

SECTION I

HOW TO BUILD A CHIMNEY SOLAR DRYER

Steps to build a chimney solar dryer using low-cost, easily available materials

FOUR MAIN COMPONENTS OF THE CHIMNEY SOLAR DRYER

The dryer design has four elements:

1. A drying table covered with black plastic or fabric.
2. A chimney covered with clear plastic with an opening at the drying table.
3. Mesh-covered drying trays to hold the produce.
4. Clear polyethylene film that covers the trays and the drying table and is sealed to the chimney.

INSTRUCTIONS

The dryer dimensions can be changed to meet various capacity needs. The chimney and the table should be the same width. The height of the chimney, as measured from the top of the table, should be half the length of the table. Note that significantly increasing the length of the table and thus the height of the chimney may be cumbersome, as the structure might tip over.



Four main components to the chimney solar dryer, clockwise from top left: a drying table, a chimney, mesh trays, and clear film to cover the drying table.

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MATERIALS NEEDED TO BUILD THE CHIMNEY SOLAR DRYER

Item description	Label in figures	Number of pieces	Size (W x H x L)	Running length (m)
Combined wood for dryer table and chimney frames				(total: 56.09 m)
Wood for table frame and chimney frame	A	23	3 cm x 3 cm x 54 cm	12.42 m
	B	4	3 cm x 3 cm x 2.8 m	11.20 m
	C	4	3 cm x 3 cm x 4 m	16.00 m
	D	8	3 cm x 3 cm x 74 cm	5.92 m
Diagonal stabilization boards for drying table and chimney	E	3	3 cm x 3 cm x 95 cm	2.85 m
	F	2	3 cm x 3 cm x 1.6 m	3.20 m
	G	3	3 cm x 3 cm x 1.5 m	4.50 m
Combined wood for trays				(total: 24 m)
Wood for 10 trays	H	40	2 cm x 4 cm x 60 cm	24.00 m
Combined wood or bamboo poles				(total: 12 m)
Wood or bamboo poles	I	3	Minimum length 4 m	12.00 m
Additional wood for support and attachment				(total: 11.6 m)
Table attachment to the chimney	J	2	2 cm x 15 cm x 90 cm	1.80 m
Pole support	K	2	2 cm x 15 cm x 30 cm	0.60 m
Pole support shelf	L	2	3 cm x 3 cm x 60 cm	1.20 m
Wood strips	M	2	2 cm x 4 cm x 4 m	8.00 m
Clear polyethylene - Greenhouse grade polyethylene plastic, thickness 0.10 – 0.15 mm, do not use milky colored PE or PVC plastic.				
Clear plastic for chimney cover		1	2.2 m x 3 m	
Clear plastic for dryer table cover		1	4 m x 3 m	
Black plastic or fabric - Thicker is better.				
Black plastic or fabric to cover dryer table (thicker is better)		1	6 m x 2.7 m	
Food grade plastic/metal mesh				(total: 6 m)
Mesh for 10 trays		10	60 cm x 60 cm	6.00 m
Note: The table lists materials, dimensions, and number of pieces needed to build a dryer with a 4-meter long table and 2.8-meter high chimney.				

In this manual, all instructions are for a 4-meter long table and 2.8-meter high chimney. This design uses 60 cm x 60 cm trays, because the table frame is 60 cm wide, and you can fit 5 trays (or 10 trays in stacks of 2) on a 4-m long table. The chimney is always 60 cm deep and the same width as the drying table.

MATERIALS

Materials needed to build the dryer include wood, clear polyethylene plastic, black plastic or fabric, and food-grade mesh. Quantities may vary depending of the size of your chimney solar dryer. Materials above are calculated based on actual dimensions. It is suggested to buy 10 percent extra material to account for minor errors or other unforeseen issues.

SITE SELECTION

A full-sized dryer, using the design in this manual will be 4 m long. You will need enough flat area with good sun exposure to

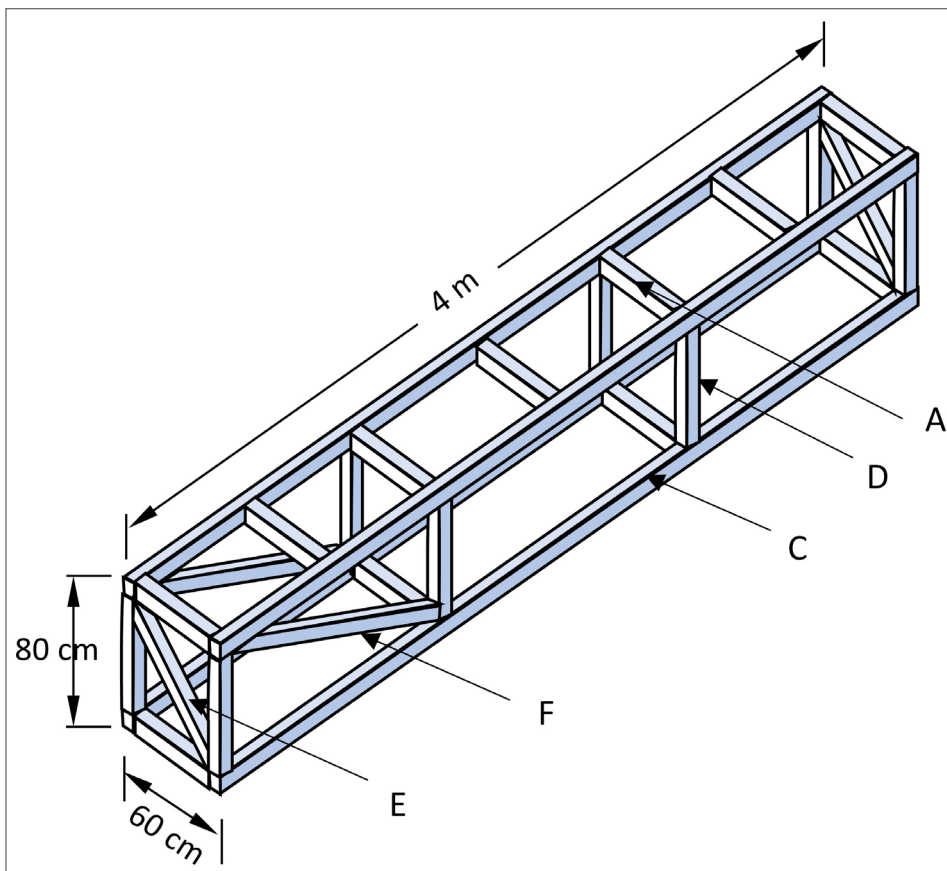


Figure 2. Wood frame for the table

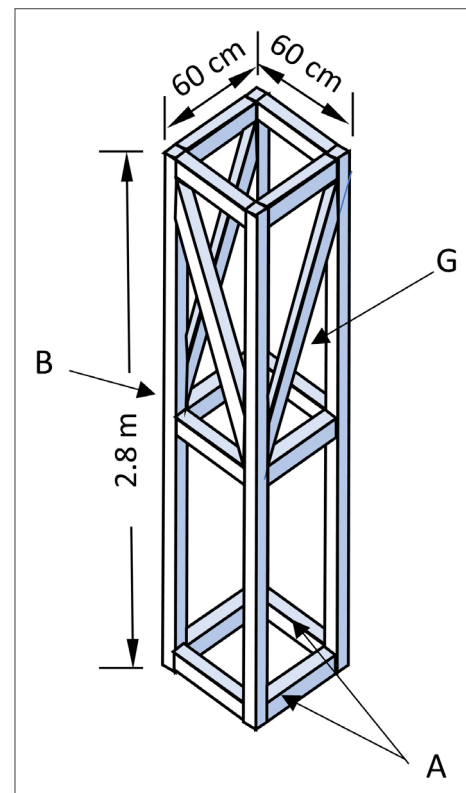


Figure 3. Wood frame for chimney

take full advantage of the dryer. The opening of the dryer should always face the equator, to maximize sun exposure. In the northern hemisphere, this means the opening of the dryer should face south, with the chimney in the north. In the southern hemisphere, the chimney would be in the south, with the opening of the dryer facing north. Select an area where trees do not shade the dryer. Make sure the ground is cleared of tall grasses, and the area is relatively free from roaming animals.

BUILD THE FRAME FOR THE TABLE

The drying table is the core of the dryer; it holds the trays and is attached to the chimney (Fig. 2). The frame can be built from scratch or you can use an existing table or other similarly shaped structure. The table height can be adjusted according to preference and should be at a comfortable height to work on the product trays. We choose to use 80 cm for the height of the table. For a 4 m dryer, the table frame will be 4 m long, 80 cm tall and 60 cm wide. Using the materials listed in the table, build a sturdy frame of wood that can support the weight of the trays filled with product. We like to use the 54 cm pieces (shown in Fig. 2 as A) as slats across the top to support the trays. Once the table frame is built, then stretch the black, non-woven fabric or plastic sheet over the top and sides of the frame and secure to the frame with staples. Attach two narrow strips of wood to the drying table on top of the black material, to hold trays above the surface.

BUILD THE CHIMNEY

The chimney is made from four planks of wood (shown in Fig. 3 as B). Make sure that the chimney is tall enough so that it rises 2 m (200 cm) above the top of the drying table (Fig. 3). For instance, if your drying table is 80 cm tall, then your chimney poles should be 2.8 m (280 cm) tall. The chimney must be as wide as the drying table and 60 cm deep. Cover the whole chimney frame in clear plastic, securing the plastic to the frame with staples, leaving the top open but covering the bottom.

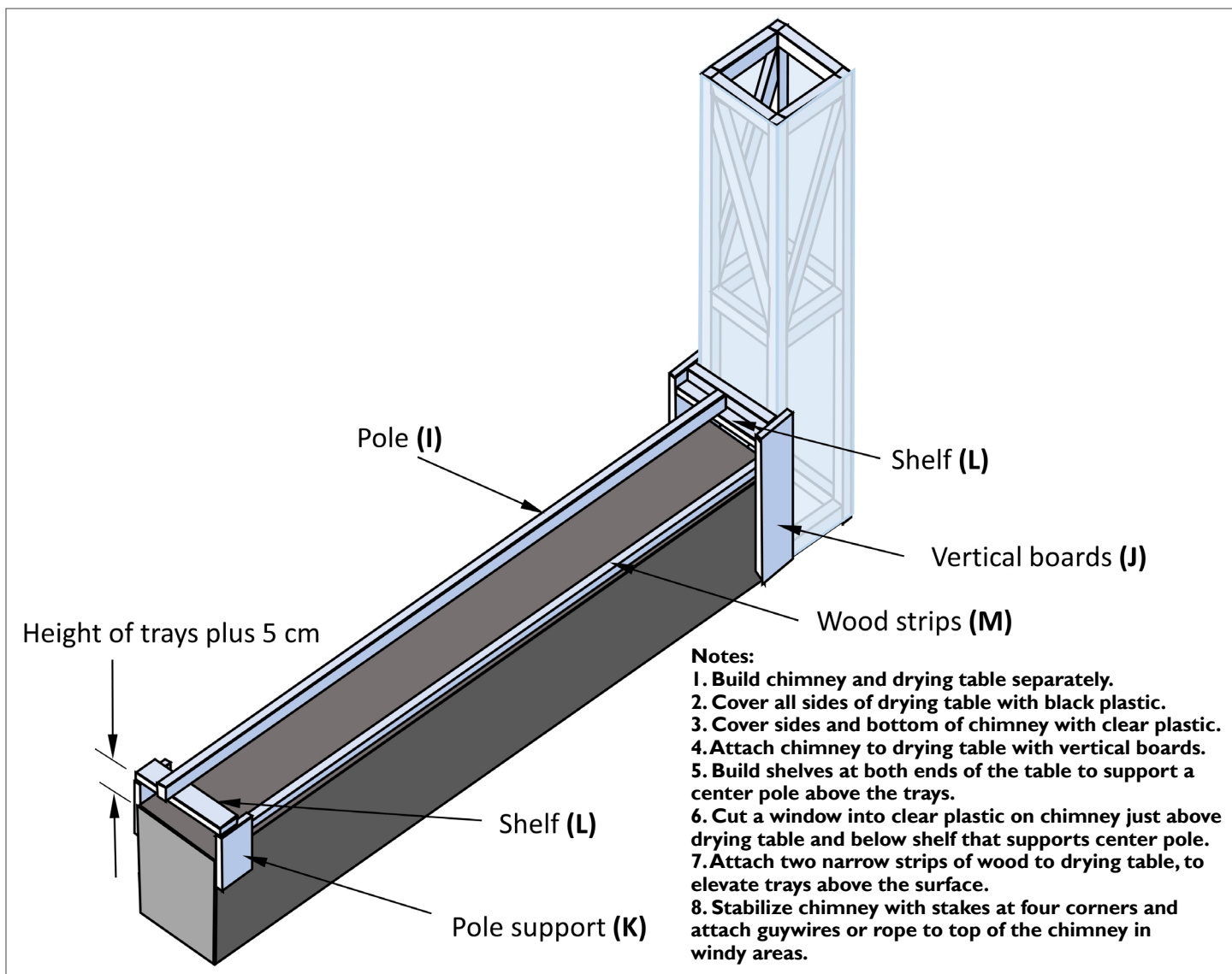
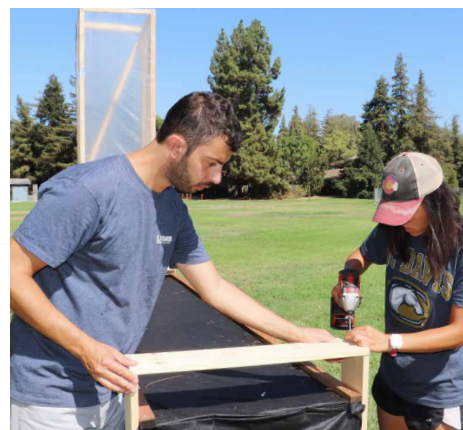


Figure 4. Sketch of the chimney attached to the drying table

PUT THE PIECES TOGETHER

Attach the table to the chimney with two vertical boards (Shown in Fig. 4 as J) and screws. Create a shelf above the table by using the two “pole support” wood pieces (Shown in Fig. 4 as K) and the two “pole support shelves” (Shown in Fig. 4 as L). This should be done on both ends of the table. The height of the space under the shelves should be equal to the height of two stacked trays plus 5 cm. Cut an opening in the chimney in the shape of a rectangle, above the drying table and below the shelves, to help create a tunnel for air to flow over the product, through this opening, and out the chimney. Place the wood pole (Shown in Fig. 4 as I) on top of the shelf and drape the clear plastic over the pole and the table. After the clear plastic has been draped over the dryer pole and trays of product, you need to secure the long ends of the plastic to the ground with a heavy pole to take slack out of the plastic on the sides of the dryer table. Attaching the plastic to a pole allows it to be rolled up and lifted off the dryer, providing easy access to the product. Tuck the clear plastic tightly between the two vertical boards and the chimney to seal. This prevents air from short-circuiting the drying table and entering the chimney.



Build a shelf above the table and the trays of product, which will support a pole over which the clear plastic will be draped.

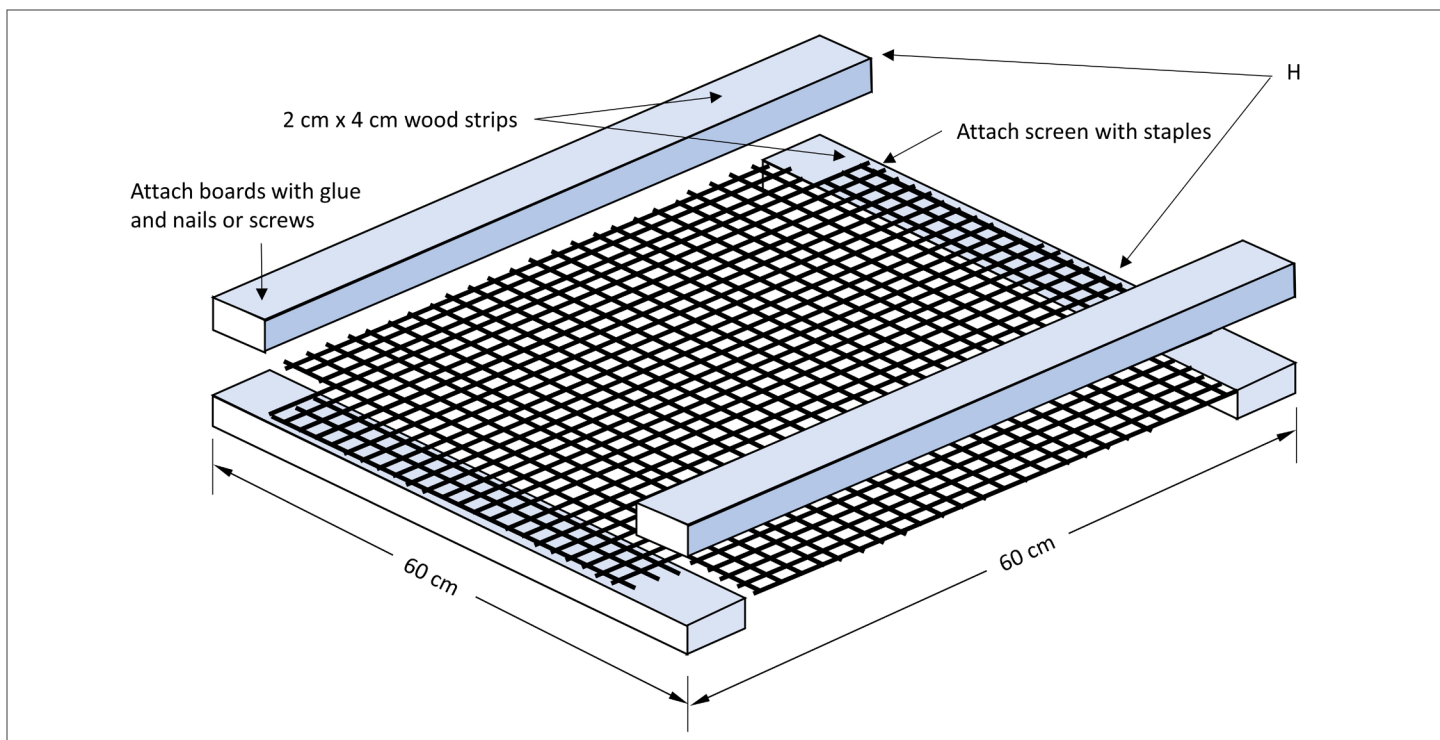


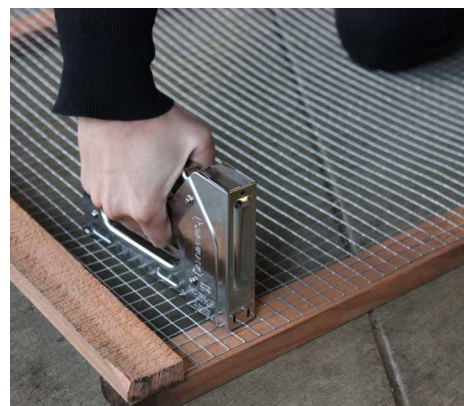
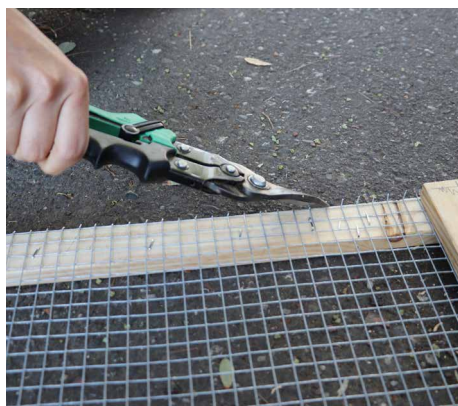
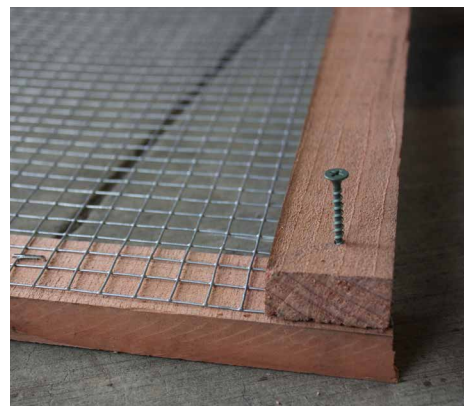
Figure 5. Expanded view of a drying tray

BUILD THE TRAYS

Use the 60 cm long wood strips to make the trays (Shown in Fig. 5 as H). Each tray will use 4 pieces (60 cm each side), one on each side. By joining the wood stacked as shown in Fig. 5, you will use less wood and still get good airflow. Pre-cut the mesh and staple it to two strips opposite each other, pull them apart, tightening the mesh, and secure the other two strips of wood, assuring the corners are at right angles and the overall tray is square. Staple along each edge to secure the mesh to the wood. Trim the edges of the mesh if needed so that edges are smooth and will not rip the plastic during use.

BEFORE YOU COVER THE DRYER WITH PLASTIC

Make sure that the desired number of trays fits on the frame; trays can be stacked one or two high. If the trays are stacked, make sure that the product on the bottom tray does not touch the tray above. Position the 4 m wood or bamboo pole just



Photos, clockwise from top left: Pre-cut the mesh, including the corners. Join the wooden edges of the tray with a nail. Staple the mesh to the wood sides of the tray. Trim any sharp edges of the mesh to prevent ripping the dryer's plastic during use.



Photos from left: Build a shelf at each end of the drying table. Cut a rectangular window into the chimney plastic and attach edge of the plastic to the shelf. Place bamboo or wood pole across the top of the shelf, which will hold plastic above trays when in use.

above the top tray, to hold the plastic above the product (Fig. 6). Then drape the clear plastic film over the drying table.

COMMON PROBLEMS IN BUILDING THE CHIMNEY SOLAR DRYER

LIMITED AIRFLOW ACROSS THE DRYING TRAYS

Ensure the clear plastic is sealed tightly to the wood shelf above the opening to the chimney and sealed tightly to the drying table near the chimney. There are two simple options to check airflow in the dryer:

- Look at the shadow of the top of the chimney, cast by the sun on the ground. When air is flowing, you will see a shimmer just above the chimney shadow.
- Another option is to hang small strips of tissue paper (0.5 x 7.5 cm) from the pole in the middle of the drying table. When air is flowing, these strips will move with the flowing air.

The height of the pole above the trays should not be more than 5 cm, or it will reduce the air speed in the tunnel.

TRAYS ORIENTED INCORRECTLY ON THE DRYING TABLE

The airflow above and below the tray is imperative; orient the trays accordingly so that edges do not block airflow. If the products on the lower tray are touching the tray above, they will block airflow through the products and products will take longer to dry. Overloading the trays with fruits and vegetable can also slow the rate of drying.

BLOCKAGE AT THE FRONT OF THE DRYING TABLE

Ensure that the clear plastic is open at the front of the dryer so that air can flow into the dryer. An open mesh screen can be used to cover the air inlet to keep animals out, if needed. Insects are usually not a problem, as they are not attracted to the fruit during drying due to the airflow.

REMOVE THE SHARP EDGES

Make sure to remove all sharp edges on the pole support, trays and shelves before putting the clear plastic over the drying table.

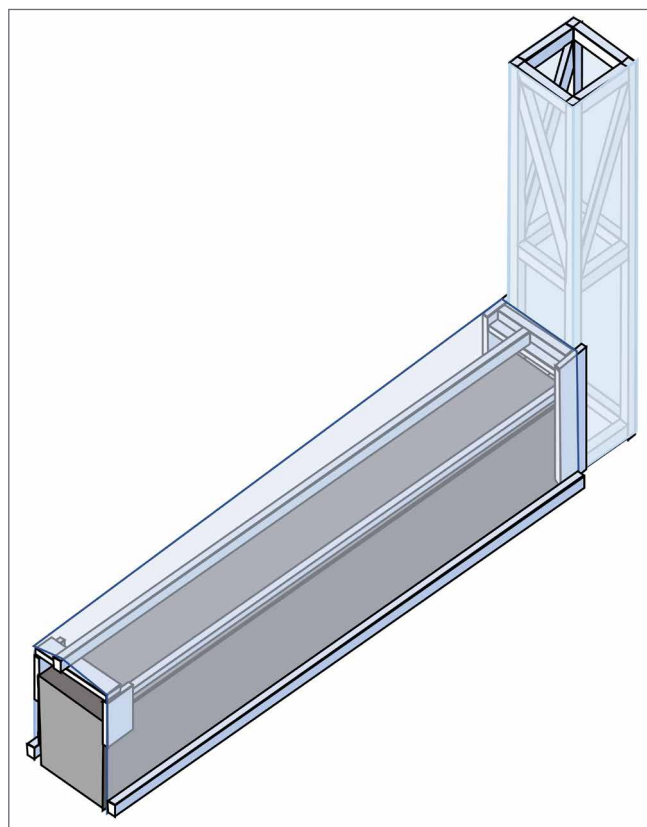


Figure 6. Clear plastic wrapped around the table