GNG 1103

Deliverable G: Prototype II and Customer Feedback

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1. Introduction

1.1. Background of the Report

This report outlines our second prototype design iteration following a recent client meeting. We are addressing and rectifying issues highlighted by the client during the meeting. Our goal is to create an improved second prototype using materials suitable for the final jig.

Prototype II is a focused prototype which highlights the baseplate as a subsystem, as well as the clamping mechanism integrated into it. This subsystem presented the most challenges in terms of feasibility of construction, which led to our decision to focus on it for this week's prototype.

1.2. Scope of the report

To illustrate the design, construction, and feedback process of prototype II, we have outlined:

- An updated CAD model of the refined prototype II concept
- A bill of materials for prototypes II and III based on their updated design
- Images of the constructed focused prototype
- Results of the tests conducted
- Feedback on prototype II
- A testing plan for prototype III

2. Updated Clamp Design

After discussion as a team as well as the feedback provided on prototype I, it was decided that our jig would be subject to the following changes, as seen in figures 1 and 2.

- Clamps will be integrated into the baseplate subsystem, rather than purchased and attached externally. This will allow more manufacturing to be done in-house, reducing expenses.
- This integrated clamp design will extend sideways, rather than being fixed on the face of the clamp. This will allow for less interference with the router, and an overall sleeker design.

2.1. Detailed Design Update

The updated design for the jig can be viewed in detail in figures 1 and 2.

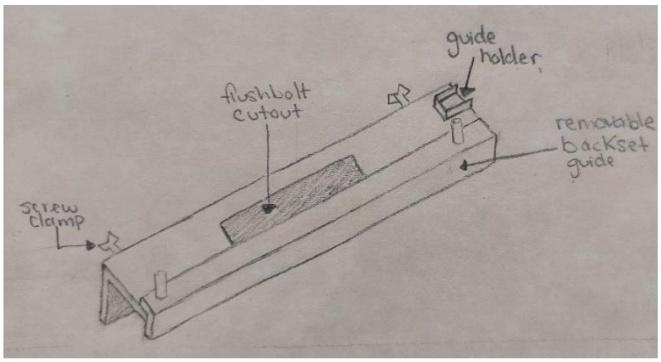

Figure 1 - Updated Design: Sketch

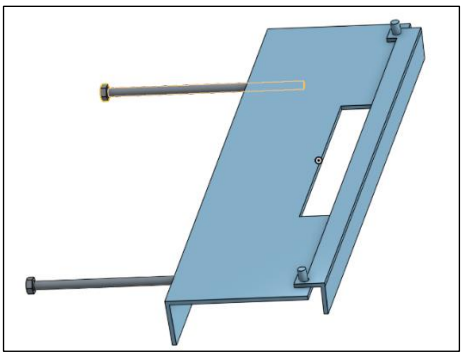

Figure 2 - Updated Design: Digital Model

2.2. Updated Bills of Materials

After updating our design for the clamp, a new bill of materials (BOM) has been created for prototype II (table 1). The BOM for prototype III can be found in section 6 and the BOMs for prototype I and the final product can be found in the Appendix.

Table 1 - Bill of Materials for Prototype II

Bill of Materials – Prototype II					
Item #	**Item Description**	**Supplier**	**Quantity**	**Unit Price**	**Amount**
1	12 x 16-inch 20 Gauge Steel Sheet	The Brunsfield centre	1	$10.00	$10.00
2	3/8 x 3-1/4-inch Bolt	The Brunsfield centre	2	$0.00	$0.00
3	3/8-16-inch Nut	The Brunsfield centre	2	$0.00	$0.00
4	3/8 Rivet Nut	The Brunsfield centre	2	$0.00	$0.00
				Total	**$0.00**

Note. all prices are in Canadian Dollars.

3. Prototype II: Focused Prototype for Critical Subsystem

Prototype II focuses on the updated clamp design explained in section 2 and the baseplate. As seen in figures 3 and 4, our second prototype is made entirely from metal and is to scale.

Figure 3 – Prototype II: Top View

Figure 4 - Prototype II: Side View

3.1. Testing for Prototype II

Once a physical, accurate, and durable prototype was created, the tests completed are more comprehensive and thorough. Table 3 shows the tests done to measure the abilities of the second prototype, and the corresponding results.

Table 2 2- Test Results for Prototype II

Test ID	Description of test method and materials used.	Results
1	To ensure system integration, use prototype I and attach the different backsets from prototype II to the baseplate. Record any measurements for misalignments.	Dimensions of the backset guides and the baseplate were consistent, and all measurements of the baseplate matched the original design.
2	To measure the ease of use, use prototype I and attach the different backsets from prototype II to the baseplate. Rate the ease of the attachment process for each backset (scale 1-10).	Due to the design change, this test was rendered redundant.
3	To verify precision, using a ruler, measure the gap between the pin on the base plate and hole on the backset.	The change in pin design moved this test to prototype III.
4	To verify precision, using a protractor, measure each of the backsets for prototype II and ensure angle is 86 degrees.	Due to the design change, the backset guide subsystems were moved to prototype III
5	To ensure clamp functionality, place scrap wood of 3 different widths in position as though it were the door and tighten clamping system to ensure it holds the door in place.	The clamping system was able to secure all the different widths of wood and hold them in place. If tightened too much the wood was

		damaged, a better material against the door will need to be added.

3.2. Client Feedback for Prototype II

While developing prototype II, feedback was gathered from Jason Demers and the CEED team. From our proposed ideas, suggestions provided included changing the design to one backset with multiple holes to accommodate each of the varying cut out sizes, rather than having many backset guides of different sizes. They also brought up that the final product could benefit from thicker metal less likely to bend out from the 86 degree angle in the backset guide. From feedback on the difficulty of welding a cylindrical peg directly to the flat sheet metal, our team decided to switch to a rectangular pegs made sheet metal bent at 90 degrees, that can be spot welded onto the base plate. This will result in slit shaped holes in the backset guide at 1/8" increments to allow for adjustability.

This feedback is valuable as it will allow for the jig to be in one piece rather than having multiple pieces which the user would need to keep track of. The client expressed a desire for a compact design, and by only having one adjustable piece this should make the design more space-saving to better satisfy their needs. Our team has decided to incorporate Jason Demers and the CEED team's recommendations for our prototype as we feel it will better satisfy the client and user needs.

4. Prototype III: A Comprehensive Prototype

Prototype III is a comprehensive prototype and will be created by adding on to our prototype II. The design for prototype III will be slightly different than in the design plans stated above as we adjusted the design based on the feedback received. These design changes are as follows:

Cylindrical pins	➔	rectangular pins made of sheet metal bent at 90 degrees, which can be spot welded to the baseplate.
Five backset guides	➔	One backset guide with five holes for different backset lengths, with engraved markers indicating door size.

The change from cylindrical pins to pins made of sheet metal allow us to spot weld the components instead of tig welding metal dowels, which would have required us to recruit someone trained in welding and would be more expensive and time consuming.

For additional clarity please see figure 5 below:

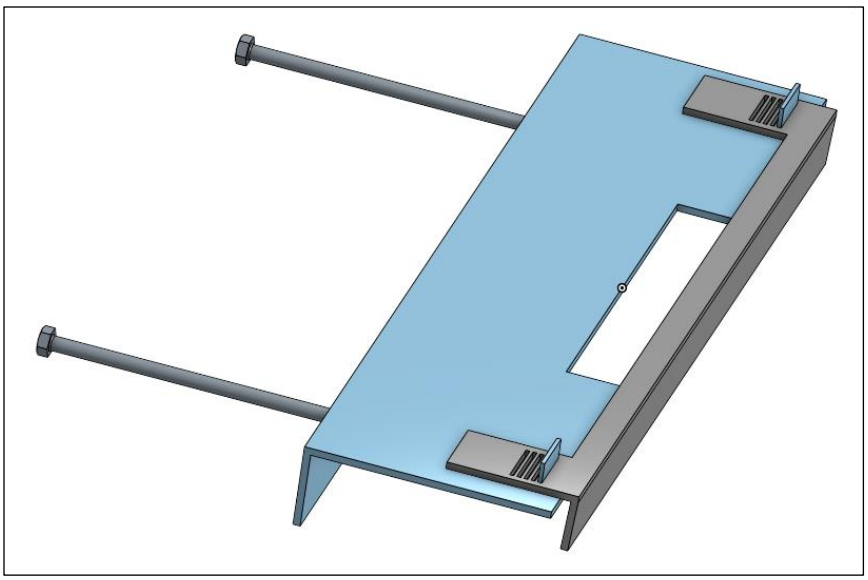

Figure 5 - A Digital Model for Prototype III

4.1. Bill of Materials for Prototype III

The BOM for prototype III can be seen below (table 2).

Table 3 3- Bill of Materials for Prototype III

Bill of Materials – Prototype III					
Item #	**Item Description**	**Supplier**	**Quantity**	**Unit Price**	**Amount**
1	12 x 16-inch 16 Gauge Steel Sheet**	The Brunsfield centre	1	$10.00	$10.00
2	3/8 x 6-inch Bolt**	The Brunsfield centre	2	$0.00	$0.00
3	3/8-inch Wing Nut	The Brunsfield centre	2	$0.00	$0.00
4	3/8 Threaded Rivet Nut**	The Brunsfield centre	2	$0.00	$0.00
5	Fridge magnet	Material from home	1	$0.00	$0.00
6	2’ x 2’, 0.08-in Vinyl fabric	Scrap material from home.	1	$0.00	$0.00
7	Super Glue 3g	Super glue | Dollarama	1	$1.25	$1.25
				Sub Total	**$11.25**
				Total	**$12.71**

Note. all prices are in Canadian Dollars.
*Product link name shortened. Please click on link directly to view product details.

**Product does not need to be purchase as it is already a part of prototype II: prototype III adds on to prototype II

4.2. Test Plan for Prototype III

The test plan for prototype III (shown in table 4) will focus on testing the jig's ease of use, effectiveness, and accuracy.

Table 4 - Tests and Objectives for Prototype III

Test ID	Test Objective (Why)	Prototype used and Basic Test Method (What)	Description of Results to be Recorded and how these results will be used (How)	Estimated Test duration and planned start date (When)
1	Ease of use – backset guide	Using the physical comprehensive prototype, set the backset to various sizes to ensure easy sliding on/off	Record ease of sliding on/off, ask a peer with no background knowledge of the product to perform the test as well to confirm.	5-10 minutes, March 15
2	Ease of use – clarity of door sizing	Using the physical comprehensive prototype, ask a peer from another group to change the backset for a 1 ¾" door, 2" door, etc. to see if the labels on the guide are clear.	Record if the individual was able to identify door sizes and appropriate backset positions easily (Y/N)	10-15 minutes, March 15
3	Clamp effectiveness	With the comprehensive prototype, clamp the jig to a piece of wood within 1 ¾" to 2 ¾" and assess stability.	Record any movement under applied forces, use these results to determine if the clamp design needs to be modified.	20 minutes, March 15
4	Accuracy – Cut-out size, backset length, 12" guide length	Using the complete comprehensive prototype, carefully measure all critical dimensions to ensure accuracy.	With tape measures or rulers, confirm that all dimensions are accurate to the design.	20 minutes, March 15

5. Conclusion

The design and construction of prototype II resulted in several positive changes to our design, ultimately resulting in a more compact, sleek, and simple to construct jig which will effectively fulfill the client needs. These changes were made as a result from feedback and construction constraints and include integrating the clamp into our baseplate, creating one variable backset guide instead of five separate backset guides, and altering the shape of the connection between the baseplate and backset guides to allow for easier and cheaper construction.

Appendix

The first prototype did not cost any money because it was solely sourced from at-home materials as shown in table 5.

Table 5 - Bill of Materials for Prototype I

Bill of Materials - Prototype I					
Item #	**Item Description**	**Supplier**	**Quantity**	**Unit Price**	**Amount**
1	Carboard	Household recycling bin	1	$0.00	$0.00
2	Plastic Packaging	Household recycling bin	1	$0.00	$0.00
3	Bottle Cap	At home	2	$0.00	$0.00
4	Pencil	Ikea	2	$0.00	$0.00
5	Blu-Tack	At home	1	$0.00	$0.00
6	Glue stick.	At home	1	$0.00	$0.00
7	Staples	At home	12	$0.00	$0.00
				Total	**$0.00**

Below is the cost of materials for the client if they were to outsource the jig on their own and did not have access to the resources at the University of Ottawa.

Table 6 – Bill of Materials for Client

Client BOM					
Item #	**Item Description**	**Product Link***	**Quantity**	**Unit Price**	**Amount**
1	12 x 16-inch 16 Gauge Steel Sheet	Paulin 12 x 24-inch 16 Gauge Steel Sheet | The Home Depot Canada	1	$25.38	$25.38
2	3/8 x 6-inch Carriage Bolt (16 UNC)	Paulin 3/8 x 6-inch Carriage Bolt - Zinc Plated - Grade 2 - UNC | The Home Depot Canada	2	$1.95	$3.90
3	3/8-inch Wing Nut (16 UNC)	Paulin 3/8-inch-16 Forged Steel Wing Nut - Zinc Plated | The Home Depot Canada	2	$0.76	$1.52
4	3/8” Rivet Nut (16 UNC)	Rivet Nut | Amazon	2	$0.85	$1.70
5	10mm x 3mm Refrigerator Magnet	Refrigerator Magnet | Amazon	1	$0.41	$0.41
6	20" x 30" x 5mm, White Foam Board	White Foam Board | Dollarama	1	$1.50	$1.50

7	Super Glue 3g	Super glue | Dollarama	1	$1.25	$1.25
				Sub Total	$35.66
				HST	$4.64
				Total	**$40.30**

Note. all prices are in Canadian Dollars.
*Product link name shortened. Please click on link directly to view product details.