

DESIGN AND FABRICATION OF MULTI-PURPOSE COFFEE**TABLE**

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ABSTRACT

A coffee table is an essential piece of furniture in modern homes. It is intended to hold beverages, remote controls, storage, displays, etc. Coffee tables come in different shapes and sizes. However, not all tables save space, especially in small houses like apartments and tiny homes. Therefore, many resorts to not having tables at all which then resulted in a messy and disorganized environment. One of the possible solutions is producing a multi-purpose coffee table with more storage and minimized spaces. A survey has been done to evaluate the customers' need for a coffee table. The questionnaires which consist of criteria, problems and demands were given to 19 correspondents with different ages, and gender. The data has been analyzed and discussed. From the study, a design of coffee table was produced with Solid Work application and materials used; plywood, screws, ball bearing slide and self-locking hinge are used to fabricate the design. In conclusion, the product produced fits the criteria of customers' demand and a few recommendations are included for better usage.

Keywords: coffee table, space, design

1. INTRODUCTION

One of the most common problems that people face is figuring out how to organize furniture in a house with limited space, particularly in small houses. A simple yet functional piece of furniture is designed to help with this. Furniture that assists in daily life includes chairs, sofas, and tables. Furniture can be made from a variety of woods, many of which reflect the culture of the region. Nowadays, the most common design is to provide multi-function furniture that meets the needs of each consumer. For example, a sofa bed is intended to provide additional bed space for people, particularly those who live in small apartments. Furthermore, sofas with storage space are intended to provide additional storage space for more organized homes. Multi-function furniture indicates pieces of furniture that adjust with different applications by transforming spatial relationships of their pieces. To maximize small spaces, multi-function items like foldable, stackable, and hide-able furniture are more preferred choices. One approach designer came up with to save space, initially without the use of mechanisms, was to create furniture that could stack on top of one another. By 1963, Robin Day had created the world's most famous stacking chair for a firm called S. Hille & Co. It was manufactured using polypropylene through the injection moulding process, hence its popular name "polyprop" [1].

Multifunctional transformable furniture that fits apartments is another solution to small spaces. Built-ins on the walls are furniture for these types of solutions. A multi-functional coffee table saves space. The space-saving furniture solves a variety of problems while fitting into the available space. These days, multi-purpose coffee tables are becoming more popular. Multi-purpose coffee tables with extra storage space are prominent among consumers due to the convenience provided. A multifunctional coffee table that serves different

functions as well as minimize space is a deal breaker.

This study will introduce stow-away furniture research. It focuses on hide able furniture with the goal of providing readers with an authoritative source of information on the origins, evolution, and current trends in this industry. Stow-away can take place in variety of ways, depending on few factors; method of stow-away, manufacturing restrictions and use in which each factor have effects on the materials, fabrication and mechanisms that well suit for any occasion and necessity. Besides, prototypes will be created to extract information on the manufacturing process and assembly, which will be displayed in a picture gallery. Through this research, the reader will have a better understanding of stow-away furniture. In the late 16th and 17th century, Italian cabinet makers popularized a blanket chest that contain a hidden compartment used to hid secret documents from prying eyes. Coffee tables in the early 20th century were typically very narrow, in contrast to the more popular, wider models of tables seen today [2]. Most furniture has a secret compartment to protect one's most valuable possession against thieves, for instance, secret safe, hidden cabinet and false bottom drawer.

The study of hide-able furniture begins with the introduction of stow-away furniture in people's life and the efficient role the play from the first secrete piece of furniture to today's remarkable ergonomic solutions for space saving. Furthermore, this research hopes to demonstrate different types of concealed furniture that suit different areas and purposes. Hide-able furniture serves multiple functions and is extremely useful to have at home. With the current fast-paced lifestyle that is overburdened with busyness and activity, most people prefer to live in a smaller house or apartment. This reduces the burden of cleaning and managing the space but raises concerns for a more modern and multifunctional design in home furniture. The goal of hide-able furniture is to increase space efficiency. Secrete furniture should be able to expand or contract based on needs, serve two functions at once, or seamlessly transition from one function to another.

2. RESEARCH METHODOLOGY

The methodology of this study is divided into two parts. The first step is to design a multifunctional coffee table. It started with concept generation and evaluation (morphological chart and Pugh chart), CAD design using SolidWorks. In recent work, focus on Computer-Aided Design (CAD) developed by SolidWorks as a tool to visualize the outcomes of the intended product before continuing with the product fabrication. This method is advantageous in terms of generating novel concepts and able to represent a wide range of concepts which allows the unexpected matching of components to be considered [3]. The second step is to fabricate the product. Figure 1 shows the flowchart of design process while Figure 2 shows flowchart of fabrication process respectively.

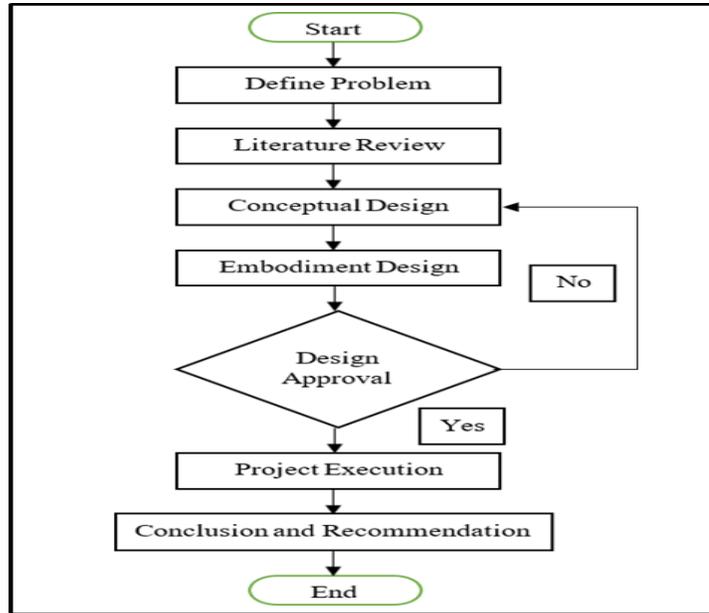


Figure 1: Design Process Flowchart

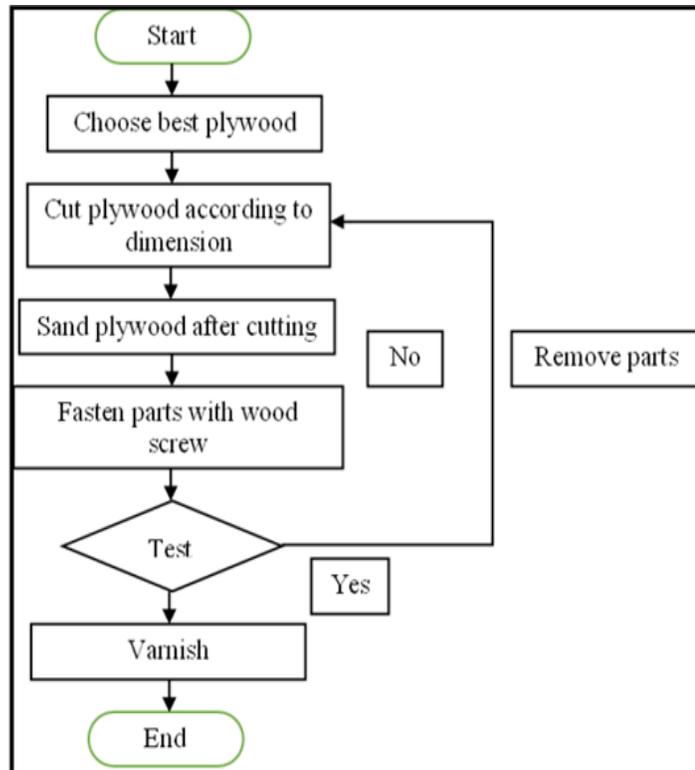


Figure 2: Fabrication Process Flowchart

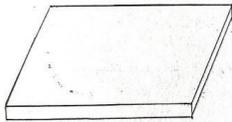
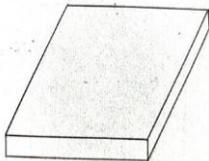
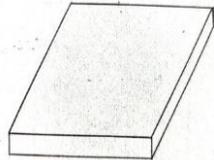
3. RESULT AND DISCUSSION

3.1 Design Process

The design process starts with the progress of concept of a product using morphological tables. The morphological table will include a complete list of drawing concepts applicable to each function. Three different designs are sketched on A4 paper. Then, from there the final design will be produced. A detailed description of the sketch is written to identify the design’s weakness and strengths. Furthermore, the description must include materials that will be used in each design. Concept’s endurance should be examined then, after each design is evaluated, the most appropriate design will be chosen. However, when choosing the best design, all aspects must be considered. A morphological chart can be used to investigate various methods and combinations of obtaining a functionality and to visually represent the functionality that a product must have. There may be several options for dealing with each component of a product’s function. Table 1 shows the morphological chart of this project.

Concept selection is the method used to determine the most suitable concept that follows all the specifications given in the decision-making criteria before proceed to the design stage process that allows a reduction to cost and time implication [4][5]. According to Augustine et al. [6], the right selection of design concepts will eliminate the cost of redesign of the final product and escalate the productivity in the project development process. This researcher has listed the possibility of multicriteria decisions to aid concept selection namely as Quality Function Deployment (QFD), Analytic Hierarchy Process (AHP), Pugh Matrix, multi-criteria optimization, and fuzzy logic methods. In this paper, Pugh Matrix or also known as Pugh Chart is selected as a systematic approach in selecting the best design from the three proposed design concepts.

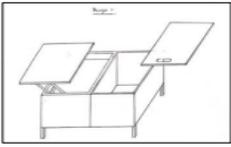
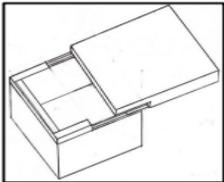
Table 1: Morphological Chart

Sub-function	Option Solution		
	1	2	3
Design tabletop	<p>Rectangle</p>  <ul style="list-style-type: none"> - Longer and wider - Large surface area - Holds up more objects. - Takes up more space as bigger in space 	<p>Square</p>  <ul style="list-style-type: none"> -Compatible with mostly Anything -Accessible from all sides -Takes up little space if small 	<p>Square</p>  <ul style="list-style-type: none"> -Compatible with mostly Anything -Accessible from all sides -Takes up little space if small

Material	<p>Acrylic</p>  <ul style="list-style-type: none"> - Easy to clean. - Goes well with any color coordination - Will not damage when exposed to water 	<p>Acrylic</p>  <ul style="list-style-type: none"> - Easy to clean. - Goes well with any color coordination - Will not damage when exposed to water 	<p>Wooden</p>  <ul style="list-style-type: none"> - Offer more traditional and rustic look - Durable and stiff - Susceptible to water
Storage	In table only	In table only	In table only
Chair	-	stool	-
Lift top table mechanism	<p>Steel hinge</p>  <ul style="list-style-type: none"> - Strong - Takes longer time to loosen 	<p>wooden hinge</p>  <ul style="list-style-type: none"> - Easy to make - Inexpensive 	<p>Self - locking hinge</p>  <ul style="list-style-type: none"> - Strong - Easy to lock
Storage access	Open top	Slide top	Slide top
Table support	Steel leg	-	-

Pugh chart is used to analyze different concepts at the same time. Pugh chart is also used to encourage individuals to evaluate the advantages and disadvantages of each design with respect to the design criteria. The best option can be chosen by using a Pugh chart to compare various concepts. As a result of its assistance with decision-making, it is also known as a decision-making matrix or decision-matrix approach. Table 2 shows the Pugh Chart used for this project.

Table 2: Pugh Chart

Description		Design Concept		
				
Criteria	Weightage	Design 1	Design 2 (datum)	Design 3
Weight	3	0	0	-
Affordable	2	+	0	+
Good material	2	0	0	+
Strength	3	0	0	-
Design	1	0	0	+
Durable	3	0	0	+
Storage	2	-	0	+
Safety	3	0	0	-
Size	3	-	0	+
	+	1	0	7
	0	7	9	0
	-	2	0	3
	Net score	-1	0	4

Scale indicator:

[+] = greater than datum

[0] = as per datum

[-] = less than datum

Scores are assigned to each design based on a weighted average of all the criteria. Design with the highest score is the best design to choose.

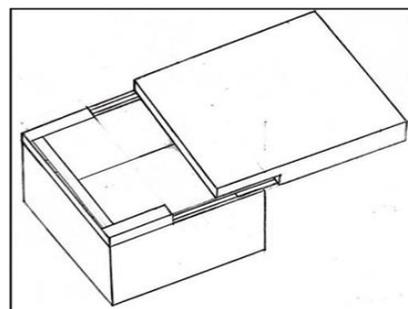


Figure 3: Final Design

Figure 3 shows the final and best design. Design 3 was chosen because the net score is the highest according to Pugh chart. This design provides the best criteria; moderate weight, affordable, strong and durable as it uses wood, safe as have extra storage and moderate size so it takes up less space. Lastly, Solid Works application is used to draw the final design. For the drawing process, Solid Works 2020 edition is used. Solid Works can be used to generate detail drawings for each component as well as assembling each component with dimensions. Each dimension of every drawing should be accurate and should be labeled as reference for the fabrication process. After the design's drawing is finalized and authorized by supervisor, fabrication process can be executed.

3.2 Fabrication Process

The fabrication process is executed in the workshop where machines needed is prepared. The multi-purpose coffee table will be created through a series of process, cutting, grinding, and drilling. After fabrication process is completed, product must be tested to ensure it is properly functioning. Modifications should be made if product does not function properly and achieve objectives.

For the fabrication process, two main parameters, which are material selection and fabrication execution will be prioritized. The multi-purpose coffee table will be created through a series of process; cutting, grinding and drilling. Table 3 shows the fabrication process of multi-purpose coffee table.

Table 3 Fabrication Process of Multipurpose Coffee Table

Process	Description
	<p>Measuring Process The fabrication process is executed in the workshop where machines needed is prepared. The process begins with measuring the right dimension of the plywood using measuring tape, try square, ruler and pencil/</p>
	<p>Cutting process Cutting process of plywood is executed with automatic jigsaw. This cutting process must be done carefully where safety equipment such as gloves and safety glasses must be worn to avoid injuries</p>
	<p>Sanding Process after being cut, the plywood was sand using coarse and fine sandpaper to make the edges smoother and cleaner</p>

	<p>Fastening Process</p> <p>Fastening process is a process where each part is fasten together using wood screw. Fastening is important because each part need to be connected to make sure project will function well.</p>
	<p>Varnishing Process</p> <p>Varnish is applied to prevent scratches and abrasion on product. Varnish also helps to waterproof wood and protect wood from knocks and spills. After fabrication process is completed, product must be tested to ensure it is properly functioning. Modifications should be made if product does not function properly and achieve objectives.</p>
	<p>Testing Process</p> <p>Items such as vase, glassware and books are used. Items such as toys and vase are put on coffee table and in storage space. For hide-away function on coffee table, self-locking hinge and ball bearing slides is important to ensure table working properly.</p>

Figure 4 shows the final side view of multipurpose coffee table where it slides well and table top lifted properly.



Figure 4: Side view of multipurpose coffee table

4. CONCLUSION AND RECOMMENDATION

The design of the multi-purpose coffee table was completed as per the planned design. Fabrication processes were carried out accordingly. Then, the product has undergone testing to ensure all the safety aspects and the objectives of this project were achieved. The focus of this project is to fabricate a multipurpose coffee table with hide-away function. The primary purpose of this coffee table is to store items in a more organized way and to maximize space. Besides, the hide-away feature was designed to facilitate user to store items, extend table and enables user to cut furniture cost. This project provides an alternative for a small space house.

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