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Abstract

Four different designs have been made for this delivery. These four designs are a flat metal sheet made to guide the drill, an adjustable metal sheet with holes for the drill bit adjustable with screws, two metal clamps for each size that slide up and down the door with holes to guide the drill bit, and a metal sheet with a handle for the worker to hold on to.

These four designs were combined to create the final design shown in this document.

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Jig Subsystems

The design for our jig is divided into two main subsystems. These include the structural system and the non-functional system.

Structural System

The structural system analyzes the structure of the design. It will determine what the material will be, what it will look like, describe the overall structure of the design, how will the design work, how will this design take care of the wood, and finally what the drilling structure will look like. It is responsible for determining all the criteria that will allow the worker to do a better and easier work.

Non-functional system

The non-functional system analyzes how will the design help the workers. It will determine how the design will be useful and beneficial for the workers at Ambico, how will the design improve the worker's production times, and the approximate structural life of the design. It is responsible for determining all the benefits this design will bring.

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Design ideas

Jordan's idea

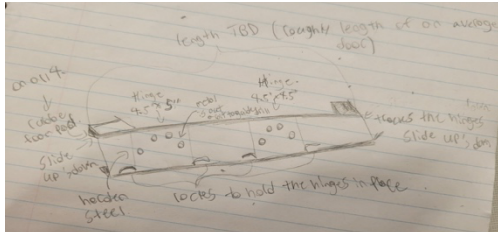


Figure 1 Structure

Structural System

The structure is similar to the operation of a sliding door. The hinges are placed on a track that will allow them to move up and down the jig. This will allow the hinges to be placed in the section they need to be and then there will be locks that will hold them in place. There are clamps on each side that are spring loaded to allow the jig to be clamped to the edge of the door so it will not move. These clamps will have rubber or foam on the bottom (sides in contact with the door) to prevent damage to the door. There will be two sizes of hinges on the jig to avoid the need to change from one to the other. The hinges will also have the holes come out a little about a $\frac{1}{2}$ " to help guide the drill and tapper to eliminate the need to keep the drill perfectly straight, which will allow faster drilling and tapping. This will also eliminate the need for marking.

Non-functional System

This will be useful because it will help speed up the process of preparing the door for the hinges. Marks will be eliminated, as the hinge can be placed exactly where you need it. It will help speed up the threading and drilling process. This will make the time the worker spends on a door faster; with faster preparation time of the hinges, they can produce more doors in a day and therefore increase profits. The service life of the structure will be at least a few years. The only thing that could shorten this time is a misuse of the jig. The first thing that will need to be changed will be the hinges, perhaps because the drill could be hitting the side of the hinge, and this wear could dilate the holes and then that could change the hole pattern over time if the holes grow large enough. But with hardened steel this should be mitigated.

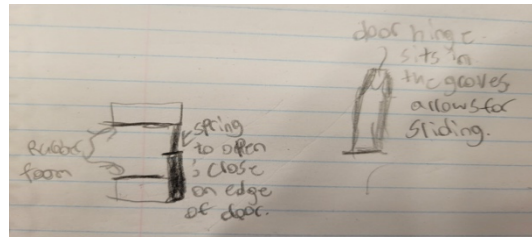


Figure 2 Clamp and Rail

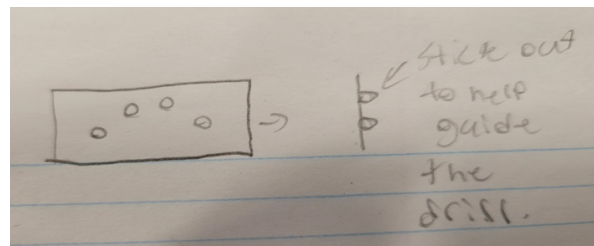


Figure 3 Nozzles

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John's idea

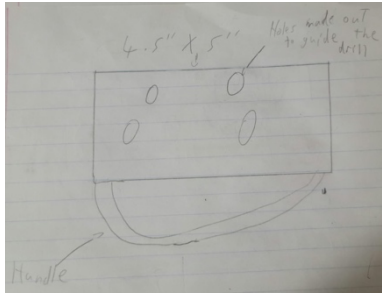


Figure 4 Structure

Structural System

The structure for this is made to be as simple as possible. It consists of two pieces of metal for the two different sizes we are dealing with. There is a handle attached to the metal piece for the worker to hold on to while drilling. The holes are made to guide the drill. The material will be all stainless steel and the handle will be wrapped in plastic to make it easy to hold. Stainless steel is more expensive, but it is better for the longevity of the product.

The device will be easy to use, the worker will hold the device up to the door and drill directly while holding the device. Due to the simplicity of the design, we will have to manufacture two different devices for the two different dimensions needed for different doors. This device can also be used to guide the drill.

Non-functional System

This device should speed up drilling because instead of marking and then drilling, the device will guide the drill, so there will be no need to use two hands to guide it (the worker will hold the device with one hand and the drill with the other). Due to the simplicity of the device and the quality of the material, the device is expected to last for years and remain usable.



Figure 5 Second Dimension

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Ramit's idea

Structural System

Using a simple flat sheet metal, we can build the drilling jig for the drill bit. This device exists as a guide for where to place the marks and drill bits for the hinge installation. The piece will have the specifications of 5" by 4.5" and 4.5" by 4.5". On the face of the sheet metal there will be pre-marked machined holes to guide the drill bit. This jig will be made of sheet metal, probably steel. In this case stainless steel is preferable to carbon steel, as it is more resistant to corrosion. In addition, non-stainless steel introduces the risk of damaging the wood should the steel piece corrode. However, stainless steel will be more expensive to produce. To use it, the operator will place the jig on the drilling surface, hold it in place, and then begin using the pre-marked holes to start the drilling process. Once finished, the jig is easily removed and stored.

Non-functional System

The drill holes will be slightly extruded to accurately guide the drill bit. To simplify the process as much as possible, the jig will only include the markings and holes relevant to the hinge to be installed. This allows the operator to simply select the size required and follow the installation process. It is a simple, non-cluttered design that is highly portable and easy for the operator to use. In addition, the absence of irrelevant markings and dimensions on the jig will reduce the number of operator errors and misplaced hinges. As stainless steel is extremely durable, we can estimate that this tool will last a minimum of 10 years.

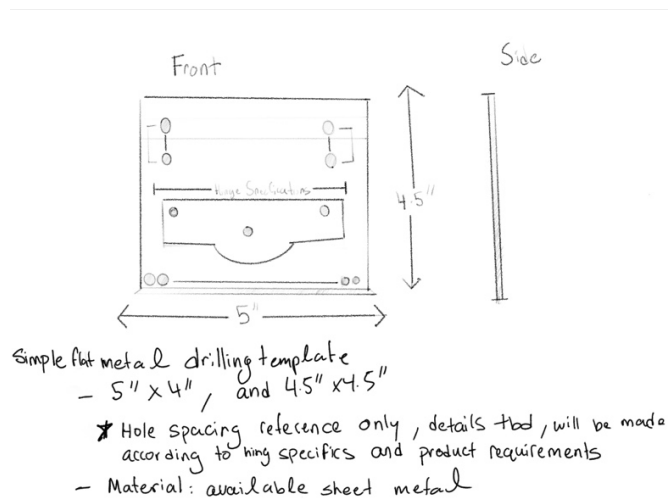


Figure 6 Template

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Nicolas' idea

Structural System

This system is designed to be easy and practical for the worker to use. It is made of a flat sheet metal with a clamp-like structure that will adjust to any backset size without any problem, making it easy for the worker to adjust the jig to different door sizes. The sheet metal will have holes where the drill will be inserted and these holes will help the worker during the drilling and tapping processes, for this, the sheet metal must be thick enough. As it is made for wooden doors, it must have foam on the surface where it contacts the door, that way it would not damage the door at all. At the end of the clamp, we will insert some screws that will keep the clamp static and that it would not move to any side.

Non-functional System

This jig will help workers in the drilling and tapping processes, as it is designed for it because of its holes, allowing workers to reduce the time they spend on each door and allowing a faster overall process for the doors. It will be easy to use because it consists of a jig attached to a clamp, where the worker would not need much knowledge on how to use it. The only limitation of this jig is the wear and tear of the sheet metal due to the drilling process.

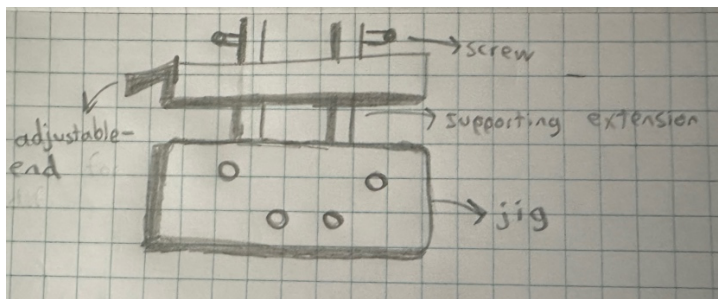


Figure 7 Upper View

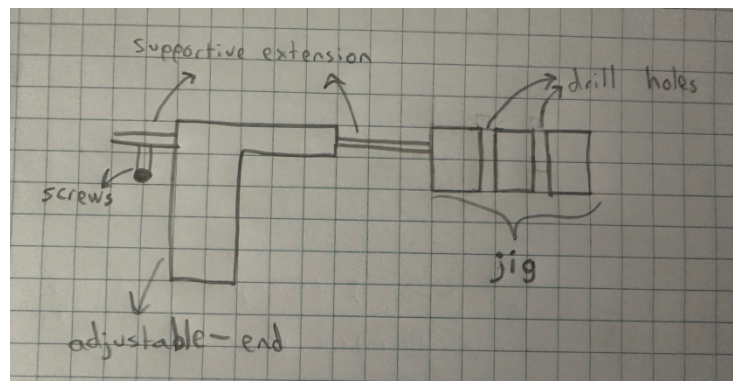


Figure 8 Side View

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Evaluation of Subsystem Designs

From the proposed designs, we evaluate each design based on certain criteria that will make the system more efficient for the client.

Table 1 Design Criteria

Design Criteria	1st solution Jordan's idea	2nd solution John's idea	3rd solution Ramit's idea	4th solution Nicolas' idea	Priority weight
Safety	satisfied	satisfied	satisfied	satisfied	6
Efficiency	well-handled	fit basic	satisfied	satisfied	5
Budget	fit basic	well-handled	well-handled	fit basic	2
Easy to use	satisfied	satisfied	fit basic	well-handled	4
Easy to make	fit basic	satisfied	fit basic	satisfied	2
Service life	well-handled	satisfied	well-handled	well-handled	3
Total Score	56	43	48	56	-

Table 2 Weight Indicator

weight indicator	
well-handled	x 4
satisfied	x 2
fit basic	x 1

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Final Proposed Design

After combining all the subsystems proposed by each of the group members, we have arrived at a final design that meets all the necessary criteria for perfect operation.

Structural System

The final jig structure is a combination of a few different ideas given by the group to make the best possible jig. It was decided that the structure will be a U-shaped clamp that can be attached to the door with a rubber band mechanism to keep the clamp in pressure with the door frame.

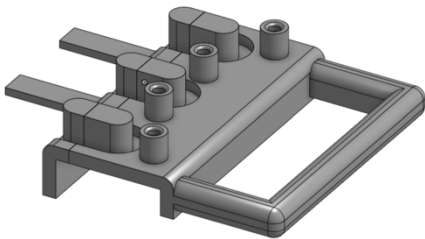


Figure 9 Closed Upper View

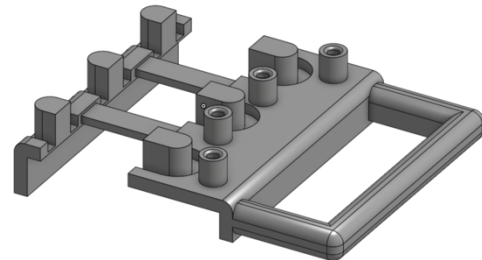


Figure 10 Open Upper View

To pull the U-shaped clamp, a handle will be included for the jig user to simply hook one side into the door and pull with one hand to secure the clamp to the door.

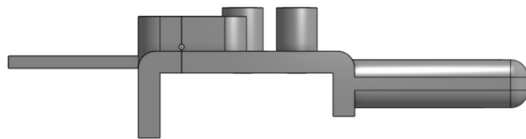


Figure 11 Closed Side View

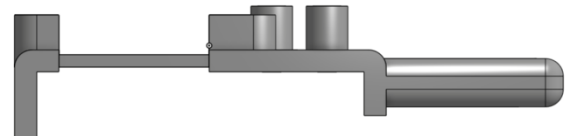


Figure 12 Open Side View

At the top of the clamping device are drilled holes with extended guides for the drill bit. This guide will help the worker to keep the drill straight and make it able to align with the desired point easily and quickly on the door frame.

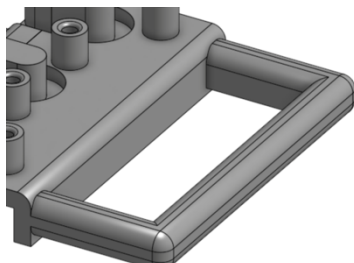
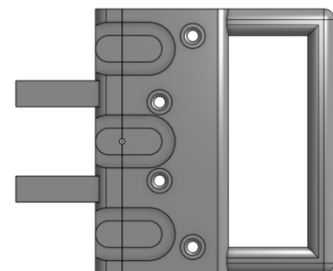


Figure 13 U-Shaped Clamp



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This design is primarily made of steel due to its strength and ease of use and the cost effectiveness and availability of the material. Also, for the two different types of hole patterns there will be two separate jigs in order to reduce complexity in the design so that the design will have a longer useable life.

Figure 14 Upper View for the U-Shaped Clamp

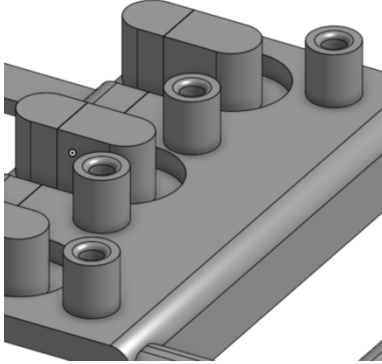


Figure 15 Extended Guides

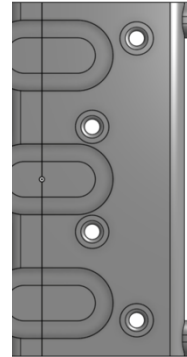


Figure 16 Drilled Holes

Non-functional System

This jig will be useful and beneficial to workers because it will save them time, as it now takes an estimated 30 minutes per door to drill all the holes. Workers will easily understand the jig and will be able to use it without training, which means they are more likely to use the device. This means that because the jig will save time per door, the factory will be able to produce more doors, which will make the company more money overall and amortize any lower costs this jig may have. This jig is designed to be simple and have no unnecessary moving parts, which means life cycle is a priority. The complexity of the designs often causes them to fail over time, but due to the simplicity of this jig, it will most likely have a very long lifespan.

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Reflection

In conclusion, the idea that we decided would be the best fit for our client. This is a mix of the ideas we came up with during our brainstorming sessions. It will have the nozzles to help guide the drill, it will have an adjustable clamp, and it will have a handle to help move the jig hinge into place before attaching it. After our next customer meeting, we will further refine the design based on customer feedback and continue to improve our jig until we meet their needs.