Filipino Disaster Relief Shelter
Mission statement:

As a team, Prestige Worldwide had a problem that needed a solution. In the Philippines there lives an active volcano that erupted one day destroying hundreds of houses. After the eruption, there were hundreds of people who needed a place to live and the team’s task was to make shelters for those who lost their home in the disaster. The team needed to design these shelters within a budget, but at the same time make them comfortable and sturdy enough to live in for about 6 months or more. The team started by creating a mission statement which is as follows:

“Our mission is to create a sustainable, temporary community for displaced Filipinos due to a sudden eruption of the Taal Volcano, near the capital of Manila. We will create a safe haven that offers shelter from the environment including rain, wind, and wildlife.”

The objectives the team felt most important to tackle were access to clean water and food, shelter from weather and debris, ventilation, and access to bathrooms. Prestige Worldwide’s mission statement was based on these requirements. While the other two categories were important, and certainly considered when developing a design, the goal for the mission statement was to send a message that the team would fulfill the most basic of human needs, at a minimum.

Context and customer need development:

Prestige Worldwide researched in great depth the region around Manila, the capital of the Philippines. What they found was that Filipinos lived with few amenities. What the team found that was particularly surprising is the poor conditions in bathrooms. Most bathrooms do not have running water. Toilets are basically just holes in the ground that one would pour water down after using. Toilet seats would be considered a luxury. The team found, after some research, that many public bathrooms had odd signs and instructions. Some would have a vending machine for toilet paper, which is another thing that would be considered a luxury. Instead of toilet paper many
Filipinos would use a small bucket of water to use as a makeshift bidet. Some signs instructed patrons not to stand on the toilet. These types of signs exist because children are taught to stand on the rim of the toilet as they go to the bathroom to avoid falling in. Falling in is a risk for small children because there are no toilet seats. However, standing the toilet leaves a possibility of the toilet breaking. Further research showed most houses were really just glorified huts. They could be made from bamboo or salvaged material such as wood. The team also found out that the Philippines have a strong Spanish influence, since they were colonized by the Spanish. The country is also 86% Roman Catholic.

The process of the research started with how the Filipinos lived. It was important for the team to understand the common conditions of the Filipinos so as not to overcompensate when designing a shelter. Overcompensation for what Filipinos would consider luxuries would just lead to spending more money than was necessary. The research then moved onto the norm of society in the Philippines. Discovering that the country was 86% Roman Catholic was integral. In learning this the team knew that being sensitive to the religion of the country was important.

C.A.R.E. was chosen as the team’s secondary customer as this organization was a huge help to the Syrian refugee crisis. They had people on the ground in five different middle eastern countries that were affected, including Syria. C.A.R.E. had consistently shown their presence in the Philippines as well. They assisted in 2009 with typhoon Ketsana, in 2012 with typhoon Bopha, and in 2013 with typhoon Haiyan. They provided both food and shelter for the Filipinos, distributing 13,905 emergency shelter kits to households in need. C.A.R.E. was chosen because they have a history in the Philippines and they have the knowledge and resources to help the Filipinos as best as they can.

Our customer needs were broken into three categories: requirements, wants, and “would like to have.” For requirements the team considered the most basic human needs such as access to clean water and food, shelter from weather and wildlife, access to bathrooms, sanitation and ventilation. Things that fell into the want category
were safety from crime and violence, light, cooking supplies, an organized system of
tavel, access to electricity. And under the “would like to have category” fell things like
furnishings, system of rules and regulations, bedrooms, showers/baths, and a play area
for children. The team felt that this breakdown was appropriate considering the current
conditions that Filipinos lived in.

**Concept Generation Summary**

The team’s specifications for designing the shelter mainly focused on keeping the
people living in the shelter safe from rain, wind, and wildlife. This is because it rains
frequently in the Philippines and the displaced people mainly need protection from the
outside world. However, they also needed to consider keeping each unit relatively small.
The team decided that the shelter needed to be about two meters tall, considering the
average height of Filipinos is just under that. They also needed the width to be about
the size of three beds, at least. If the team could fit three bunk beds into the unit, then
that would house six people. The team decided to go with two room units each with
slanted roofs that conjoined in the middle, this way two families could be housed in one
unit. The slanted roof allowed rain to run off instead of collecting on top of the roof and
eventually ruining it. Keeping size in mind, the team decided to have bunk beds, the
only problem with this is that whoever is on the top bunk next to the roof could suffer
from heat exhaustion if the shelter is not properly ventilated. Keeping this in mind the
team decided to have slits on either side of the roof that will allow for airflow throughout
the shelter. These slits would then have a roofing system over them to prevent water
from being able to get into the shelter through the ventilation system. The shelter itself
was built to be more wide than it was tall.

**Test Report Summary for Prototype 1**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Test</th>
<th>What is “Pass”?</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Shelter</td>
<td>Put in front of a fan.</td>
<td>Can withstand 30 km/hr winds. (to</td>
<td>PASS</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
<td>Result</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>Water Shelter</td>
<td>Put under the faucet of a sink and allow large amounts of water to be released in a short amount of time.</td>
<td>Can withstand 15 mm of water in a day (to scale: 1mm in a minute) PASS</td>
<td></td>
</tr>
<tr>
<td>Ventilation</td>
<td>Measure the temperature inside and outside.</td>
<td>Prefer it to be cooler, but same temperature is okay. PASS</td>
<td></td>
</tr>
<tr>
<td>Light allowance</td>
<td>Using a smartphone app, measure, in lux, the brightness of the light outside and inside of the structure.</td>
<td>At least a 2:1 ratio from the outside. FAIL</td>
<td></td>
</tr>
<tr>
<td>Stability (Earthquake protection)</td>
<td>Drop it down stairs.</td>
<td>Can withstand two flights of stairs with minimal visual damage. PASS</td>
<td></td>
</tr>
<tr>
<td>Protection from debris and volcanic ash</td>
<td>Throw dirt at it.</td>
<td>15mm of dirt can layer the flooring of the house. (to scale: 1mm) FAIL</td>
<td></td>
</tr>
</tbody>
</table>

The reason the first prototype had failed the light test was because the team was unable to create windows in the top of the roof. This was in their design, but it could not be duplicated given the materials that were available to them. They wanted to have windows that were covered in glass or plastic but these materials were not available. The reason they did not cut
holes in the top was because they knew that that would cause the prototype to fail the water test. The failure of the debris test is because the team put windows in the side that were not covered with a screen. Again, they had this in mind when designing but the materials were not available to them when prototyping. If the shelter were to actually be built, these things would surely be added.

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Concept Refinement Summary:

After the tests the group decided to put more emphasis on allowing more light into the shelter and protecting the inhabitants more from debris and possible ash in the air from the volcanic eruption. This wasn’t too hard to execute. All they needed to do was come up with a way to prevent soot from coming in through the ventilation system and come up with a way to allow more light into the shelter, possibly through the roof. There were no major changes that needed to be made to the initial prototype, just some minor adjustments to allow for more comfort for the displaced people living in the shelter.

Test Summary Prototype 2:

The initial prototype failed the light and debris protection test and it was decided to adjust the second prototype accordingly. In order to increase the level of lighting within the team’s shelter, clear windows were added to the roof, which in turn would

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1 Figure 1: Prototype one going through the weight bearing test, a way to measure the durability of the prototype.
allow more sunlight to enter the living space. Research showed that a lighting of 200 lux would be appropriate for our shelter, but after modification the team successfully achieved a value of 540 lumens. To keep volcanic ash from seeping into the shelter, mesh screens were added over the air ventilation slits on the peak of the roof.

**Cost Analysis:**

The shelter will be constructed from recycled plastic lumber, a lightweight and environmentally friendly building material that proves to be more beneficial than regular wood. Each unit would cost $202.84 in raw materials, but if materials were purchased in bulk it would be possible to build 1000 shelters for $192,975.00, that's $9865 in savings. Building materials will be provided by McMaster-Carr, a company that ships raw construction materials across the world.

**Consideration of human needs:**

When designing the shelter, basic human needs as well as the current Filipino lifestyle needed to be taken into account. After some research it was discovered that Filipinos do not have the luxuries that many take for granted. Most Filipinos do not have running water, plumbing systems, or even toilet paper. The team realized these problems and made adjustments to the design to help meet the basic human needs without spending unnecessary money on luxuries that the displaced people don’t usually have. Some of the applications are as follows: Strong waterproof roofs to shelter from the harsh winds and rain, access to clean water through either boiling or collection from gutter system, access to a communal outhouse far enough away that sanitation is still present in the community, appropriate ventilation on the roof and windows to counter the hot weather, and sanitation stations in the each of the shelters to help fight disease and infection.

Prestige Worldwide’s most integral consideration was ventilation. The research showed how high the average temperature of the country was, about 80°F. The team
took this into consideration when designing and that is why there is the open area at the top of both prototypes 1 and 2. This open area at the top allows the risen heat to escape. The team wanted to make sure that anyone who slept at such a height, like in a bunk bed, would not overheat or suffocate.

**Consideration for camp:**

Recycled plastic lumber was chosen as the building material for a number of reasons, most importantly for its ease of transportation and its durability. Using recycled plastic we could ensure a cleaner and more sanitary camp environment as the plastic makes no room for insect infestation or rotting. In addition to that, the camp will be set up similarly to a cul de sac, where multiple shelters will be stationed to form smaller circular communities. This gives disaster victims the ability to maintain the social aspects of their lives allowing for an easier transition into the camp. Furthermore, in the middle of these cul-de-sac-like area could be placed a firepit for cooking. These families could join together to cook and eat their meals in this scenario.

**Re-design ideas/thoughts and conclusion:**

If Prestige Worldwide were to pass this project onto another group, the team would advise them to factor in more of the upper half of Maslow’s hierarchy of needs. Even though the two-shelter system was for families to be able to bond and relax outside, the need for children to run around and play was not factored in. The dream prototype #3 for Prestige Worldwide would be the same as prototype #2 with the addition of a recreational area set aside for children to run around and release some energy and to have some fun.

If this project were to be done again by this group, there would be more focus on the brainstorming phase of the process. In the beginning, there was too much fixation on one shelter and consideration for anything else was absent from everyone’s mind.
Overall the process in which this project was completed was very well-executed. The team delegated different tasks very well and finished them in a timely matter. From initial brainstorming to final prototyping, Prestige Worldwide worked as a team in and outside of the classroom. Although this design and shelter will not be used in a real world setting, the team learned many valuable lessons on how a design process works, different lifestyles around the world, and what it’s like to be an engineer.
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