GNG 1103

Conceptual Design

Project Deliverable D:

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Abstract

Creating a cut to insert a flush bolt is a time consuming and tedious task, one that could be simple. This team has brainstormed to create a straightforward easy to use jig to reduce the time and effort required to make the cutout. The design has three simple subsystems, the base plate, the clamp system, and a guide to measure and centre the device to the right place on the door. These subsystems were then compared to the leading design criteria to determine the combination that would fulfill all the needs of the jig. After much conceptualizing and analyzing, a durable, adjustable, and cost-efficient jig has been created. Essentially, the jig will have a base plate that is cut to the given dimensions of the flush bolt, with holes for screws to allow for interchangeable plates with different back sets. There will be magnetic ruler attachments to guide the plate to the correct place from the top or bottom of the door (12” or 24”). There will be two modified C-clamps in place with rubber pads to avoid damaging the door. This design will ensure a much faster cut-out process and is less prone to error by the user.

Table of Contents

List of Figures

List of Tables

1. Introduction

This report summarizes the conceptual design and selection process for the development of the flush bolt jig for Ambico windows and doors. The conceptual design process involved the design of three major subsystems by each group member:

- Base plate: The portion of the jig which provides a template for the 6 ½ by 1 inch routed divot to prep the wood doors for a flush bolt.
- Clamp: The mechanism which fixes the jig to the door through the process at the appropriate back set distance.
- Guide: The system which guides the operator to place the flush bolt hole 12" or 24" from the end of the door, depending on door height.

The designs for each subsystem were evaluated on our previously determined design criteria and ranked through a selection matrix. The best subsystems were then combined into three distinct solutions, and the best of these three has been deemed our current best design.

2. Subsystem Design

The following section is a walk-through of the selection of the best subsystem designs. Key designs from each member and their pros and cons are listed, and the subsystems are compared in a selection matrix. The points allotted to each subsystem in the selection matrix were then used in creating the top three complete designs.

2.1 Concepts and Discussion

The group members all designed different subsystems and full constructions of the jig independently, and a meeting was held to compare and contrast the subsystems to determine the best combination of everyone's ideas. The original designs from all members are found in figures 3-10 in the Appendix.

Key decisions and takeaways from the group meeting included:

- The clamp and back set guide should fix to one side of the door at the appropriate back set length, then tighten on the other side (as seen in figures 5 and 6).
- The clamp should have a rubber lining or pads to prevent damage to the door.
- As the back set only varies within half an inch in ¼" increments, three separate back set guides would be more appropriate than one, for ease of use in maintaining accuracy.
- While no one included this in their original design, a new idea was brought forwards of having a detachable 12" and 24" guide, perhaps with a magnet.

All of the proposed subsystems are compared in the selection matrix below, which led to our top three subsystem combinations (Figure 2) and finally our current best design.

The distinct subsystems developed by the team are found in figure 1 below, after redundancies and repetitions were removed.

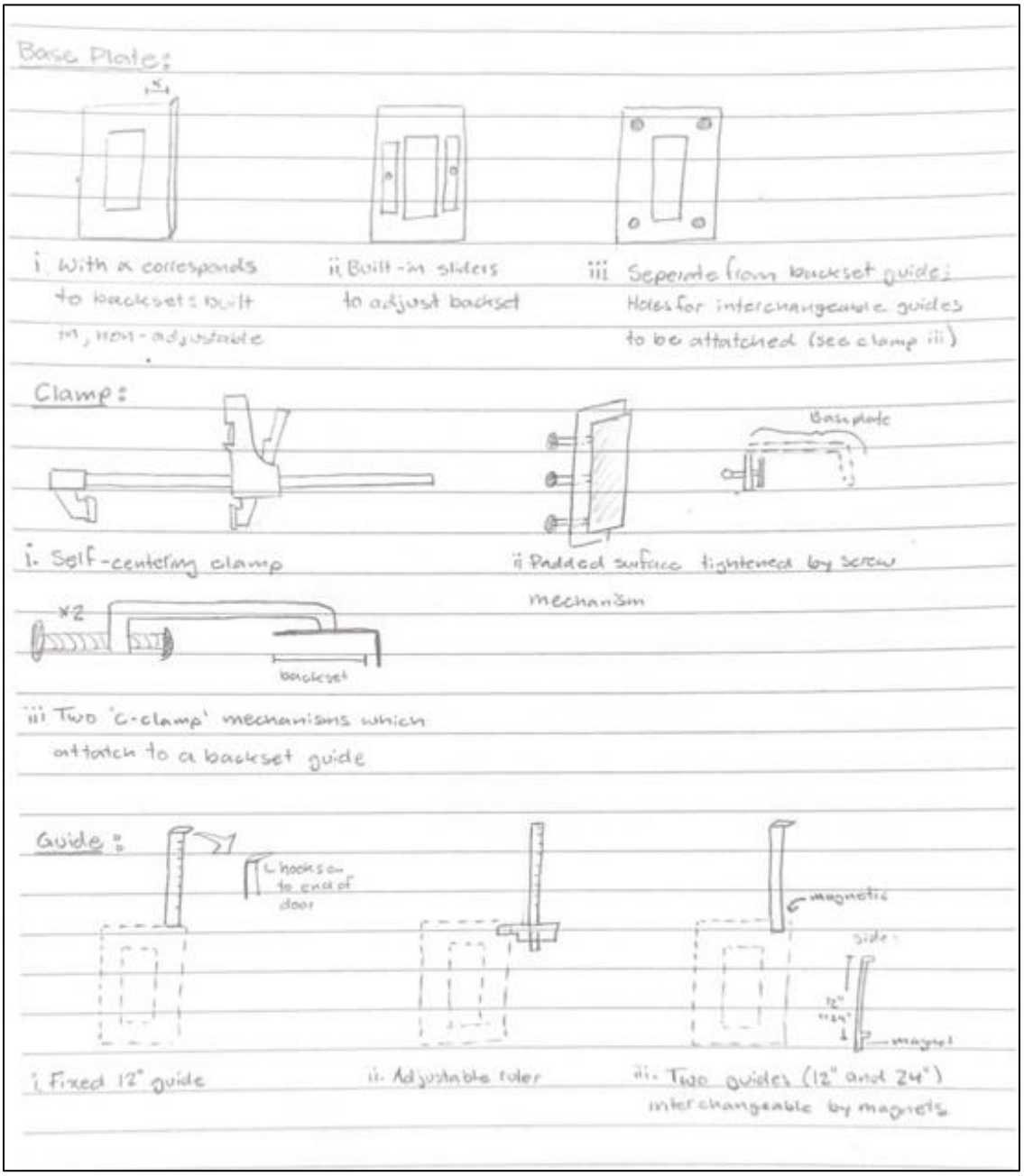


Figure 1: Summary of Subsystem Designs

2.2 Selection matrices

Below are the selection matrices that we used to determine the best subsystems. The first selection matrix (Table 1) shows the ranking for each subsystem design based on the design criteria determined in Deliverable C. The second selection matrix (Table 2) then shows the rating for the best subsystems.

Table 1: Selection matrix 1: Design Criteria

Subsystem / Criteria	Baseplates			Clamps			Guides		
	i	ii	iii	i	ii	iii	i	ii	iii
Adjustable	1	3	3				1	3	3
Reduces time									
Simple/non-clunky	3	2	3	2	2	3	3	2	3
Attaches to door				3	3	3			
Does not damage the door				2	3	3			
Durable in harsh environment	3	2	3	2	2	2	3	2	2
Resilience	3	2	3	1	2	3	3	2	3
Guides to 12” or 24” from top/bottom							3	3	3
Total	10	9	12	10	12	14	13	12	14

Note. 1=low performance, 2=medium performance, 3=high performance.

Table 2: Selection Matrix: Comparison of each Subsystem

Design / Subsystem	i.	ii.	iii.
Baseplate	1	2	3
Clamp	1	2	3
Guide	2	2	3

Note. 1=low performance, 2=medium performance, 3=high performance.

During our brainstorming sessions, our team engaged in lively discussions aimed at identifying the most effective subsystems for our project. After thorough evaluation, we pinpointed 3 standout subsystems to significantly enhance our design. To make an informed decision on which subsystems to incorporate into our testing design, we utilized a selection matrix. This matrix enabled us to rank the subsystems based on various criteria relating to the client needs and

requirements. Through this process, we identified the top-performing subsystems that align closely with our project goals.

2.3 Top three subsystem combinations

The combinations of the best subsystems are shown in figure 2 and they are the current top three designs. This is based on receiving the most points in the selection matrix (Table 3).

Table 3: Selection Matrix: Comparison of Complete Designs

Full Design / Subsystem selected	a. (iii,iii,iii)	b. (iii,iii,ii)	c. (ii,i,iii)
Baseplate	3	3	2
Clamp	3	3	2
Guide	3	2	3
Total points	9	8	7

Note. 1=low performance, 2=medium performance, 3=high performance.

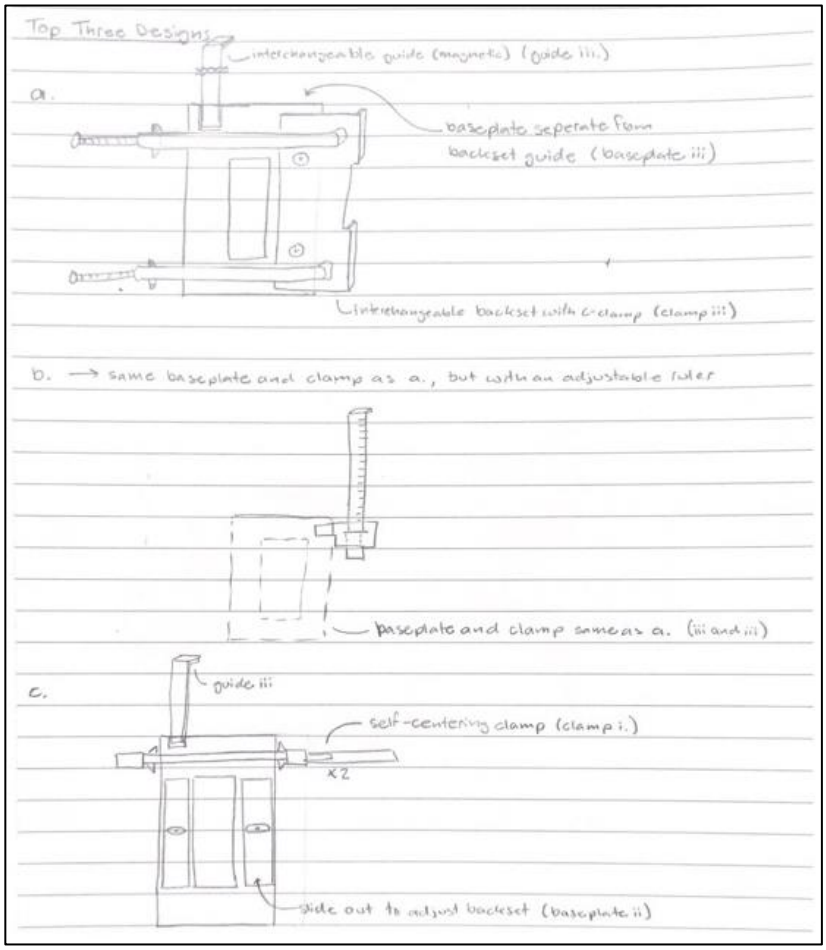


Figure 2: Top three designs

The top three designs all include different advantages and weaknesses. Design a. is highest performing in all areas of the design criteria, but a significant drawback to consider is the fact that the backset is only adjusted through manually switching out one sized guide for another, which could increase process time. Design B also contains this weakness, as well as the fact that the 12” to 24” guide could add to the clunkiness of the design. Option C has the advantage of being fully adjustable in terms of backset length, but contains more small parts which could present an issue in terms of longevity and dusty environment.

3. Current Best Design

Our top design is design *a*, as seen in figure 2. This is a combination of Sam and Abby’s designs, as seen in the Appendix. The clamp Abby designed (clamp option iii) is ideal because it is self centering and easy to use. Additionally, if we modify the design to have a rubber pad, then the clamp is unlikely to damage the door. Sam’s interchangeable idea for the base plate (plate iii.) is highly desirable because it allows the user to customize the backset according to the door’s width. For the guide, we decided to use a 12” ruler that was attached to the jig via magnetization. This design is the best because it allows the guide to be removed for taller doors. Further, we could design a 24” guide that could be attached to the jig for when AMBICO needs to install flush bolts on tall doors.

Rachel’s clamp idea (option i.) was also a good option but was not chosen because the plastic used to make the clamp would not be as durable as Abby’s metal clamp design. Furthermore, the plastic clamp would have smaller components which would be harder to manufacture and therefore cost more. For the baseplate, Abby’s idea (option ii.) was a close second but was not chosen because the backset was not as easy to adjust as Sam’s (option iii.). All designs for the guide were similar with the main drawback being they only went to 12”. Thus, we redesigned the guide to be removable, so that the 12” guide could be interchanged with one that is 24” for taller doors. This also prevents the guide from being cumbersome during the tracing or routing process, as it can be removed once the clamp is in place.

4. Conclusion

To conclude, our team has created a reusable jig to reduce the time and effort required to make the cut out for a flush bolt. From each group members proposed subsystems the best base plate, clamp system, and guide was selected based on the leading design criteria. The base plate will have an interchangeable backset to adjust according to the door's width. The clamping system will be self centered for ease of use and will have rubber padding to avoid damage to the door. A 12" and 24” guide will be attachable by a magnet to the jig. This allows for the operator to remove either guide after the jig has been placed in the desired position to reduce incommodious size. Our final design for the jig utilizes the design criteria to provide AMBICO with the best possible jig.

5. Future Work

The next steps in our process are to decide on materials for the jig and start prototyping our best design. This design will be tested and receive feedback, allowing the iteration process of testing and making modifications to begin. Client feedback will be a critical part of this process, as we present our current designs to the client and take their concerns into consideration.

6. Appendix

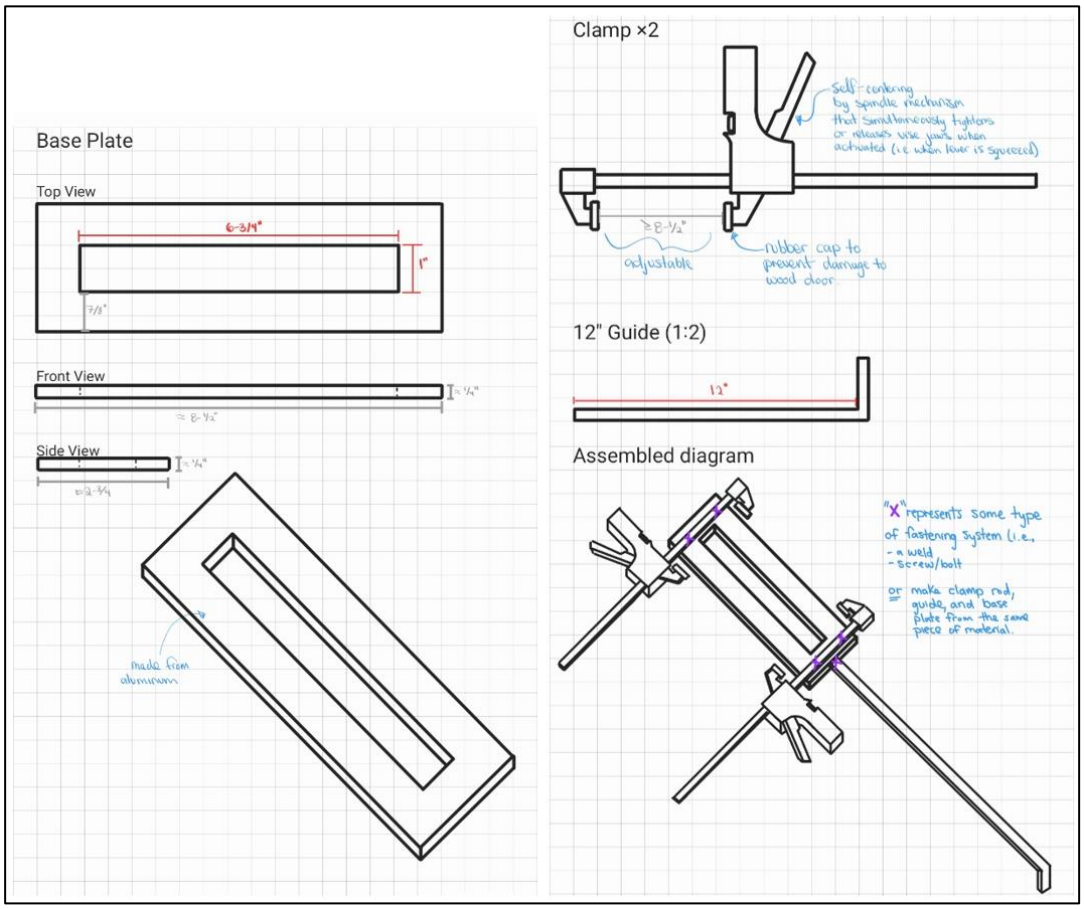


Figure 3: Rachel's Subsystem Designs

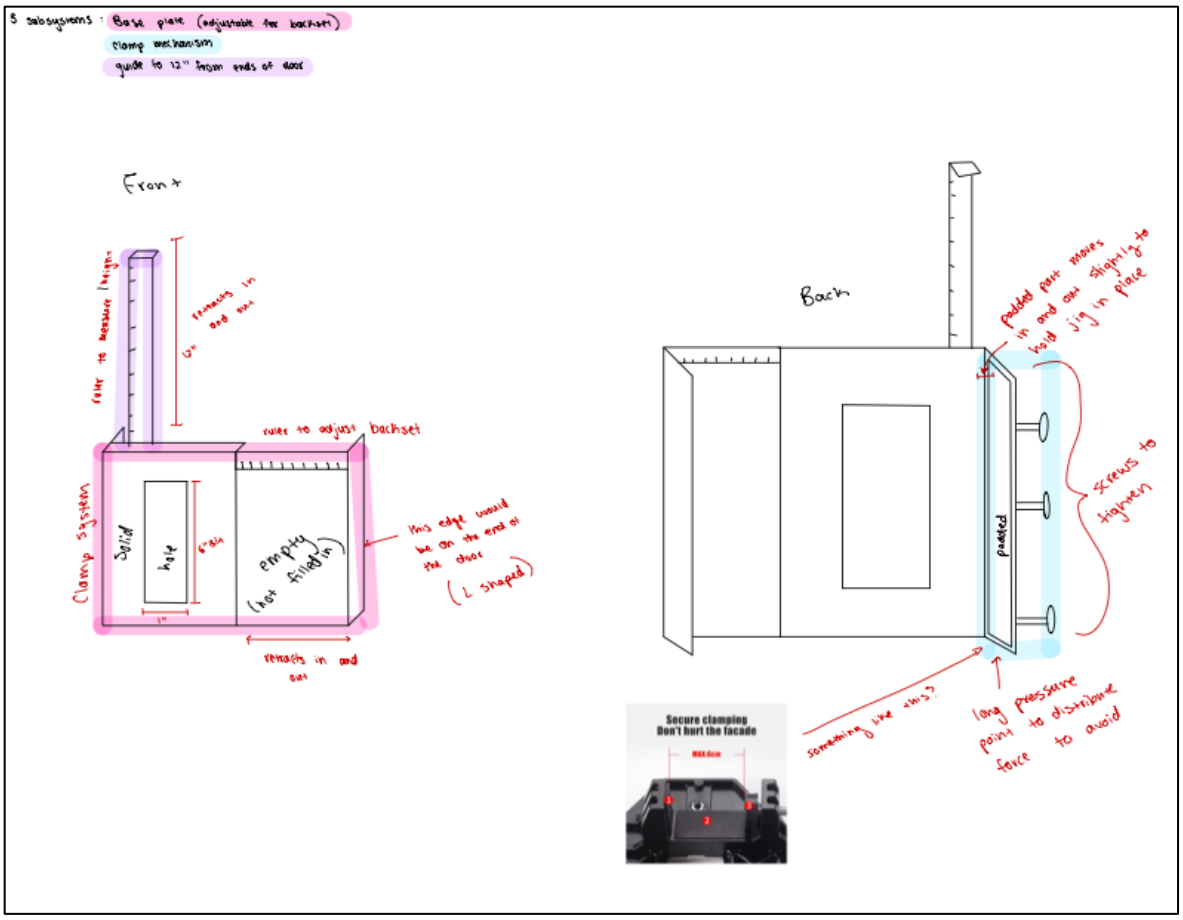
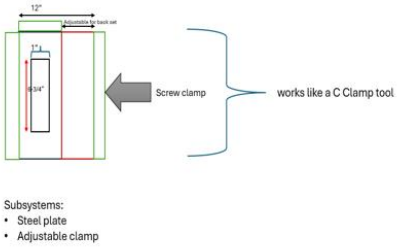


Figure 4: Samantha's Subsystem Designs



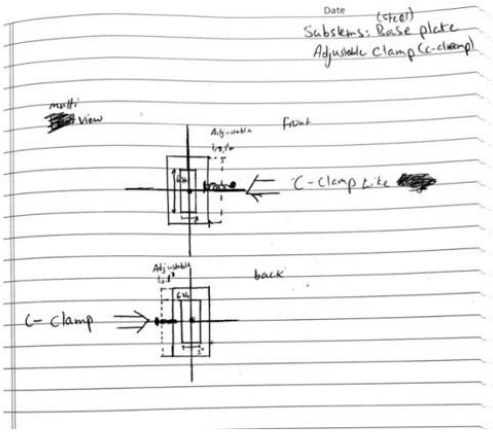


Figure 5: Amrou's Subsystem Designs

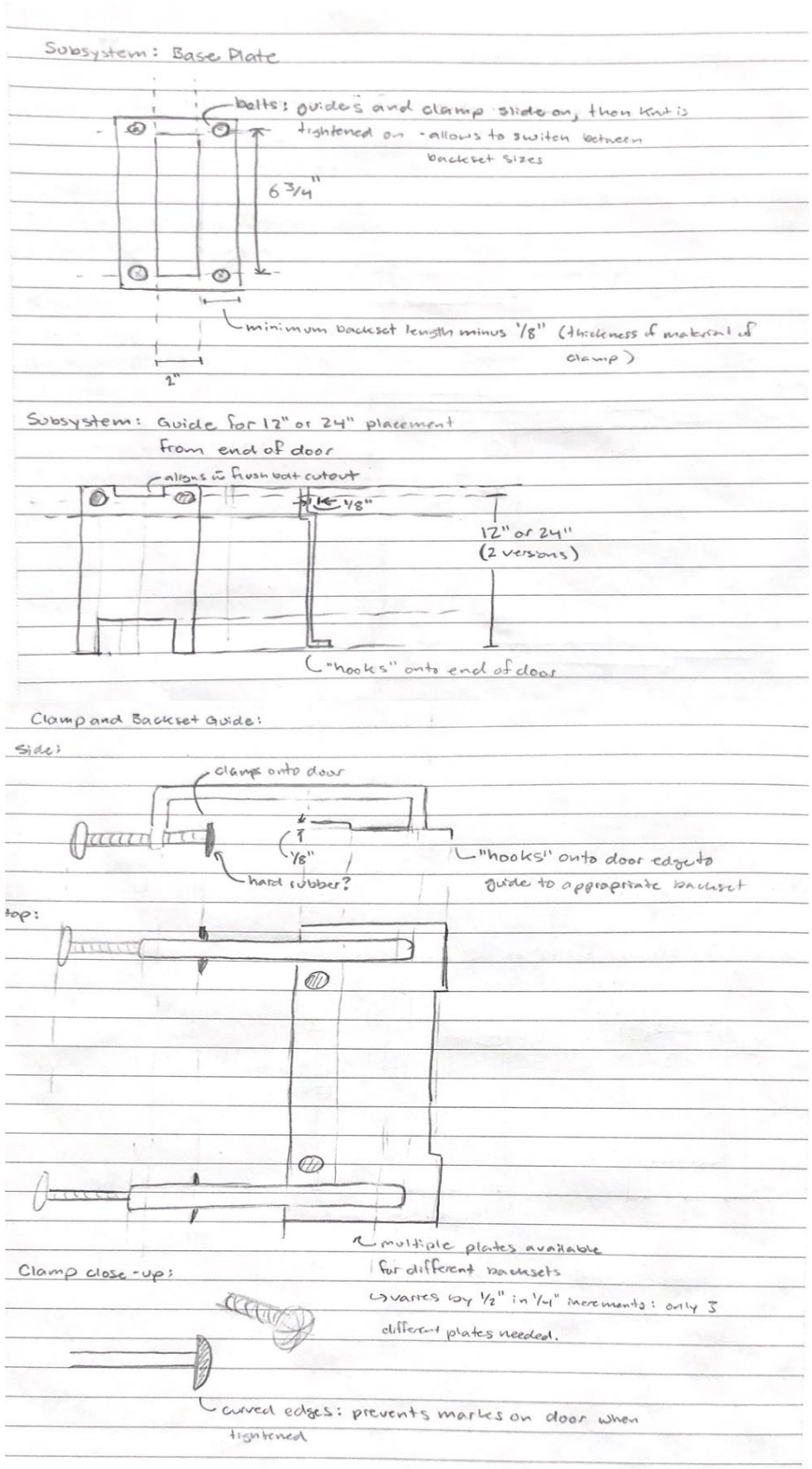


Figure 6: Sam's Subsystem Designs

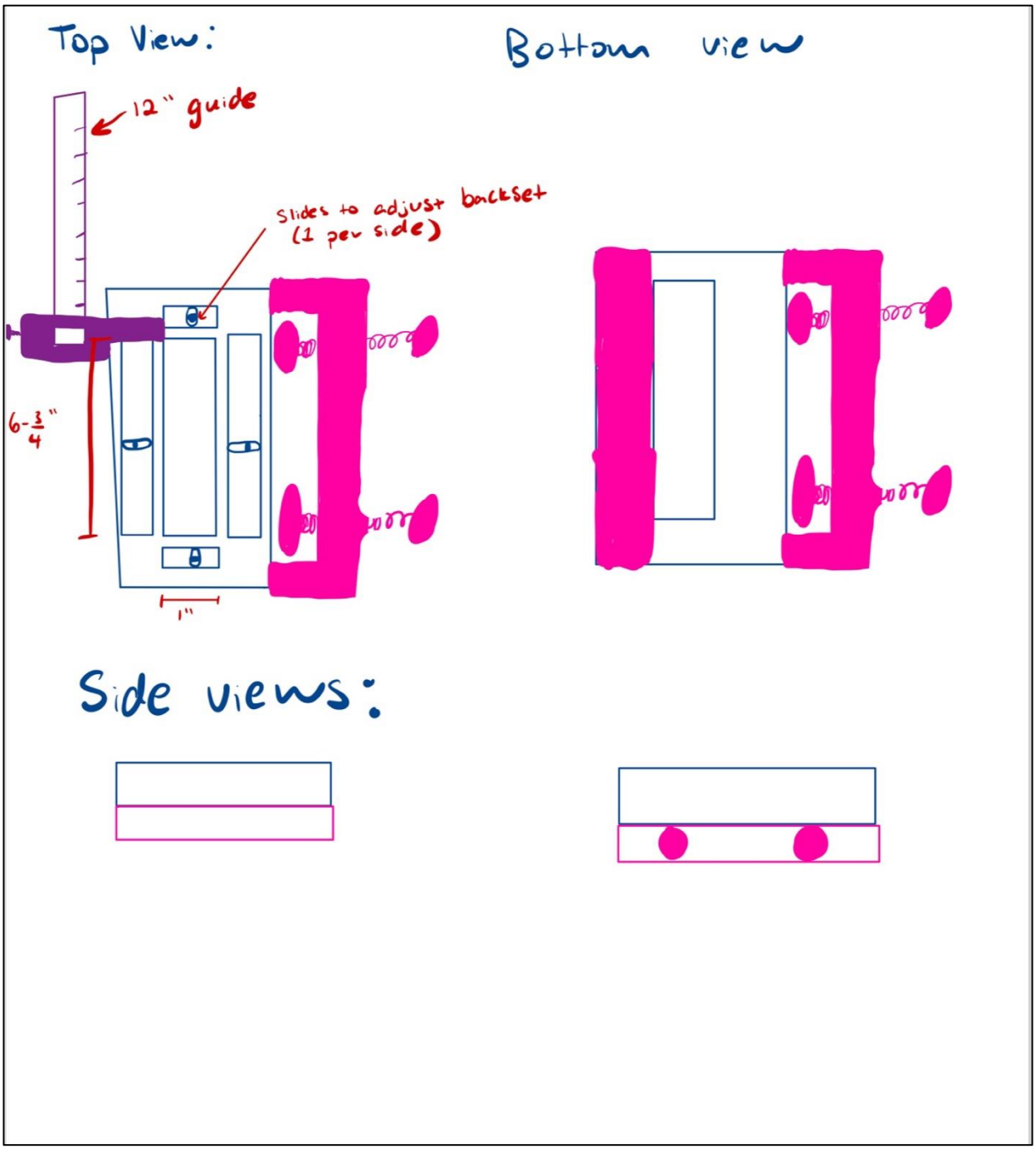


Figure 7: Abby's Subsystem Designs

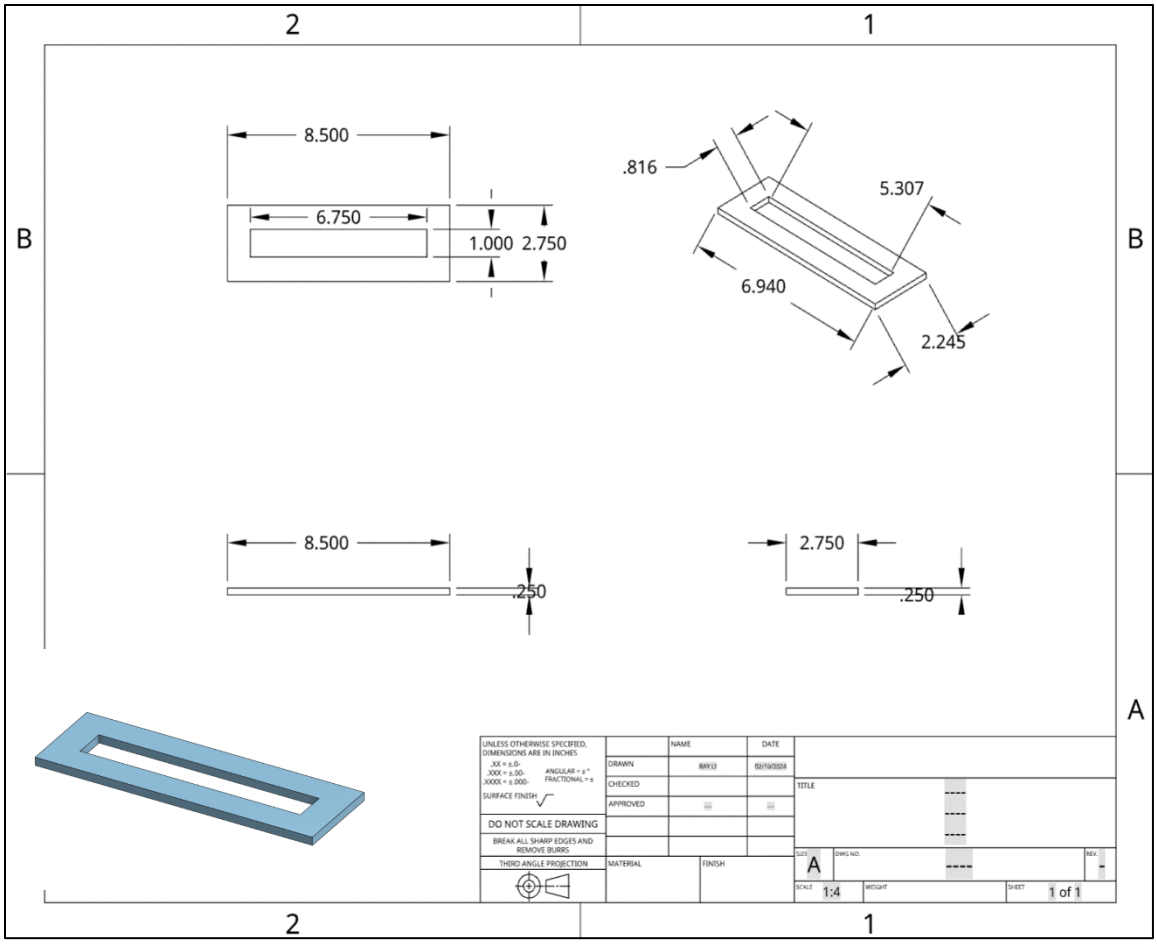


Figure 8: Ray's Baseplate Design

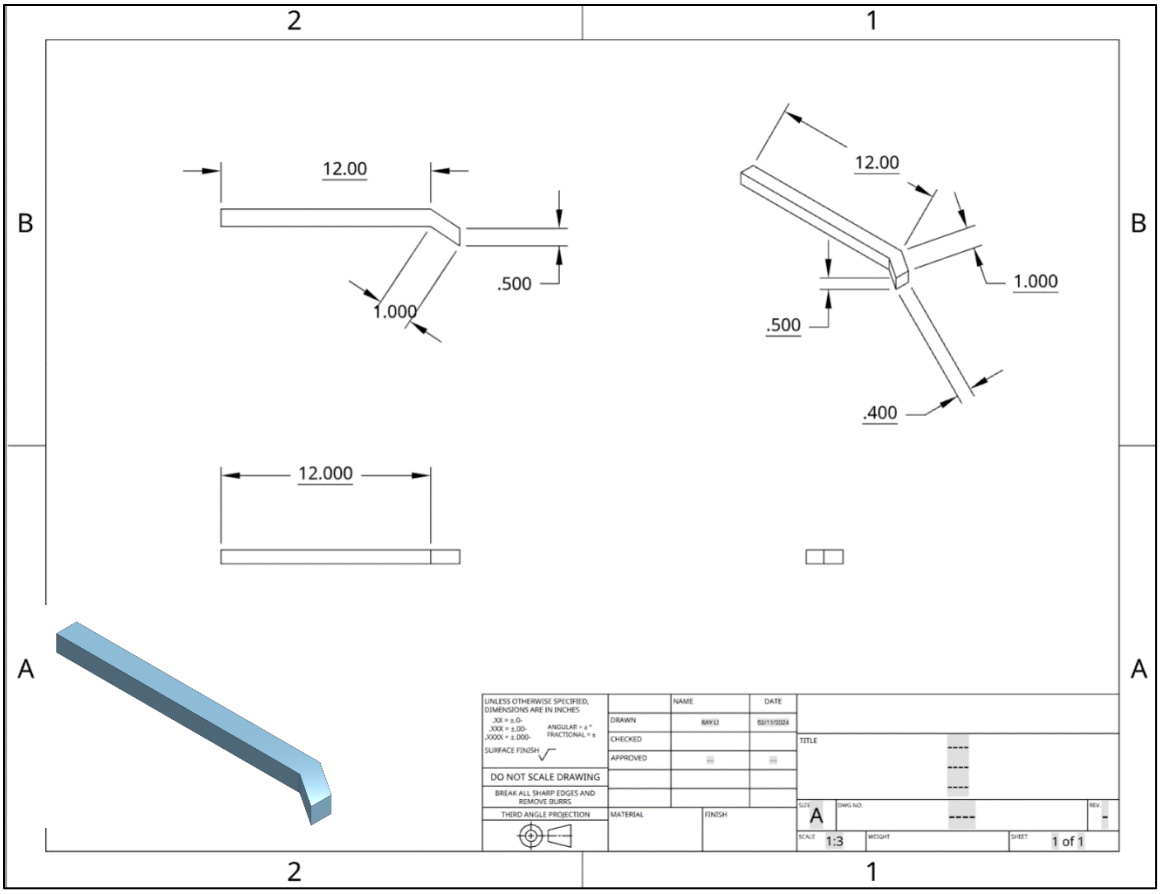


Figure 9: Ray's Guide Design

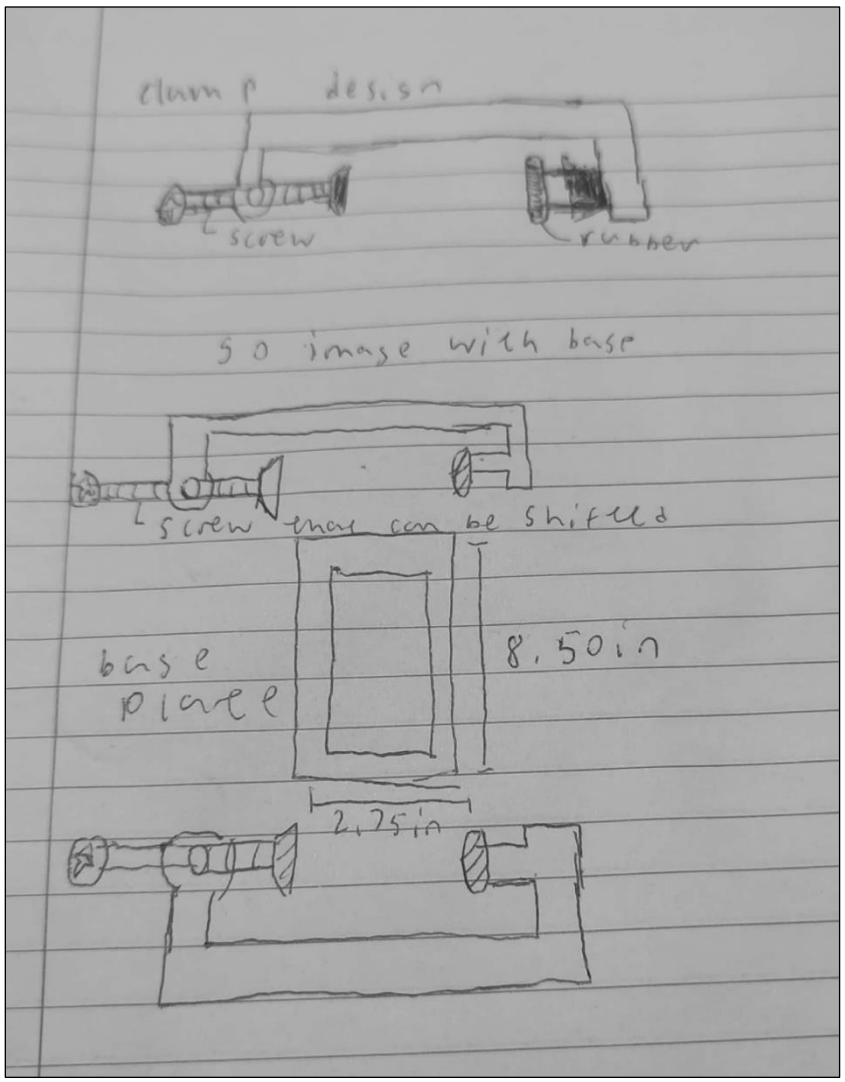


Figure 10: Ray's Clamp Design