

Acrylic Shake Table Dollhouse--original designers and builders

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Mid-America Earthquake Center

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<http://mae.cee.illinois.edu/K-12/dollhouse.html>

University of Minnesota, Dept. of Civil Engineering Machine Shop. My reference instructions for the assembly of one acrylic dollhouse. huiex001@umn.edu

Mail/shipped in three units to school.

Instructions, color photos (9), CAD drawing (1), MAE center web copy (1)--*mailed* separate.

Aluminum angles (2) & wood lattices (4)--tube *shipped* separate.

Acrylic dollhouse, nodes & misc. hardware in cardboard box, 5" x 27-1/2" x 29-1/4" *shipped* separate.

Material list--cardboard box

Exterior walls:

Quantity

- (2) exterior window walls
- (1) exterior garage & door wall
- (1) exterior window & door wall
- (1) L-shaped second floor,
- (3) floors (one second floor—two first floors)
- (2) Roofs

subtotal: 10

Interior walls:

Quantity

- (2) first floor interior walls

- (1) second floor interior long wall with door
- (1) second floor interior short wall with door
- (1) second floor interior wall (next to two door walls)
- (1) second floor large solid wall (next to stub wall)
- (1) second floor stub wall

subtotal: 7

TOTAL: 17 pieces of sized 1/8" thick acrylic sheet

The rest:

Quantity

(24) Nodes & hardware (one baggie)

Aluminum angle hardware (one baggie)

Tools required to begin assembly:

CAD dimension drawing, instructions, 24" metal ruler, dial vernier is helpful, X-acto knife or single edge razor blade, large flat working surface, precise squares and clamps.

Sent direct from vendor, ePlastics

IPS Weld-On #16 acrylic glue, pint...Quantity (1)

Hypo 65 Applicator....Quantity (3)

Metal handled craft and glue dispensing Brush....quantity (6)

I used "kant twist" brand parallel clamps, steel scrap weights (to hold glued pieces together), machinist granite precision surface plate & two cast iron precision angle plates (see example color setup photo).

Hint: Improvise with small c-clamps, a hard flat surface, carpenter squares or homemade angle plates.

To apply glue on bare acrylic edge: Leave on as much protective covering as possible--to minimize glue smears/fingerprints. Use Hypo 65 Applicator or brush to apply liberal amount of glue (if not enough glue--the house will shake and come apart-- when demonstrated). After setting up and gluing ONE edge--leave **overnight**--to fully adhere (see directions on IPS Weld-On #16). Set up and glue SECOND edge, etc. Remove all remaining protective covering LAST when ALL dollhouse glued edges have completely dried. Patience!

My gluing order for one half of house—modify sequence as needed!

1) **First & Second** floor flexing interior walls (7): glue bottom edge ONLY--per CAD dimension drawing.

IMPORTANT: Your dollhouse's first and second floor interior VERTICAL walls are only glued on their bottom edge. Why? The vertical walls are not connected to enable flexing.

- Measure wall locations remove 1/8" wide protective paper from floor—setup—glue.
- Every component is: 90 degrees to wall or floors using precise squares.

2) **First** exterior window wall glue to first floor. (note drawing locations)

Setup

- Place first floor on machinist granite precision surface plate, apply glue to first window wall *open* area and slide to edge of first floor. Apply angle plates, clamps, and weights to hold glued edges static until dry (see color photo and CAD drawing close up) leave static till dry.
- For example: First floor gluing: measure 1/8" up from bottom edge on one side of exterior window wall, score upside, peel off 1/8" wide paper--glue to first floor edge. (see color photo of surface plate & angle plates with setup)

3) **Second** floor: glue--place first exterior window wall down on flat surface (first floor is attached) setup, glue, leave static till dry.

For example: Second floor glue--use CAD drawing dimension measure from BOTTOM edge of exterior window wall to TOP of second floor on exterior window wall. Use 24" straight edge metal ruler parallel to bottom edge--draw a pencil line—then draw another line 1/8" LOWER. Using 24" ruler--as a blade guide--score two lines with a single razor blade or X-acto knife—peel off protective strip exposing acrylic surface for gluing second floor. Measured from the bottom edge of exterior window wall to the TOP of second floor will measure 10.375" (see CAD drawing).

4) **Second** opposite exterior wall (with 1 door or 1 garage & 1 door) setup, glue to first and second floors, leave static till dry.

5) **Roof:** setup, glue, leave static till dry.

6) **Nodes:** setup, glue, leave static till dry.

Node (wood lattice attachment point) 12 nodes per each half house--for a total of (24) acrylic nodes.

The opposing roof peak **highest** 2 nodes are 24.875" from bottom edge of outside window walls to centerline of node, setup, glue.

After dollhouse is dry and done--apply glue on two sides of node and place on floor and wall surface—the inside corner of both floors, roof peak area and **flush** with open wall--clamp if needed.

- Hint: remove excess dry glue and chamfer one corner of node—this will insure it is fully flat to exterior window wall/floor and flush with open wall/floor.
- 12 nodes on each HALF house are #10-24 screw attachment points for dollhouse supplied wood lattice stiffeners (4) and your chosen attachments. Four lattices on one house side--shaped in an X for rigidity—two lattices upper floor and two lattices lower floor.

Aluminum Angles: mount to completed dollhouse LAST.

Two "base" aluminum angles (1-1/2" x 1-1/2" X 44") are bolted to acrylic dollhouse 1/8" thick first floor, the completed dollhouse with aluminum base is attached to main shake table.

Fit aluminum angle on YOUR metal shake table place in position of function (POF) centered X & Y axis, remove blocking aluminum if you have clearance issues for attaching.

Set each half houses first floor **centered** in both X & Y axis— measure X distance between the two halves (4.58"--see CAD drawing) use new sharpie pen to fully mark centerline through existing countersink mounting holes in aluminum angle (hardware included)—remove completed house from aluminum angles, drill holes in acrylic first floor.

Hint: Use a piece of scrap acrylic sheet clamped **behind** each hole location--before drilling--this prevents cracking and distortion of acrylic sheet drilled hole. Drill 3/16" (.1875) hole through 1/8" acrylic first floors--for a total of 12.

Attach to house.

DONE

Shake Table Dollhouse

A team of graduate students (Jaret Lynch, Can Simsir, Erich Bretz, Omer Erbay, and Duhee Park) and undergraduate students (Sarah West, Cindy Safin, and Wade Clarke) designed a dollhouse that may be used, along with a miniature shake table, to demonstrate the devastating effects of earthquakes.

Simulated earthquakes of varying magnitudes show these destructive results, while also displaying retrofitting and preventative measure benefits. The design can be duplicated and/or altered to fit individual needs.

Materials

Materials Required	Materials for Retrofit & Rehabilitation
2 - 4'x8' sheets of 1/8" thick plexiglass (and appropriate glue)	String
#10-24 threaded rod (48" in length)	1/8" wooden dowel rods
8 - #10-32 bolts	Strips of foam
8 - #10-24 bolts and nuts	Strips of elastic
2 - 4' x 1 1/2" x 1/8" aluminum angle	Sheets of plastic
3/4" sq. plexiglass (48" total length)	Cardboard

The two-story dollhouse consists of seven rooms and one garage. Each room will contain typical dollhouse furnishings. It is approximately one-ninth the size of an actual two-story house. The dollhouse is constructed of plexiglass to allow the spectators to see through the house during the demonstration, and remain self-supporting.

One half of the house is capable of being retrofitted with a variety of materials. These materials range from rubber bands to popsicle sticks. Members of the audience will be able to choose retrofitting materials. This will increase spectators' interest by being involved in the protection of the structure from earthquake damage.

Structural Design

Overall Dimensions		
L = 44"	W = 20"	H = 27"

The structure is modeled as a typical dollhouse, except for minor adjustments. The dollhouse is split into two sections, virtually cut down the middle. Only one side of the house will be retrofitted so the spectators can witness how the two separate sides react differently in a simulated earthquake. There are two exterior walls, front and back, while the sides of the house are left exposed. There are no sidewalls because their presence would provide unnecessary stiffness. For the same reason, all interior walls that are in the plane of motion are not connected to any adjacent walls or the ceilings. Also, there are a small number of in-plane interior walls in order to maximize motion.

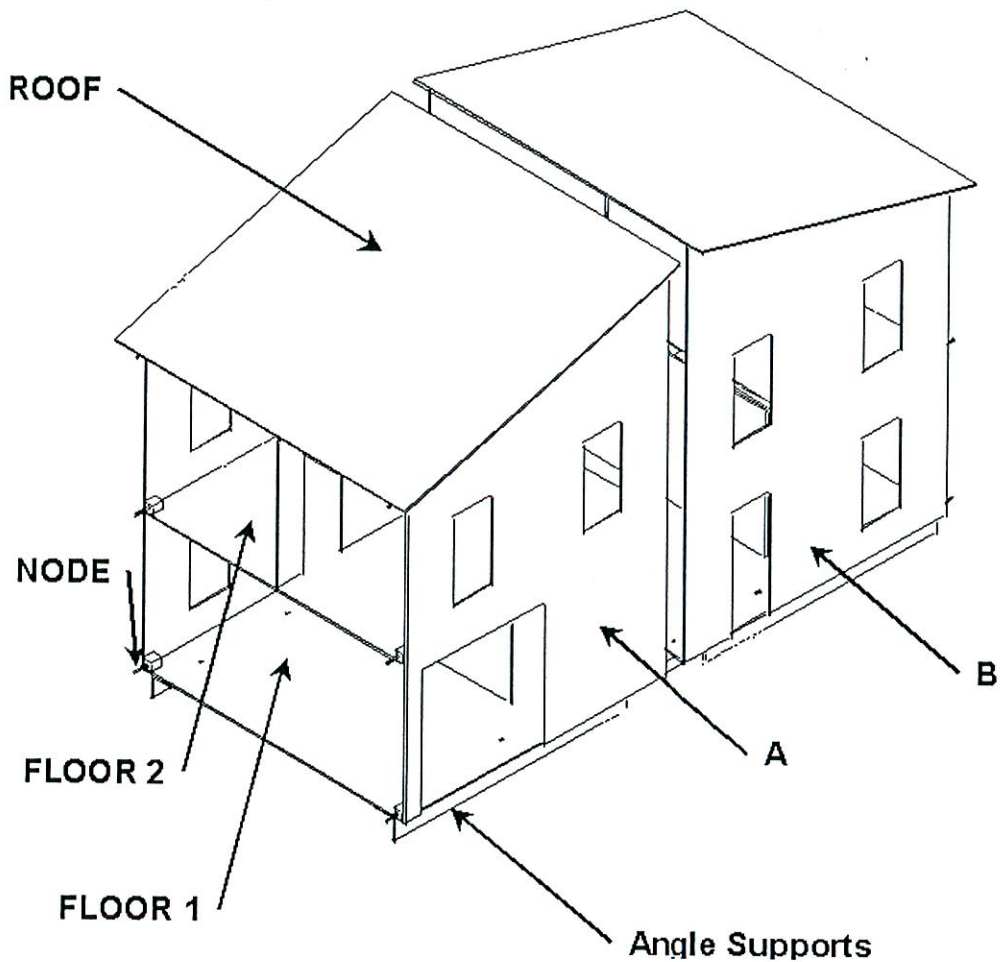
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Dollhouse Design Plans

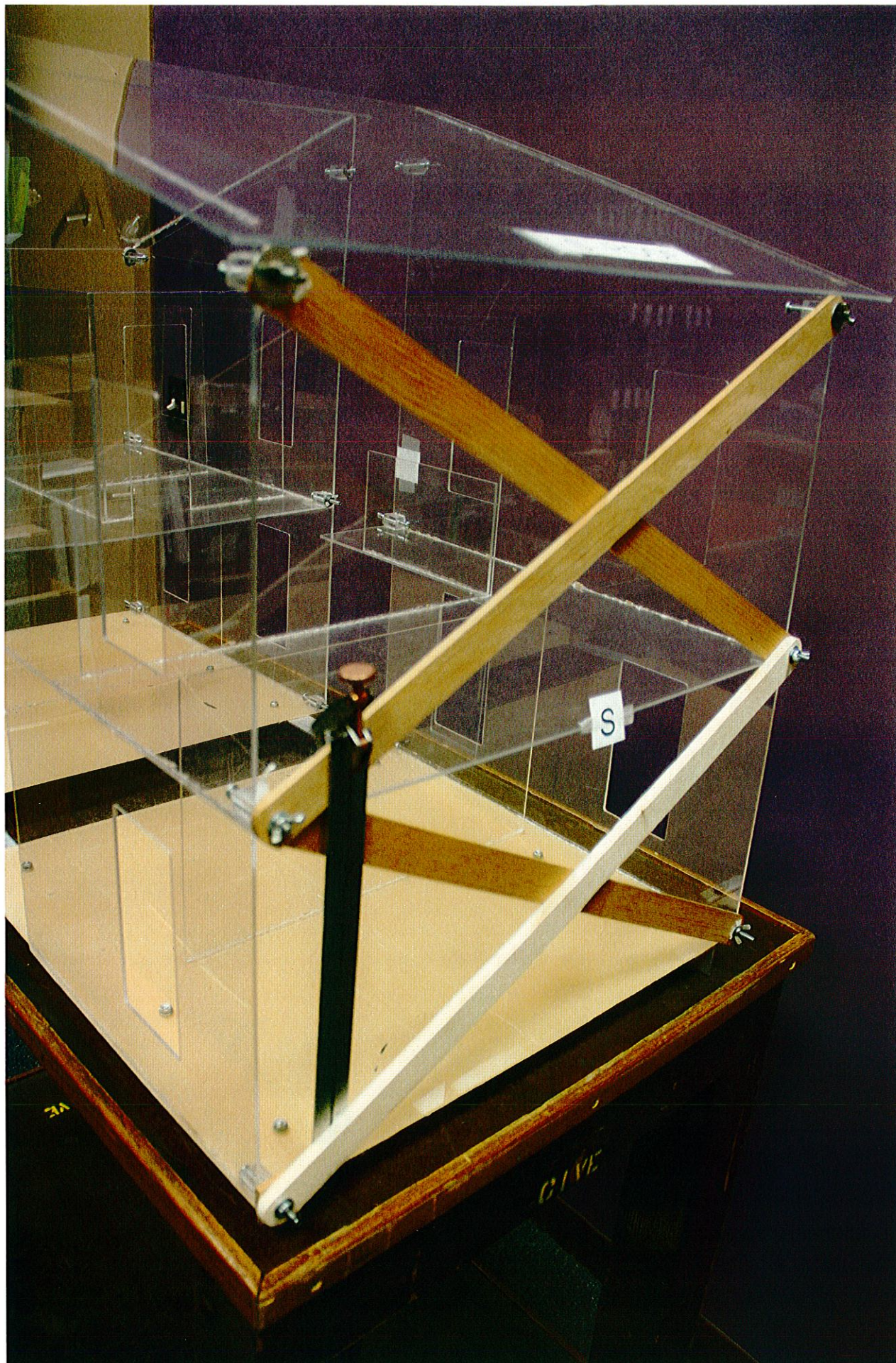


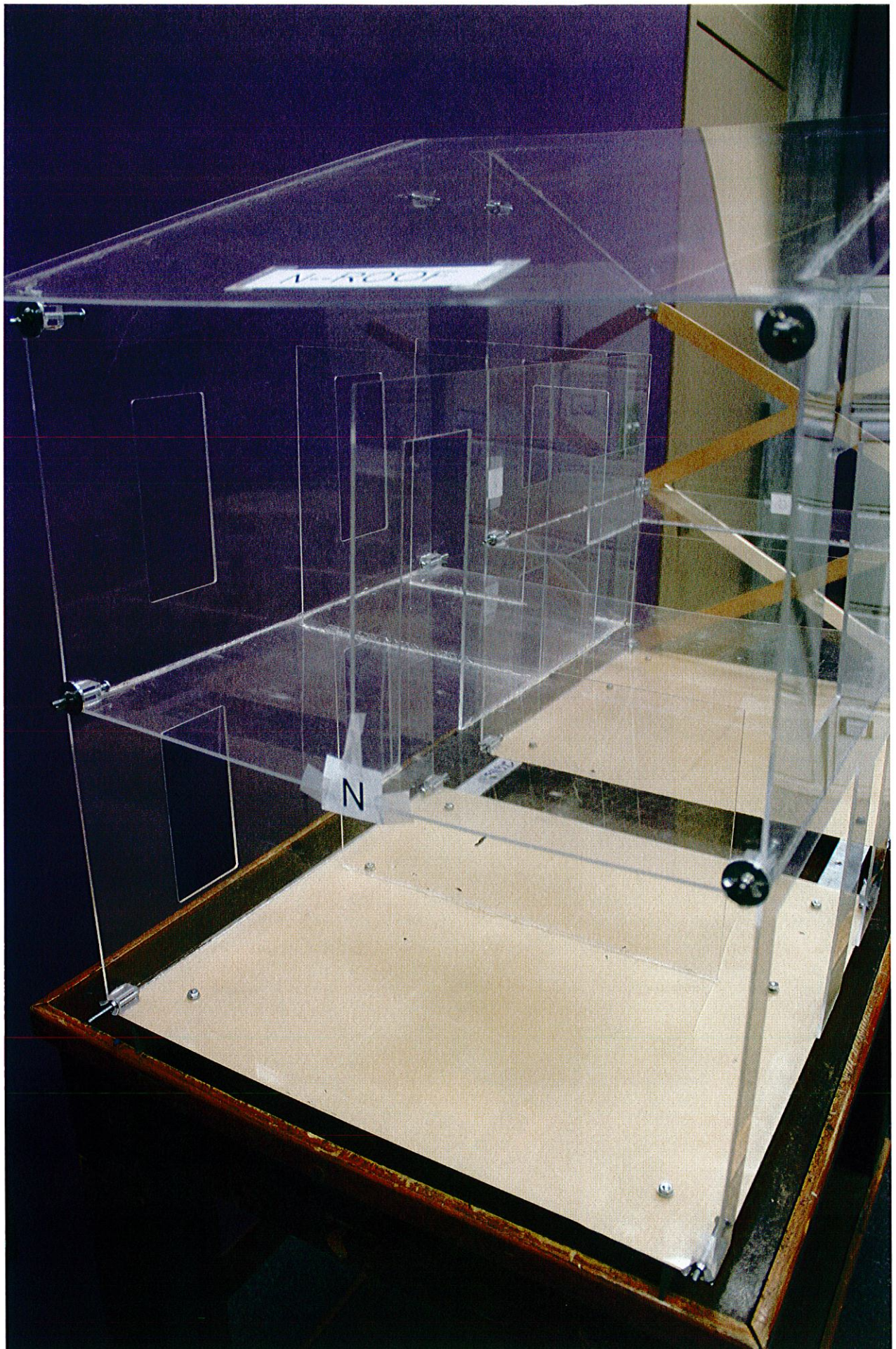
Headquarters at the University of
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88

