The Aqua Pouch

Team 4 i.e. Team 'Murica

EDSGN 100 section 20 Spring 2013

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From left to right:

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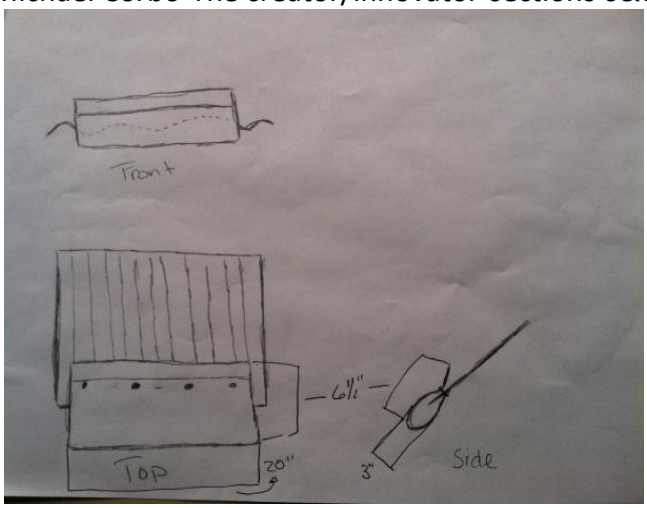


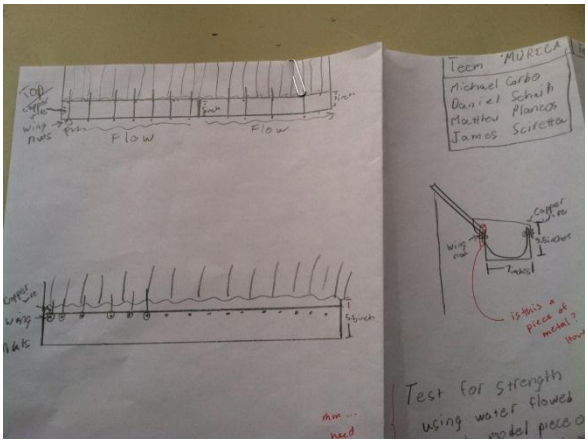
Problem Statement: The DEM problem is to create a gutter system that can attach to a tin roof with cheap enough materials that can be used in Kenya, while being strong enough to catch the maximum amount of rain in any sort of rainfall.

Concept development: The group used a variety of resources, including national websites and books, to gather information about Kenya. This information encompassed rain and weather patterns, economic statistics and incomes for families, and a brief history of Kenya. Based on the research, the team agreed that the most important aspects of the gutter were large enough to hold all water flow, a strong support system, and cost efficient. Cost efficient means that the system would be able to function with the least amount of materials possible. For Prototype 1, the group created an AHP table with weights, and the most weighted design features matched the three important aspects of the gutter.

	A	B	C	D	E	F	G	H	I	J	K
1											
2											
3											
4											
5		large enough to hold all water flow	easy to repair	use available materials	recyclable	cost efficient	easy to install	sustainable	strong support system	Total	Weight
6	large enough to hold all water flow	1.000	5.000	6.000	9.000	1.000	2.000	5.000	0.500	29.500	0.239
7	easy to repair	0.200	1.000	2.000	3.000	0.250	0.333	1.000	0.125	7.908	0.064
8	use available materials	0.167	0.500	1.000	3.000	0.250	0.333	2.000	0.250	7.500	0.061
9	recyclable	0.111	0.333	0.333	1.000	0.125	0.333	1.000	0.125	3.361	0.027
10	cost efficient	1.000	4.000	4.000	8.000	1.000	2.000	5.000	1.000	26.000	0.211
11	easy to install	0.500	3.000	3.000	3.000	0.500	1.000	4.000	0.500	15.500	0.126
12	sustainable	0.200	1.000	0.500	1.000	0.200	0.250	1.000	0.333	4.483	0.036
13	strong support system	2.000	8.000	4.000	8.000	1.000	2.000	3.000	1.000	29.000	0.235
14											
15										123.253	

Our first design was named Prototype 0, because once the testing was complete, we realized that it was required to completely re-design our gutter in order to fulfill all of the design features and constraint. For our prototype #2 and final design, we named the gutter the Aqua Pouch. We called it this was because the design was very simple, yet the own gutter was its own support system. The gutter bent around the roof like a pouch, and could easily be unattached for cleaning and maintenance.

Prototype #1



Testing: Testing prototype was great to get a feel for where we were at with our project.

We put the gutter to the test using approximately about one Liter of water at a time. As shown to the left. We tested it four times, doing two different tests twice. The gutter seemed to react very well to the two times we poured the water slowly as if there was a slight rain. Also the gutter reacted really well to the two times we poured the water at a vigorous speed, simulating hard rainfall. The U

shape we made with double layers of the sheet metal helped was especially useful for when the rainfall was simulated at a hard rate. Overall it was a successful prototype besides the fact that after testing the project we realized it would be too hard to attach the U shaped sheet metal to the corrugated roofing. We tried bending the roof, cutting it and screwing in the U shape sheet metal. During the testing we realized that this was very unlikely because the roof formed crevices and it was not strong enough with the slits to do so. These results made us have to significantly rethink our gutter system. After vigorous debating between the realizations of the attachment problem from prototype one made us realize we should just keep it simple rather than doing double layers and a complicated attachment as explained.

Design Refinement: Through AHP we realized that there were a lot of aspects that we had to heavily re-consider the design on prototype. We did really well on efficiency of getting the water out of the gutter. The major problem that the matrices reaffirmed though was the easy of manufacturing. The attachment was the sole reason for this. Also the matrices made us realize how important the cost was to the gutter system. The double layer of sheet metal

really drove up the cost. So our solution to the cost problem first was that we would have to use only one layer of the sheet metal and also a smaller gauge of it. This made the attachment problem much easier to fix. We realized that we were making it to complicated by trying to bend the corrugated

roof. Then we all agreed that we would just bend it in a U shape and just attach it straight on as shown to the left. We used Philips head sized screws to attach the sheet metal. Then we just bent the lip up to make it easy to collect the hard rainfall. The overall dimensions of our second prototype were 20” long by 16” with a lip to catch any stray rainfall with a length of roughly 3”.

TESTING PROTOTYPE #2

Matt and Dan putting in the final screws and bending the lip

The group making sure water flows through the prototype properly

The Group testing the efficiency of water flow through the gutter system

Testing the efficiency of the added lip to the gutter system

After running the similar two tests as mentioned about prototype one, we got the results we were looking for. We noticed the changes we made to the gutter system helped. The single layer was durable enough to hold the rain water. Whether hard rainfall or light rainfall the gutter system was shown to hold the water and the lip we made in the gutter system was extremely beneficial for splash back on the corrugated roof. The drawback we realized through the experiment was how we are going to clean this thing? The addition of the wing nuts made it really easy to access the inside and clean it real quick.

Costing: The cost was calculated to be about $4 per meter. The product is more expensive than what we previously wanted to accomplish. This is mainly due to the material used to hang the gutter from the roof. Materials like bolts and wing nuts drove the price up because they are expensive in Kenya. Because of the simplicity of design of our product, it is not necessary to hire a skilled worker to hang the gutter for you. This is where our design would more cost efficient to others that would require skilled workers. Although, to hire a skilled worker it would be about a day's work for the worker and not extremely costly, depending on the price of the worker that the customer hires.

Lessons learned: If there were a prototype #3 build and test, then we would keep the general idea of the fold over design and find new material to hang the gutter. For example, instead of using wing nuts and bolts, we would use some of the natural materials that we can find lying around Kenya. What went well for our team was our team's intuitiveness and chemistry between teammates. We used our intuitiveness to come up with a successful design in minimal time when our prototypes failed and we were down to the wire. Our team chemistry

helped a lot because we were able to come together and create our final design. Our initial concept designs for the gutter did not work out as planned; the only thing I would change if I could is being able to get more workshop and research time in class. The DEM activity could be improved if the case prompt stated to the students included the materials that were cheap and accessible and their exact prices in Kenya so there would be less guess work and more intuition focused on design of the product rather than what it was made of and that DEM project would be longer and have a further do be able to have a final prototype and allow the students to take the project the distance they could.