Deliverable D: Conceptual Design

Charlie Tourangeau, Maysam Jaber, Nick Mesquita, Rachelle Kim Salazar

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Abstract

This report outlines the process for selecting a door jig design that meets AMBICO's requirements. Following the development of the design criteria, individual designs were proposed and evaluated based on their consistency with these criteria and their potential to meet AMBICO's requirements. After a thorough evaluation, the third global design was chosen as the final design as it ensures both quick setup time and accuracy, which are the main requirements that AMBICO is looking for. While the first and second global designs are functional, they do not meet all the main requirements for AMBICO.

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1. Introduction

The objective of this deliverable is to create a design for the flush bolt door jig, aiming to solve AMBICO's issue of using a door jig that is inefficient and inaccurate. After reviewing the design criteria developed in Deliverable C and conducting benchmarking, each team member is proposing designs for the door jig. The advantages and disadvantages of each design, as well as their subsystems, are being assessed. Based on this assessment, global designs are created by combining all the proposed designs. The specifications of the global designs are outlined and ranked by importance. After evaluating the global designs, a final solution for the AMBICO door jig design is created.

The door jig design includes 3 subsystems: fastening system, cutout attachment, back set adjustment. The function of the fastening system is to securely hold the jig in place on the door, preventing movement while maintaining the correct position. The cutout attachment subsystem is designed to enable precise measurements of the flush bolt. The flush bolts are standardized to the same size, and this attachment is crafted to accommodate that standard size accurately. Finally, the back set adjustment subsystem is utilized to adjust the cutout according to the desired back set, which varies based on the door thickness.

2. Original Subsystem Designs

2.1. Charlie's design concepts

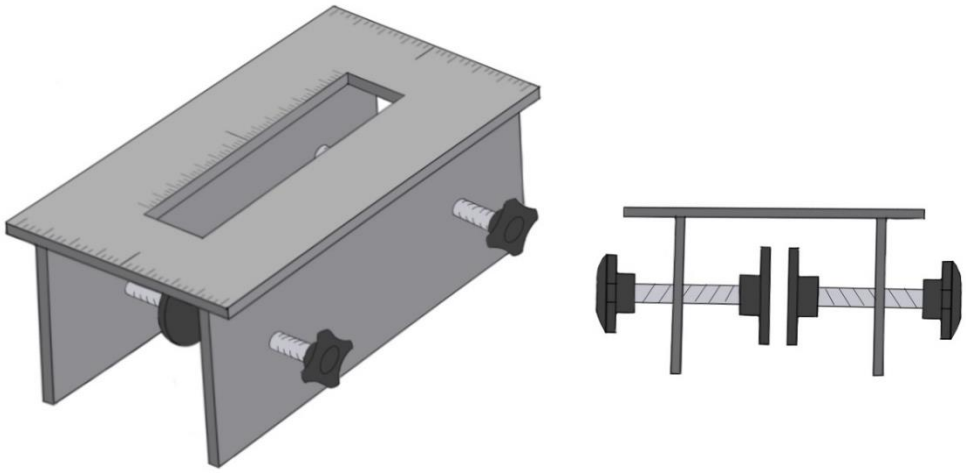

Figure 1: Flush Bolt Jig with Screw Claps and Measurement Indicators

Figure 1 depicts a flush bolt jig with a fixed cutout plate and two sets of screw clams. The fastening system works by pinning the door between the two sets of clams, allowing the jig to fasten to a range of door thicknesses. The cutout attachment is a fixed connection between the top plate and the two side panels that hold the screws. The cutout is centred on the top plate to allow for various back set sizes. Adjusting for different size back sets can be done by centering the jig on the door. The jig can be centred using the sets of screws and aligned with clearly labelled measurement markings on the top plate. This design is simple, making it straightforward to use.

2.2. Kim's design concepts

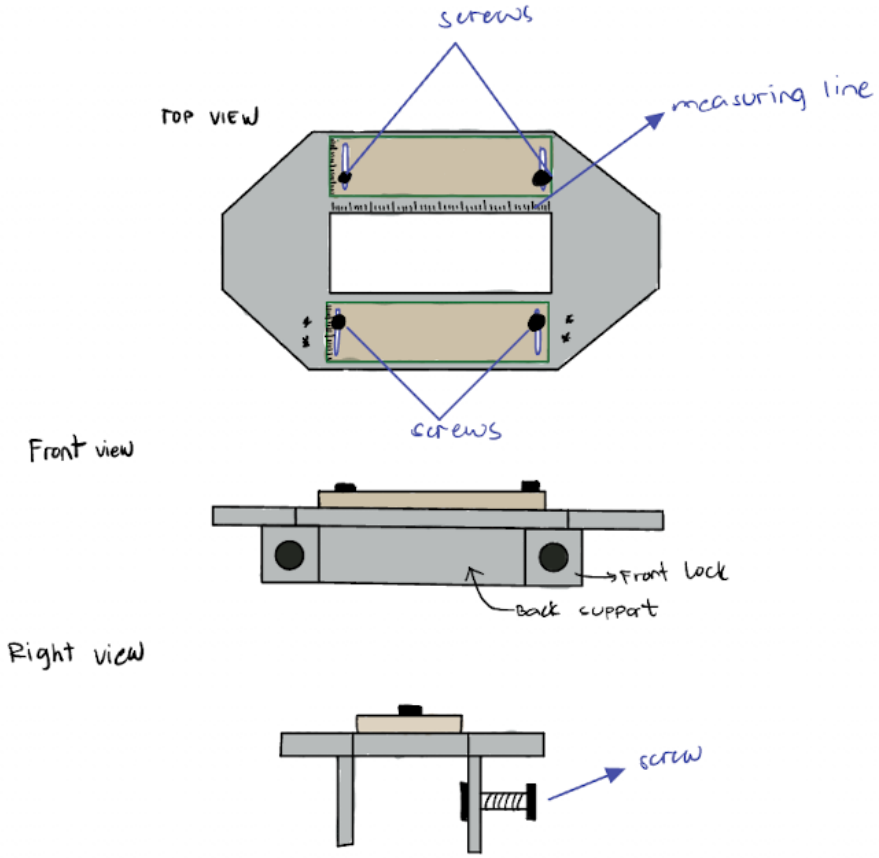

Figure 2: Jig Design Concept Adjustable Back Set with Measuring Line

The jig's suggested design idea is a flexible and scalable instrument with a measuring line to enable accurate adjustments for different back set measurements. This creative jig has an easy-to-use screw clamp function that makes it possible to rigidly attach it to the door edge while cutting the hole for flush bolt. The adjustment mechanism for the back set measurement involves loosening the four screws on the

top to align with the desired measurement, followed by tightening them to secure the chosen setting. The jig's changeable design allows it to be adjusted to various door designs, providing a workable way to get precise and reliable results. The addition of a measuring line improves the accuracy of back set adjustments and simplifies the cutting process in general, making it more effective and user-friendly. Furthermore, the screw clamp feature adds still another level of simplicity, offering solidity and user-friendliness to both DIY enthusiasts and craftsmen. The design is constrained by the fact that the setup time for this jig will exceed 5 minutes due to the manual adjustment required for the back set. This design's subsystem is **screw clamp,** centered on how simple it is to quickly attach the jig onto the door edge. This is accomplished by turning it until it fastens firmly, guaranteeing a strong and dependable fastening.

2.3. Maysam's design concepts

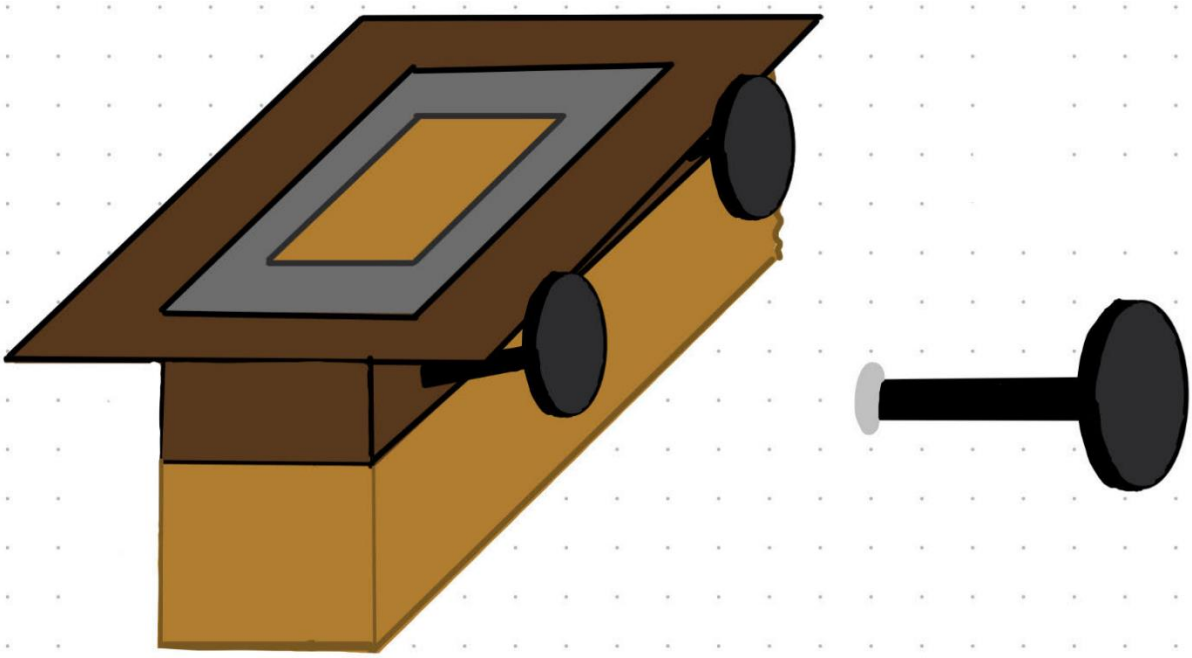

Figure 3. Third Proposed Jig Design

The proposed jig design in Figure 3. features one side that rests against the door and another side with pre-drilled holes for screws. These screws not only secure the jig in place but also enable its use with doors of varying thicknesses. To prevent damage to the door and ensure a secure grip, the screws are equipped with soft ends that provide friction without damaging the door. The jig has changeable inserts to accommodate all back set measurements without needing to measure, making the process faster, more accurate, and more efficient. The highlighted subsystem in this design is the cutout attachment, which enables custom back set measurements without the installer needing to spend time measuring, ensuring accuracy and precision in the process. The issue with this design is that it does not accommodate assorted sizes of cutouts for the back set. Since there would be multiple cutouts required, the proposed design only highlights one cutout, indicating a lack of flexibility to fit various sizes.

2.4. Nick's design concepts

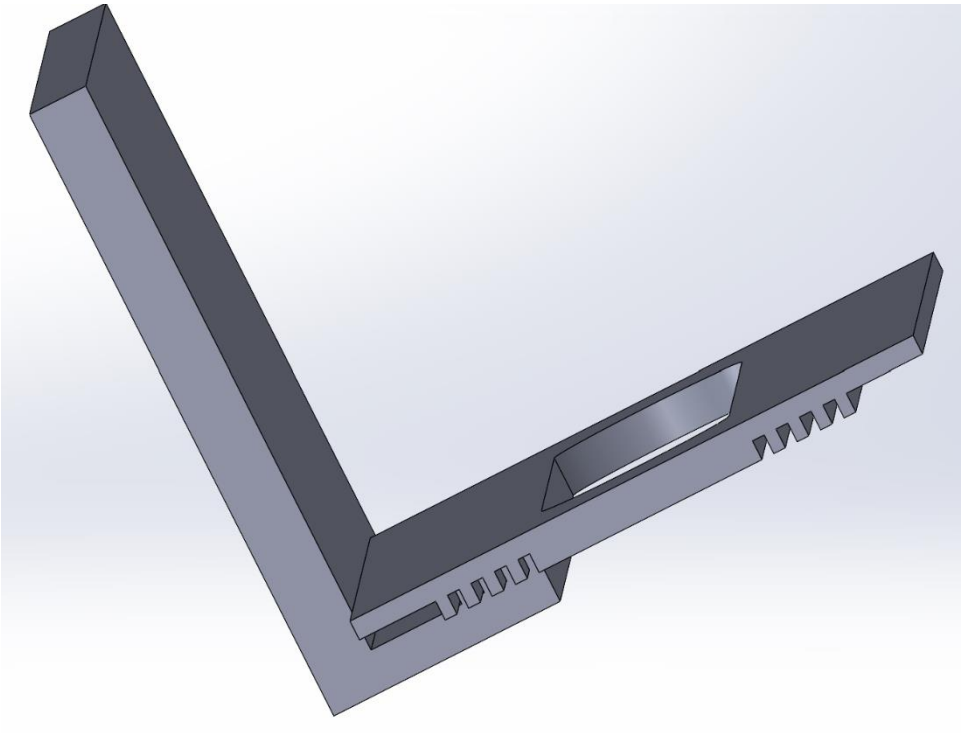

Figure 4

This proposed jig design would use slots in four locations to secure the jig to the door and maintain accuracy. Two sets of slots would be on the main panel, as shown above, with the two pieces that form the side of the jig containing a set of slots each. These slots would be placed 1/8 of an inch from each other on either side, to ensure that the width increases by ¼ inch increments consistently. This design concept values consistency and accuracy very highly, for as long as the parts are in the right slot for the width of the door, the same cutout would be given every time without any fine adjustment.

3. Global Concepts

3.1. First global concept

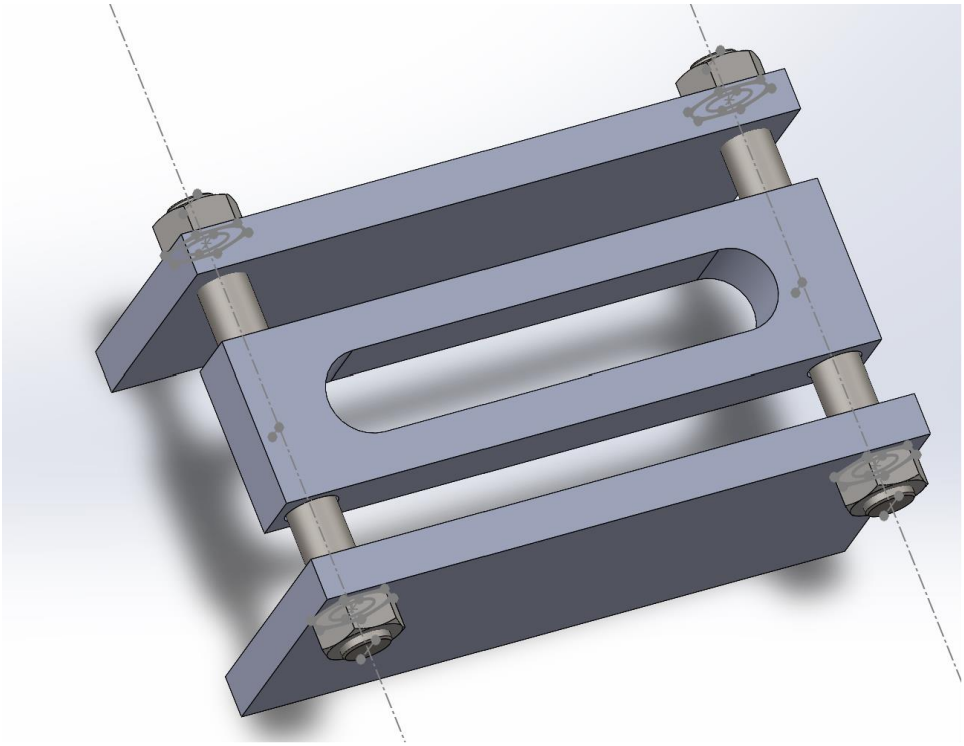

Figure 5: Flush Bolt Jig with Adjustable Rail System

This global concept borrows from a previous version of Kim's design, which instead of using two independently moving plates, uses a plate running on a rail with screw to correctly position the plate. The realized prototype would have measuring lines to ensure proper width and placement of the plate along the track, in addition to a locking mechanism which would allow the plate to stay in place. Some drawbacks of this design include several moving parts, as the more moving parts there are the greater the chance of error, in addition to the introduction of human error given by mismeasurement from the measuring lines.

3.2. Second global concept

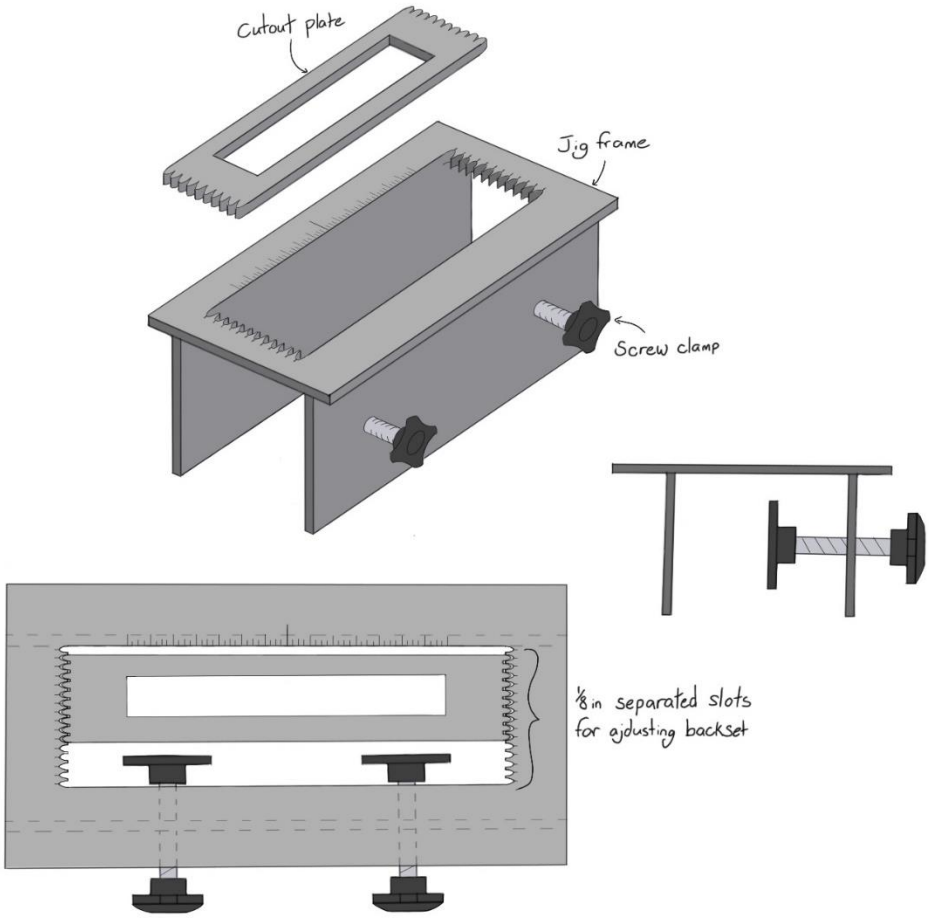

Figure 6: Flush Bolt Jig with Adjustment Slots and Removable Cutout Plate

This global concept incorporates ideas from Kim and Nick's subsystems. Kim's subsystem involves the use of a tightening screw used to secure the jig to the door, which is incorporated into the idea above. Past this, the measurement system the addition of the measuring line allows the user to ensure that their placement of the jig onto the door is precise and consistent. Nick's subsystem involves the use of slots for a consistent and adjustable placement, which has been adapted from a straight-edged slot to a tooth-based slot system. This adjustability is increased by the addition of the routing plate itself being adjustable and removable, increasing the ease of use.

3.3. Third global concept

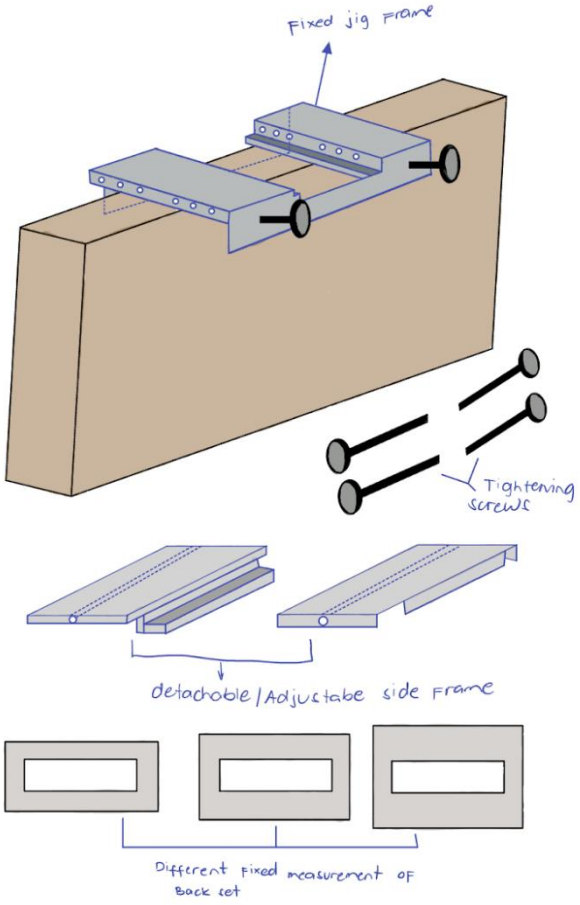

Figure 7: Jig with Adjustable Side Frame and Three Variation Cut Out Back Set Measurement

The innovative concept design of this jig incorporates a fixed jig frame featuring a screw clamp for secure attachment to the door edge, ensuring stability during operations. Complementing this, an adjustable side frame has been integrated to accommodate diverse cut-out sizes with ease. The adjustable side frame operates through a system of strategically placed holes on both the adjustable side frame and the fixed jig frame. Each set of holes corresponds to specific back set measurements, streamlining the process by eliminating the need for manual measurements each time. The tightening screw plays a crucial role in locking the adjustable side frame securely to the fixed frame, ensuring a precise and repeatable setup.

In addition to the adjustable side frame mechanism, this design offers three fixed back set sizes, providing users with a range of options for quicker setup times and enhanced convenience. The incorporation of a variety of fixed back set sizes contributes to the overall efficiency of the jig, catering to different requirements without the need for constant adjustments.

This design approach is rooted in the careful consideration of subsystems, including the screw clamp for attachment, the adjustable side frame with predefined back set measurements, and the availability of three fixed back set sizes. Despite these thoughtful considerations, it was decided not to proceed with this design due to concerns about its assembly complexity and the potential for complications arising from the

numerous parts involved. The decision prioritizes a streamlined and user-friendly design, aiming for simplicity and ease of use in the final product.

3.4. Concept design selection matrix

Specification	Importance	Global Design 1	Global Design 2	Global Design 3
Material	3	Metal	Rubber, Plastic, Metal	Rubber, Metal, Plastic
Simple Design	4	Multiple parts	2 separate parts	Multiple Parts
Measurement Indicator	5	Measurement line along vertical edge.	Ruler line along horizontal and vertical edges. Has set slots	Multiple fixed cut out with different back set measurement
Set up time	5	5 mins max	5 mins max	5 mins maximum
Fastening System	4	Screws/ plate locking system	screw clamps	Screw clamp
Cost	3	Unknown	Unknown	unknown
Total		37	54	41

4. Final Concept

The final design chosen for the flush bolt jig is the second global concept. Its simple design is intuitive and allows for a quick set-up time. Having predetermined slots for the cutout ensures precision and consistency in the placement of the flush bolt for various door thicknesses. The first global concept, although having a simple design, included many moving parts, making it more difficult to achieve precise, consistent measurements. The third global concept provides a similar precision as the second global concept with both designs having predetermined measurements for the different back sets sizes. The third concept contains several separate parts creating a less user-friendly experience. After considering these three global concepts, the second concept proved to align best with the design criteria.

5. Conclusion and Recommendations

The objective of this deliverable was to devise a design for a door jig that addresses AMBICO's problem. After assessing the proposed designs by each team member and comparing their features to the design criteria, a final design was decided upon. The final design chosen was the second global design proposed because, while the first and third global designs had redeeming qualities, they both fell short in terms of setup time. The third design, however, became the preferred choice due to its ability to ensure quick setup time and precision with predetermined cutouts.

6. Future Work

Our future work consists of having a meeting with the client to discuss the proposed design thoroughly. During this meeting, we will address any lingering questions to refine the design further and proceed with making the prototype