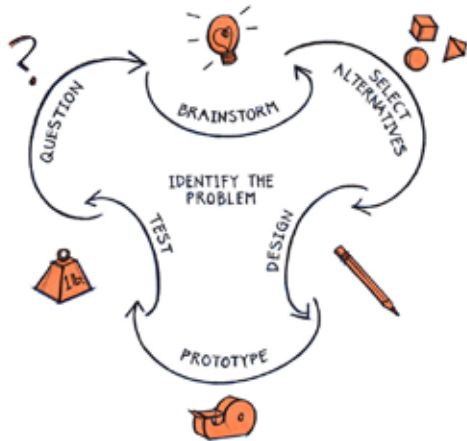


Build: Anti-Funicular Form Guidelines



Anti-funicular forms are very efficient for specific loading conditions. Engineers and architects including Heinz Isler, Felix Candela, and Antoni Gaudi regularly built anti-funicular forms to help guide their designs. Anti-funicular forms are primarily in compression so must they must be constructed of materials that are able to resist compression such as steel, concrete, or plaster.

Design Goal: Design and build an anti-funicular form. What type of form do you wish to design? Will your form serve a certain purpose or do you just wish to experiment with different forms? Will your anti-funicular form be able to support loads? Maybe the load of a heavy book?

Supplies:

- Cheesecloth works best for anti-funicular forms but a lightweight fabric will also work; we typically use Grade 60 cheesecloth with a 32x28 thread count. If doing paper mache, you will need newspaper.
- Plaster of Paris, water, disposable mixing bowl or flour and water for paper mache. Plaster of Paris is available at most hardware and craft stores.
- Tape
- String



Question: Research different anti-funicular forms designed by Heinz Isler, Felix Candela, Antoni Gaudi and others. Or sketch designs of your own. What forms do you like? Why? Will your anti-funicular form include openings? How will it be supported? Will you apply additional loads?



Brainstorm: Sketch or build lots of different models of anti-funicular forms. You can build simple models using paper.



Select Alternatives: Be sure to select alternatives that meet your design goal. If your anti-funicular form will support a load be sure to create a stable place to load the structure.



Design and Prototype: Review the guidelines for creating an anti-funicular form using cheesecloth and plaster or paper maché. Build several different prototypes to experiment with form.

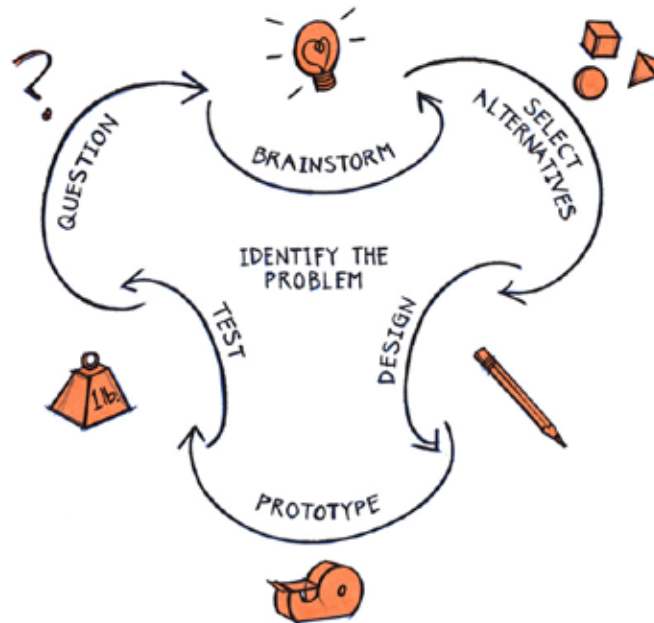




Test and Reflect:

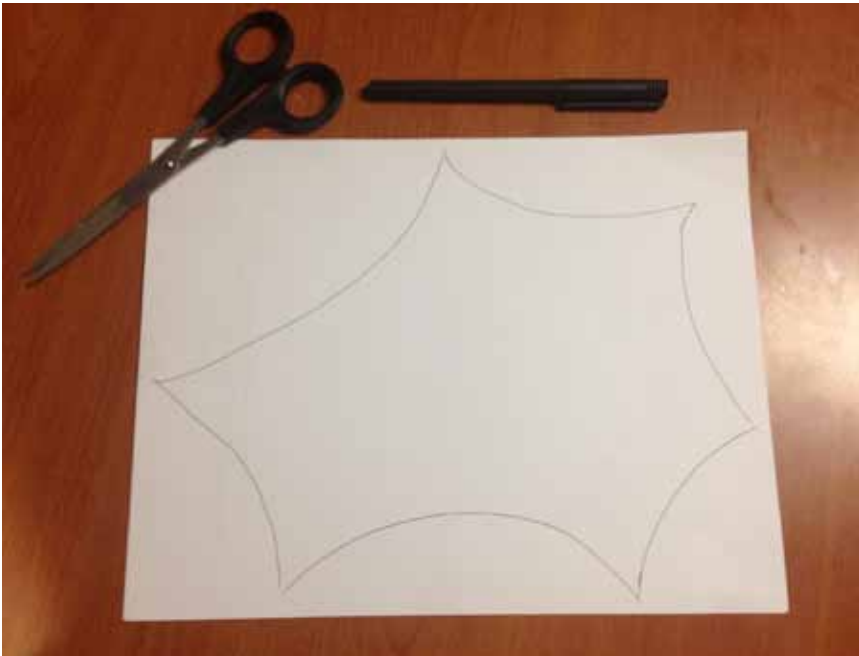
- How do the forces flow through your anti-funicular form?
- Can your anti-funicular form support a load?
Try pushing down on the top of the form or placing a book on the top.
- Do you need to add supports at the base? Or is your form self-supporting?

Remember to reflect on your design: What worked? What didn't?
What factors seem to affect strength, stiffness and stability?



Guidelines:

Step 1: Create an outline of your form. I find it easier to first draw it on paper.



Step 2: Cut out your design in cheesecloth using your paper model as a guide.

Step 3: Tie strings at locations where you plan to hang your funicular form. Rather than trying to create holes in the cheesecloth I find it easier to simply tie the string around the corner of the cheesecloth. You'll need to find some place to hang your funicular form: a drying rack or laundry basket or cardboard box work well. Be creative finding someplace to hang the form!



Step 4: Mix up plaster or paper maché. I used a metal tray to mix the plaster but you could use a paper plate or different type of container. Plaster shouldn't be washed down the sink, as it can clog pipes or drains. When you're done with this project, just scrape any leftover or dried plaster into the trash. To make clean-up easier, mix the plaster in a plastic bag and throw it away as soon as you're done. Two recipes are given below. Always add water slowly while stirring and stop once the consistency is smooth.



Plaster Recipe: $\frac{1}{2}$ cup plaster, $\frac{1}{4}$ cup water

Paper Maché Recipe: $\frac{1}{2}$ cup water, $\frac{1}{2}$ cup flour (if you have it, add a tablespoon of white glue for a smoother finish)

Step 5: Dip your funicular form in plaster. Hang your funicular form by connecting the strings to whatever frame you've chosen – tape or binder clips work well to support the strings.



Step 6: Once the plaster is dry, cut the strings, flip over your funicular form and voilà, an anti-funicular form.

