DEM Corner Cover

Edesign 100
Section 21
Spring 2015
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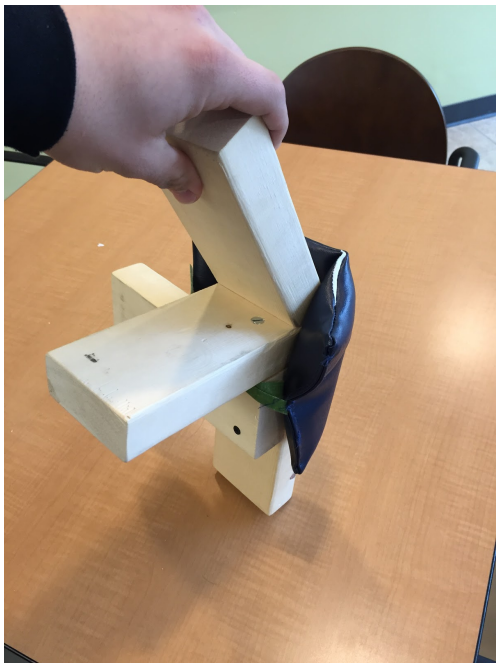
Team:DISC



I. Mission Statement:

Product Description

Our solution is a cushioned covering to enlarge the contact area between the joint and the glazing. This would also serve as a protection for the glazing, keeping the joint from rubbing and creating holes. The basic design is a foam piece enclosed in a durable, waterproof fabric covering, which has velcro strapping that wraps around joint.

Benefit Production

The benefit of our addition to the greenhouse is huge. Our design will almost completely eliminate the risk of tearing the glazing in response to high winds and wear and tear over time. While there are obviously outstanding circumstances, the coverings for the joints will solve the immediate problem of friction between the joint and the glazing. Producing these coverings will be a huge asset to the general greenhouse, working to solve the main current problem. With this greenhouse being fully functional, the people of Mozambique will be able to grow their own food and provide for their families.

Key Business Goals

The main business goal of these coverings is to prevent damage to the glazing. The entire greenhouse revolves around the glazing material to encase the plants. With our idea, the product will be nearly flawless, assisting in the marketing of the product and ultimately an increase in demand.

Primary Market

The primary market for this product is the designers of the greenhouse, HESE. This organization is the backing for the entire product. With their design aspects and ability to implement, they deserve the credit as well as the benefit for the product. The other part of the primary market would be the manufacturer, who HESE goes to with their designs.

Secondary Market

The secondary market for this product are the people of Mozambique who already own the greenhouses, or who do not. Due to lack of arable land, citizens are in need of ways to produce food for consumption and market. Whether their glazings have already torn or not almost all owners would see how big of an asset the corner cover would be. Another aspect of the

secondary market are the greenhouse companies in Mozambique who could sell these corner covers with the greenhouses.

Assumptions

The main assumptions for our product is that each greenhouse is made to the exact same dimensions. Though we understand that different villages might be using different types of woods with different thicknesses or textures, we are assuming that each joint will be almost uniform. Our product is extremely flexible to the size since it is just a cushioned cover however, if there are large discrepancies in the joint dimensions, the product may not work.

Stakeholders

The stakeholders regarding this product are the Mozambique farmers, HESE, and whichever company HESE decides to use to physically sell the product. The farmers only have potential benefits while the other two companies/organizations face some relatively high stakes. Any company investing in a humanitarian project has some risks for failure. However, since this product has already been implemented in third world countries, our addition to the original greenhouse will only increase the benefit of the product.

II. Summary of HESE:

HESE stands for Humanitarian Engineering and Social Entrepreneurship and is a program at Penn State University where people from all disciplines come together and solve problems that are faced by the developing world. But instead of simply solving the problems, they make sure these solutions are sustainable where they will be implemented. The four aspects of sustainability that are focused on are "technologically appropriate, environmentally benign, socially acceptable and economically sustainable." This means that the people at HESE make sure that the solutions can be used effectively in the environment they are put into. For example if a water purifier is installed in a village in africa that doesn't have electricity, the designers must keep this in mind. HESE looks at these situations in a holistic way and solves the problems to make this world a better place.

III. Location Research:

Our team is researching ways to improve upon portable greenhouses being sold in Mozambique. With that being said, it is important that we have an understanding of the country in which our product will be distributed and sold. Mozambique is located in southeastern Africa between South Africa and Tanzania (Mozambique Country Profile, 2015).. The climate and terrain vary depending on location. The country is separated into several distinct regions: the

coastal lowlands, uplands in the center, high plateaus in the northwest, and mountains in the west (Mozambique Climate, 2015). There has been significant growth in Mozambique; however a civil war and corrupt government has hindered their development.

After ten years of war, Mozambique gained their independence from Portugal in 1975, leaving them destitute and poor. At that time they were one of the poorest countries in the world (Rural Poverty Portal, 2015). After gaining their independence, FRELIMO (Front for Liberation of Mozambique) came to power and facilitated a transition to democracy. Unfortunately FRELIMO turned out to be corrupt and allied with the Soviet Union, establishing themselves as a socialist state. Outraged, a group called RENAMO (Mozambique Resistance Movement) was formed in 1975 to combat FRELIMO (Mozambique Country Profile, 2015). The country soon after fell into a horrible civil war. The civil war caused destruction to existing infrastructure and soiled good farmlands with land mines. Although, technically the civil war ended in 1992, tensions still run high and there are still terrorist activities run by RENAMO. Furthermore, the government continues to be corrupt, using government resources for individual benefits such as campaigning for reelection (Mozambique Country Profile, 2015).

The country is also racked by drastic climate changes. The coast tends to be mild year round, while the rest of the country experiences rainy season beginning in December. The temperatures are hot and humid, until the end of rainy season (Mozambique Climate, 2015). Then in March cooler and drier weather gradually spreads from the South to the North. Rainy season often brings with it floods and dry season brings droughts. Both tend to make farming difficult (Mozambique Climate, 2015).

Only 6.5% of land is arable, so greenhouses will help increase farming yields (The World Factbook, 2015). 95% of farming is done by small family farms, which are subject to the whims of the weather (The World Factbook, 2015). Therefore, during certain seasons family's won't have enough food to eat let alone sell for a profit.

It is our goal as a team to realize what these challenges means to us in order to increase the productivity of small farms. We hope that with implementation of improved greenhouses in Mozambique, small farmers will be able to produce enough crops to support themselves comfortably.

IV. Decision Making Process

In order to solve our problem, we brainstormed several broad concepts. These concepts were then refined for specific applications. Our first ideas ranged from making a patch for the tarp to using items such as spray foam to expand and fill the gaps. After these ideas, we focused the main points and picked the most realistic and applicable solution. With these concise ideas we used a decision making matrix. For each of the three concepts we either put a + - or 0, showing if it would be better, worse, or the same as not having anything on the corner. Refer to

Table 1 (below). Eventually we came with the conclusion that the corner cover was the best solution to our problem.

Specific Needs

- To prevent glazing from tearing.
    - The solution has to ensure that the glazing would not tear upon contact with the glazing and the joint. The was the main concern.
- Be cost efficient
    - Each joint has to be producible with a two dollar budget. The joint cannot be a financial burden to the greenhouse budget.
- Be easy to assemble
    - Each joint should have quick and easy assembly with little direction. The people using the greenhouses will not have the resources or education to use a difficult product.
- Be easy to produce
    - Each joint should be producible quickly and efficiently. These greenhouses are meant to be assembled rapidly and cannot be slowed down by our product.

Brainstorming Ideas

- Wrap a pillow like object around joints
- Use corner guards on joints
- Tennis ball/ pool noodle along the edges

Selection Chart

After brainstorming

Criteria	Reference	Wrap-Around Pillow Tarp	Cushion Guard/Corner Cover	Tennis ball/Pool Noodle
1)Easy to install	0	+	+	0
2)Within Cost	0	+	+	+
3)Durability	0	+	+	0
4)Effectiveness	0	+	+	+
5)Producible	0	-	+	+
Sum of + Sum of 0 Sum of -	0 5 0	4 0 1	5 0 0	3 2 0

Net Score Rank	0	3	5	3

Table 1. Decision Making Matrix

V. Prototype Planning, Fabrication, and Testing

Prototype 1

Before we made our "first cut" in the machine shop we brainstormed and sketched out some ideas. We knew we had to recreate the joint that would be the part of the greenhouse we would be testing our prototype on. The initial sketch of the joint is shown below in Figure 1. We took the pictures that HESE gave us of the greenhouse joint and sketched it out and decided what type of wood material we wanted to use.

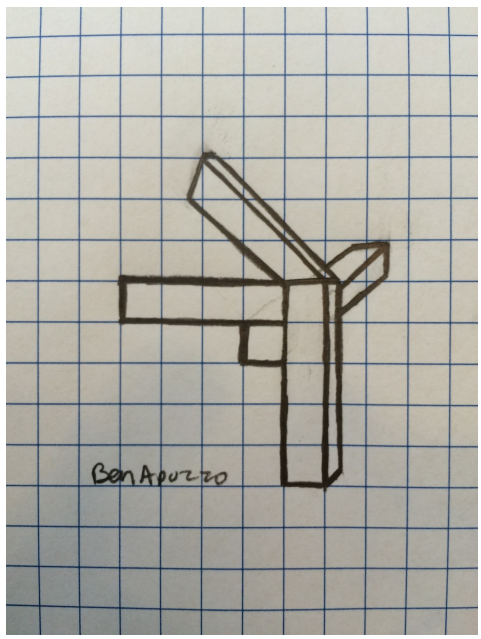


Figure 1. An initial sketch of the joint

Test Results Summary

	Number of Rubs	Did plastic covering Break?
Joint with Prototype Cover	50	No
Joint without Prototype Cover	50	Yes

Table 2. Test Results for Prototype 1.

We needed to test Prototype I to see if it would in fact protect the glazing. We chose to do this by using a friction and stress test. We attached the glazing to a 10lb weight and rubbed the glazing over the joint 50 times. We performed this test once with the prototype cover and once without the prototype cover. It was discovered that the glazing would tear after 23 rubs when there was no protection on the joint. Meanwhile, the glazing showed no sign of stress after being rubbed on top of the joint with the prototype cover. The results of the testing are picture in Table 2 (above). The test was a success, because the prototype will keep the glazing from tearing, if weather forces the glazing to rub against the joint.

Observation Summary

Overall our test was successful because we realized that our prototype's purpose, to protect the wearing of the plastic covering over time with movement, was effective. The protective cushion over the wood piece had less wearing of the plastic covering than only the wood and plastic covering by itself. It was also successful because we realized that our method of connecting the cushion to the wood was ineffective and needed to be replaced.

We realized that we needed a better method of strapping our protective cushion onto our wooden piece. Since we used rope to connect the two pieces together it didn't hold as well as we would've liked. This is why we decided to use Velcro to connect the cushion and wood piece together.

Throughout the testing, we didn't experience any surprises. The data matched up with our hypothesis.

Prototype 2

Alterations

We found that our strapping of just using twine was not successful so we went ahead and bought velcro. We also felt that using duct tape to hold together our corner cover was not good enough so we sewed it together. Therefore, we attached the corner cover onto the joint, this time using the velcro, and dragged the plastic covering with the weight over the corner 50 times.

Test Results Summary:

We performed the same test as in Prototype 1 for Prototype 2. Our results were nearly identical with the only change being the strapping.

VI. Lessons Learned

If our group were to make a third prototype, we would focus on using less materials for the cover. Our final prototype consisted of a fabric pouch concealing a cushion. The fabric is on both sides of the cushion, allowing the assembly process to be similar to covering a pillow, quick and easy. However this uses a substantial amount of fabric that if cut down, would make the cover cost less. Our current design utilizes a pillow but in an attempt to minimize materials, we would investigate a manner of covering a pillow with less resources.

Our team, DISC, worked very well together. Each of our four members had a different but important skill set. While some were good at the physical construction of the cover, others were good at brainstorming and thinking outside of the box. We balanced one another and were able to work together and produce a successful prototype.

The only aspect of the project we struggled with was the brainstorming. Our ideas were all relatively similar and it was difficult to come up with new solutions. This made evaluating our solutions almost useless. The designs were too similar. In the future, we will need to think even more broadly when coming up with solutions.

The DEM project itself could be improved by presenting the students with a more challenging problem, requiring us to be innovative and use the materials provided to us. While HESE's work is interesting and innovative, solving the problem of the glazing did not leave much room for creativity on the students part. There was generally one solution to fixing the glazing problem, covering the joint. Us students had access to various machines and materials but hardly needed to use them. With such access, we would like to be challenged and encouraged to use our resources to come up with some innovative and different.

VII. Works Cited

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