8 sheets

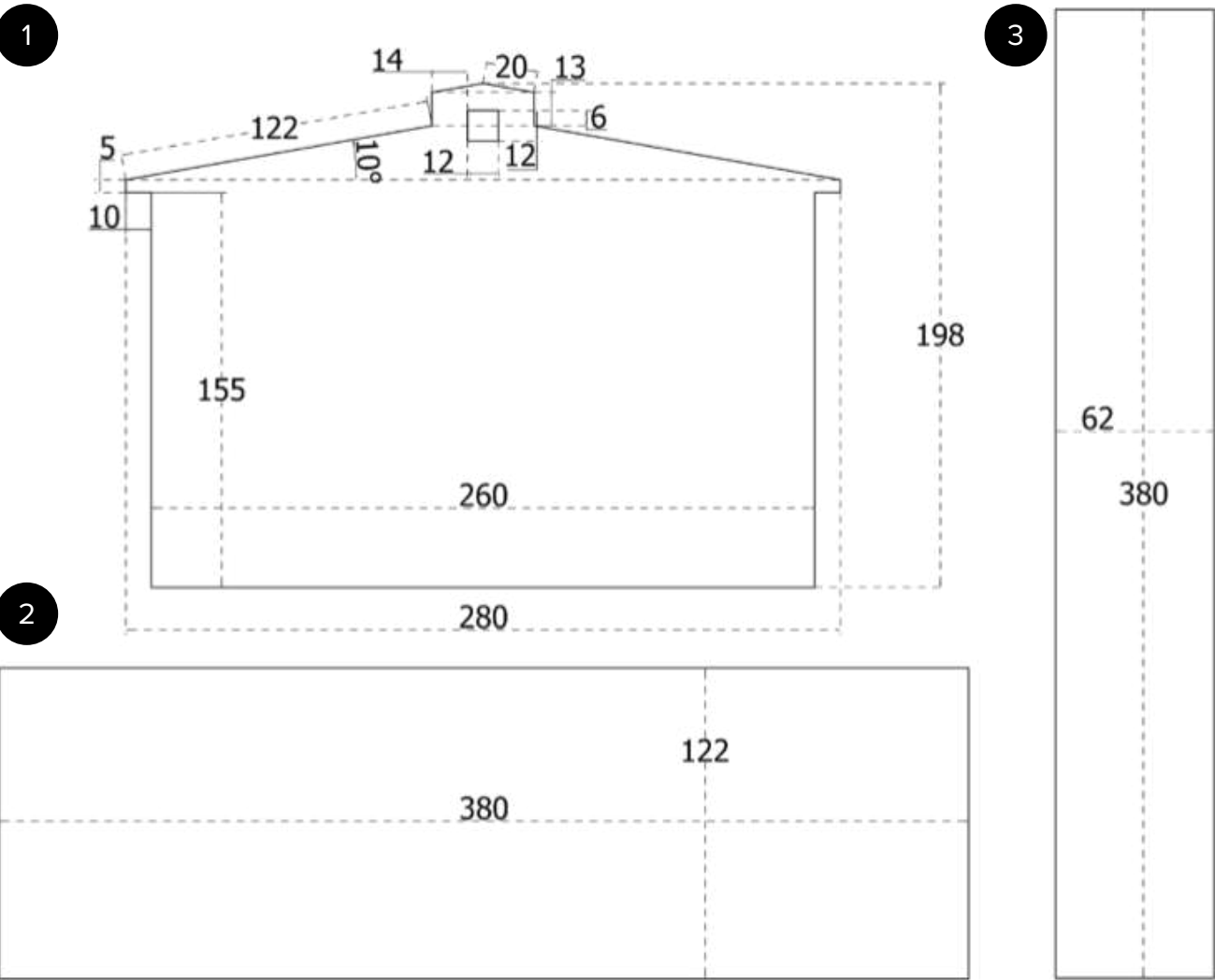
Step 15: Door installation at the laterals of the dryer

Illustration of door installation



Step 16: Polycarbonate as wall and roof of the nutmeg solar dryer

Polycarbonate cutting size (cm)

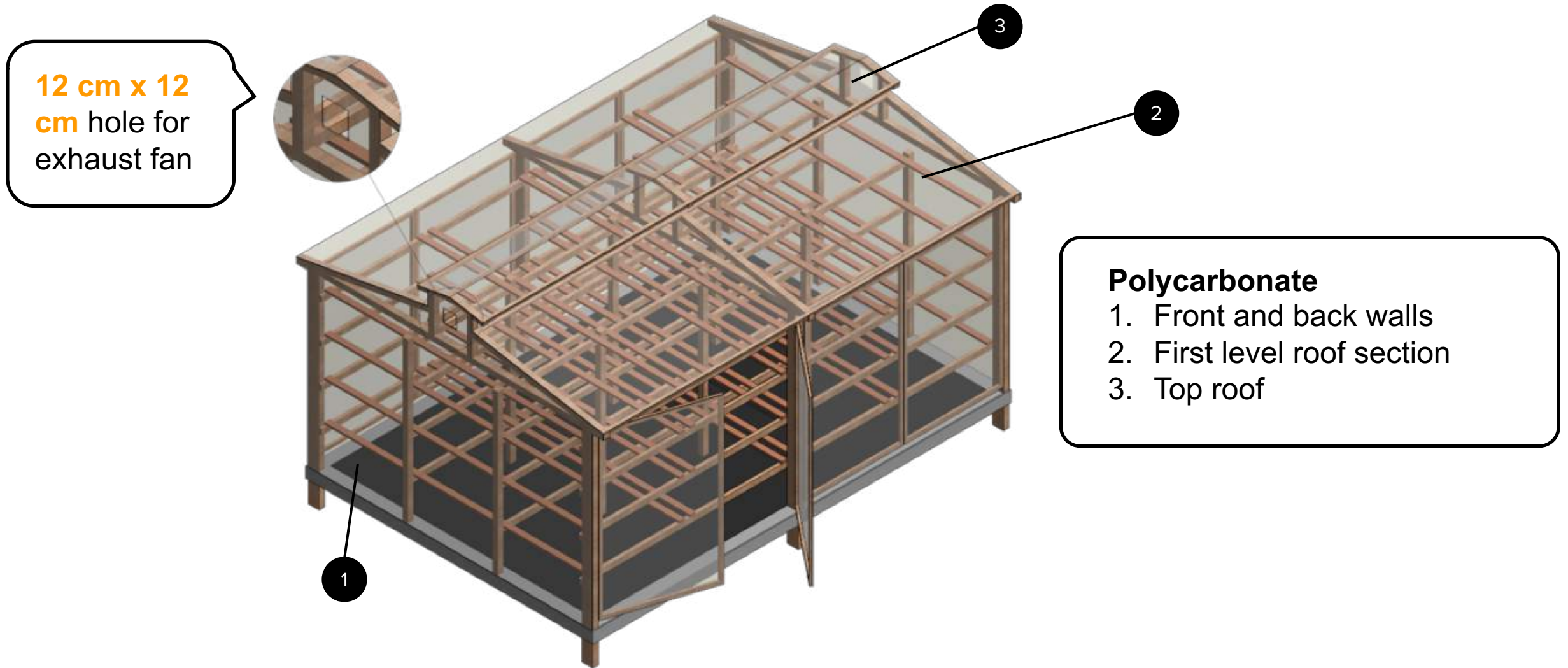


List of materials

No	Material	Qty.
1	Polycarbonate (4-5mm thick) – 198 cm x 280 cm	2 sheets
2	Polycarbonate (4-5mm thick) – 122 cm x 380 cm	2 sheets
3	Polycarbonate (4-5mm thick) – 62 cm x 380 cm	2 sheets
4	Roofing nail	2 kg
5	Silicone sealant	2 units

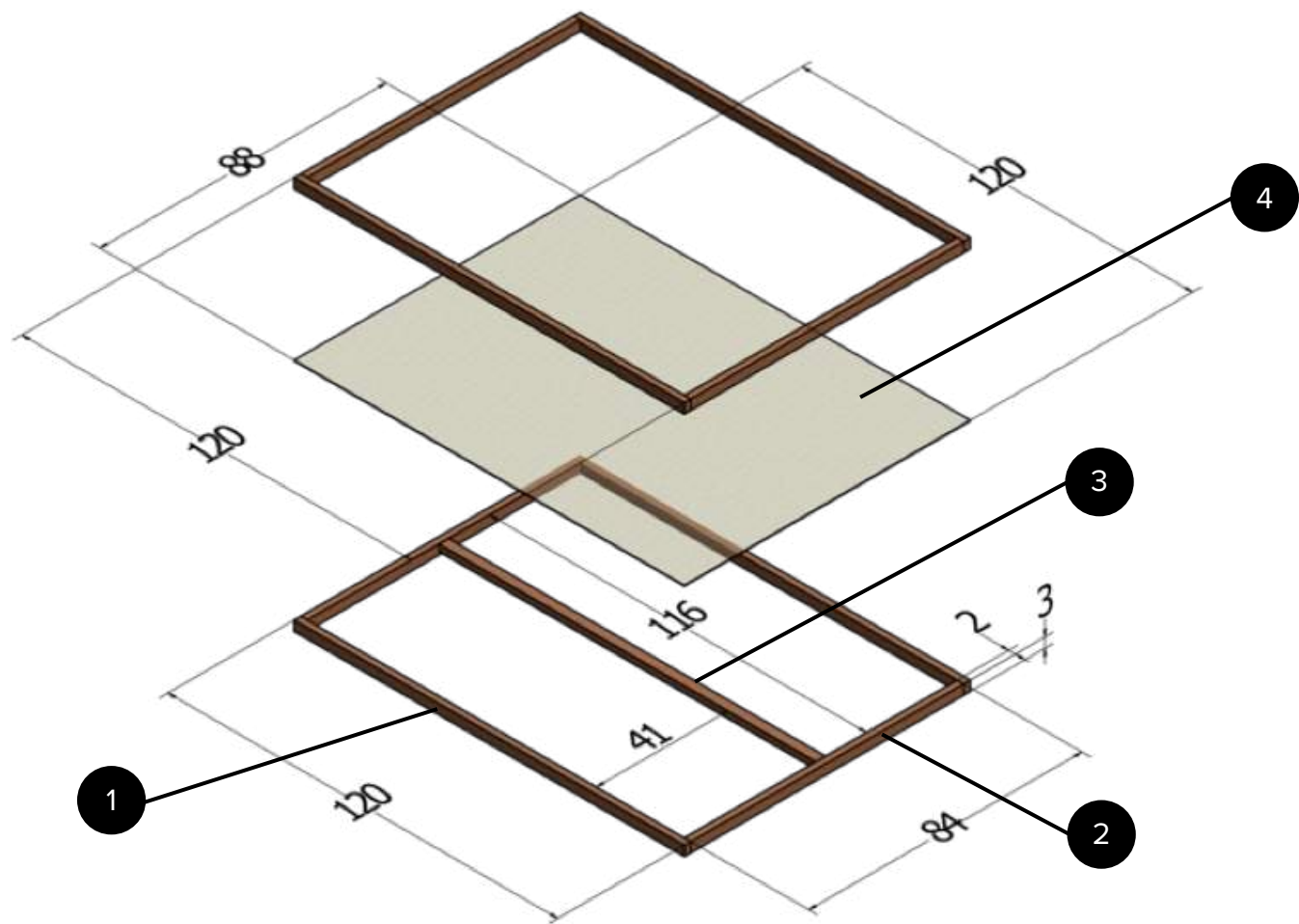
Step 17: Polycarbonate sheets are fastened to the main frame and wooden roof support with tack and silicone glue.

Illustration of installed polycarbonate



Step 18: Nutmeg tray assembly

Size of tray (cm)

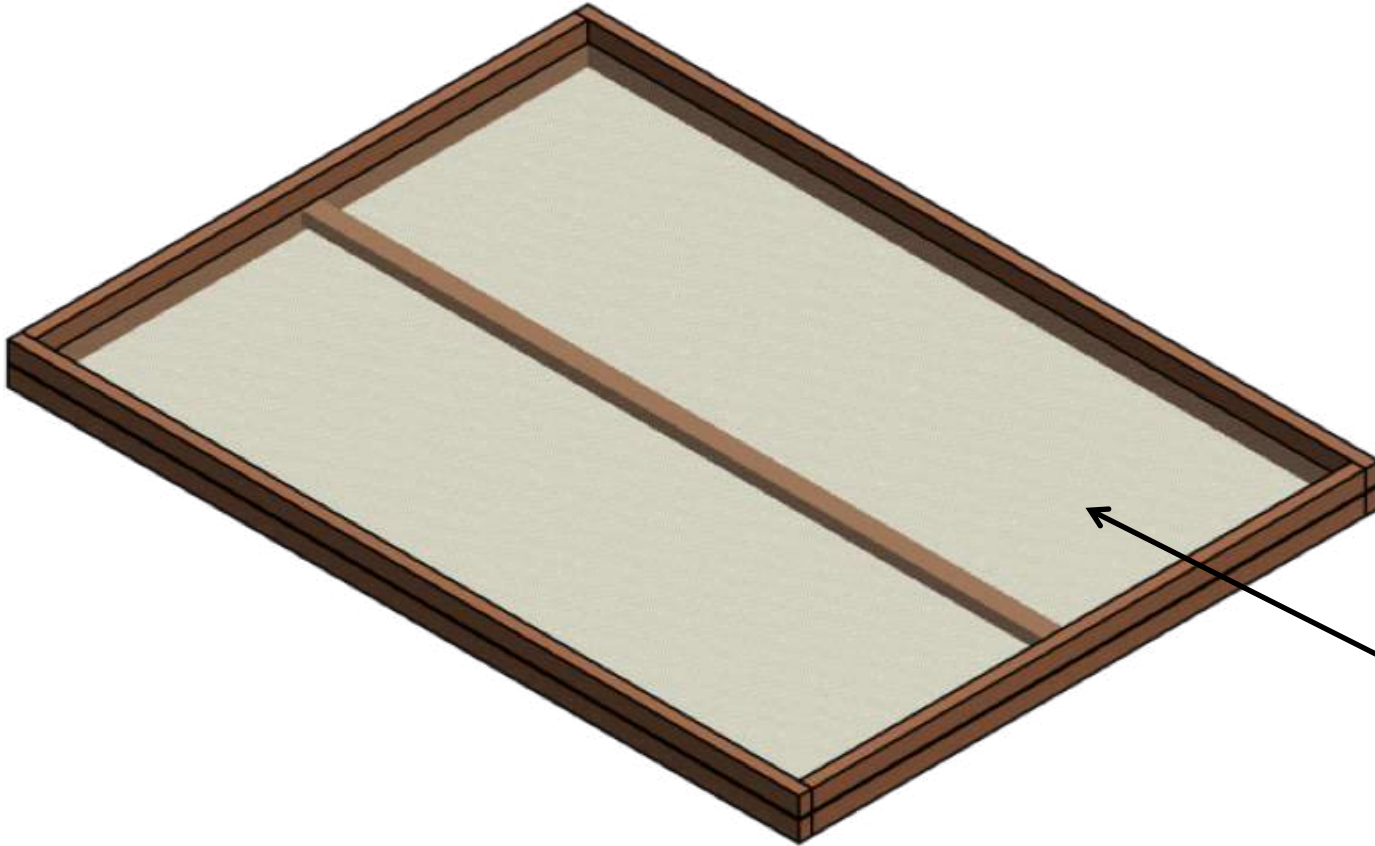


List of materials

No	Material	Qty.
1	Kaso wood 2 cm x 3 cm – 120 cm	128 units
2	Kaso wood 2 cm x 3 cm – 84 cm	128 units
3	Kaso wood 2 cm x 3 cm – 116 cm	32 units
4	Net	1 roll
5	Nail (3 cm)	2 kg
6	Nail (5 cm)	1 kg

Step 19: Nutmeg tray (32 units).

Nutmeg tray



The assembly is done separately between the upper and lower frame. After fastening the net to the lower frame, the upper frame is joined to the lower frame

Net is fastened to the lower frame by using 3 cm nails that are curved at a distance of **10 cm**

Step 20: Equipment to mount the exhaust fan which can be found at electronics or computer store.

List of materials for fan installation



No	Material	Qty.
1	Exhaust fan 12 cm x 12 cm – 1.6 A	2 units
2	Cable tie 20 cm x 2 cm	8 units

Step 21: Install two fan units on the front and back the solar dryer.

Illustration of installed fan

Create four **holes at the end of the fan** using a small drill

Secure the fan with polycarbonate using cable ties

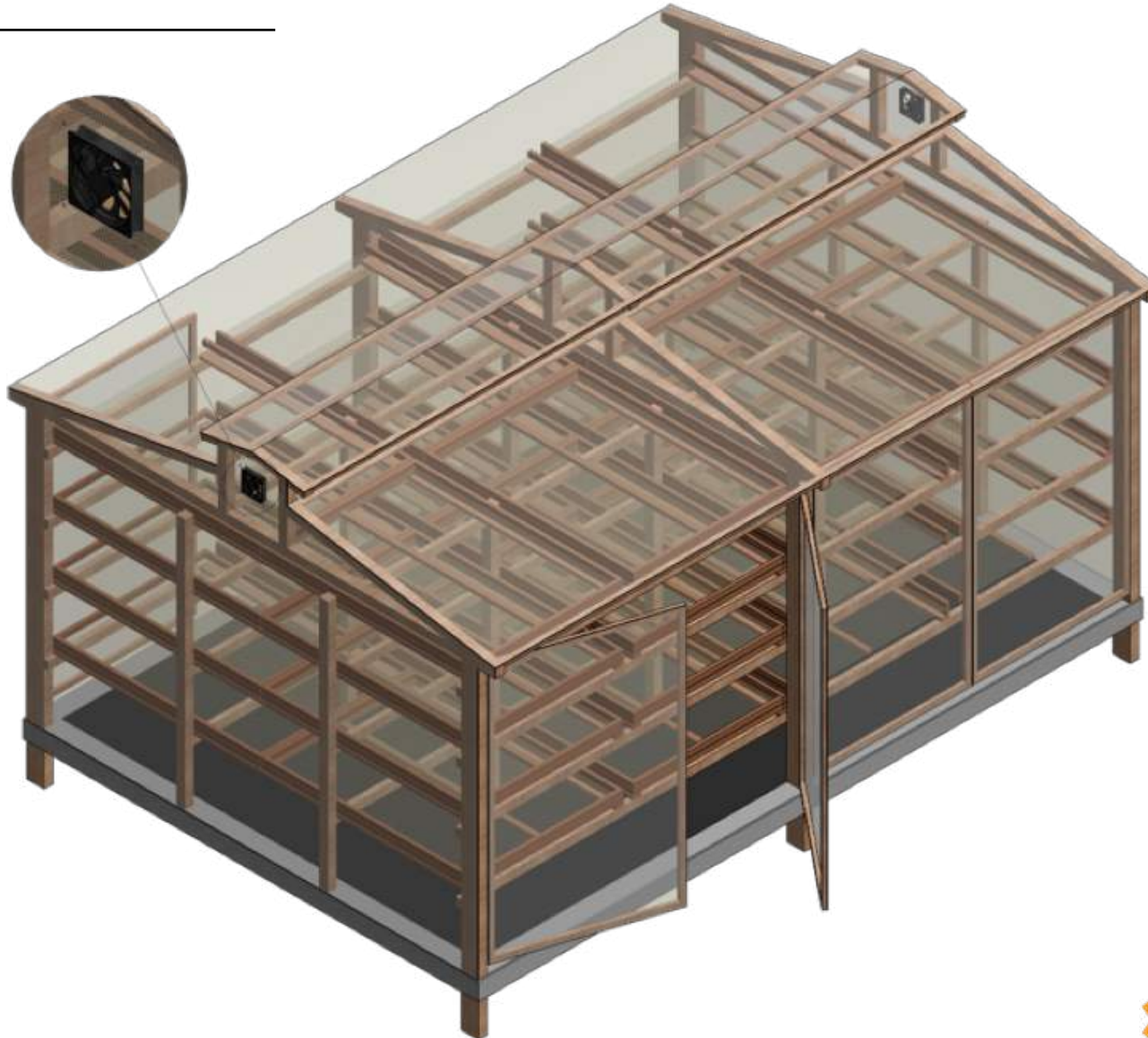


Illustration of the completed solar dryer



Total cost estimation and details of materials for nutmeg solar dryer... (1)

ITEM	SIZE	QTY.	UNIT COST (IDR)	TOTAL COST (IDR)
Polycarbonate	11.8 m x 2.1 m x 5 mm	2 roll	4.000.000	8.000.000
Ironwood	5 cm x 10 cm x 400 cm	3 unit	70.000	210.000
	5 cm x 5 cm x 400 cm	20 unit	35.000	700.000
	3 cm x 5 cm x 400 cm	17 unit	26.000	442.000
	2 cm x 5 cm x 400 cm	32 unit	20.000	640.000
Kaso wood	2 cm x 3 cm x 400 cm	94 unit	10.000	940.000
Net	100 m	1 roll	700.000	700.000
Iron plate	240 cm x 120 cm x 1.5 cm	3 unit	500.000	1.500.000
Construction sand	1 m ³	1	750.000	750.000
Cement	50 kg	5	90.000	450.000
Gravel	1 m ³	2	300.000	600.00
Door hinges	2 1/2	8 pairs	10.000	80.000
Nut	M8	100 unit	2.000	200.000
...

Total cost estimation and details of materials for nutmeg solar dryer... (2)

ITEM	SIZE	QTY.	UNIT COST (IDR)	TOTAL COST (IDR)
Nail	7 cm	1 kg	20.000	20.000
	5 cm	2 kg	20.000	40.000
	3 cm	4 kg	20.000	80.000
Tack	3 cm	2 kg	40.000	80.000
Silicone sealant	300 ml	3	25.000	75.000
Exhaust fan	12 cm x 12 cm – 1.6 VA	2	150.000	300.000
Cable tie	2.5 x 15 cm	1 pack	50.000	50.000
Others	-	1	2.000.000	2.000.000
Contingency (10%)	-	-	-	1.785.700
Total				19.642.700

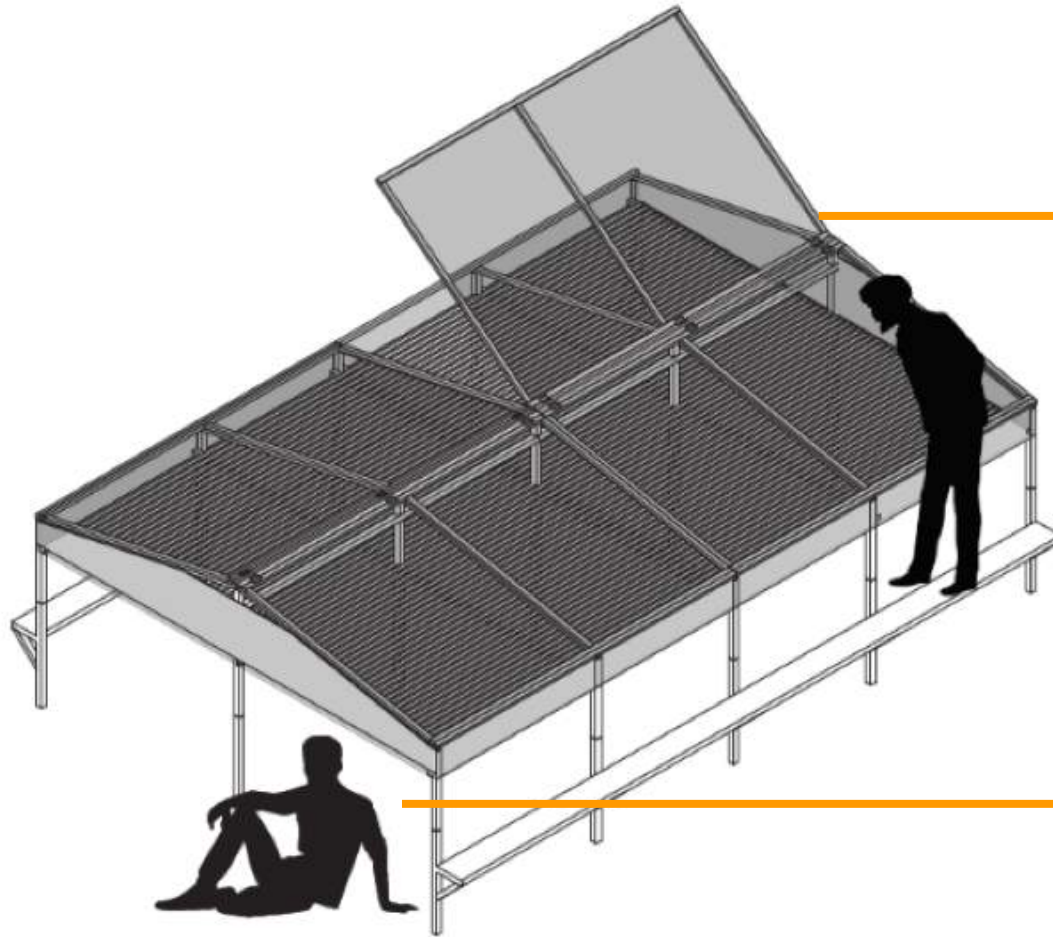
SEAWEED SOLAR DRYER

A large, rectangular, raised solar dryer for seaweed is the central focus, built on a concrete base. The interior of the dryer is divided into several long, narrow channels by low concrete walls. The entire structure is set in a sunlit courtyard. In the background, there are traditional houses with corrugated metal roofs and satellite dishes. A large tree stands in the center background, and laundry is hanging on a line to the left.

The seaweed solar dryer characteristics are adapted to the selected location, which includes building a docking as a base for the dryer.

Seaweed solar dryer model

Main advantages

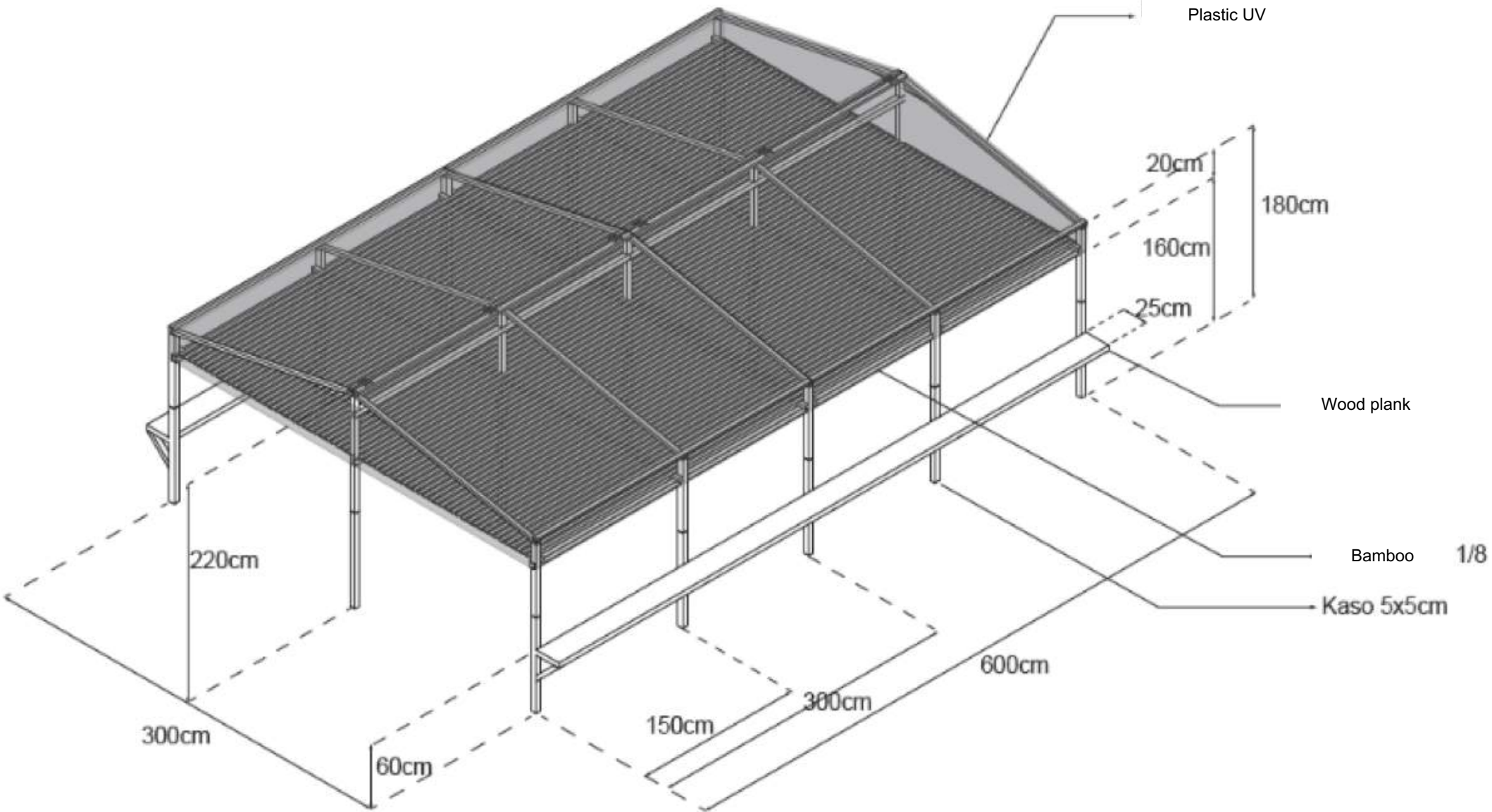


Solar dryer cover is equipped with **hinges** to ease the drying of seaweed

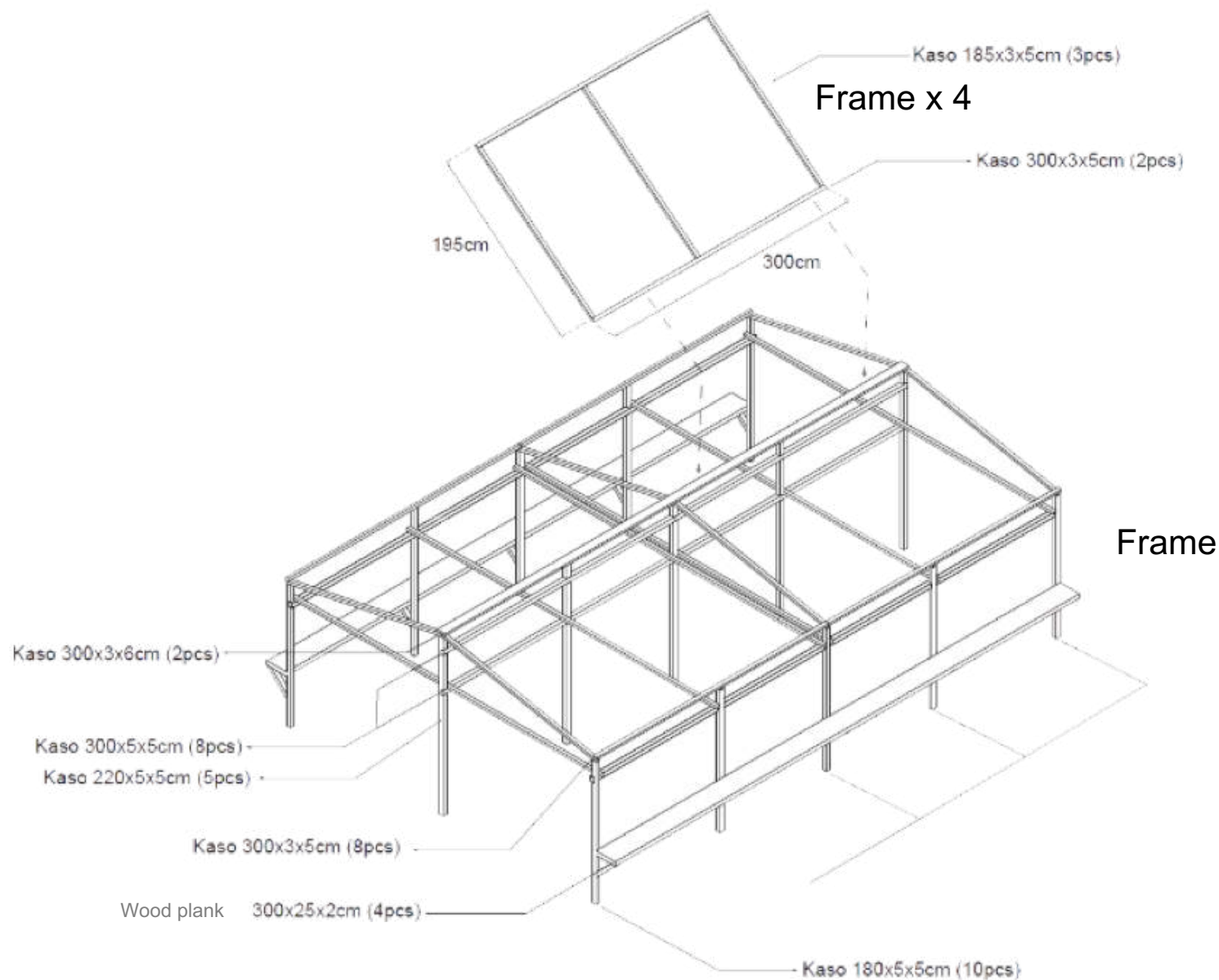
Farmers will be able to stand next to the solar dryer to hang seaweed in the net

Farmers can utilize the space between a buffer and a solar dryer to store equipment.

Seaweed solar dryer detailed dimensions



Seaweed solar dryer materials



Purpose	Item	Size
Cover	UV Plastic / PP roofing	50 m
Door	Kaso	300 x 3 x 5cm (2pcs)
	Kaso	185 x 3 x 5cm (3pcs)
Frame	Kaso	180 x 5 x 5cm (10pcs)
	Kaso	300 x 3 x 5cm (8pcs)
	Kaso	300 x 3 x 6cm (2pcs)
	Kaso	300 x 5 x 5cm (8pcs)
	Kaso	220 x 5 x 5cm (5pcs)
	Wood plank	300 x 25 x 2cm (4pcs)
Drying mat	Bamboo	3m (8pcs) divided 1/8

Total cost estimation and details of materials for the docking

PURPOSE	ITEM	SIZE	QUANTITY	UNIT COST (IDR)	TOTAL COST (IDR)
Docking	Wood planks	30 cm x 3 cm x 4 m	1.5 m ³	4.000.000/m3	6.000.000
	Wood	5 cm x 10 cm x 4 m	2 m ³	4.000.000/m3	8.000.000
	Wood	10 cm x 10 cm x 4 m	2 m ³	4.000.000/m3	8.000.000
	Bolt		150 unit	3.000/unit	200.000
	Nail		10 kg	25.000/kg	450.000
Others	Labour	10 days	5 person	100.000/person/day	5.000.000
Total					27.650.000

Total cost estimation and details of materials for seaweed solar dryer.. (1)

PURPOSE	ITEM	SIZE	QUANTITY	UNIT COST (IDR)	TOTAL COST (IDR)
Roofing	PP Roofing UV Protection	2 mm x 1 m	40 m	70.000	2.800.000
	Tack	3 cm	3 kg	40.000	120.000
Door	Kaso wood	3 cm x 5 cm x 300 cm	2 unit	20.000	40.000
	Kaso wood	3 cm x 5 cm x 185 cm	2 unit	20.000	40.000
	Door hinges	2 ½ inch	4 pasang	25.000	100.000
Frame	Kaso wood	5 cm x 5 cm x 180 cm	10 unit (5 unit 4 m)	25.000	125.000
	Kaso wood	3 cm x 5 cm x 300 cm	8 unit	20.000	160.000
	Kaso wood	3 cm x 6 cm x 300 cm	2 unit	22.000	44.000
	Kaso wood	5 cm x 5 cm x 300 cm	8 unit	25.000	200.000
	Kaso wood	5 cm x 5 cm x 220 cm	5 unit	25.000	125.000
	Wood plank	25 cm x 2 cm x 300 cm	4 unit	30.000	120.000
...

Total cost estimation and details of material for seaweed solar dryer.. (2)

PURPOSE	ITEM	SIZE	QUANTITY	UNIT COST (IDR)	TOTAL COST (IDR)
...
Drying base	Bamboo (1/8)	3 m	8 unit	50.000	400.000
Others	Nail	5 cm	3 kg	30.000	90.000
	Nail	3 cm	3 kg	25.000	75.000
	Silicone sealant	300 ml	2	35.000	70.000
Contingency (10%)	-	-	-	-	450.900
Total					4.959.990