Project Deliverable D- Conceptual Design

GNG1103 - Engineering Design

Faculty of Engineering - University of Ottawa

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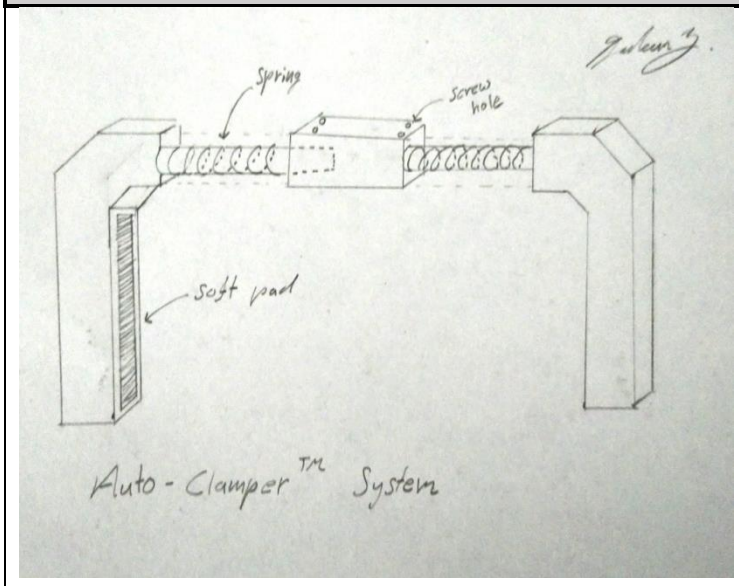
1. Introduction:

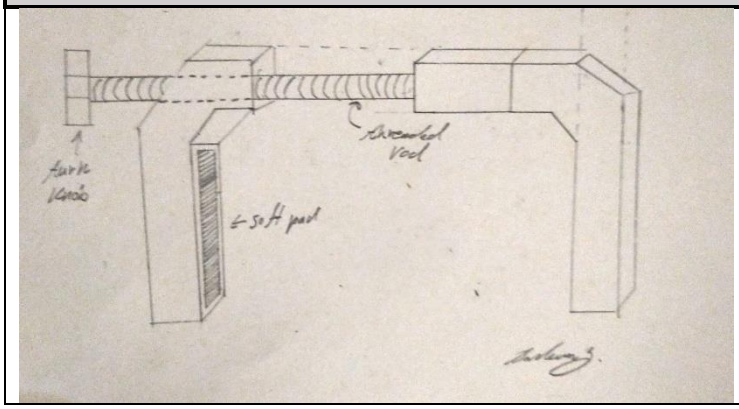
For a jig that is intended to precisely and accurately provide a location of cutout and assist in the creation of the cutout; there are many components that should be taken into consideration. Components include: the clamping system, the platform, the guide plates, and handling/carrying system. The creation of this jig involves the dividing of subsystems, assignment of said systems to members for development, and the creation of the final concept design.

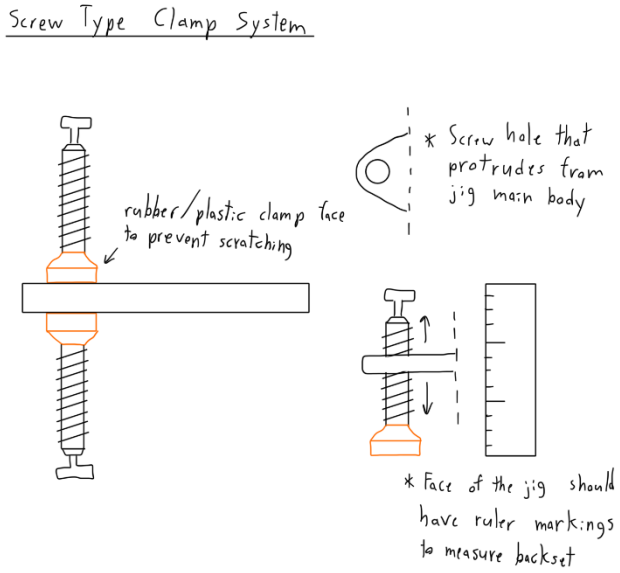
2. Subsystems:

2.1. Clamping and Surface Mount System:

The clamping and surface mount system is an essential component for the jig, it provides the jig the ability to stick to the door side. This component should not damage the frame and should provide a strong connection between the jig and the doorframe. The clamping should have a connection interface to the platform of the jig and should have a varying clamp extension.

Clamping System Design 1:	Pros:	Cons:
	The spring-based clamping allows for an auto clamp system, where manual screw clamping is not needed. This allows for greater simplicity. The soft pad will prevent any damage to the sides of the door. Due to the spring-based clamping, over tightening is no longer a possible issue. Over tightening with the screw clamp could damage the wood.	The spring-based clamping adds complexity to the design. Due to the involvement of the spring, the elasticity could degrade over time. Jeopardizing the longevity. If the spring constant is too high, stretching/opening the clamp could be too hard, or if the constant is too low the clamp is not tight. This complicates the choice of springs.

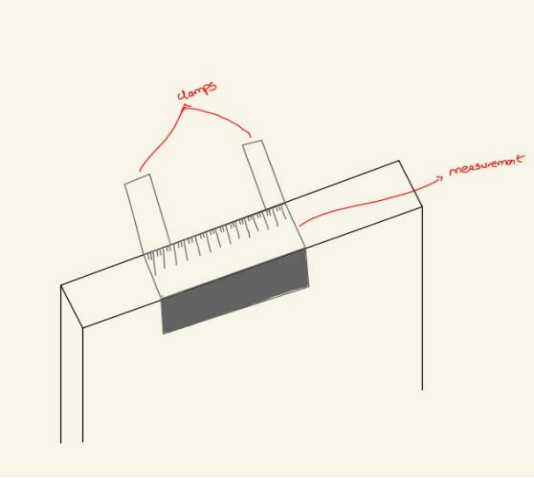
Clamping System Design 2:	Pros:	Cons:
	The screw-based clamping is a simple design, easy to implement. The soft pad creates protection for the wood against any potential damage by clamps. Due to simple design, the longevity will be enhanced	With this design, over clamping could be an issue. If someone were to over tighten it could damage the wood, even with soft pad. The screw-based design requires manual turning, increasing time of jig set up.

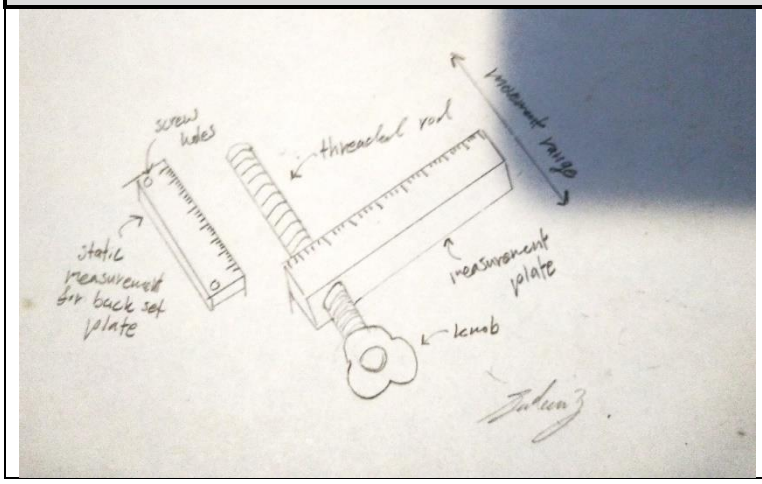
Clamping System Design 3:	Pros:	Cons:
	The screws can remain in place while cutting is being performed. A rubber or soft plastic clamp face prevents scratching the wood. The screw design makes precision adjustments of both sides easy. Simple design; can be made using commercially available parts.	Screwing the clamps shut may take more time and effort. Overturning the screws may still result in damaging or scuffing the wood. Screw threads may wear out over time. Threaded rod is difficult to build, purchasing parts is required.

2.2. The Guide Plates with Measurements

The guide plate subsystem is an important part of the jig. It ensures that the jig is help securely to the door and that measurements can be accurately taken without the jig shifting. The guide plate should not cause damage to the door and should enable the jig to be attached to the door easily.

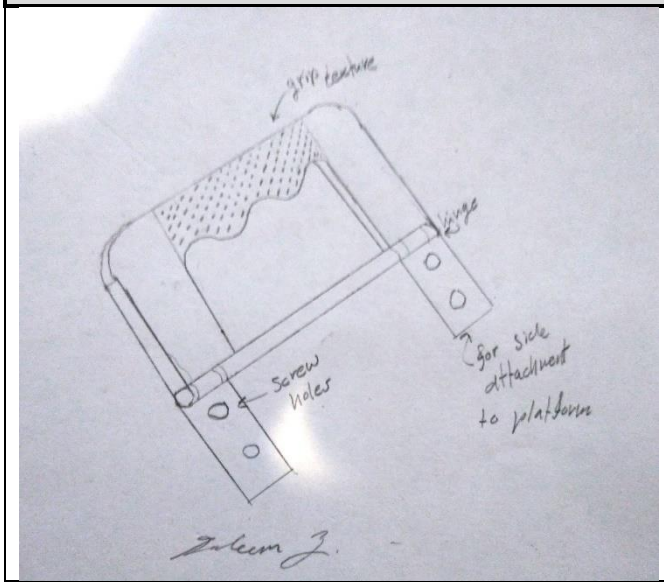
Guide plate design 1:	Pros:	Cons:

	The measurements are built in so accurate measurements can be taken for each door conveniently. Instead of using a separate tool for measurements so this jig would save time	Make take a couple of tries for workers to use tool correctly and save time Measurements may fade off or become difficult to read over time.

Guide plate design 2:	Pros:	Cons:
	Plate are of simple design and easy execution. The threaded rod allows for movability to adjust the back set based on the static plate's measurements.	Measurements could fade over time and become unusable. Threaded rod adds bulkiness to the jig, increasing weight.

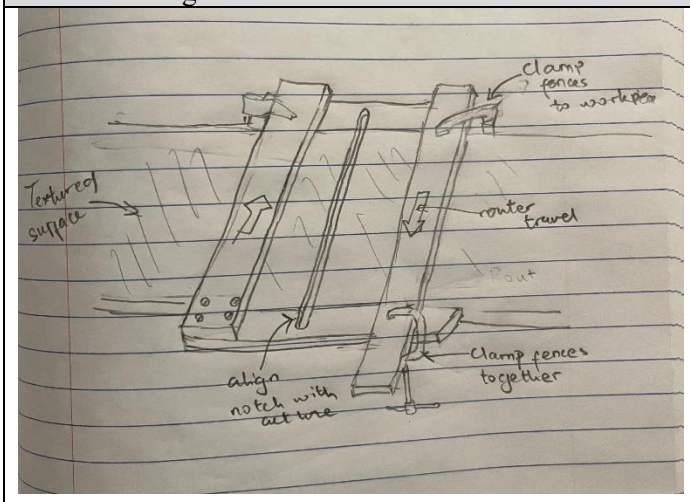
2.3. The Handling/Carrying Functionality:

For easy carrying and transporting, having a handle or some way of hanging the tool to store it later is a function that should be present. The handle should feel comfortable and practical, it should not be too smooth to allow slipping. A hinge should be part of the design to make the handle movable; it makes it convenient in cases where the handle is in the way.

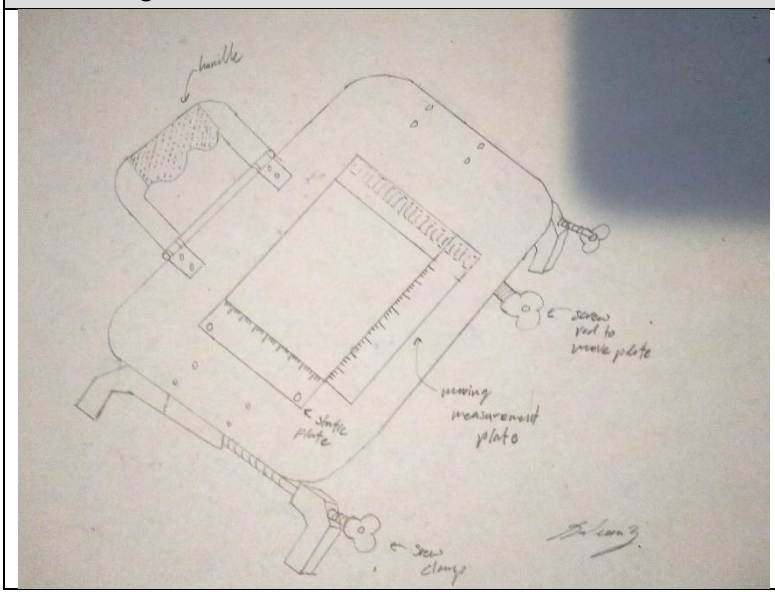
Handling/Carrying Design 1:	Pros:	Cons:
	The grip texture of the handle ensures that there would be no slipping while carrying the jig. The hinge adds movability to the handle, making it so that the handle can be moved away if it is in the way. The grooves in the handle add an ergonomic aspect, which makes carrying the jig more comfortable.	Grip texture adds complexity to the design, could require too much time to design for too little effect. The grooves in the handle also add complexity to the design. Implementing this design could be costly in terms of time. Due to the complexity of the design, the handle would have to be 3D printed. This could affect the longevity.

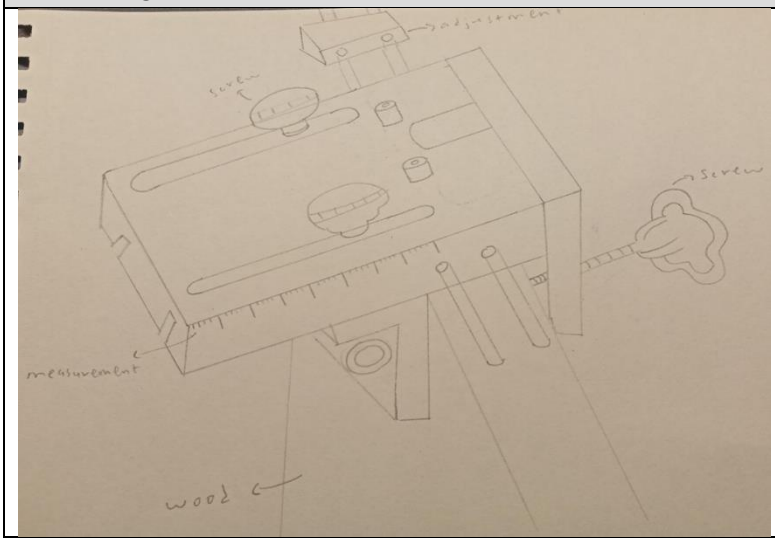
2.4. The Platform

The platform subsystem of the flush bolt cutout routing jig serves as the foundation for supporting the door during the routing process. This conceptual design focuses on providing stability, adjustability, and compatibility with various door sizes and styles.

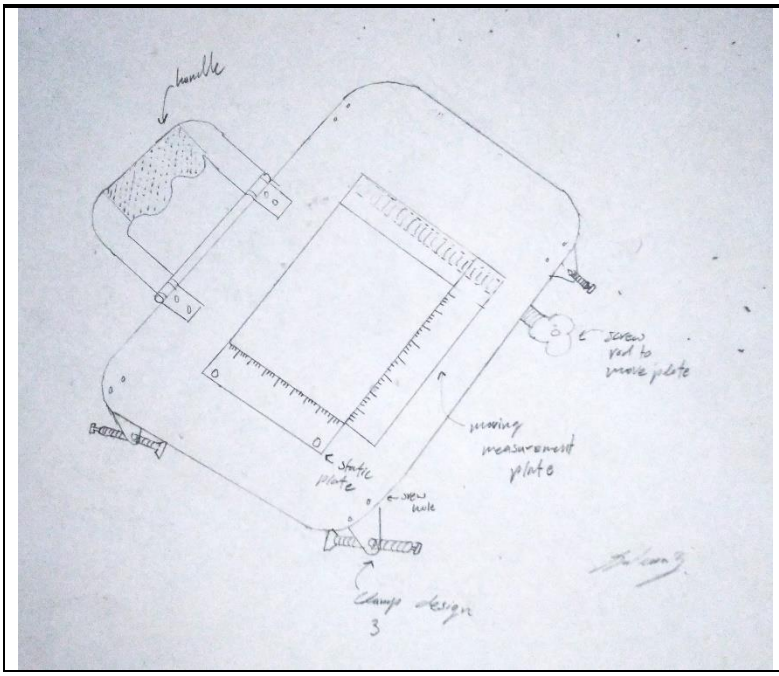
Platform Design 1	Pros:	Cons:
	Adjustable clamping mechanism accommodates doors of different sizes and thicknesses Integrated levelling system facilitates quick and easy alignment of the door for precise routing Provides stable support for door during routing process, ensuring accuracy	Manual adjustment of clamping and height mechanisms may require additional time and effort Over-tightening of clamps could potentially damage the door surface. Requires periodic maintenance

3. Final Designs

Final Design 1:	Pros:	Cons:
	The final build has an adjustable back set that allows for a variety of doors to be fitted. The handle is texturized for better grip. Handle allows for easy gripping and storage.	Bulky frame and clamps; may have issues with weight.

Final Design 2:	Pros:	Cons:
	Rests firmly on the door; no risk of movement. Adjustable for doors of varying widths.	Bulky and difficult to carry. All metal design means increased weight. Complicated appearance (difficult to learn to use). Has a very limited width range.

Final Design 3:	Pros:	Cons:

	Adjustable screw clamps on both sides allow for fine precision. Moveable measuring plate for small hand adjustments. Easy to carry and store with handle. Minimizes risk of scratching wood surface.	Number of moving parts may affect precision. Use of screws may slow down setup. Commerical parts may be needed (cost issue).

4. Analysis using Decision Matrix

Specs/Jig	Weight	Final Design 1	Final Design 2	Final Design 3
Potential Cost:	5	Moderate-High	High due to all metal material	Moderate
Adjustability:	4	Has adjustable back set that allows for different measurements of back set for any doors. Uses threaded rod guide plates.	Very little adjustability, a set measurement for back set. Only adjustable to fit on different width doors	Has adjustable back set that allows for different measurements of back set for any doors. Uses threaded rod guide plates.
Practicality:	3	Easy to use, surface mounted. Has built-in clamps for convenience. Is bulky due to clamp design. Has soft pad on clamp to reduce damage to wood.	Easy to use. Is surface mounted onto the door, however, it needs to screw into the door; damaging it in the process.	Easy to use, surface mounted. Has built-in clamps for convenience. Uses clamp design that lowers bulkiness and is of higher convenience. Uses rubber stoppers at the ends of each clamp to minimize any damage
Accuracy:	5	Accuracy is high due to the adjustability and built in measurements on the guide plates.	The jig has a predefined and set in stone cut out. Due to the lack of adjustability, this jig becomes inaccurate as soon as different door widths are introduced.	Accuracy is high due to the adjustability and built in measurements on the guide plates.
Material:	3	Metal + Plastic	All Metal	Metal + Plastic
Potential Weight:	2	Heavier compared to option 3, again due to bulky clamp design. Lighter than option 2 due to plastic+metal combination	Heavier compared to all other designs due to proposed all metal design.	Lightest due to simplified clamp design and metal+plastic material combination.
Has Clamps:	3	Yes	No, uses screw mount	Yes
Total:		62	31	72

5. Conclusion

The chosen global design based on the decision matrix would be Final Design 3 with a final score of 72 compared to Design 1 with a final score of 62; and Design 2 with a final score of 31. It is the least bulky of all three designs, has decent adjustability, and minimizes the risk of damage to the door.

In conclusion, our team embarked on a comprehensive design journey, fueled by a deep understanding of our problem statement, priorities, and client needs. We meticulously dissected the requirements and identified four critical subsystems: the clamping system, the platform, the guide plates, and the handling/carrying system. Each team member brought forth innovative ideas, honing in on the unique features and functionalities within their respective subsystems. Through collaborative discussions and refinement, we combined the most promising elements from each concept into our final design. This process enabled us to craft a conceptual design that seamlessly integrates precision, durability, and ease of use. As a result, we are confident that our jig design meets the expectations of our clients.