

Outdoor Sofa with Storage Compartment

Abdul Aziz Achsan¹ & Mohamad Ali Selimin^{1*}

¹Department of Production and Operations Management, Faculty of Technology Management and Business,
Universiti Tun Hussein Onn Malaysia, Batu Pahat, Johor, 86400, MALAYSIA

*Corresponding Author

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Abstract: In Malaysia, the majority of outdoor sofas are subject to environmental humidity and direct sunlight. The quality of the cushion may be harmed if it subjects to all those types of climatic conditions for a lengthy period of time. Therefore, the purpose of this study is to determine the design criteria for designing and fabricating a prototype of an outdoor sofa with storage compartments. This study employs a questionnaire to collect data. Based on the finding from the questionnaire, the majority of respondents preferred an outdoor sofa having square or rectangle legs with canyon brown finishing color, and dark colour for cushions. Based on the inputs acquired through the simple final design survey, the final design was decided. The prototype was built in accordance with the approved design. In line with this study, an outdoor sofa may increase the life of its cushions by storing them when not in use beneath the seat in built-in storage spaces where they are protected from weather-related damage.

Keywords: Outdoor Space, Outdoor Sofa, Climate Environment, Cushion

1. Introduction

Furniture is any moveable item used to make a space an appropriate for living or working in, such as tables, chairs, or desks (Holder and Lange, 2014). Furniture is designed and manufactured to let people sit and relax, work and play, arrange or exhibit goods, and partition space (Postell, 2012). When it comes to furniture, it is best to consult with experts to acquire better pieces that serve the designated space and function. Thus, a furniture design is required to give the best solution for a space filled with furniture. Furniture design can be influenced by ideas of beauty, design principles, theory, material properties, fabrication technologies, business economies, environmental design matters, and the surrounding spatial context in which it is placed (Postell, 2012).

A patio or deck, covered or uncovered, a yard, a walkway, a parking lot, or a section of any of these spaces are examples of outdoor space. A patio, deck, or balcony is a paved outdoor area off of a house or structure that is used for seating, resting, or living space. People are increasingly placing furniture such as a sofa, lounge chair, and coffee table on their patio, deck, or balcony. A sofa is a long,

*Corresponding author: aliselimin@uthm.edu.my

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upholstered seat with armrests, a back, and a large seating space. The distinction between indoor and outdoor furniture is that indoor furniture is not exposed to the climate weathers, but outdoor furniture is.

Malaysia has humid weather all year round. The average daily temperature in Malaysia is from 21°C to 32°C (MyGovernment, 2022). This demonstrates that outdoor furniture in Malaysia is frequently subjected to rain and harsh sunlight. In Malaysia, the majority of outdoor sofas are exposed to the elements' sunshine and moisture. It is not recommended to let the cushion to absorb all of these types of weather for an extended length of time since it may affect the cushion's quality and lifespan. Because cushions are largely comprised of polymers and fabric, UV radiation from the sun can cause them to fade and degrade, especially if they are exposed in a hot under direct sunlight. According to a study, the most fundamental and common UV damage process in polymers is called chain scission by photolysis - the splitting of large chains into shorter ones by the direct impact of high-energy photons shattering the "backbone" of the molecule. This decrease in a polymer's molecular weight nearly often results in a deterioration of physical attributes such as strength and ductility, as well as a degradation of aesthetic properties such as color and texture (El Messiry *et al.*, 2022).

Outdoor sofas are typically placed by users under a roofed patio, deck, or balcony. However, the outdoor sofa can still be exposed to climate change, such as the sun reaching the patio sofa according to its natural degree movement and rain and its water vapor reaching the cushion due to the heavy wind. Most materials are quite vulnerable to weather exposure, and they may not survive very long if left outside of the house. Choosing a suitable material is critical to ensuring that the outdoor sofa cushion furniture has a longer life span when left outside of the house and exposed to the environment.

Therefore, the objective of this study is to design an outdoor sofa with a storage compartment. This intended storage compartment will be utilized to protect the cushion from severe weather while not in use. Merbau wood will be used to make the sofa's structure since it has a long lifespan. Merbau's durability is well-known because to its inherent oils, which allow it to withstand extreme temperatures, harsh climates, oceans, and other hostile environments. This indicates that it may be used outside.

2. Research Methodology

This study adopted a methodology described by Kor and Selimin (2023) and Lim and Selimin (2023).

2.1 Questionnaire

The survey is a means of collecting data from respondents in order to gather opinions and insights on various issues. This study was carried out utilizing a design survey strategy. It collects quantitative data through questionnaires. Two sets of questions were administered: 1) the design criteria survey and 2) the final design survey. Multiple-choice and closed-ended questions were included in the questionnaires that were developed. The questionnaires are distributed online to targeted respondents who receives the URL link who is legal and able to reside, own, or live in a house with a patio in Peninsular Malaysia. The questions will be disseminated using the Google Forms. The design criterion survey is divided into two sections: Section A is a about demographics and Section B is a about design criteria. It consists of two multiple-choice questions and eleven closed-end questions. The questionnaire results will serve as an outline for designing an outdoor sofa.

2.2 Visual Research

The aim of visual research is to increase the cultural attraction and worthy of today's layout or product by using appropriate images, format, space, typography, and colors. In this study, the visual research can be obtained from resources including a webpage, papers, and other feasible sources. The

visual research includes the appearance of an outdoor sofa, leg types, and cushion color. The compilation of visual research details will aid in determining the preliminary design criteria and the direction for this study, which is required for the next design phase.

2.3 Ideation Sketches

Ideation is the process of producing ideas and solutions in the furniture design business through sketching or graphic workshops. Ideation is also the most exciting stage of a design project since it requires the creation of a large number of ideas, which must then be filtered and reduced to the best, most realistic, or most creative in order to promote new and improved design solutions and products. It results in the original design being transformed into a superior design. In this study, 5 ideations were selected from a pool of twelve for next design process.

2.4 Idea Development

Next, idea development is about creating and testing the new concepts, as well as all of the aspects that contribute to and enrich the selected ideation. At this stage, the selected ideation is further improved in order to meet as many design criteria obtained earlier. The story is relatively easy to follow, and everything should make sense. This research employed idea development to go into deeper detail regarding the design that resulted from ideation. During the idea development process, the illustrations were drawn in isometric view, top view, front view, and side view with some details to convey additional information about the design. Three ideas were developed from the five selected ideation sketches. The three ideas then used as final design candidates in a simple final design survey to come up with one final design.

2.5 Final Design

Before finalizing the design, a design survey was done. After rendering and displaying the design information, three ideas from idea development stage were taken as pre-final designs and presented in the design survey. The pre-final design was presented nicely in isometric view with color and texture to aid respondent with clear direction of the design. The sketch also demonstrates how the outdoor sofa operates and performs. These sketches also included annotations to illustrate and mark the concept. The graphic comprises the design as well as voting information; the design with the most votes will be regarded the final design developed as a prototype.

2.6 Mock-up Development

A mock-up is a scale model of a real product that is used for product presentation or demonstration. It is built at 1:10 scale. A mock-up's fidelity is typically modest to superb. Any material may be utilized to make a mock-up as long as it fits in well with the design concept. The mock-up for this study was made with a sponge, popsicle sticks, shirt cotton, sandpaper, and fast-drying glue. All of the wooden surfaces are constructed of popsicle sticks, and the cushions are made of sponge and shirt cotton to replicate the original materials.

2.7 Technical Drawing

AutoCAD software is often used to create technical drawings. The visual style for the drawing will be generated in 2D wireframe. The technical drawing contains line drawings, exploded views, top views, side views, front views, isometric views, and rendering. The drawing illustrates all of the fasteners, fittings, and joint works. Every view will provide the precise dimension remark. The technical drawing will include a bill of materials (BOM) at the top right corner of the layout. BOM is a detailed description of all the raw materials, pieces, and instructions needed to make or assemble the outdoor sofa.

2.8 Prototype Fabrication

After the design has been confirmed, a prototype will be created. Prototyping covers the fabrication process, which involves material selection, cutting of raw materials into desired dimension, assembly as well as finishing process. The complete process of developing a furniture prototype is referred to as furniture manufacturing. The Merbau wood was used in furniture-making process in this study; it must transform all of the essential raw materials into furniture. Cutting, drilling, jointing, sanding, and finishing procedures were utilized to fabricate an outdoor sofa with storage compartment prototype.

3. Results and Discussion

3.1 Questionnaire Analysis

The findings of an online survey performed using a Google Form are summarized in Table 1. The surveys were completed by 98 individuals. According to the survey, the majority of respondents preferred square leg type outdoor sofa, canyon brown finishing, and dark color cushions. These findings will serve as the study's design criterion. These criteria will be used to choose the final design as well as in idea development process. The visual research selection comprises of many types of legs and styles based on what's currently available in the market to construct an outdoor sofa design. Meanwhile, Table 2 shows the summary of the design criteria survey.

Table 1: The demographic information analysis

Question	Answer	Frequency	Percentage (%)
What is your gender?	Male	44	44.9
	Female	54	55.1
What is your age?	21-30 years old	63	64.3
	31-40 years old	2	2.0
	41-50 years old	2	2.0
	51-60 years old	31	31.6
What is your race?	Malay	95	96.9
	Chinese	3	3.1
	Indian	0	0
What is your employment status?	Employed	28	28.6
	Unemployed	6	52.0
	Self-employed	13	13.3
	Housewife	51	6.1
What is your household income?	B40 (below RM4850)	51	52.0
	M40 (RM 4,850 to RM 10,959)	24	24.5
	T20 (RM 10,959 and above)	23	23.5
What is your house type?	Semi D	11	11.2
	Bungalow	21	21.4
	Condominium	7	7.1
	Apartment	7	7.1
	Flat	5	5.1
	Terrace house	47	48.0

3.2 Visual Research

In this study, six pieces of visual research were created in order to find the best design solution. The visual research comprises an outdoor sofa's look, leg forms, and cushion color. The visual research for this study as presented in Figure 1.

Table 2: Design criteria analysis

Question	Answer	Frequency	Percentage (%)
Do you have a patio/balcony?	Yes	61	62.2
	No	37	37.8
What issues have you encountered while placing an outdoor sofa on a patio/balcony?	Cushion and sofa's frame are broken due to weather exposure	65	66.3
	The life span of sofa is reduced due to harsh weather	60	60.0
	Discoloration of the sofa's wood component	48	49.0
What type of sofa legs do you prefer?	Square or rectangle leg	56	57.1
	Rounded leg	27	27.6
	Platform base	14	15.3
Do you prefer an outdoor sofa with cushions storage?	Yes	69	70.4
	No	29	29.6
What color of the cushion that you prefer?	White color	20	20.4
	Light color	19	19.4
	Dark color	59	60.2
What colour of finishing do you prefer for the merbau wood?	Honey Gold	20	20.4
	Cedar Natural tone	19	19.4
	Redwood Natural tone	17	17.3
	Canyon Brown	42	42.9



Figure 1: Visual research

3.3 Ideation

The researcher utilized four pieces of A3 paper to develop distinct ideas throughout the brainstorming process. The centerpiece of the brainstorming process is an outdoor sofa with a storage compartment that can hold the cushion. Figure 2 depicts the concept for the outdoor sofa.

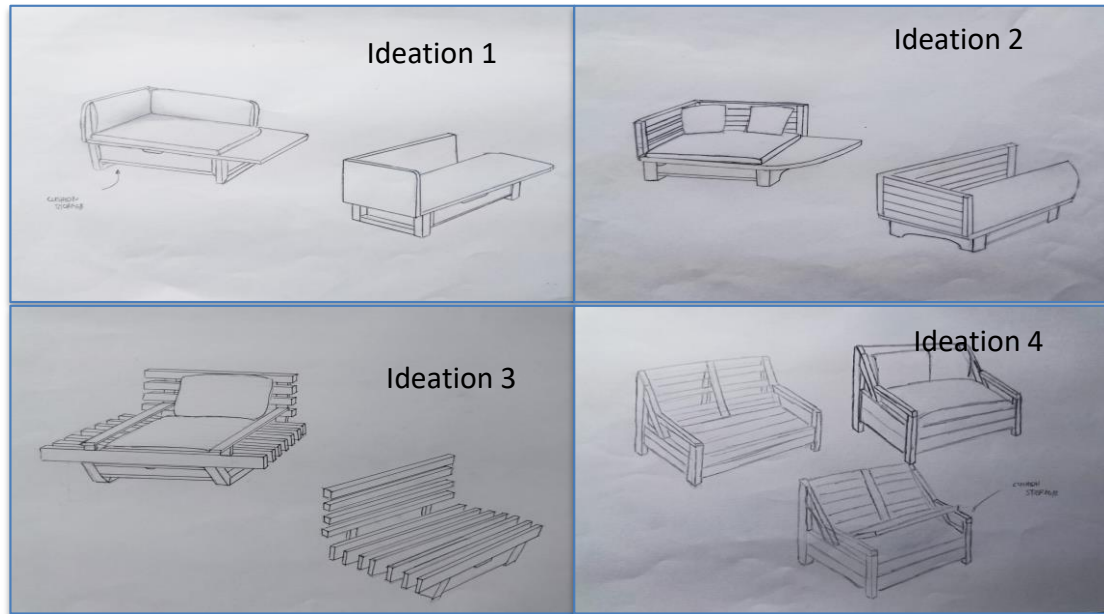


Figure 2: Ideation of outdoor sofa with storage compartment

3.4 Idea Development

Idea development include coming up with new concepts and testing them out, as well as all of the minor details that contribute to and enrich the initial ideation. In this research, idea development was utilized to demonstrate further depth on the design that originated from ideation. It designed with some elaboration during the idea development to provide extra information about the design. Four proposals were created from the four selected ideation drawings. The four idea designs were moved on to the next stage of the process, which will result in a final design for this study. Figure 3 displays how it developed of this study's idea.

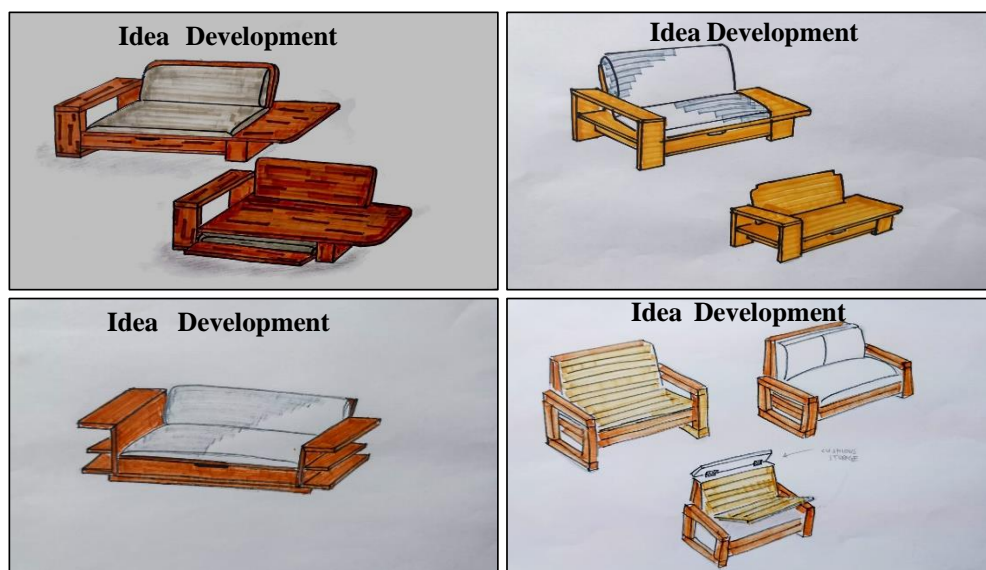


Figure 3: Idea development of outdoor sofa with storage compartment

3.5 Final Design

In this study, idea development 2 was serve as the final design. Idea development 2 had satisfied the respondents' preferences. Minor upgrades and alterations will be made to the design in order to bring greater furnishings and value. Figure 4 demonstrates the final design of the outdoor sofa with storage compartment.



Figure 4: Final design of outdoor sofa with storage compartment

3.6 Mock-up Development

The mock-up for the study was made with a sponge, popsicle sticks, shirt cotton, sandpaper, and fast-drying glue. All of the wooden surfaces are constructed of popsicle sticks, while the cushions are built of sponges as an alternative to the original materials. Figure 5 shows the mock-up development process.



Figure 5: Mock-up of outdoor sofa with storage compartment

3.7 Technical Drawing

The technical drawing contained line drawings, exploded views, orthographic views, isometric view, and rendering of the final design, as can be seen in Figure 6. The drawing illustrated all of the fasteners, fittings, and joint works. Every view will provide a specific dimension.

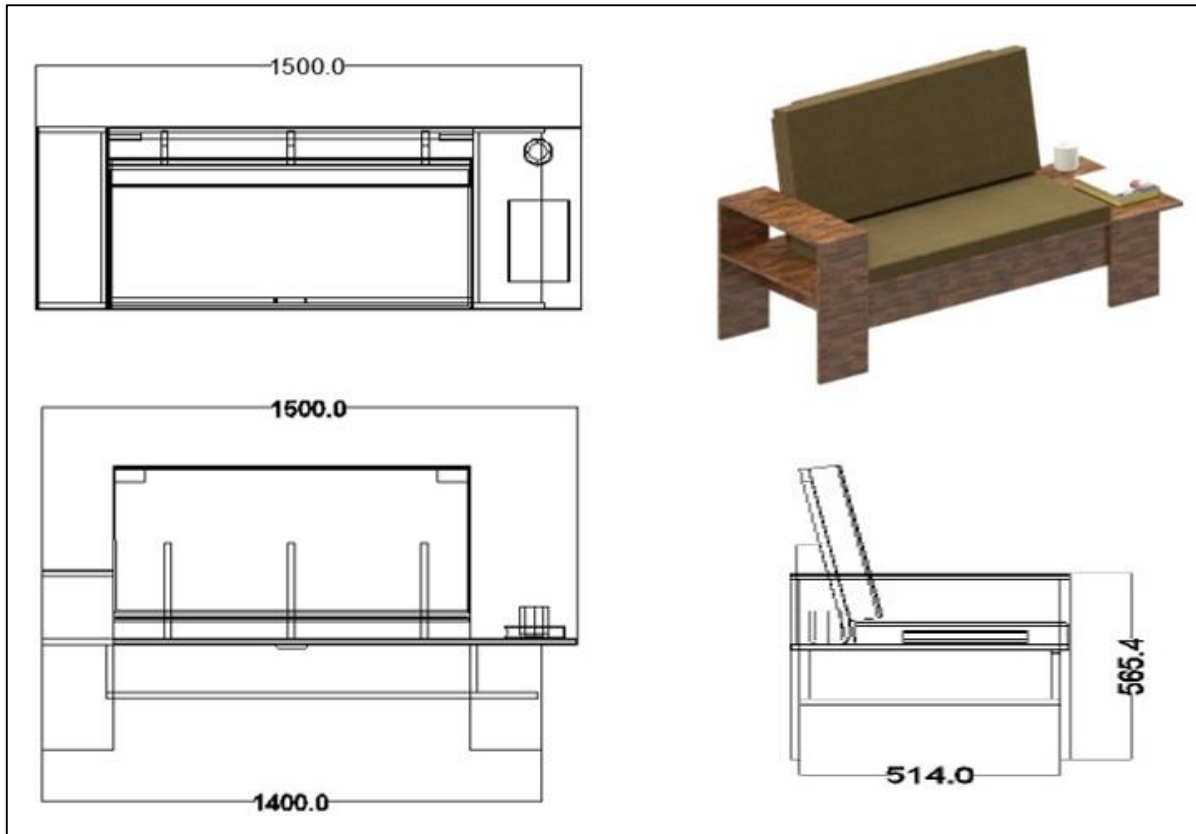


Figure 6: Technical drawing of outdoor sofa with storage compartment

3.8 Prototype Fabrication

The prototype is comprised of merbau board, cushion foam, and cotton fabric. Merbau board was cut using a circular saw and a table saw in the simplest method feasible. The cut elements are then joined according to the design. To keep the cost of this prototype low, a used folded single bed is employed. The foldable single bed is trimmed to fit on the outdoor sofa and handstitched with cotton canvas, saving half the expense of purchasing new cushion foam. Figure 7 displays the prototype of outdoor sofa with storage compartment.



Figure 7: Prototype of outdoor sofa with storage compartment

4. Conclusion

In conclusion, this study was successful in producing the prototype of the final design. By placing the cushion in the storage compartment, the outdoor sofa can protect it from changes in the weather. For future studies, the researcher may need to do more investigation on the existing outdoor sofa in the market as well as the current market value for the outdoor sofa in order for the new design of outdoor sofa prototype to be accepted in the market, especially in Malaysia.

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