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**Project Deliverable G: Prototype II and Customer Feedback**

**GNG 1103 – Engineering Design Faculty of Engineering – University of Ottawa**

## Prototype II Design

Materials Required

| Material | Cost | Source |
|---|---|---|
| Plywood | $15.54 | https://www.homedepot.ca/en/home/p.sureply-premium-underlayment.1000671964.html |
| Velcro Straps | $11.98 | https://www.homedepot.com/p/VELCRO-Brand-6-ft-x-2-in-All-Purpose-Strap-with-Handle-Black-90482/203307539 |
| Wheels (x4) | $8.00 | GNG1103 - Lab |
| Hinges (x4) | | |
| Lock (x1) | | |
| Nails (x70) | | |
| Screws (x30) | | |
| Brackets (x4) | | |
| U-bolts (x2) | $3.32 | https://www.homedepot.com/p/Everbilt-5-16-in-x-1-3-4-in-x-4-3-16-in-Coarse-Zinc-Plated-Steel-U-Bolt-806876/204273751 |

Table 1

## Prototype II Test Plan

Tests shall be performed on Prototype II to determine whether the current design is capable of accomplishing the desired tasks effectively. Furthermore, the prototype will allow us to gather feedback from the customer as it is a better representation of our final product. These tests will permit us to notice issues with the current design and modify them for the next prototype.

Test Objectives

1: Determine the stability of velcro straps to reduce the risk of damage to Bowie
2: Determine the dimensions of the storage unit for a lightweight and solid build
3: Testing the efficiency of the wheels on surfaces that Bowie will encounter during transport

| Objective | Test methods |
|---|---|
| 1. Velcro straps | ● travel with unit at various velocities<br>● travel with unit on different surfaces<br>● drop tests on unit |
| 2. Dimensions | ● observe if entrance/exit is suitable for Bowie (the ramp is 8-9 degrees<br>● test strength with weight in unit |
| 3. Wheels | ● test at different speeds<br>● test on different surfaces |

Table 2

Test Criteria

Objective 1:
The shelter is structurally sound if the velcro straps are able to protect Bowie from getting damaged. A 'fake' Bowie, with exact dimensions of Bowie, can be placed in the unit and tested at various velocities, along with drop tests, to observe success or failure.

Objective 2:
The shelter is large enough for Bowie to enter through the door frame as well as lightweight for one person to transport. If 'fake' Bowie is able to enter and exit the shelter without getting stuck (or pose other issues) we know that Bowie will fit.

Objective 3:
The wheels make the shelter easier to transport in comparison to lifting. If the wheels move smoothly on the surfaces that Bowie will encounter, it will be observed that the wheels can withstand that surface.

Prototype Test Plan

The reason we are performing these tests is to determine whether the current design is capable of accomplishing the desired objectives effectively. Furthermore, the prototype will allow us to gather feedback from the client as it is a better representation of our final product. These tests will permit us to notice issues with the current design and modify them for the next prototype.

The specific test objectives are outlined in Table 2. The first objective is to determine the stability of velcro straps to reduce the risk of damage of Bowie. The second objective is to

determine the 3D dimensions of the storage unit for a lightweight and solid build. The third objective is to test the efficiency of the wheels on surfaces that Bowie will encounter during transport.

The prototype is to help the design team learn and improve our design to fix any flaws that impact the effectiveness of our design. The prototype is being used to communicate the appearance and functionality of the shelter to the client.

The possible types of results from the testing process include quantitative and qualitative information. Quantitative results would involve metric specifications such as suitable dimensions of the unit for Bowie. Qualitative results would involve specifications through trial and error, such as observing the wheels moving through different terrains. These results will be used to help determine if a specific feature is not functioning as intended. The results will impact the decisions of the design team to decide if a change is required.

The criteria for test success or failure is the storage unit not undergoing any damage through testing objectives.

Prototype II is a comprehensive prototype as the testing is implementing many different product attributes. The comprehensive prototype was the preferable selection for our storage unit because testing of multiple attributes is required. We are low on budget and therefore the testing was not as rigorous as we had hoped due to the cost constraints. Physical prototype is the better option for our testing because it is easy to make a physical prototype than an analytical prototype. The different attributes to be tested on Bowie were the security of Bowie's movement within the storage unit (with velcro straps), the dimensions of the unit, and how the wheels interact with various surfaces.

The wheels are tested on various surfaces (grass, laminate, pavement) by moving the shelter at both walking speed and jogging speed along these surfaces. Next, we tested the dimensions with simulations of Bowie entering and exiting the shelter through a custom made cardboard model of Bowie's dimensions. Furthermore, we utilized the above mentioned cardboard model in order to test the effectiveness of the velcro straps by securing them and moving the model at several speeds to determine if the straps secure Bowie sufficiently.

The information being measured on the storage unit is the dimensions. This attribute is the most important as having Bowie fit in the storage unit is essential for the project. There is other information being measured but not necessarily metrically. The security of Bowie in the unit and how well the wheels interact with various surfaces are observed by feel and movement. This information was recorded by visual analysis and then documented in this Deliverable. The materials that are required and the approximate estimated cost can be observed in table 1 above.

The future testing that must be done for the next prototype is to test the water resistance of the storage unit after applying a wood sealer and to determine the accuracy of the reading distance, as well as a suitable location of the camera on the storage unit. In order to complete the future testing, the work that needs to be done is to assemble the unit properly with nails, in order to apply the layer of wood sealer and to have the camera arrive by courier.

Prototype II was built on Saturday, November 3rd with testing taking place directly after the build. To determine if the dimensions are accurate for the unit, strict measurements shall be taken prior to the assembly of the unit. Once built, the ‘fake’ Bowie will be placed both in and out of the storage unit as if it were driving in and out, therefore the ramp angle is a measurement that is taken into high consideration. In order to test the security of Bowie with the velcro straps, the unit must be fully completed and the ‘fake’ Bowie (exact same size) is placed inside the unit with the velcro straps around it. Before the wheels are tested on various surfaces, they must be attached to the storage unit.

A Gantt chart for the tasks and testing has been completed and is currently being updated on a weekly basis should small changes occur. Thus far, the design team has been relatively on schedule. Delivery of the camera device is a testing objective the team is pending on.

The test results have given the design team thorough knowledge on what is working so far and what objectives could use improvement. The objective that requires further discussion is how the wheels move through different terrains. Currently, the wheels are quite small and causing some issues with easy movement. It may be required that bigger wheels will need to replace the smaller wheels. Next week, the design team will be prepared to assemble the unit properly to apply wood sealer and test the camera parameters. The Secure Portable Storage Unit shall have the next round of testing completed by November 10th.

## Pictures of Prototype II