

# Concrete Arborloo Base

P14416

## Background & Motivation

- Poor access to sanitation in Haiti
- Current design (Peter Morgan) is heavy to carry and requires skill and time to build on site

**Arborloo?** Pit toilet with moveable slab base; named for ability to grow tree in used pit

### Customer Needs

1	Affordable
2	Covers Hole
3	Safe to Use
4	Moveable
5	Simple to Setup
6	Comfortable
7	"Modern" Aesthetics
8	Serviceable
9	Allows Financing in Parts



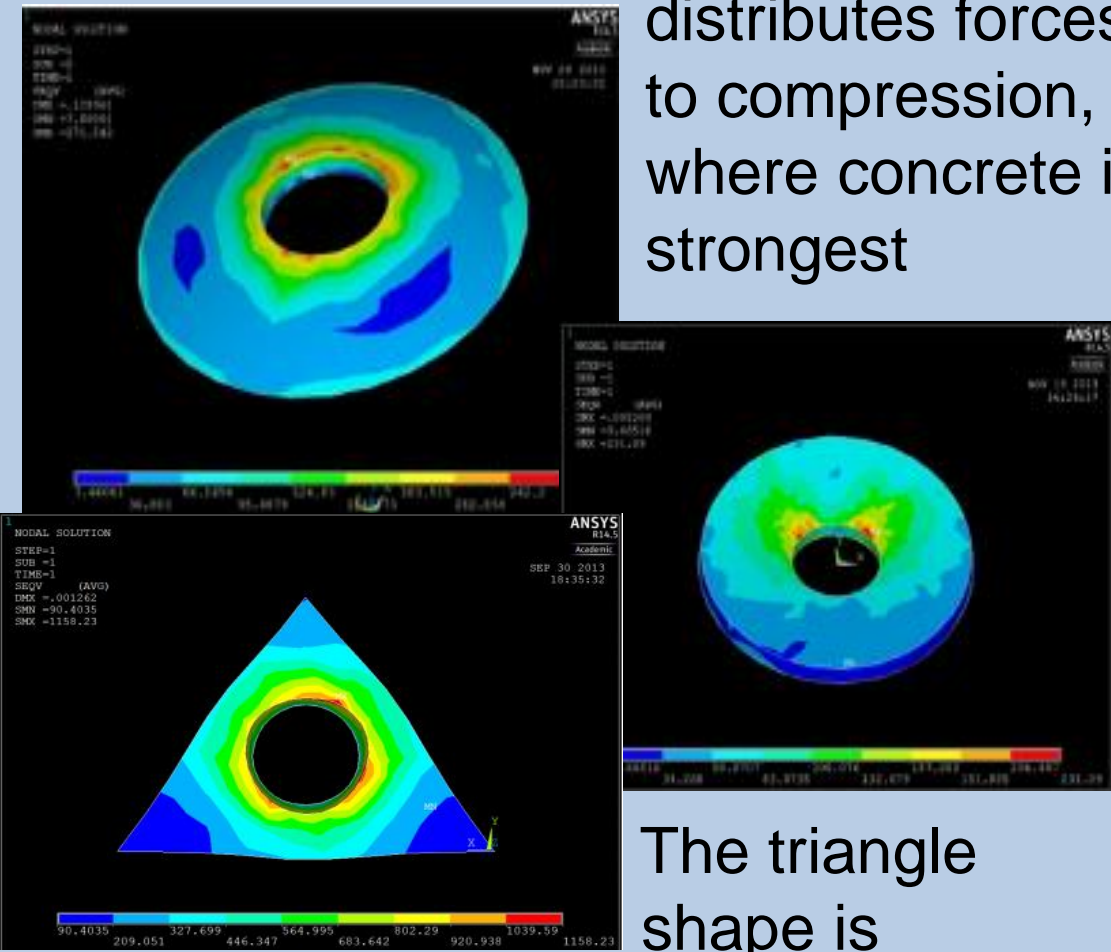
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## Concept Selection

### ANSYS Modeling

Analysis highlighted pros and cons of geometries

The dome distributes forces to compression, where concrete is strongest



The triangle shape is inefficient since the extra volume at the edges are not significantly loaded.

### Compression Testing (ASTM C39)



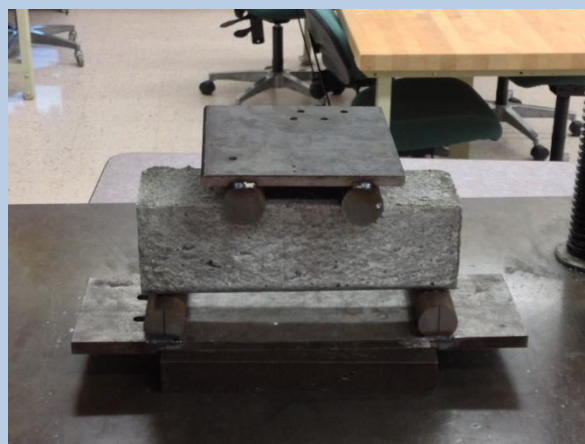
20 different mixes were tested using recycled, light-weight materials

- Limestone Gravel
- Rubber Mulch
- Coconut Shells
- Sand
- Styrofoam
- Plastic Beads



### Flexural Testing (ASTM C78)

3 different reinforcements were tested in a regular concrete mix (cement and sand)



Bird Netting Coconut Fibers Industrial Fibers



Reinforcement	Avg. Strength of Test Specimen [psi]
Coconut Fibers	403.7
Industrial Fibers	378.8
Bird Netting	283.5

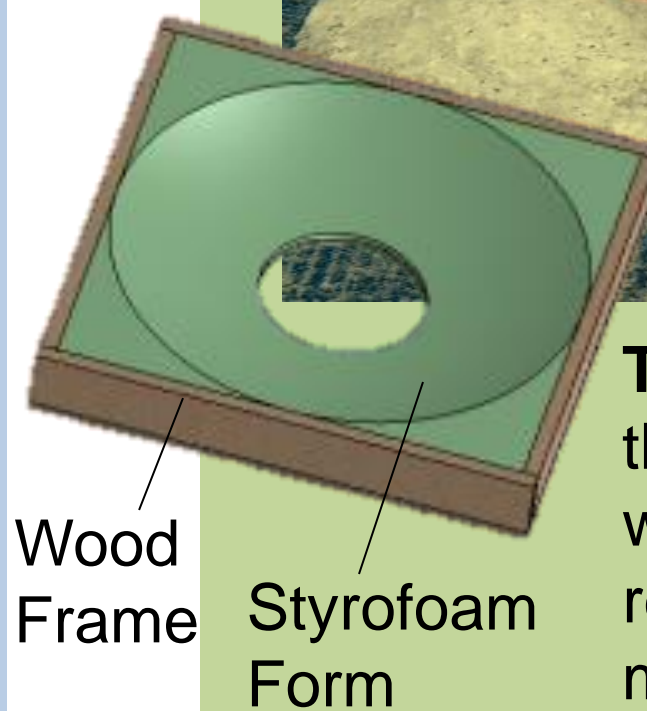
## Mixture Design

The mix selected (shown right) incorporates Styrofoam, coconut shells, and coconut fibers and best balances cost, weight, and strength objectives.

[% by weight]	Dome	Circle
Cement	33.2%	33.2%
Sand	21.6%	14.5%
Coconut Shells	44.6%	51.9%
Styrofoam	0.5%	0.4%
Coconut Fibers	14.7g	14.7g

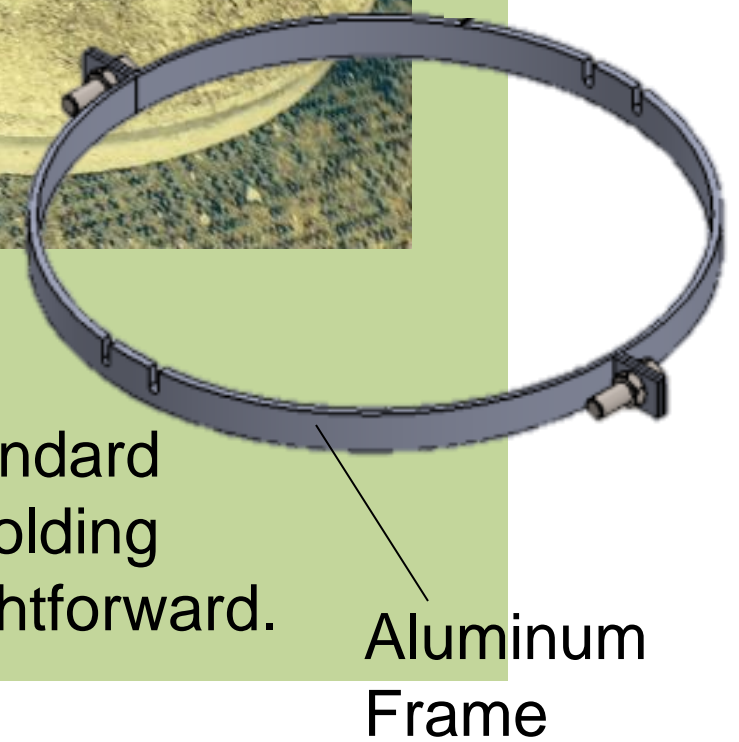
## Final Designs

### Dome



The dome provides the same strength with less weight, but requires more skill to mold properly.

### Circle Slab



The circle slab is simple, and similar to the standard Arborloo. The molding process is straightforward.

## Results

Key Engineering Requirements	Customer Need #	Marginal Value	Ideal Value	Circle	Dome
Purchase Cost	1	\$50	25	3.83	3.78
Load it can support	3	270 lbs	450	375	403
Hole diameter it covers	2	18 in	20	22	22
Time to assemble	5	2 hrs	1	0.75	1
Tools needed to assemble	1,5	3 tools	0	1	1
Weight of heaviest piece	4,5	100 lbs	80	43.5	31.02
People needed to move	5	2 people	1	1	1

\*Costs include materials and labor

- Both designs meet cost, load, size, assembly, and transportability specifications.
- As a saleable product, the quality is of a higher standard, and minimal assembly is required.
- The addition of handles reduces the weight impact
- Overall, the customer needs are addressed.



Load support test set-up