Constructing an AFM Vibration Cabinet

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1 INTRODUCTION TO THE VIBRATION CABINET

A vibration cabinet is an acoustically insulated box which helps in improving the imaging details of the Atomic Force Microscope (AFM). Placing the AFM equipment suspended by a bungee cord inside the cabinet reduces the noise caused by acoustic vibrations.

The exterior size of the cabinet is approximately 20.5 inches deep by 22.5 inches wide and 38 inches tall. For the box frame, two butcher block tables will be used. It is recommended that the box frame is already built when purchased (available at IKEA) since it would be difficult to build the box frame with the accurate dimensions. The exterior panels are made of ¾ inch thick MDF board.

2 TOOLS AND SUPPLIES

The following supplies are purchasable at IKEA:

Quantity	Description	Application
2	BEKVAM Butcher Block Table	Used as the frame for the cabinet
1	PLUFSIG Kids Play Mat	Used for sound insulation from inside the cabinet

The following supplies can be purchased at a local hardware store:

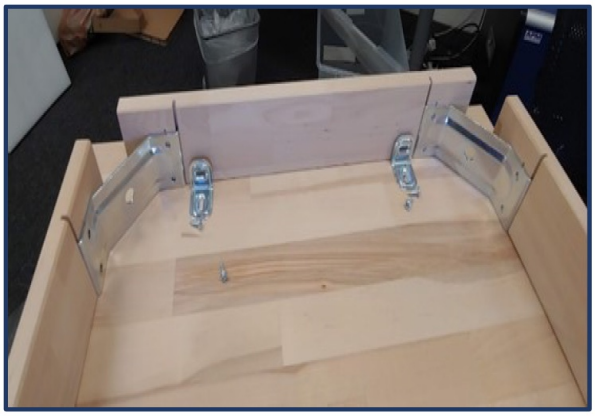
Quantity	Description	Application
Medium Density Fiber (MDF) Board (pre-cut to sized indicated below)		
2	18.5” x 36” x ¾” MDF board	Box sides
1	20.5” x 36” x ¾” MDF board	Box back
1	22” x 35 7/8” x ¾” MDF board	Door
1	12” x14” MDF board	AFM platen
2	2” x 8” MDF board	Cable pinchers
Hardware		
4	Nailer plates, 90 degree 2” x 2”	To attach the top and bottom table legs
4	Bolts, ¼-20 2” long with nuts and 8 spacers	For cable pinch plates
1	Door handle	
2	Door hinges, 2” x 4” flush mount	
50	Drywall screws, 1 ¼” long	To attach MDF cabinet sides and back to frame
4	Bolts with flush head, 1/4-20 1” long	Door side of the hinges
4	Acorn nuts, ¼-20	Door side of hinges
4	Wood screws flush Philips head, 1 ¼” long	To attach door hinges to the side of the cabinet
4	Eyehooks with wood screw, ½” diameter	Attachment for instrument platform
6	Ceramic tiles, 12” x 12”	For added weight to the instrument platform
1	Liquid nail	One tube
1	Velcro strap, about 12”	Used for keeping the door tightly shut
1	Pack of self-stick weather seal, 3/8” wide x 3/15” thick	Used for sealing the door enclosure and the cable pinchers
1	Bungee cord, 50’ long, 3/8” diameter	Used to suspend the instrument platform from the ceiling of the box
10	Cable ties	Used for tying off the bungees on top of the cabinet

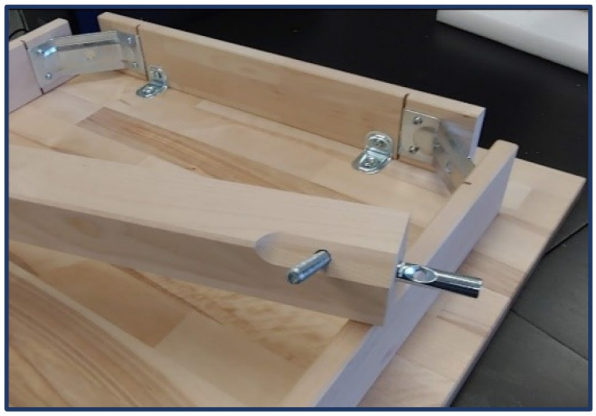
The following tools are needed to construct the cabinet:

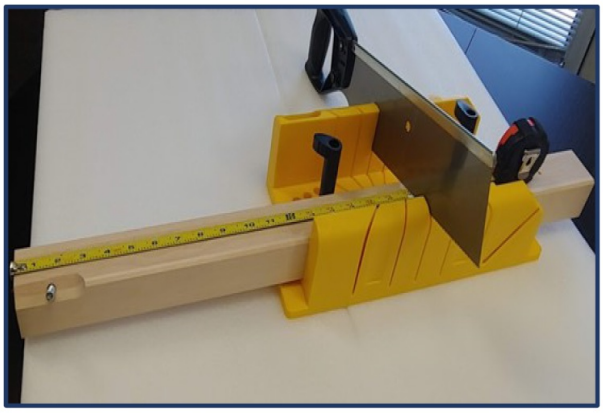
1. Electric drill/screwdriver
2. Drill bits (1/8” to 3/16”)
3. Miter saw
4. Pliers
5. Hammer/rubber mallet
6. Measuring tape
7. Caulking gun
8. Socket set
9. Hex driver set

3 Assembly of the Butcher Block Tables

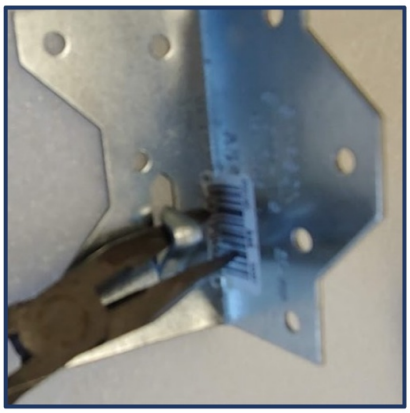
The instructions delivered with the IKEA product should be enough to assemble each table. The tabletop is the only thing to be assembled. The legs will need to be shortened to 18” before mounting them to the tabletop.







Once the tables are built, form the cabinet frame using each table for the top and bottom. Fasten the table legs using the 2” x 2” nailer plates. Place one table upside down and the other table on top of the legs.



4 Attaching the Exterior Panels

Now that the frame is built, attach the exterior panels for the sides and the back using the three large pre-cut MDF boards.

2	18.5” x 36” x ¾” MDF board	Box sides
1	20.5” x 36” x ¾” MDF board	Box back

Use the drywall screws for fastening the panels. The back plate will be mounted flush with the frame and the side plates will be mounted on the exterior.

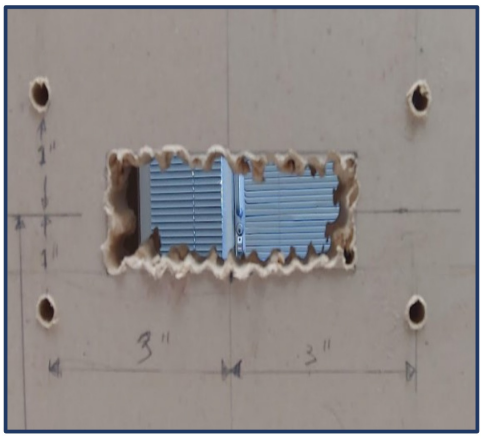
Mount the back wall first and use 4 screws on either side equally spaced along the 36” cabinet. Mark the line 1” from the sides of the board in order to hit the frame correctly.

Attach the side panels using 4 sidewall screws on a line 1 ¾” from the side. Both the side panels and the back panel should be attached using 8 screws on each plate.

5 Making the Electrical Ribbon Cutout and Pincher Blocks

The electrical ribbon is what connects the AFM equipment to the computer. It needs to be connected through the back plate and pinched in place to avoid sound noise from entering the box.

To prepare this, cut a hole on the back panel and make two blocks of MDF board that slides in slots and attaches to the box using bolts.



Use a drill to cut out the center slot with the dimensions of 2”x8”. Place the center of the slot 11” from the side and 9 ½” from the base of the back panel.

Cut 4 holes away from the edges of the center slot. These holes will be used for the bolt with a diameter of ¼”.

Attach two blocks of MDF board fastened with bolts with “sliding” slots on both sides. The two blocks should be pushed together while the bolts are tightened to get a good seal.

Fasten the slot using the following:

2	18.5” x 36” x ¾” MDF board	Box sides
1	20.5” x 36” x ¾” MDF board	Box back

Use a wood file to smoothen out the surface for better appearance.

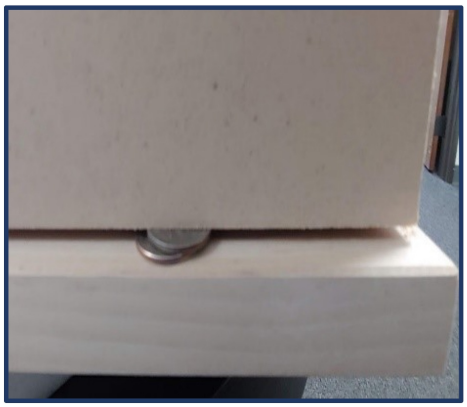
6 Mounting the Door

To complete the housing panel of the vibration cabinet, cut a door panel 1/8” shorter than the side and back panels, just enough to swing freely within the frame when opening and shutting close.

Put a couple of coins under the door panel to elevate before mounting into the box.

Push the door in the frame and hold it in place with tape so the hinges and fastener holes can be placed before drilling.

Place the door hinges and use a tape to temporarily hold in place before drilling.



Use wood screws to guide in fastening the hinges, which needs to be at least 1 ¼” long to reach the cabinet frame.

Fasten the hinge flap in the front side using 1” long ¼-20 bolts. Mark the holes and drill through it. Use acorn nuts for a better finished look.

When tightening the hinge bolts, make sure the coins propping up the base of the door is still in place to get a consistent alignment with the frame.

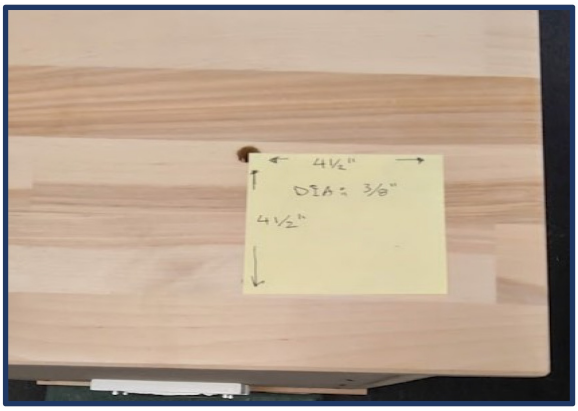
7 Assembly of the Instrument

The AFM equipment shall sit on a platform that is suspended by bungee cords inside the cabinet. The following materials are used in constructing the platform:

4	Eyehooks with wood screw, ½" diameter	Attachment for instrument platform
6	Ceramic tiles, 12" x 12"	For added weight to the instrument platform
1	Liquid nail	To glue the MDF board and tiles together
1	12" x14" MDF board	To be used as the base of the platform
1	Bungee cord, 50' long, 3/8" diameter	Used to suspend the instrument platform from the ceiling of the box
10	Cable ties	Used for tying off the bungees on top of the cabinet

Drill holes for the eye hooks in each of the four corners of the MDF board. The holes should be ½" away from the shorter side of the board and 1" away from the long side.

Drill four holes in each corner of the top cabinet for the bungee cords with a diameter of 3/8", with the holes 4 ½" away from the edges.



Place the MDF platform resting on the eye hooks. Apply liquid nail between each layer (MDF to tile, tile to tile) and let it set. The liquid nail may take hours to completely set.

8 Sound Insulation

To reduce acoustic noise coming from the outside, foam insulation must be installed inside the vibration cabinet. BEKVEM foam insulation is a product available on IKEA which can be used in this application.

Tear off the plastic fabric to reveal five foam segments that will be used to insulate the inside of the cabinet.

Two of the foam pieces will fit directly on the sides without cutting. The base of the cabinet will also be placed with foam that fits the base dimensions.

The foams to be placed at the cabinet door and at the back need to have an additional 1 ½” strip cut to fill the spaces properly. The back foam needs to have a cut-out of 1” by 4” dimension hole for the ribbon cable.

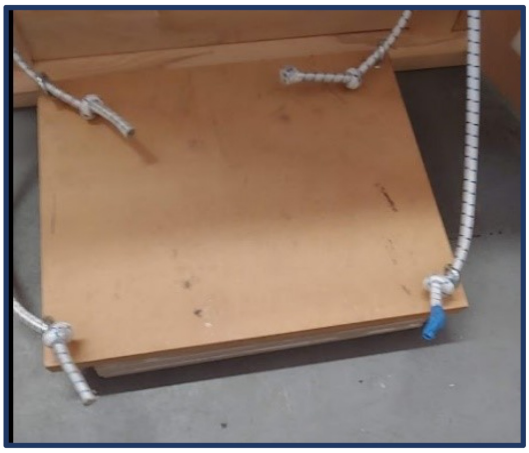
Use liquid nail to adhere the foam to all sides of the cabinet.

9 Aligning the Instrument Platform

Now that the insulation of the cabinet has been incorporated, the next step is to suspend and level the instrument platform inside.

Before doing this, make sure that the liquid nail used from the previous steps has set firmly.

Cut the bungee cord into four 5’ segments and thread through the eye hooks. It might be useful to have the cords already threaded through from the top of the cabinet first than from the underside.

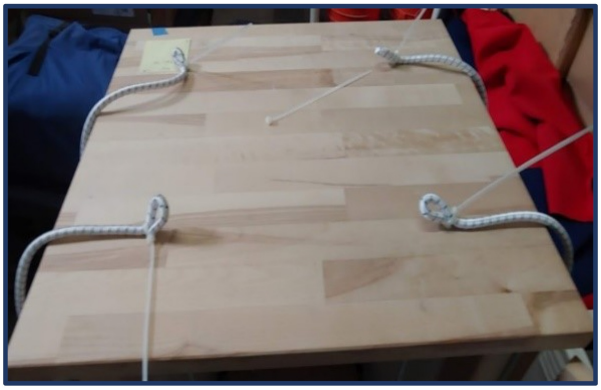


Use a portable level to level out the plane of the platform. The top of the platform should be about 10” above the cabinet flooring before the AMF equipment is placed on it.

Pull the cables up to place and attain the appropriate plane level and position of the platform.

Use clamps to temporarily hold the bungee cord on top at the desired level. It is easier to hold it diagonally at first, so that the second diagonal will require minimal adjustments.

Use cable ties to tie off the bungee cord on the top to adhere it in its desired location. Trim the edges of the bungee cord and cable ties as desired.

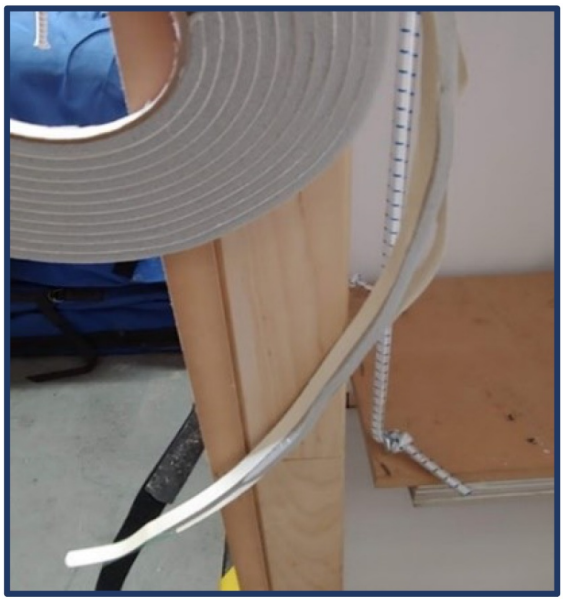


10 Final Steps

A few minor but important steps are needed to complete the construction of the vibration cabinet.

The door needs a handle and a door closure. Attach the handle to the door at the desired level.

A Velcro strap can be used for the door closure to tighten the door in place.



The door needs to be insulated from the frame – not doing so can severely reduce the scan quality.

Use the 3/16” foam insulation and apply around the entire door frame to seal and prevent contact with the door.