

# Saving Space with Foldable Single Bed for Single Household

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DOI: <https://doi.org/10.30880/rmtb.2025.06.02.046>

## Article Info

Received: 30 September 2025

Accepted: 01 November 2025

Available online: 01 December 2025

## Keywords

Bed, single bed, single household,  
foldable furniture, saving spaces

## Abstract

A development of a single bed that can save space inside a bedroom to because bed is one of the largest horizontal furniture in a bedroom that can take a lot of spaces and this study will help to make the bed design become space saving furniture to solve the problem mention by Hussein Ali Hussein in 2020 where he mention that traditional furniture occupy a lot of space in a small household. The objectives of the study are to identify the design characteristic of a foldable single bed, to design a foldable single bed that can save space and to produce a foldable single bed prototype that can save space. The study is conducted with the collected of 162 respondents consist of individual who are 18 years and above who are living in a single household and those who plan to purchase a single bed in the area of Batu Pahat, Johor. The results were achieved through the distribution of online questionnaire which is Google Form. The design later finalizes in 3D CAD software to simulate real life bed and bedroom comparison. The prototype is created with squared hollow metal with vary size and 12mm plywood. The study aims to design a single bed with respondents' preferences which are the height of the respondent, the design of single bed in the market, and the preferred features and design criteria that the respondent wanted. This study was anticipated could contribute as on the solution to solve the problem of the big size of single bed that can cause a lot of irregularity and wasted spaces in a bedroom. The prototype has been found to consume less space in a bedroom as aim for the objective. The foldable bed also show that it is easy to handle when cleaning the bed area as it has the mechanism needed to flip and clean under the bedside.

## 1. Introduction

With the advent of new technology has shown that the traditional use of space in furniture design has become increasingly worse in modern living, especially for single households with limited space. In the journal made by Husein Ali Husein in 2020, he highlights the inefficiencies and wasted space that are caused by the traditional furniture in a small household such as apartment. He proposed the need of contemporary furniture designs that are efficient in space but still has the feature of comfort and productivity by applying multipurpose furniture and custom-made pieces that serve multiple functions while occupying less space. "Multum in Parvo: A Place for Everything and Everything in its Place" research made by Edwards in 2013 discussed how space saving furniture and furniture organisation can help the issue in the journal of Husein Ali Husein 2020 where he said that "Often, there's a lack of space in these rooms, -: however, a human being needs to feel space; when many

things and furniture surround them; they can get stressed and overwhelmed.”. Building on these ideas, a modular system furniture was proposed by Namjoo (2020) research that can increase the expandability of spaces in a small living area. Namjoo method was combining essential bedroom furniture into multifunction unit that can maximize the use of space and resident satisfaction. As an example, combining bed, desk and wardrobes into single furniture unit. Besides, Namjoo in 2020 also mention, a multifunction furniture is needed to save spaces in a small space such as bedrooms. The furniture single bed is chosen with the foldable method because Li, 2016 summaries research made by Mollerup in 2001 that effective space-saving is not merely about reducing the size of furniture but about designing pieces that can collapse or fold efficiently. Among various space-saving techniques like stacking, implosion, and bundling, folding is particularly common and well-practiced in furniture design. This method offers numerous creativities and geometrically challenging solutions, demonstrating versatility and practical application in maximizing space such as bed in a bedroom. A single bed size mention by Namjoo, J., 2020 are 1850mm in length and the width of 700mm was standardized.

The connection between foldable single bed or foldable furniture in general with the single household are because of the increase of single person households and the changing of demand in furniture style, has led to a new urban living spaces such as a single room households and studio house (Namjoo, 2020). This is supported by Yeung, W in 2015, her research where the single household increased over the year due to widowhood, delayed marriage, divorce and increased geographic mobility. According to Department of Statistic Malaysia, 2022 single household in Malaysia has increased from 0.8% in 2010 to 1.6% in 2022. This data caused the need for foldable single bed as it can maximize efficiency, level of comfort and productivity in a small space for current furniture design. Kim (2016) analysis provided that the single household’s consumption tendency of home furnishing market can be increased through a product that uses technology and mechanism to save space around the environment of single households. There is existing bed are seen as oversized beds that can take up much of the room, leaving little floor space and hindering movement, which may cause a feeling of confinement and restrict the arrangement of other important furniture. To resolve this, consider using space-saving options such as foldable beds, Murphy beds, or beds with built-in storage, as these solutions can optimize floor space and enhance the room’s overall functionality (Shwarze, 2025).

An issue is elevated when furniture becomes a hassle when the standard size perceives as big in a small size room or houses. This statement was supported by research in 2020 made by Husein Ali Husein on how furniture occupies a lot of space and causes a lot of irregularity and wasted spaces in a small apartment and the issue he found was that small spaces cannot hold enough necessity furniture. Kyung (2018), who made research in furniture composition system for single person household in 2018, expected that a multi-functional furniture for single households in the current context should be increased the efficiency of spaces. He mentions several preferred multi-functional furniture compositions which are counter-tops and chest of drawers, followed by chest of drawers and beds, counter-tops and tableware, lighting and beds, closets and drawers. The research was concluded with a limit where it is necessary to present a more detailed multi-functional household composition of single-person households by considering the frequency of use of the furniture. This includes the use frequency of furniture inside a bedroom consisting of wardrobe-bed-desk/table (Namjoo, 2020).

Based on this two previous research, space has always become issue for furniture to be used properly when it comes to a small space’s bedroom such as a house of a single household. This study aims to create a bedroom furniture which is a single bed for single household resident with a modular and multi-functional characteristic to create space while covering more space in a small bedroom. The single bed is proposed for single house resident who living in the area inside Batu Pahat, Johor. The results can be achieved through the distribution of online questionnaire which is Google Form to Parit Raja Facebook page and multiple Whatsapp group chats that mostly student and resident of Universiti Tun Hussein Onn, Parit Raja, Johor. The data collected randomly for a larger input. The collected questionnaire data then analysed through data statistical analysis in order to get the design criteria and feature needs on the product. The importance of this research is to revolutionize bed design and feature. The current bed that exists in the market currently causes a lot of irregularity and wasted spaces (Husein Ali Husein, 2020). User who are disturbed by the size of a bed, even a small single bed can be perceived as big in a small bedroom. This research can help in designing a new space saving bed by using foldable system that can help user feel unclamped in a small bedroom. Other than that, this research can create a new bed design that can be included in the current market that can give user all the feature they need so the bed can become one for all furniture in a small bedroom. The research is also important to create a new foldable single bed design that can provide a practical solution to maximize the utility of small apartments, studio flats, and other compact living environments. Research in this area can lead to innovative designs that help individuals and families make the most of limited square footage. This study aims to identify the design characteristics of foldable single bed, to design a foldable single bed that can save space, and to produce a foldable single bed prototype that can save space.

## 2. Literature Review

### 2.1 Foldable Furniture

Furniture that is foldable, collapsible, or transformable offers excellent portability and space savings. Deployable structures have the ability to change shape, seamlessly transitions, when needed, from a small, packaged configuration to an enlarged one with operational capabilities. People's requirements over the years have driven them to find creative ways to live more comfortably. As a result, downsizing is not always necessary to save space effective methods of collapsible furniture can make a big difference. Folding is possibly the space-saving technique used on furniture the most common among the many others, including stacking, implosion, and bundling (Li, 2015). The common characteristic in current folding piece of furniture, is the ability to be fold flat or to a smaller size and be stored in a stack and in a row. Even though the folding system are restricted to the furniture industry, folding system can be practiced in a number of ways, depending on the materials, unions, hinges and fitting. Folding includes the constraint movement of rigid parts that often require clearing space to avoid collision among other part, hence some folding furniture have empty space for the clearing space to exist (Raphael, 2016). Folding furniture requires a mechanical system to achieve it folding movement seamlessly and it folding ability can be divided into many categories as an example; sliding, rolling, paper folding (origami), pop up designs, nesting, collapsing, and flat pack.

### 2.2 Bed

Bed, a set of mattresses, a fitted sheet, pillows and a blanket. The term making a bed means arranging each of these items to create a sleep environment that is both clean and aesthetically pleasing to watch and lay down for a nap. Creating your bed is the first step towards having a neat, cozy bedroom. While the individual activities are not too complicated, there are other details to remember, and these can change based on your preferences and on your bedding. A mattress, fitted sheet, pillows, and a blanket such as a duvet or comforter are the minimum components of a made bed (Logan Foley, 2023). LAVINO, an online furniture shop depicted that the single bed size in Malaysia is about 3 feet or 91 centimeters width with 204 centimeters length. Meanwhile the size is differed in a small percentage from the SleepAdvisor article written by Zwarenstejn (2024) with the width of 38 inches or 96.52 centimeters and having the length of 75 inches of 190.5 centimeters. The bed's prime function is to sleep or rest. The function becomes versatile depending on its design and environment. Sleep and rest are very important for human being as maintained by Ogbunike (2017) in Sleep Neurophysiology and Effects of Sleep Deprivation stated that the percentage of sleeping in human lives is 35% which shown that sleeps are indeed important for human to be energized to do daily work.

### 2.3 Single Household

According to United Nation of Economic and Social Commission for Western Asia (UNESCWA) IN 2022, single household consists of an individual who lives alone in a separate dwelling unit or who lodges in a separate room or rooms of a dwelling unit without interacting with other residents to form a multi-person household. A single household means an individual who alone or lives separately under the same room but does not share essential item or service together. Single household in Malaysia aggregate to 0.96 million or 12.0 percent with the highest amount recorded in Selangor (189.4 thousand/10.7% and Johor (117.6 thousand/11.8%) (Department of Statistic Malaysia, 2022). An example of demographic that considers choosing and are living in a single household are elderly people and young adults. The elderly people live alone due to widowhood, meanwhile young adults are living alone because of divorce, delayed marriage and increased geographic movement. The elderly who majorly are woman are the major population who live along due to women have higher life expectancy compared to men. Young adults who live alone are more likely migrant worker and working-class people. They choose to live alone due to financial distress and don't want to have any responsibilities other than personal responsibilities (Yeung & Cheung, 2015)

### 2.4 Space Saving

For the purpose of creating adaptable, user-friendly, and space-saving multipurpose furniture units, modern technological methods are essential. Economic planning and industrialization are being adopted by society, and it is crucial that we pay attention to these strategies in order to advance society (Labib, 2019). For centuries, furniture intended to become a tool or object to give an easier and comfortable life for human beings, but as human, the furniture design evolved to have more function per piece of furniture. As an example, the wardrobe and cabinets are made for storage, sofa and bed for people to rest, tables, and chairs for dining and working. In this age, space saving furniture is available to fulfil the desire of people in their taste for furniture in design and function. The most common space-saving furniture in regular residential buildings is the sofa-bed that can

become both sofa and bed which becomes convenient and flexible furniture that gives comfortability for the small size of their home (Husein Ali Husein, 2020).

## 2.5 Murphy Bed

The pioneer of transformable bed, the designer of so called "Murphy Bed" which are a William Murphy, who obtained the patent for the well-known Murphy bed in 1900, was a pioneer in the field of motion furniture. Murphy was raised in a one-room apartment in San Francisco after being born in Stockton, California, in the late 1870s. He wanted to use this flat to host visitors, but there wasn't enough room. Murphy started creating prototypes for a bed that would fold away when not in use after realizing that his bed used a sizable portion of his available floor space. A door bed with a spring-operated counterbalancing mechanism to stop sleepers from inadvertently folding into walls was the most successful model. The Murphy door bed was the name given to this, and a business by that name (Perre, 2016). Murphy beds are now commonly incorporated into large living-room cabinets rather than being sold as standalone pieces. These beds can fold or rotate to reveal various features such as bookshelves, single shelves, work desks, dining tables, or simply an open space. Some Murphy beds are part of bedroom modules, and there is also double Murphy beds designed as bunk beds (Perre, 2016). This versatile, space-saving solution, which eliminates the need for an extra bedroom, has gained popularity in the DIY community. Many individuals opt to build their own Murphy beds as a more affordable alternative to the often-high-priced commercial versions available in the market.

## 3. Research Methodology

### 3.1 Research Design

The process of research design consists of development of questionnaire, sketches, design survey and mock-up. The research is based on the observation and survey. In the survey, it consists of closed-ended question which is the respondents are given a list of predetermined responses from which to choose their answer. The respondents of the survey have been collected 162 respondents through Google Form. The survey has been divided into four sections which are the demographic section, and three design criteria section. The respondents of the survey are from Batu Pahat, Johor who are 18 years old and above who live alone or planning to purchase a single bed. They survey will help in providing detail information about the design criteria of foldable single bed. The survey made with Google Form was spread using WhatsApp and Facebook page that related to the area within Batu Pahat. The target respondent would be the Batu Pahat resident who live in a single household and those who have and want to purchase a single bed. The respondents consist of 162 individuals from the sample calculation of 95% confidence level with 7% margin of error from 503400 total population in Batu Pahat (DOSM, 2020).

### 3.2 Sketches

#### 3.2.1 Thumbnail

Thumbnails are the process of making a quick sketch drawing on the topic ideas to generate the ideation of the product. Its involving exploring through observation and plot it into the sketches. It was drawn in a piece of A3 paper and get about 15 quick sketching. A 3D drawing can help in figure out the design ideation on foldable single bed mechanism and design to be implement into the product. There was a piece of thumbnail sketches which about 5 thumbnail sketches in order to generate with the design inspiration. From the collected data of the surveys, 3 ideas were selected to become ideation foldable single bed.

#### 3.2.2 Ideation

Ideation is the process of generating the ideas and solution through sketching. It presents a better-looking design idea from the thumbnail sketching that bring the best and interesting among the ideas to foldable single bed and at the same time solve the problems. 9 ideation was draw in order to deliver the idea through sketching. The design ideation is to create a foldable single bed that can save space and has the feature suggested by the respondent.

#### 3.2.3 Idea development

The process of idea development is including the idea and design concepts being include. It is important so that, the materials, manufacturing method, functionality and aesthetic of the product can be generate throughout the idea development. Three idea development from the ideation been coloured and plotting more detailing on it such as the dimension of the product.

### 3.2.4 Final Design

The final design process is to choose the best final outcome out of the design ideation. The best was chosen based on the most completed based on problem and design ideation concept of the product. It chooses based on the design criteria of foldable single bed that can save space.

### 3.3 Mock up

Mock up is literally provide the demonstration, design evaluation involves testing of various colour, finish and design details which provide at least functionality that cannot be visualized in the sketches. The scale size of mock up is up to 1:6 and detail can be seen distinctly.

## 4. Results and Discussion


### 4.1 Design Survey Finding

Two final designs have been chosen to find the best foldable single bed design. The design created with the criteria of previous questionnaire that has led to the chosen final design with each its own characteristic to fit with the taste of respondent. The design created with 3D Solid-work software to give a better perspective of the product design. The first design is called "Foo Fighters" due to the 'F' shape of the side frame and the second design called "D4C" due to the 'D' shape of the side frame. The design survey is separated to four part which three are for the design individually and with the demographic part. The design survey was conducted for 3 weeks and has received 162 responds. The design criteria collected after analyzing the survey answer, the foldable bed should meet these criteria, which is space saving design, great structure and ergonomic design

**Table 1** Design criteria analysis

Bed Design	Criteria	Ergonomics	Design Preference%
Foo Fighter	Space Saving	120	74.07
	Ergonomics	136	83.95
	Design Likeliness	157	96.91
	Great Structure	84	51.85
D4C	Space Saving	126	77.78
	Ergonomics	116	71.60
	Design Likeliness	154	95.06
	Great Structure	85	52.47

**Table 2** Bed Design

Design Name	Bed Design
Foo Fighter	

D4C



From design survey, bed design D4C are chosen to be move into prototype phase due to it has the highest amount of respondent choosing it as a saving space design. The design also preferred by due to leg frame use less space compare with design Foo Fighter with the ergonomically design pattern. The D4C bed design also has a better structure compared with Foo Fighter, this is also can be seen with the vote of respondent show design D4C to have better structure. This design also has no need to have any support or be wall mounted.

## 4.2 Sketches

### 4.2.1 Thumbnail

The early ideation exploring various type of folding mechanism and shape to form a space saving bed with the reference of product and concept that exist in the market.

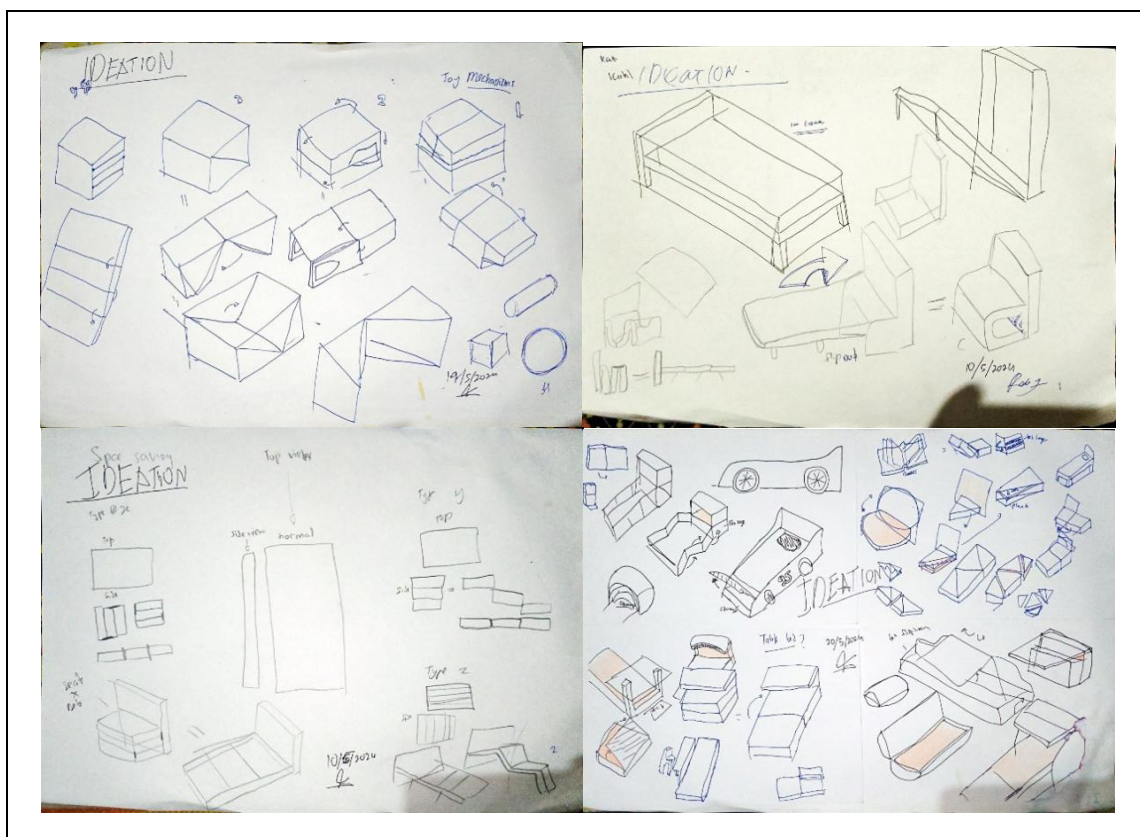


Fig. 1 Sketches

### 4.2.2 Idea Development

Idea development that are chosen sketch from ideation to develop and design the folding pattern and mechanism with the current tools or mechanism exist in the market so it can logically be manufactured.

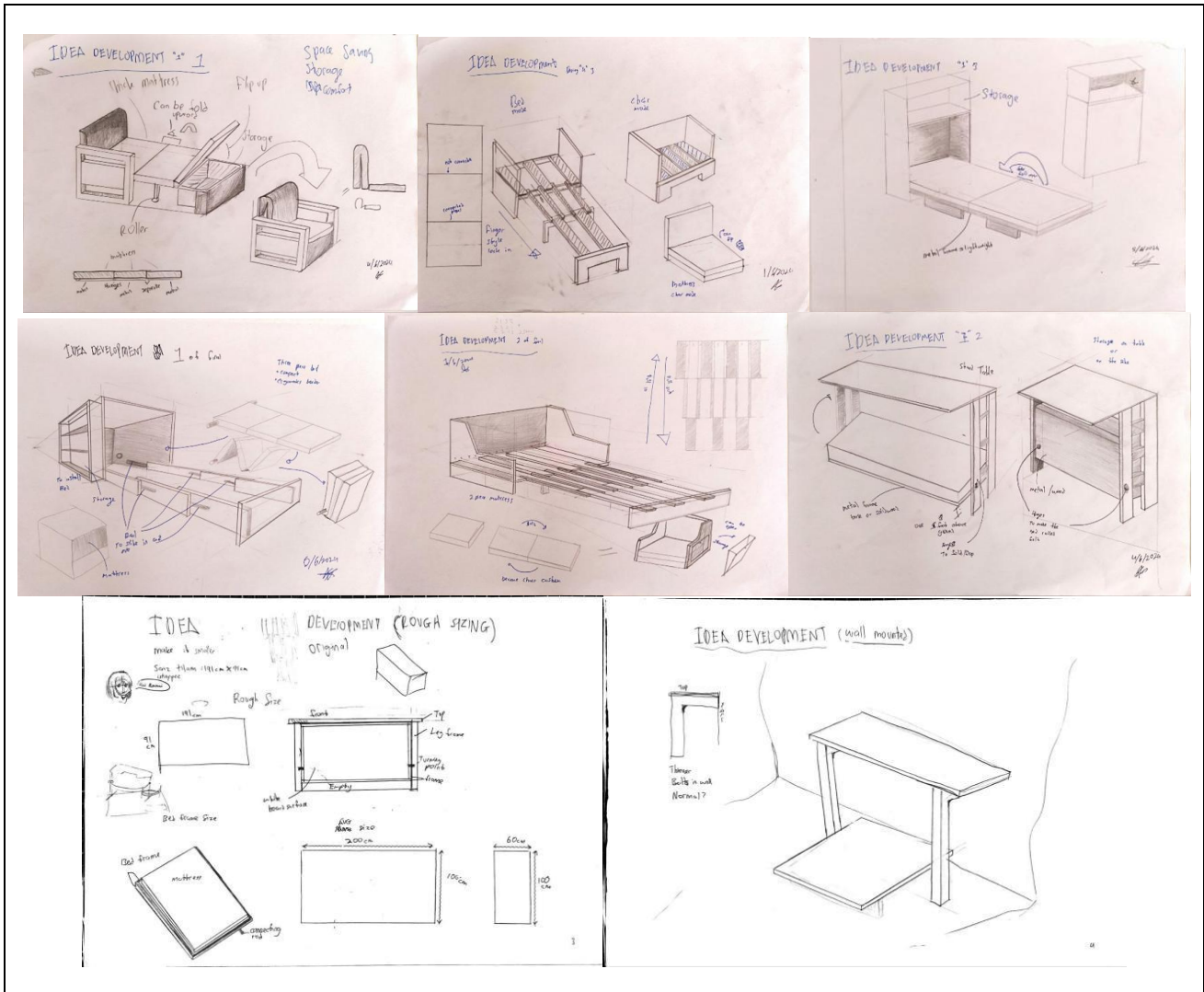


Fig. 2 Idea developments

The last sketches are the chosen basic functional form of the foldable single bed for further design process in 3D software by using Solidwork to create the artificial visual to get the measurement and improve any structural error before creating a mock-up of the single bed.

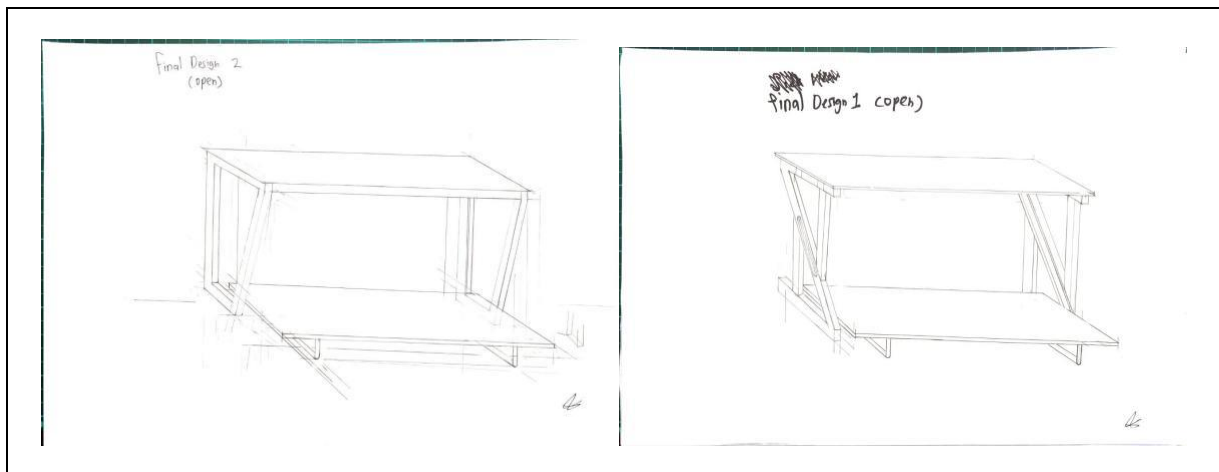


Fig. 3 Final design

### 4.2.3 3D Design with Technical Drawing

The 3d design is using Solidwork software. The design render shows in Fig. 4 show the size scale with human. This is a great representation of how the prototype should be with the height and can use to plan to buy material for creating the prototype. Fig. 5 technical drawing are the detail sizing of the 3D creation with each measurement will be referred to create the prototype.



Fig. 4 3D rendering with Solidwork

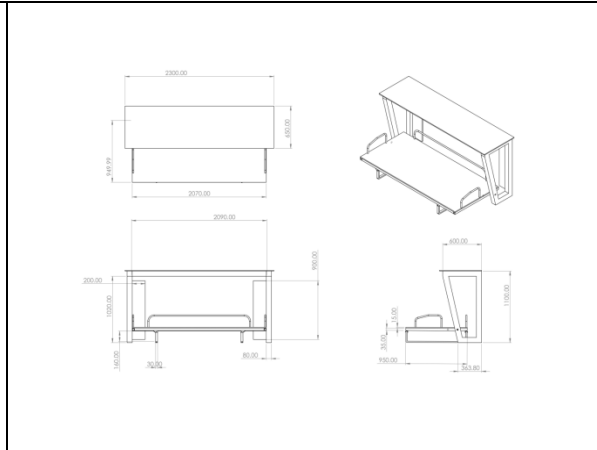


Fig. 5 Technical drawing

### 4.3 Mock Up

The mock up created from 3mm plywood, wire and wood stick with different size. The mock up scale is 1:10.

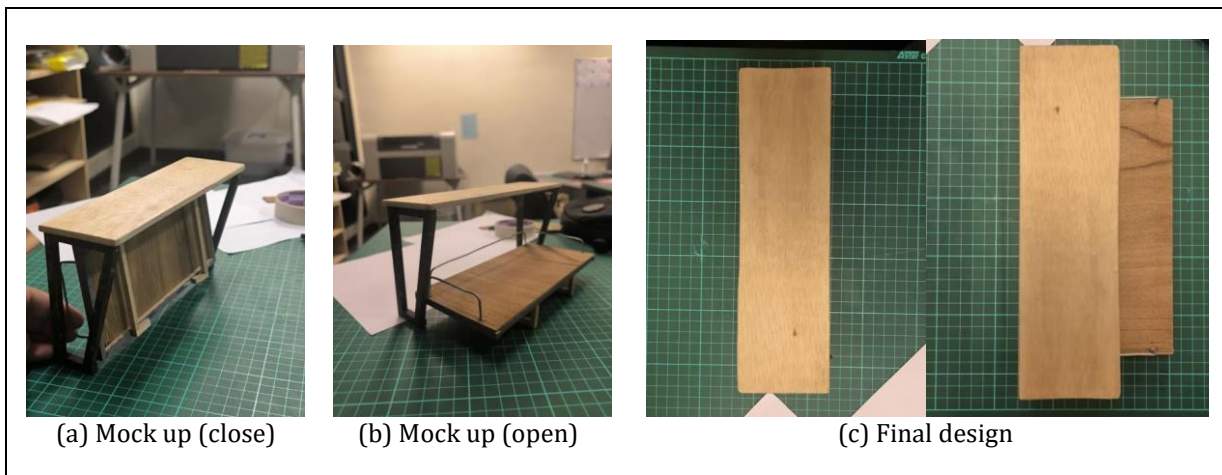


Fig. 5 Mock up

## 5. Conclusion

According to the findings, the respondent in Batu Pahat, Johor, prefers beds with space-saving features for their bedroom. According to the design poll, the respondents' selected design did meet the space-saving requirements. As stated by Husein Ali Husein in 2021, the user will not feel suffocated by the current design choice because furniture takes up a lot of room and creates irregularities and wasted spaces in a small bedroom. The problem he discovered was that the small spaces could not accommodate enough necessary furniture. This foldable bed prototype created solved the issue found by Husein Ali Husein. After the creation of the prototype, researcher found that the design had durability. Also, the benefit of having foldable or liftable bed, cleaning the under the bedside by folding the bed in close mode, the mechanism of the foldable bed makes it easier for the user to clean below the bed or grab any fallen properties that fall when sleeping such as smartphone and earphone. The design of the leg frame can be designed to fulfill the empty area for added strength that are open for designer to create. The material for the bed can use a lighter material for more user friendly towards user to use the foldable system. Furthermore, the methodology can be improved by enlarging the scope of research from a district to state level. The concept of Murphy Bed do need to be explored more so transformable furniture can slowly be integrated and become relevant in the market of new home furniture or even office furniture as it is expensive and homeowner rather create the Murphy Bed design themselves as mentioned by Perre (2016).

## Acknowledgement

Communication of this research is made possible through assistance by Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia,

## Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

## Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Mohamad Raimi Iskandar Maliki, Ahmad Anwar Safwan Sidek; **data collection:** Mohamad Raimi Iskandar Maliki; **analysis and interpretation of results:** : Mohamad Raimi Iskandar Maliki, Ahmad Anwar Safwan Sidek, **draft manuscript preparation:** Mohamad Raimi Iskandar Maliki, Ahmad Anwar Safwan Sidek. All authors reviewed the results and approved the final version of the manuscript.

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