KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

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SANiBED

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CIVIL ENGINEERING DEPARTMENT WOOD BASED TECHNOLOGY PROGRAMME

SESI 1 : 2024/2025

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THIS REPORT WAS SUBMITTED IN PARTIAL FULFILLMENT OF REQUIREMENTS FOR THE DIPLOMA IN WOOD-BASED TECHNOLOGY, DEPARTMENT OF CIVIL ENGINEERING POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

CIVIL ENGINEERING DEPARTMENT WOOD BASED TECHNOLOGY PROGRAMME

SESI 1 : 2024/2025

DECLARATION OF ORIGINAL AND OWNERSHIP

1. We are third-year students in Wood-Based Technology, Civil Engineering Department, Politeknik Sultan Abdul Aziz Shah.

2. We acknowledge that our SANiBED is not taken or copied from any party but rather the work or design of our group itself.

3. Made and truly acknowledged by the said

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ACKNOWLEDGEMENT

Our sincere gratitude goes to the project supervisor, Mr. Teo Eng Yeaw, for providing invaluable guidance and supervision during the duration of this semester-long endeavour. His aid in finishing this assignment, particularly with the report-writing element, and all the guidance and support he has provided us are greatly appreciated. This endeavour has benefited immensely from his support and perseverance. We also appreciate the lecturer's remarks and ideas on this project, as well as the coordinator of the final-year project. Finally, we would like to thank Mr. Dickson Wing, the inventor of SANiBED, as well as our parents and classmates, for their continuous support during our study. We could not have completed our job successfully without their unwavering encouragement and support. We would also like to thank everyone in our group for their collaboration and sense of teamwork.

ABSRACT

Bedridden individuals often face challenges related to hygiene and comfort, which can complicate their care and quality of life. SANiBED is an innovative, affordable, and portable sanitary bed designed to address these challenges, particularly focusing on ease of cleaning and patient comfort. The design incorporates the golden ratio to enhance aesthetics and ergonomics. Through this project, two prototypes of SANiBED were developed and tested with real-world volunteers: a 70-year-old bedridden woman and a 20-year-old male with lower limb paralysis. Each prototype underwent a series of evaluations involving feedback from caregivers and patients, as well as observational analysis of the bed's functionality. Improvements were made based on initial feedback, especially in terms of size and mattress thickness. The results show that SANiBED significantly enhances the overall care experience by providing a more comfortable and hygienic solution for both patients and caregivers, making it a viable option for long-term use in home care settings.

Keywords: SANiBED, sanitary bed, bedridden individuals, Golden Ratio, affordable and portable, ease of cleaning, enhanced care experience

ABSTRAK

Individu yang terlantar sering menghadapi cabaran berkaitan kebersihan dan keselesaan, yang boleh merumitkan penjagaan serta kualiti hidup mereka. SANiBED adalah katil sanitari mudah alih yang inovatif dan mampu milik, direka untuk menangani cabaran ini, dengan memberi tumpuan khusus kepada kemudahan pembersihan dan keselesaan pesakit. Reka bentuknya menggabungkan nisbah emas untuk meningkatkan estetika dan ergonomik. Melalui projek ini, dua prototaip SANiBED telah dibangunkan dan diuji bersama sukarelawan sebenar: seorang wanita berumur 70 tahun yang terlantar dan seorang lelaki berusia 20 tahun yang mengalami lumpuh anggota bawah. Setiap prototaip dinilai melalui maklum balas daripada penjaga dan pesakit, serta analisis pemerhatian terhadap fungsi katil tersebut. Penambahbaikan telah dibuat berdasarkan maklum balas awal, terutamanya dari segi saiz dan ketebalan tilam. Hasilnya menunjukkan bahawa SANiBED meningkatkan pengalaman penjagaan keseluruhan dengan menyediakan penyelesaian yang lebih selesa dan bersih untuk pesakit serta penjaga, menjadikannya pilihan yang sesuai untuk penggunaan jangka panjang dalam persekitaran penjagaan di rumah.

Kata kunci: SANiBED, katil sanitari, pesakit terlantar, Golden Ratio, mampu milik dan mudah alih, mudah dibersihkan, memudahkan urusan penjagaan

LIST OF CONTENTS

LIST OF TABLES

LIST OF DIAGRAMS

LIST OF FIGURES

LIST OF ABBREBIATIONS

WHO – World Health Organization

UN – United Nation

CHAPTER 1

INTRODUCTION

1INTRODUCTION

The need for affordable and functional healthcare solutions has become increasingly important as the global population ages and the demand for long-term care continues to rise. According to the World Health Organization (WHO), the number of people aged 60 years and older is expected to grow significantly, with many facing mobility challenges due to chronic diseases and disabilities (WHO, 2021). For bedridden individuals, maintaining comfort, dignity, and hygiene is a priority, yet the cost of specialized care equipment often presents a barrier, particularly in low-income households.

In response to this challenge, the SANiBED was developed as an affordable, portable sanitary bed designed to address the needs of bedridden individuals and their caregivers. Incorporating the Golden Ratio in its design for both aesthetics and functionality, SANiBED offers an adjustable backrest for comfort, storage compartments for medical supplies, and an innovative side sliding drawer with a toilet basin for efficient hygiene management. The design is intended to ease the burden on caregivers while providing dignity and ease for the

patient, aligning with the increasing demand for patient-centered care solutions (Naylor et al., 2020).

By integrating practical features like an accessible waste disposal system and an ergonomic design, SANiBED provides a cost-effective alternative to more expensive care beds, making it an attractive option for households and healthcare providers alike.

1.2 PROBLEM STATEMENT

The need for effective and practical solutions in the care of bedridden individuals was assessed, focusing on the limitations of traditional sanitary beds. Traditional sanitary beds are often expensive and bulky, taking up precious space while lacking in comfort and portability (Inventor of SANiBED, 2024). These limitations pose significant challenges for caregivers, who must ensure the safety and well-being of patients while managing space and resources efficiently. Existing beds do not adequately address the hygiene needs and comfort of patients, often leading to complications such as pressure sores and discomfort. Therefore, the primary aim of this study is to develop SANiBED, an innovative, affordable, and portable sanitary bed designed to enhance both patient comfort and caregiver efficiency while overcoming the shortcomings of traditional beds.

1.3 HISTORY OF SANiBED

The concept for SANiBED originated with an inventor named Dickson Wong, who sought to create a more dignified and manageable solution for waste disposal for bedridden individuals. His innovation introduced a sliding drawer mechanism, equipped with a bowl for waste management, integrated into a bed design. This sliding drawer design, unique in its simplicity and practicality, was patented. However, Dickson Wong chose not to hold the patent himself; instead, the patent rights were entrusted to his wife and a company named Kemudi Lambaian. Although the reason for this arrangement remains unclear, Kemudi Lambaian holds exclusive rights to the sliding drawer mechanism, rather than to the entire bed.

With the patent secured, Kemudi Lambaian reached out to educational institutions, seeking collaboration to further develop and enhance SANiBED. This initiative led the company to partner with our Politeknik, where our team was tasked with researching, testing, and improving the existing SANiBED prototype.

Our Politeknik received the SANiBED prototype from another company, InCube, which provided the foundation for our research. From there, we analyzed its existing features, identified limitations, and began making the necessary adjustments. We also focused on applying the golden ratio to the design, adding both ergonomic and visual harmony to enhance the user experience.

The name *SANiBED* itself is a blend of “sanitary” and “bed,” emphasizing its purpose as a hygienic and user-friendly solution for bedridden individuals. Through these efforts, SANiBED continues to evolve, guided by the goal of improving the quality of life for those who rely on it.

1.4 OBJECTIVES

Improvise existing innovations by applying the “Golden Ratio” principle in design to achieve user comfort as well as lighten the burden of patient care.

1.5 SCOPE OF STUDY

To address the challenges faced by bedridden individuals and their caregivers, field research was conducted focusing on the design and functionality of SANiBED. In-person interviews were carried out with patients and their caregivers to gather insights about the specific needs of patients who require sanitary beds.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The design innovation in the creation of Sanitary Bed, Medical Bed or Hospital Bed has advanced significantly over the years. One design after another has been developed, providing great benefits to both caregiver and patient (bedridden) who has been suffered. Before that, what is bedridden? Bedridden individuals are unable to get out of bed due to medical conditions, disabilities, or injuries. This condition can result from various factors, including chronic illnesses, post-surgical recovery, neurological disorders, or severe mobility impairments (López et al., 2021). Bedridden individuals often require assistance with daily activities such as personal hygiene, eating, and mobility. Their prolonged immobility can lead to complications, including pressure sores, muscle atrophy, and respiratory issues, making proper care and support essential for their health and well-being (Bours et al., 2020). This chapter will explore what is sanitary bed, types of sanitary bed that has been developed, design and market price.

2.2 SANITARY BED

A sanitary bed or medical bed, often called a hospital bed, is designed specifically for patients in healthcare settings. These beds have adjustable features that allow the head, feet, or entire bed to be raised or lowered. This adjustability helps improve patient comfort, makes medical examinations easier, and aids in the care of bedridden patients (Haghighat et al., 2020). Medical beds also include safety features like side rails and wheels for easy mobility. Some may even have monitoring systems to track patient health (Li et al., 2021). They are commonly used in hospitals, nursing homes, and for home care, helping enhance comfort and recovery by reducing the risk of pressure sores and improving circulation (Bourne et al., 2018).

2.3 SANITARY BED TYPES IN MARKET

Sanitary beds have evolved significantly over time, with each design iteration improving the comfort and safety of patients and caregivers. Early models primarily focused on adjustable height and reclining mechanisms, allowing caregivers to attend to patients with minimal physical strain (Smith & Jones, 2019). However, newer designs have incorporated more advanced features, such as built-in waste management systems, to facilitate easier hygiene maintenance for bedridden patients. These features address a critical need for cleanliness and convenience, enhancing patient comfort and helping prevent infection (Doe et al., 2021).

2.3.1 HOSPITAL BED 4 FUNCTIONS MANUAL

There are 4 functions in this medical bed which is adjustable backrest, adjustable footrest, dining table and toilet bowl. These features offer conveniences for both patients and caregivers. Unfortunately, the size is quite large, and it may take a lot of space. It's also not portable making it difficult to bring it anywhere.

***Figure 2. 1**: Hospital bed 4 functions manual (Shopee.com, 2024)*

2.3.2 HOSPITAL BED 2 FUNCTIONS MANUAL

For this hospital bed, the price is quite affordable for a hospital grade bed. However, there's only 2 functions on this bed which is backrest adjustable and footrest adjustable and it doesn't have a built-in toilet bowl making it a burden for both the patient and caregiver when it comes to defecating process.

***Figure 2. 2**: Hospital bed 2 functions manual (Shopee.com, 2024)*

2.4 HISTORY OF GOLDEN RATIO

The golden ratio has a fascinating history that dates to ancient times, with its roots found in early mathematics and geometry. The ancient Greeks were the first to describe this proportion, and it was defined by Euclid around 300 BC in his seminal work *Elements*, where he discussed the concept of dividing a line in the "extreme and mean ratio." This ratio, now known as the golden ratio, was admired for its aesthetic appeal and was even applied in architecture, with the Parthenon in Athens as a prime example (Livio, 2003).

During the Renaissance, the golden ratio gained renewed attention as artists and architects sought mathematical principles to guide their work. Leonardo da Vinci and Luca Pacioli were among the notable figures who incorporated the golden ratio into their studies and creations. Da Vinci's *Vitruvian Man* is often celebrated as a representation of the golden ratio, showcasing the concept of ideal human proportions. Meanwhile, Pacioli referred to this ratio as the "divine proportion" in his book *De Divina Proportione* (1509), which explored its applications in art and architecture and featured illustrative discussions on its significance (Pacioli,1509).

In modern times, the golden ratio continues to be valued in various creative fields. Artists such as Salvador Dalí and Piet Mondrian used it to achieve balance and harmony in their compositions, a quality that has captivated viewers and creators alike. The golden ratio is also evident in natural phenomena, such as the spiral arrangement of sunflower seeds and the positioning of leaves, where its patterns emerge organically (Kagan, 2018).

Mathematically, the golden ratio is closely related to the Fibonacci sequence, in which the ratio of successive numbers approximates the golden ratio, denoted as φ, as they increase. This relationship has intrigued mathematicians and scientists, who have explored its applications in fractals, spirals, and other complex patterns, showing how deeply it resonates across both natural and mathematical landscapes (Durell, 2006).

2.5 GOLDEN RATIO IN DESIGN

In hospital furniture, including sanitary or hospital beds, the golden ratio can be an effective design principle to create not only aesthetically pleasing but also ergonomic and harmonious proportions. By applying a ratio close to 1:1.6, designers can achieve visual balance that intuitively feels comfortable and accessible to users. This approach can contribute to overall patient well-being, as well-designed beds aligned with these proportions may help improve the patient and caregiver experience by fostering a calming, visually harmonious environment that can subtly impact the perception of comfort and safety.

For example, when determining the height, length, or section dimensions of a hospital bed, the golden ratio can guide optimal sizing that feels intuitive and accessible, providing ease of reach and interaction. This design approach has been observed in various furniture pieces, helping to improve usability and comfort in healthcare settings by leveraging naturally harmonious proportions. As noted, the golden ratio also enhances coherence among different furniture elements in a room, fostering a sense of unity, which can be especially valuable in spaces intended to reduce stress and anxiety, like hospital rooms (Malone & Dellinger, 2011; Krovel Furniture Co., 2023)

2.6 DESIGN AND PRICES OF HOSPITAL BED IN THE MARKET

Three examples of available hospital beds are displayed in Table 1. The internet market provided us with information on this hospital bed. The hospital bed, between the cheapest to expensive.

***Table 2. 1**: The sanitary bed design, dimension, price and material in the market*

Brand A	Description
	Dimension: 208 x 96 x 52 cm Price: RM 1160.00 Material: Steel, plastic and aluminium

Brand B	Description
	Dimension: 220 x 93 x 50.7 cm Price: RM 1099.00 Material: Steel, plastic and aluminium
Brand C	**Description**
	Dimension: 208 x 96 x 50 cm Price: RM 780.00 Material: Steel, plastic and aluminium

2.7 MATERIALS

The main materials are used to make SANiBED is Plywood 9mm thickness, Foamboard 9mm thickness, and Nyatoh lumber 2”x2”.

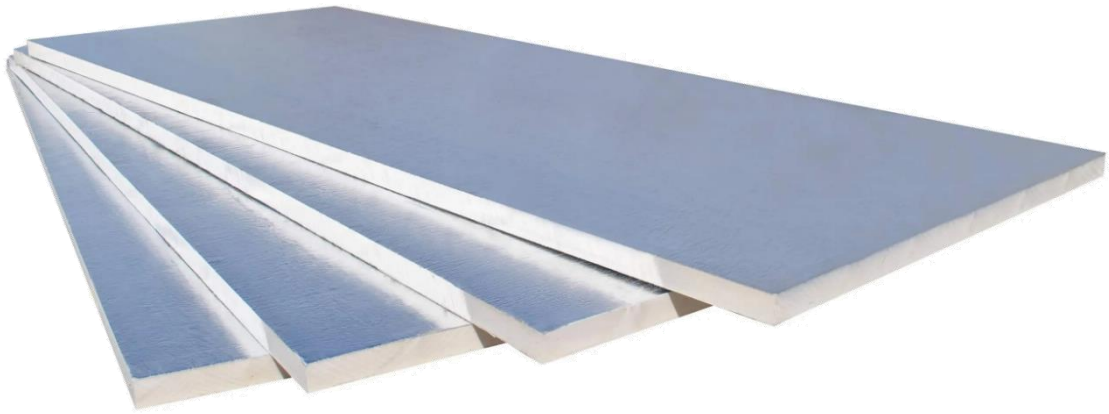
Plywood	Nyatoh Lumber
	
Foam Board	
	

***Figure 2. 3**: Plywood, Foam Board and Nyatoh Lumber*

2.8 ADHESIVE AND FASTENER

For the adhesive and fastener Wood Glue and Screw are used.

Wood Glue	Screw
	

***Figure 2. 4**: Wood Glue and Screw*

2.9 ACCESSORIES

Using accessories such as Hinge for storage part.

Hinge


***Figure 2. 5**: Hinge*

2.10 TOOLS

Here are some tools used in making the SANiBED. Measuring tools such as measuring tape and L ruler. Masking Tape and F Clamp used to hold the two woods in gluing process. Cordless Drill used to make holes and screwing while Sander used to clear the sharp edge and surface.

L Ruler	Measuring Tape
	
Masking Tape	**F Clamp**
	

Cordless	Sander
	

***Figure 2. 6**: L Ruler, Measuring Tape, Masking Tape and F Clamp*

2.11 SAW MACHINES

There are three types of saw machines are used in SANiBED making, which is Jig Saw, Mitre Saw and Table Saw.

Jig Saw	Mitre Saw
	
Table Saw	
	

***Figure 2.** 7: Jig Saw, Mitre Saw and Table Saw*

2.12 FINISHING

Regulations concerning the environment and technological developments make finishing systems even more crucial. defence of wood surfaces. Wood will possess the appropriate quality based on the finishing technique employed (Gibbia, 1981).

2.13 MATERIAL FINISHING USED

Wood Filler and Water based paint are used as finishing in the making of SANiBED.

Wood Filler	Water Based Paint
	

***Figure 2. 8**: Wood filler and Water Based Paint*

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

The planning is very important in the making of SANiBED. All the small details to the biggest details need to be planned accurately and structured carefully so that it will be done in time. Before producing the final product of SANiBED, we've done a lot of research on SANiBED including using the "Ohsuga Method" to improvise SANiBED until the final phase. We also held a fieldwork study to 2 bedridden patient's houses to see any need to be taken into consideration on the SANiBED prototype. We also did a modification on the SANiBED prototype for those 2 bedridden patients and their caregivers base on their liking. Below is a picture of us during the fieldwork study at 2 bedridden patient's houses which is Mrs. Khadijah and Mr. Iman.

Fieldwork study at Mrs. Khadijah's house	Fieldwork study at Mr. Iman's house
	

***Figure 3. 1**:Fieldwork study at Mrs. Khadijah's and Mr. Iman's house*

From the fieldwork study, we've obtained various data that needs to be studied on the existing SANiBED prototype. There are two major problems that need to be solved on the SANiBED prototype which is the mattress for the bed are being too thin which results in discomfort and back soreness. The other problem is the bed doesn't have a leg making it difficult for their caregivers to transfer them from the bed to a wheelchair and from a wheelchair to the bed.

3.2 FLOW CHART OF THE PROCESS IN MAKING SANiBED

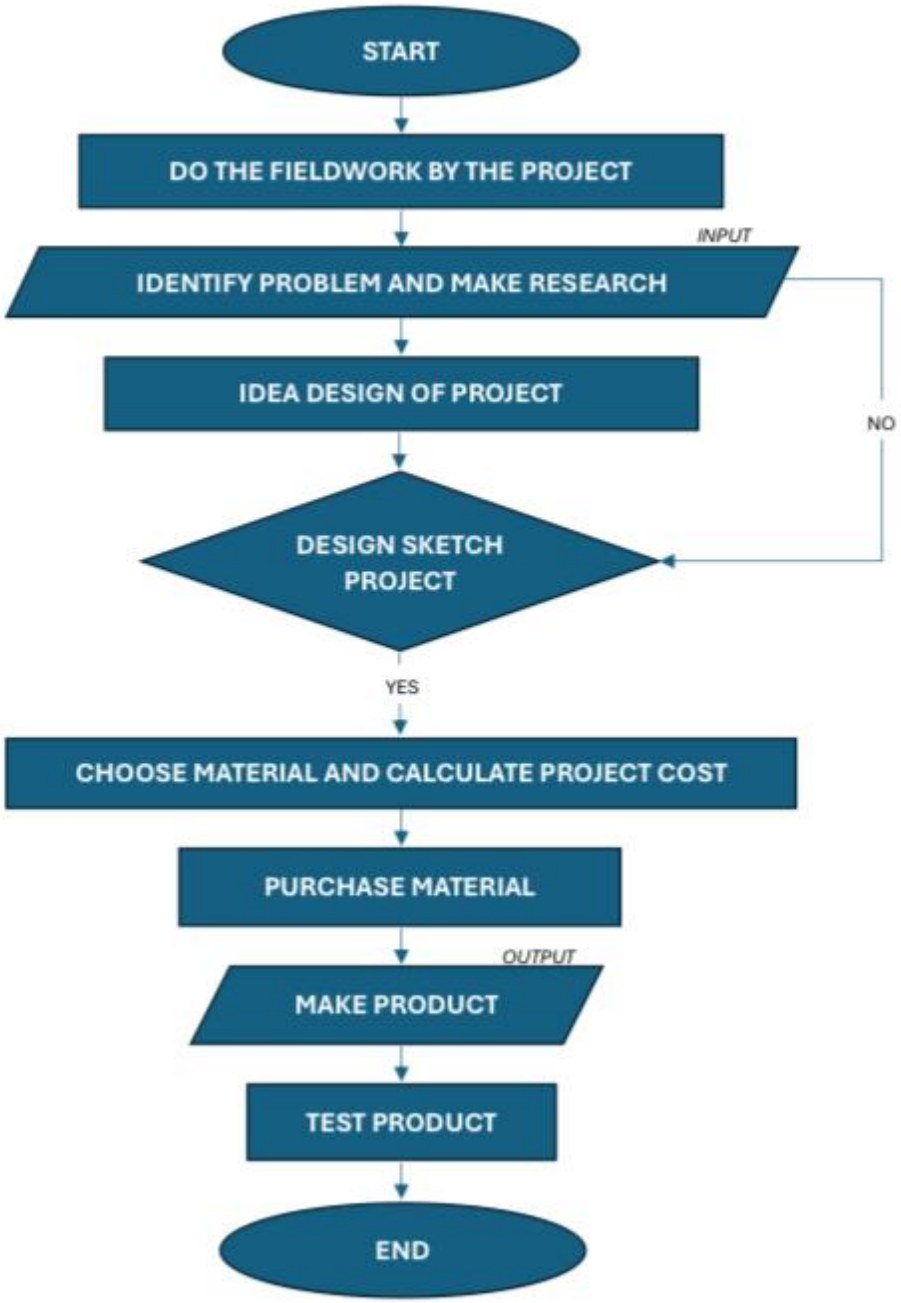


***Diagram 3. 1**: Flowchart for SANiBED making process*

3.3 INITIAL SKETCH OF SANiBED

Before creating the actual design in AutoCAD, we started with an initial sketch of SANiBED to plan out the layout and features, ensuring that every component fit together effectively.

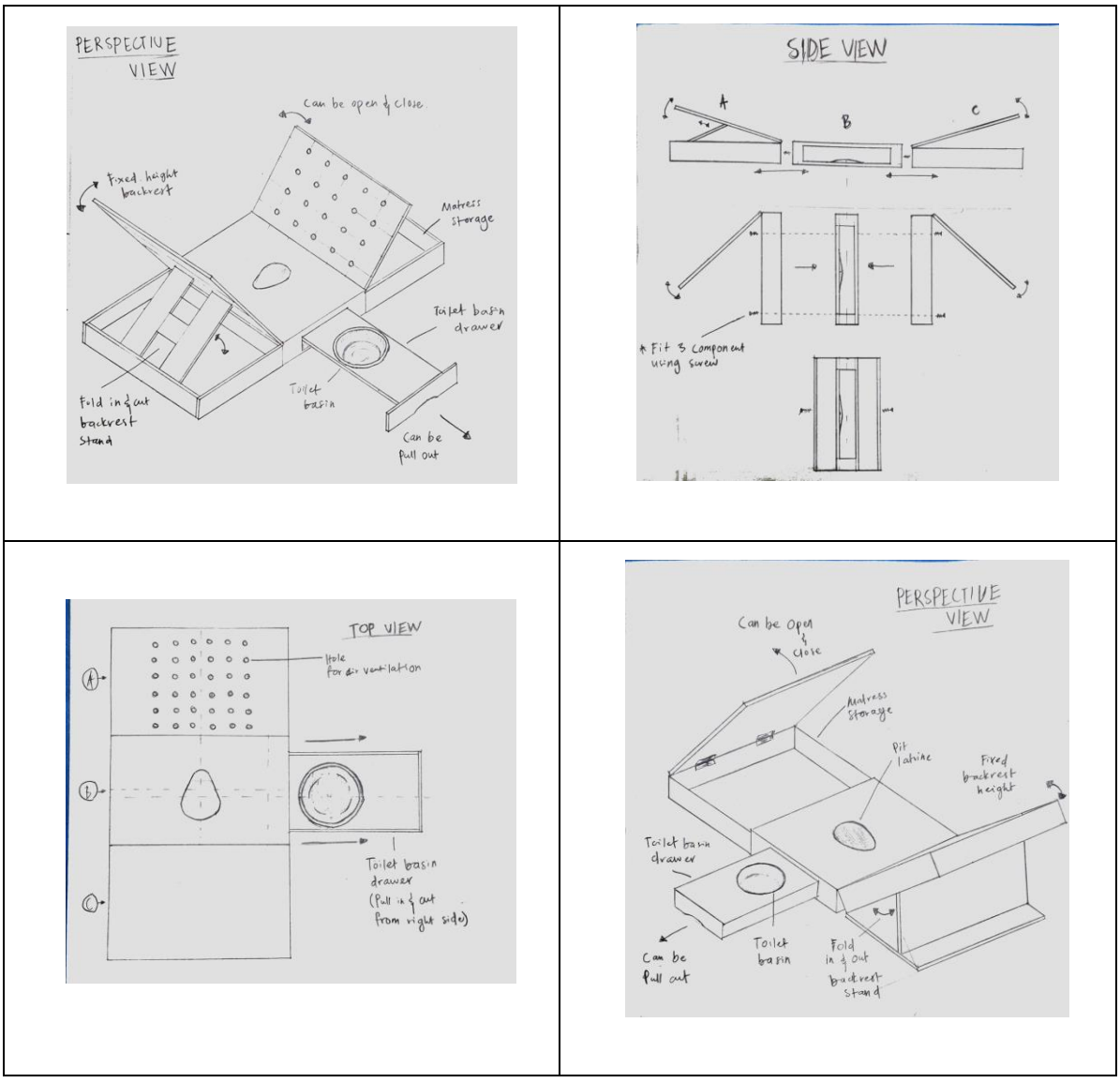


***Figure 3. 2**: Initial sketch of SANiBED*

3.4 CAD DRAWING FOR SANiBED

The CAD drawing for SANiBED provided a detailed, precise representation of the bed's structure, including the adjustable backrest, storage compartments, and waste management system, enabling accurate visualization and refinement of the design.

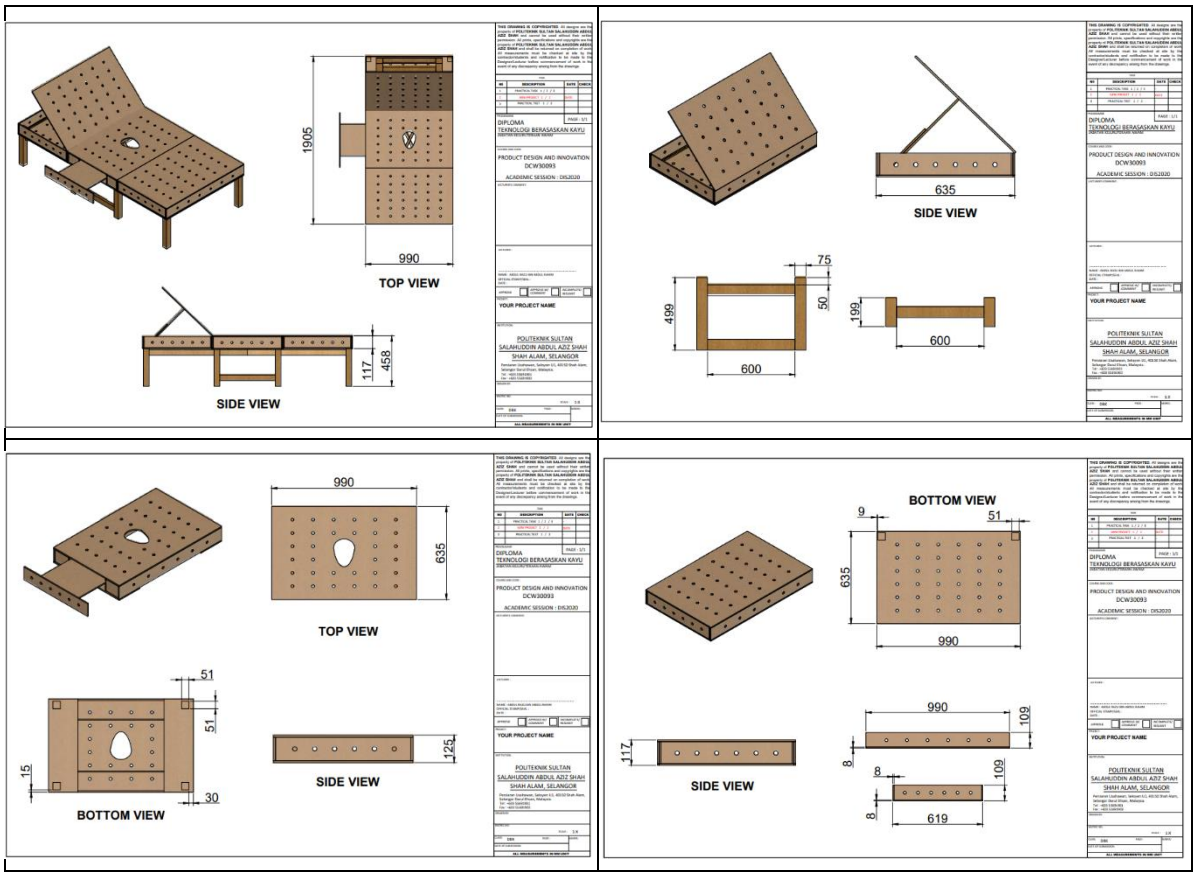


***Figure 3. 3**: CAD drawing of SANiBED*

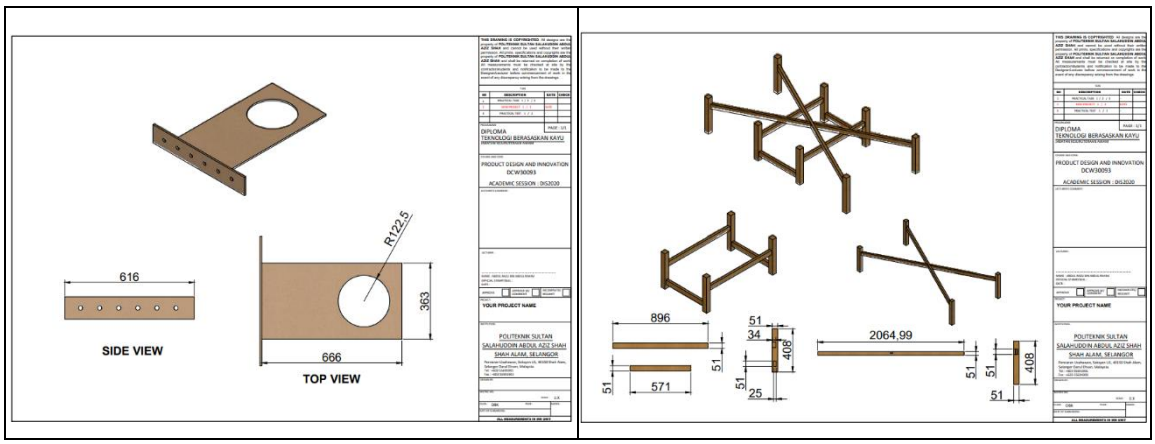


***Figure 3. 4**: CAD drawing of SANiBED*

3.5 SANiBED MAKING PROCESS

The SANiBED making process begins with marking, where guidelines are drawn on materials for accuracy. Next, the materials are measured to ensure they meet the correct dimensions. In the cutting process, each piece is shaped, then smoothed in the sanding stage to remove any rough edges. Once ready, the pieces are assembled to form the bed. Finally, in the finishing process, the bed receives its final touches for quality and durability. This step-by-step process ensures a well-made SANiBED, ready for use.

3.5.1 PREPARING THE MATERIAL

The factor in selecting the equipment and raw materials that will be used is one of the most important aspects of the production process. This is to ensure that there are no materials that will go to waste and to make sure that the product will finish according to the plan. In addition, the product will be more reliable. Among the tools and machines used are pencil, L-ruler, measuring tape, sandpaper, and table saw. Materials that will be used are plywood, foamboard, and Nyatoh lumber.

***Figure 3. 5**: Preparing the materials*

3.5.2 MARKING

Once the required raw materials and work planning are done, the next step is to mark the raw materials into the measurements according to the plan. This process is important in the manufacturing process of a product in order to avoid wastage of raw materials. This process uses various hand tools such as measuring tape, ruler, L-ruler, and pencil. These tools are used to ensure accurate and straight measurements on wood.

***Figure 3. 6**: Marking process on a plywood*

3.5.3 MEASURING

For measuring process, lots of measuring tools will be used. This process will be guided according to the size planned. This process is important in order to avoid materials waste before cutting to smaller pieces.

***Figure 3. 7**: Measuring process using a measuring tape*

3.5.4 WOOD CUTTING

The wood cutting process will be operated by using a table saw machine. Before proceeding with the cutting process, we make sure that all the measurements are correct and accurate to avoid problems when assembling. We also make sure all safety procedures are taken into consideration and followed when handling the table saw machine to avoid injuries and accidents.

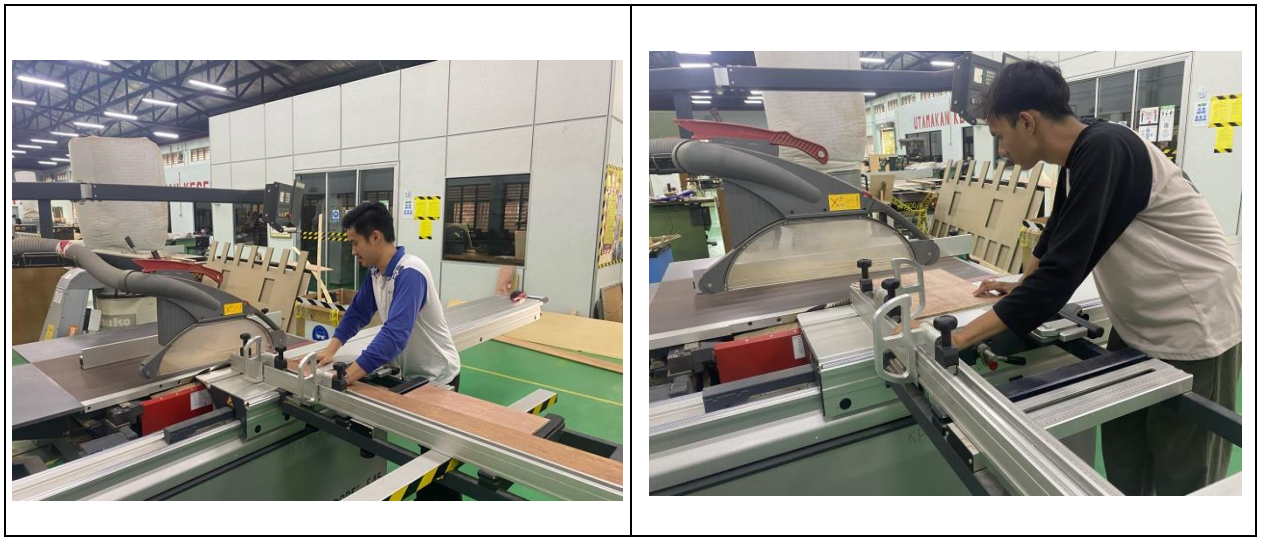


***Figure 3. 8**: Cutting process using a table saw machine*

3.5.5 SANDING

For the sanding process, the edge and surface of the plywood and foamboard will be smoothen using a sandpaper with different grade such as 180 to get a nice and smooth surface and edge. To obtain a smooth and flat surface, sanding needs to be done in the direction of the grain.

***Figure 3. 9**: Sanding process on the edge and surface of materials*

3.5.6 FINISHING

After everything is done, some of the parts will be glued and nailed. Most of the parts will also be applied with water-based paint and filler. Finishing enables the wood surface and the product last longer and protected from any damage. The finishing process can also make the product look more attractive and aesthetically pleasing.

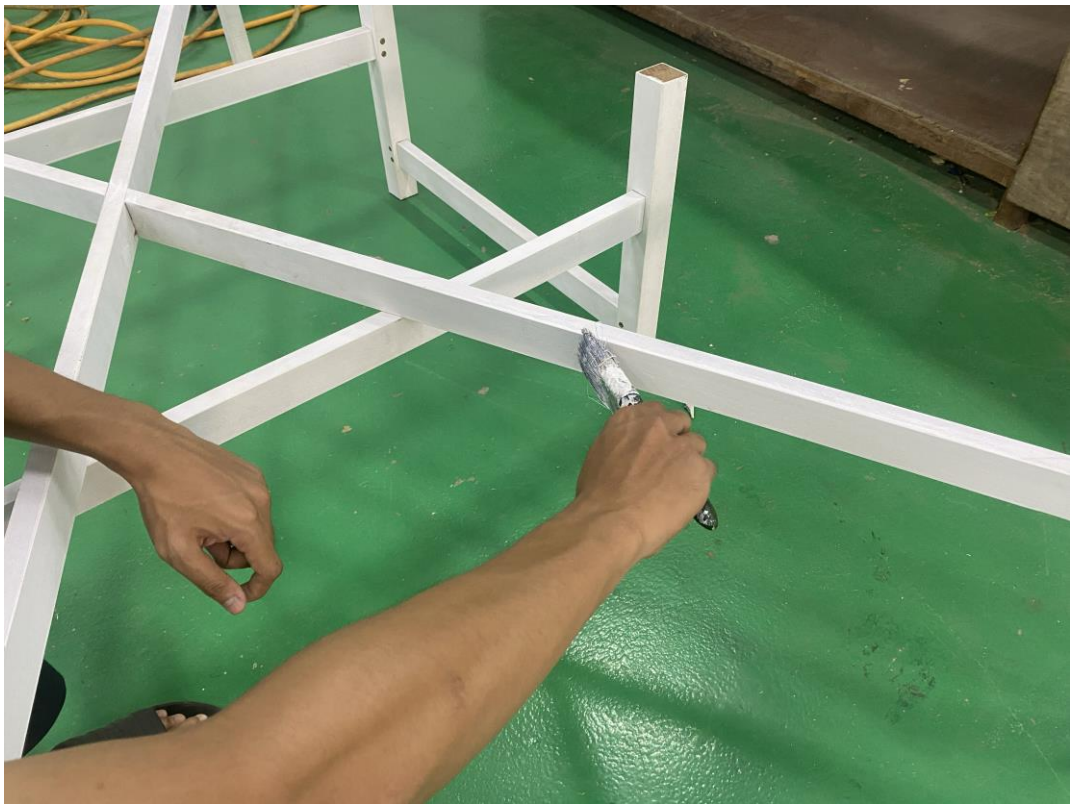


***Figure 3. 10**: Finishing process on the product*

3.5.7 ASSEMBLING AND BUILDING

The assembly needs to be done very carefully and accurately to make sure the end-product does not have any defects and other problems. The assembly process will use a cordless drill, screw, and glue to make sure that the materials bond and hold strongly so that the SANiBED can last longer.

***Figure 3. 11**: Assembling and building process on the product*

3.5.8 SANiBED FINAL FORM

SANiBED has three different part which is top (from head to waist), middle (from waist to knee , and bottom (from knee to toe). The best part of this sanitary bed is it can disassemble easily into three different parts and easy to carry it anywhere. There are several mechanical parts such as adjustable backrest at top part and sanitary drawer on middle part.

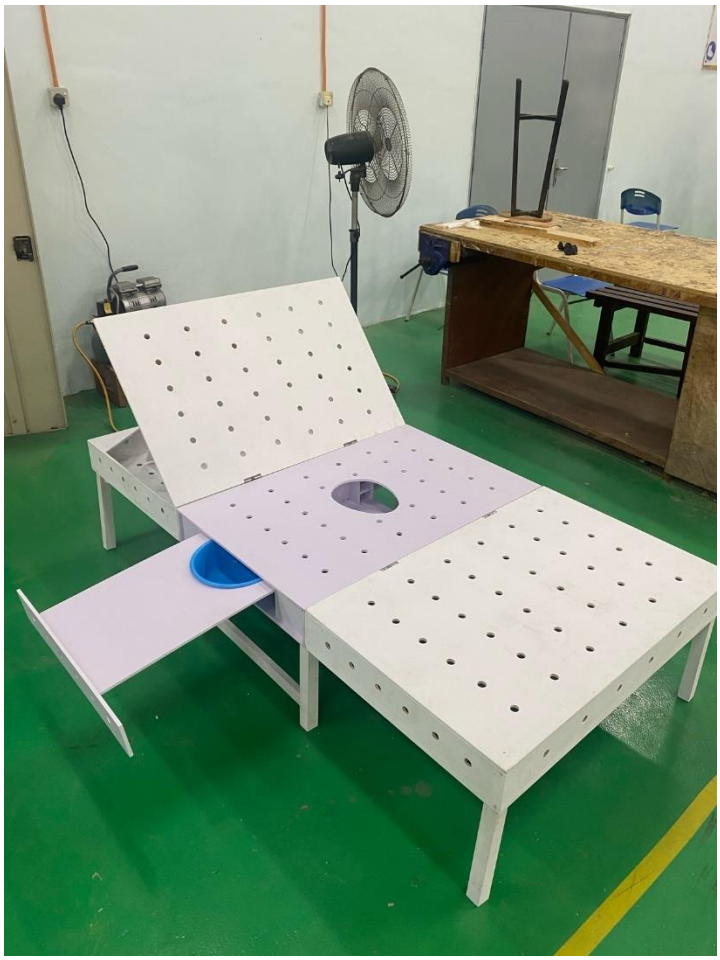
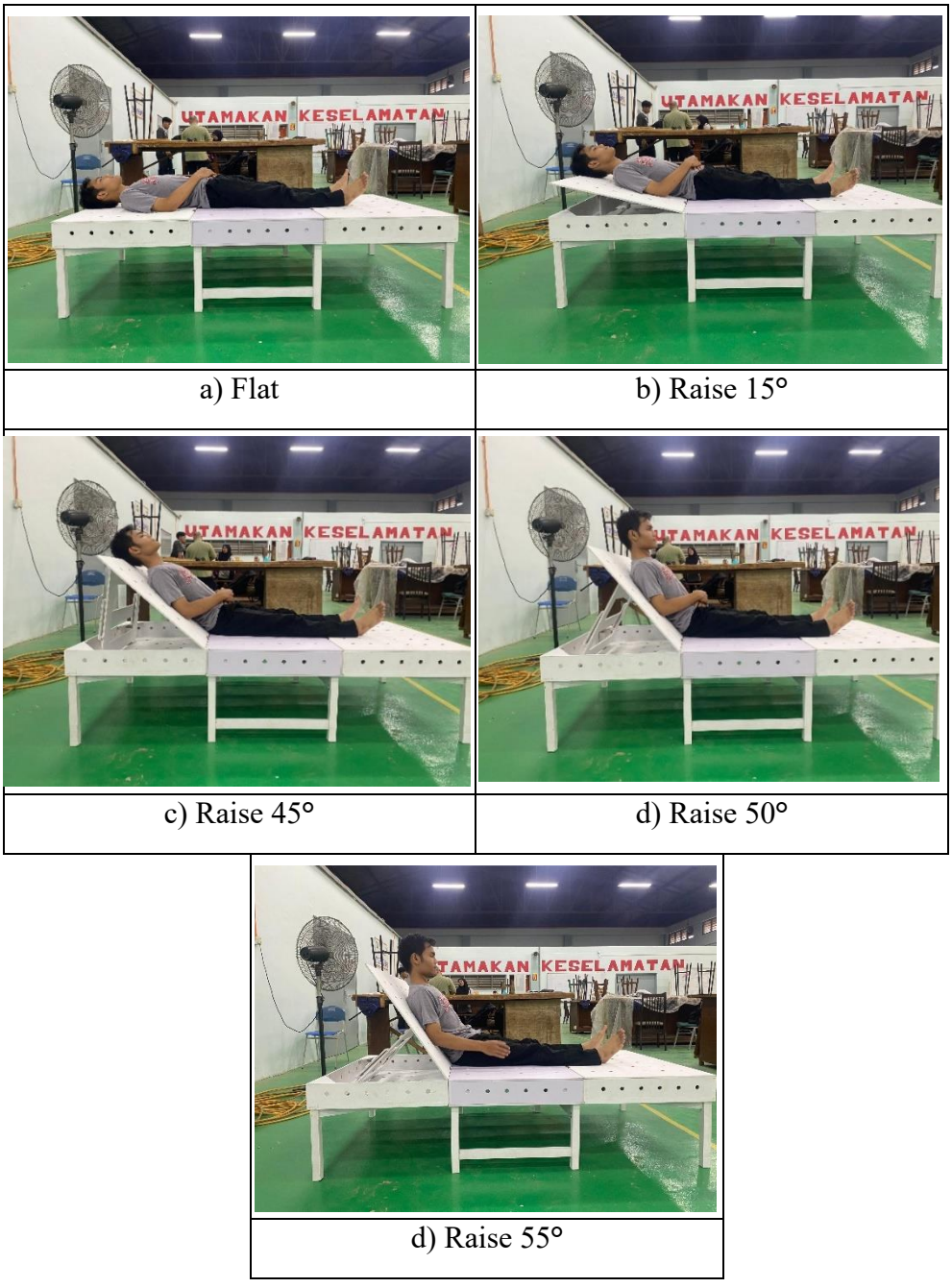


***Figure 3. 12**: SANiBED final form*

3.5.9 ADJUSTABLE BACKREST LEVEL

As it known sanitary bed or hospital bed is a bed for patients. It is necessary to have adjustable backrest to give the comfort and ease towards the patient. In SANiBED there are four levels of adjustments which is two of them made specifically for some activities, figure below



a) Flat | b) Raise 15°

c) Raise 45° | d) Raise 50°

d) Raise 55°

***Figure 3. 13**: Show the levels of SANiBED backrest adjustment*

3.6 THE PORTABILITY OF SANIBED

With total weight of (top-10.6 + middle-7.1 + bottom-8.8) 26.5 kg SANiBED is considered as a light sanitary bed compared to others in market. Because of its form which is can be disassemble into three parts it's also can be carried anywhere with a quite small hatchback car such as Myvi gen 3 (table 3.5). Before load the SANiBED into the car the back passenger's seats must be folded down for the wide space.

***Figure 3. 14**: Disassembled SANiBED form in a hatchback car*

3.7 OHSUGA DESIGN METHOD ON SANiBED

The Ohsuga Method relates well to the SANiBED project, as both emphasize structured development, prototyping, and user-centered design.

In the SANiBED project, we started by identifying user needs for bedridden individuals and their caregivers. This aligns with the Ohsuga Method's focus on clear requirements analysis, ensuring we understood the functionality needed for easy waste management, comfort, and storage in the bed's design. The use of feedback loops also resembles the iterative testing with volunteers, where each prototype was refined based on real-world use cases and comfort, addressing any issues early on.

The SANiBED's design also incorporates knowledge representation, as we considered not only the physical but practical needs for bedridden care. Following these structured stages and receiving continuous feedback helped us improve the design, making the Ohsuga Method's principles highly relevant to the SANiBED project's success.

3.7.1 OHSUGA DESIGN METHOD

The Ohsuga Design Process is shows in figure 3.6.1, provides a structured, stage-by-stage approach to the design process, ensuring that projects progress in an organized manner from initial requirements gathering through conceptual design, preliminary design, and finally into detailed design. Each stage serves a distinct purpose but shares a common methodology that involves creating models of the design, followed by analysis, evaluation, and refinement. This iterative process allows designers to continuously improve their solutions by testing and adjusting their models as they move from one stage to the next (M.m.m. Sarcar, K. Mallikarjuna Rao, K. Lalit Narayan, 2008)

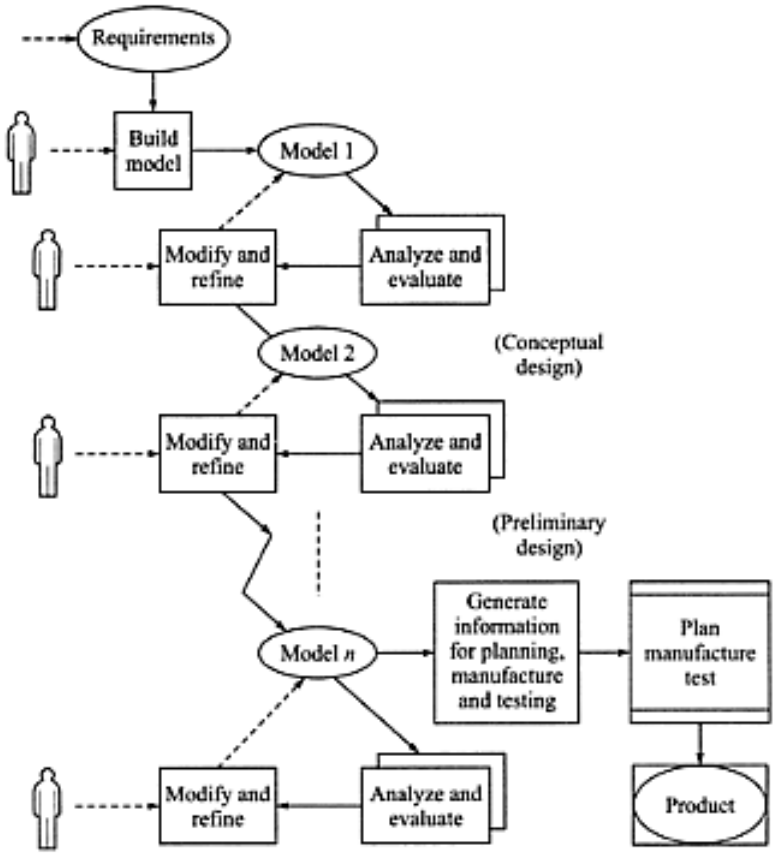


***Diagram 3. 2**: Ohsuga design process*

3.7.2 FIRST BUILD MODEL OF SANiBED

Requirement: - integrated side sliding (toilet facilities)

- portable can carry by part and easy to assembly

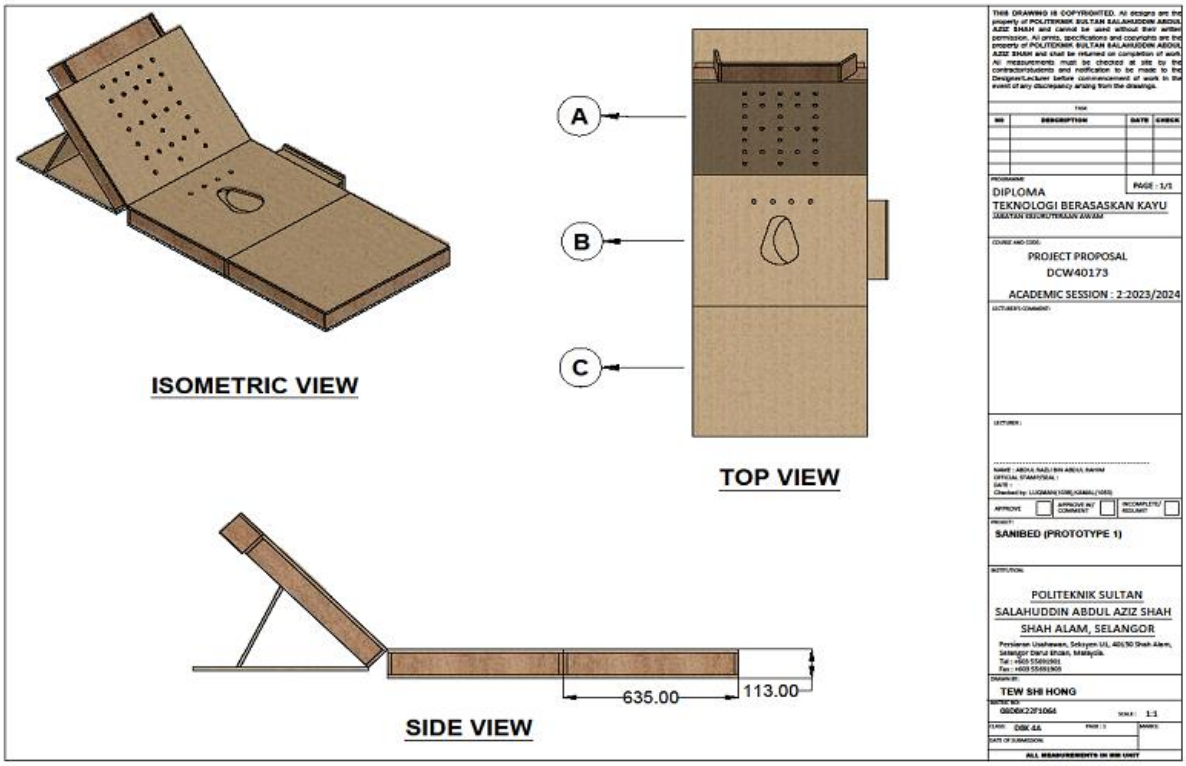


***Figure 3. 15**: First build model of SANiBED*

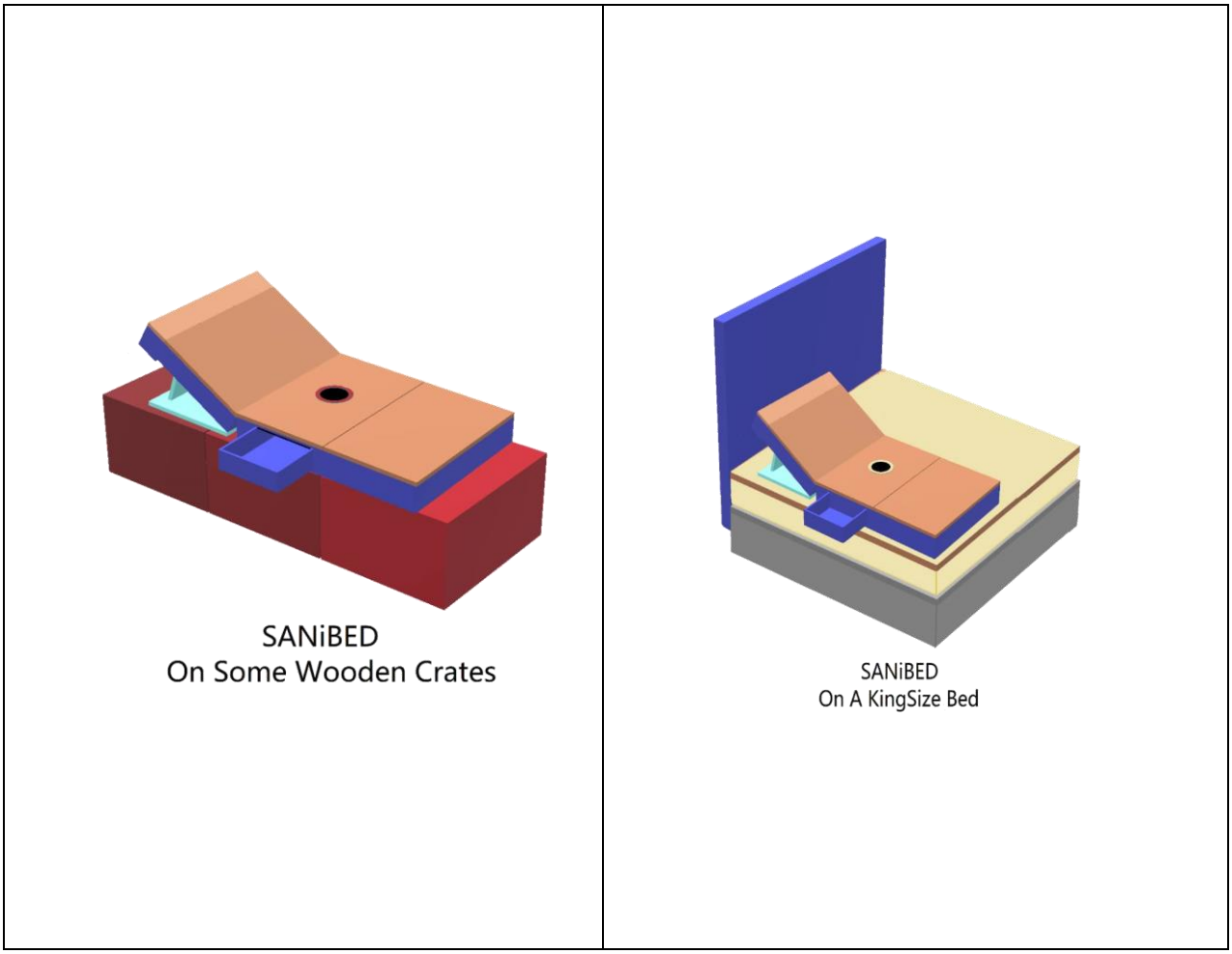


***Figure 3. 16**: SANiBED on wooden crates and king-sized bed*

3.7.3 FIRST MODEL OF SANiBED

***Figure 3. 17**: First model of SANiBED*

Analyse and Evaluate: -

- The side sliding (toilet facilities) can only be opened on one side, need to be opened from both sides.

- The part of top direction is open in wrong direction, the correct way to open is on the board not the box.

- The head rest is too short, need to make it higher.

Modify and refine: -

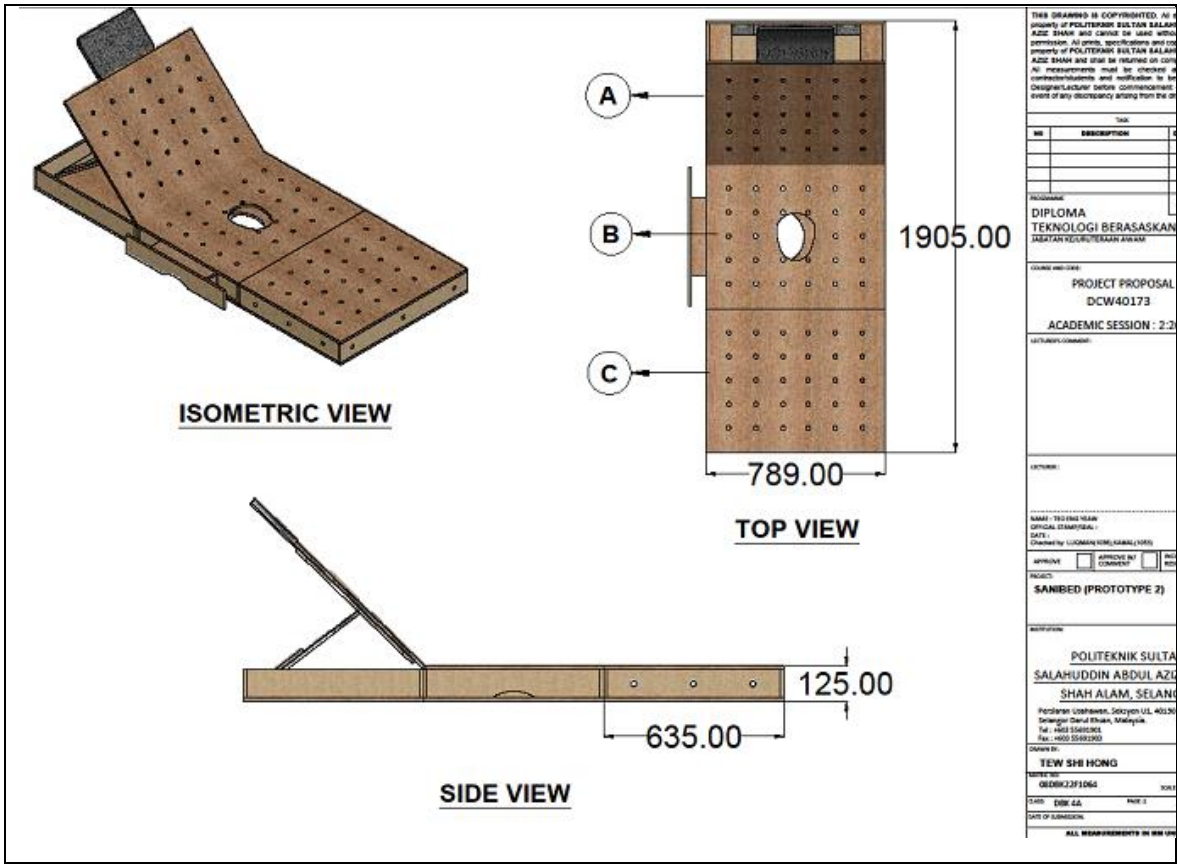


***Figure 3. 18**: SANiBED drawing after modification and redefining*

3.7.4 SECOND MODEL OF SANiBED

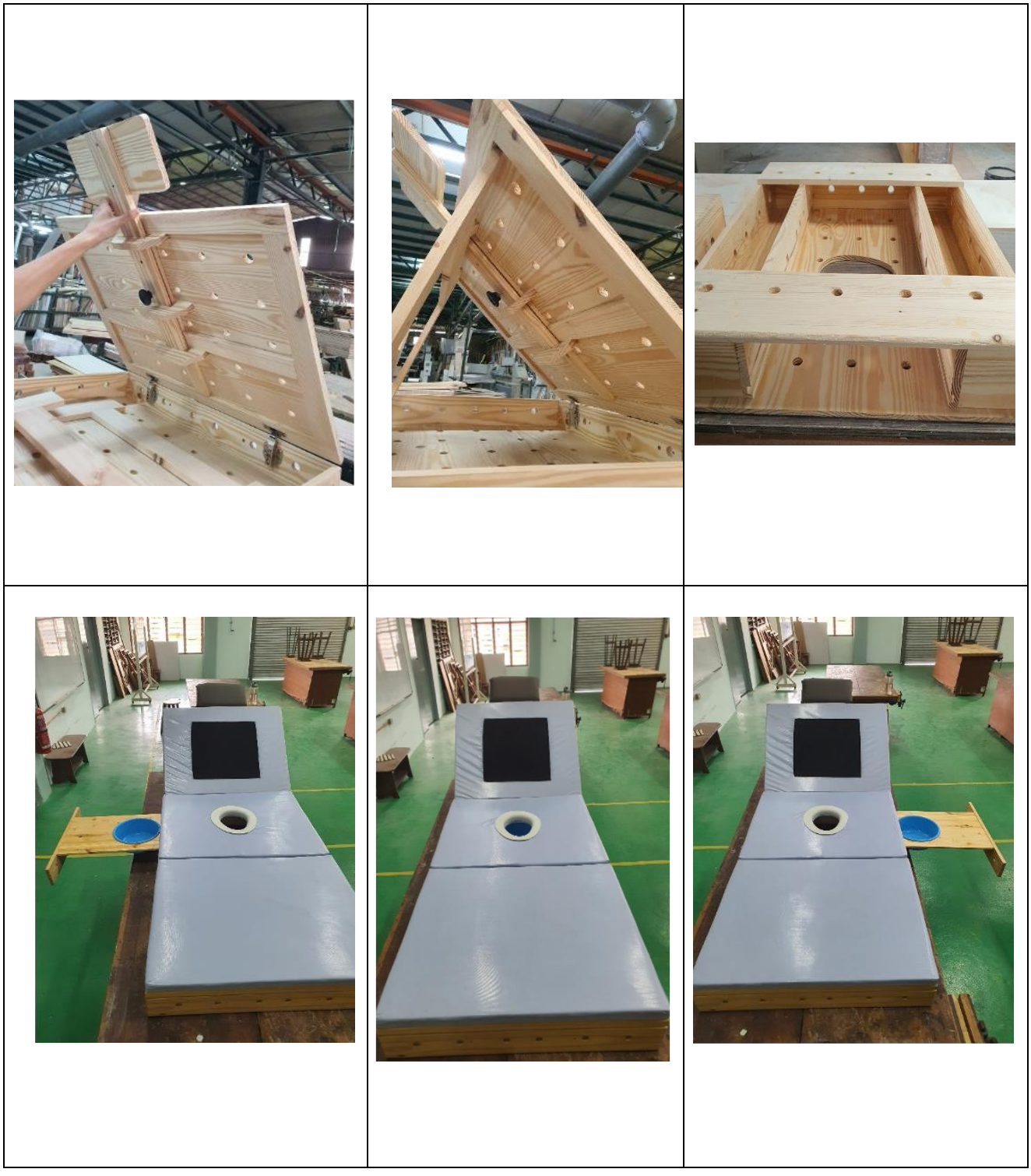


***Figure 3. 19**: Second model of SANiBED*

Analyse and Evaluate: -

- The side sliding (toilet facilities) of toilet bowl is little bit small, correct to bigger and longer size.

- The toilet sit is fixed, not suitable for every patient, correct to more position and with design of Golden Ratio

Modify and refine: -

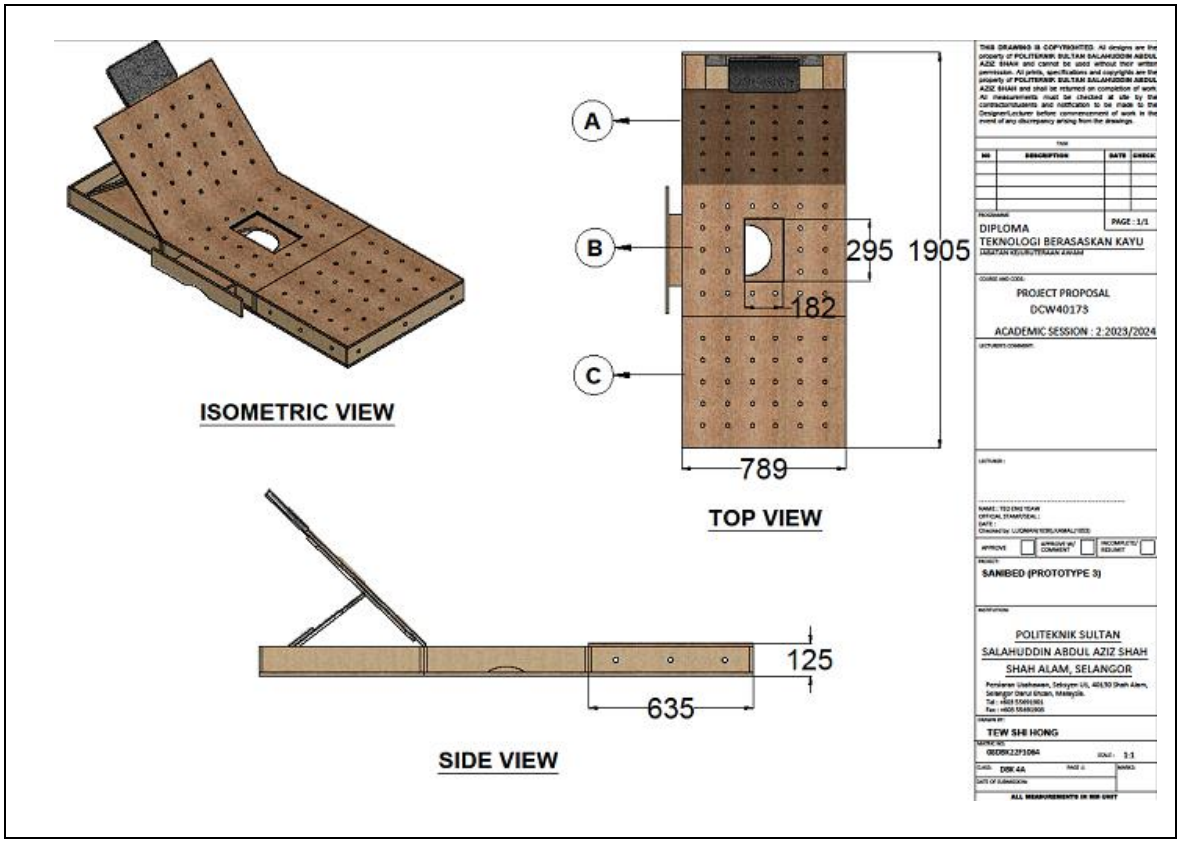


***Figure 3. 20**: Second model of SANiBED after modification and refining*

3.7.5 THIRD MODEL OF SANiBED

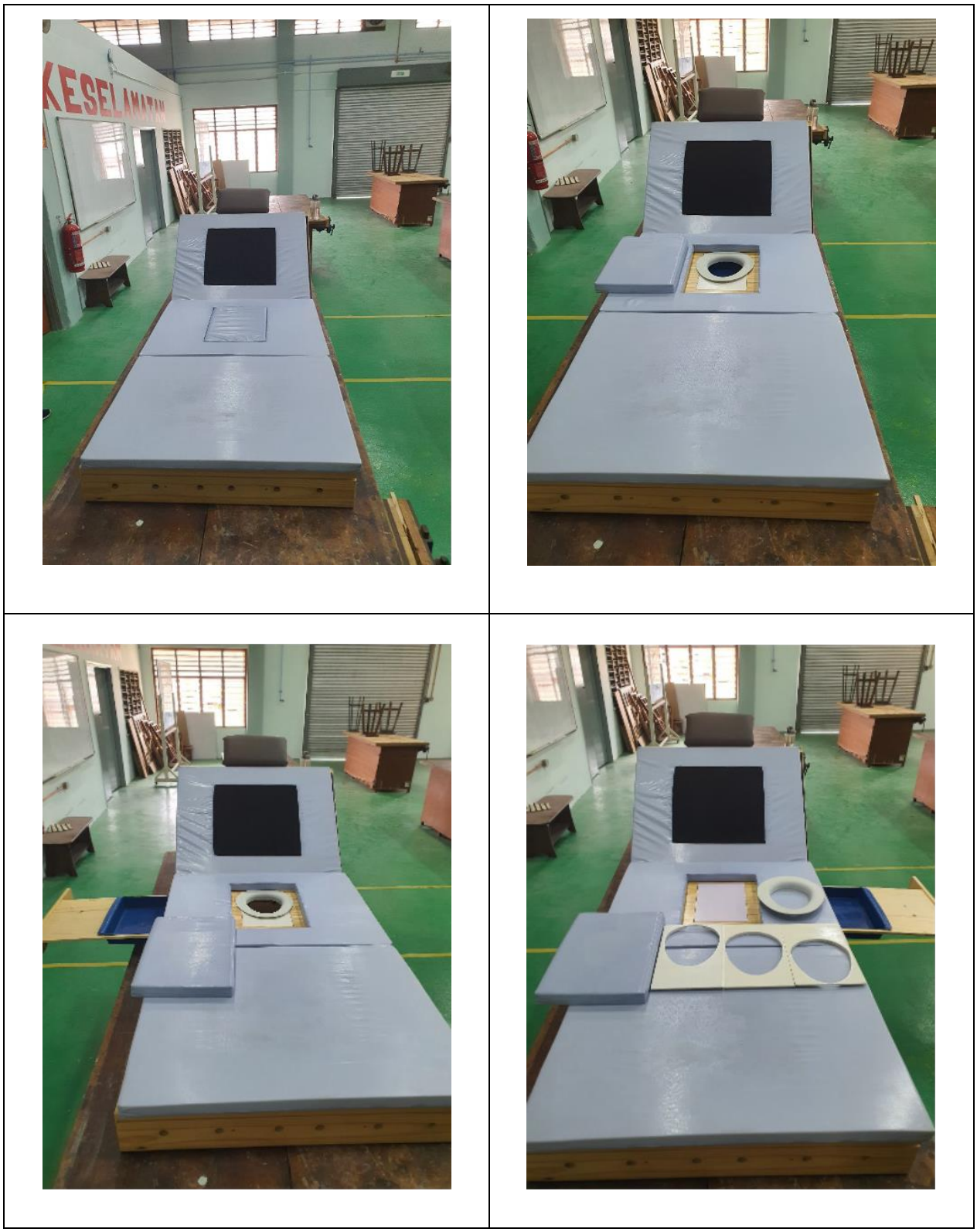


***Figure 3. 21**: Third model of SANiBED*

Analyse and Evaluate: -

- Reshape/redesign the overall bed design following the golden ratio
- Bed is too heavy, change to the light weight material
- Paint the bed with to for the finishing

Modify and refine: -

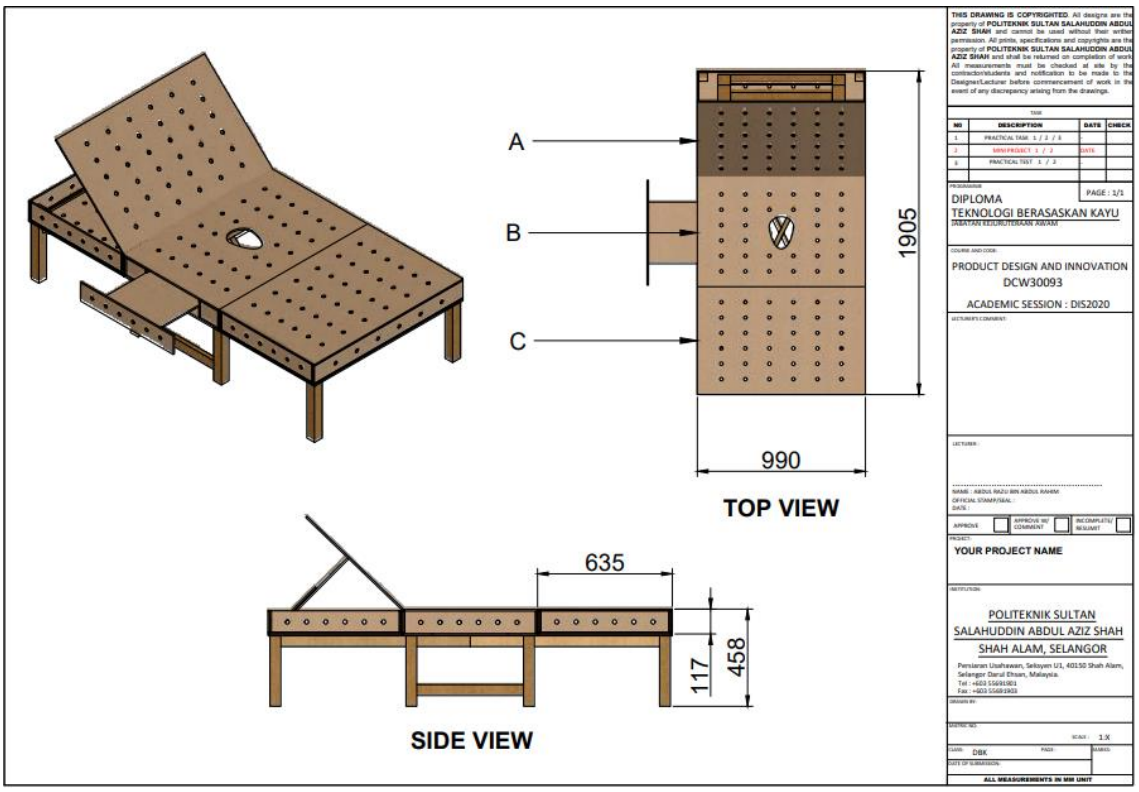


***Figure 3. 22**: Fourth model of SANiBED*

3.7.6 FOURTH MODEL OF SANiBED

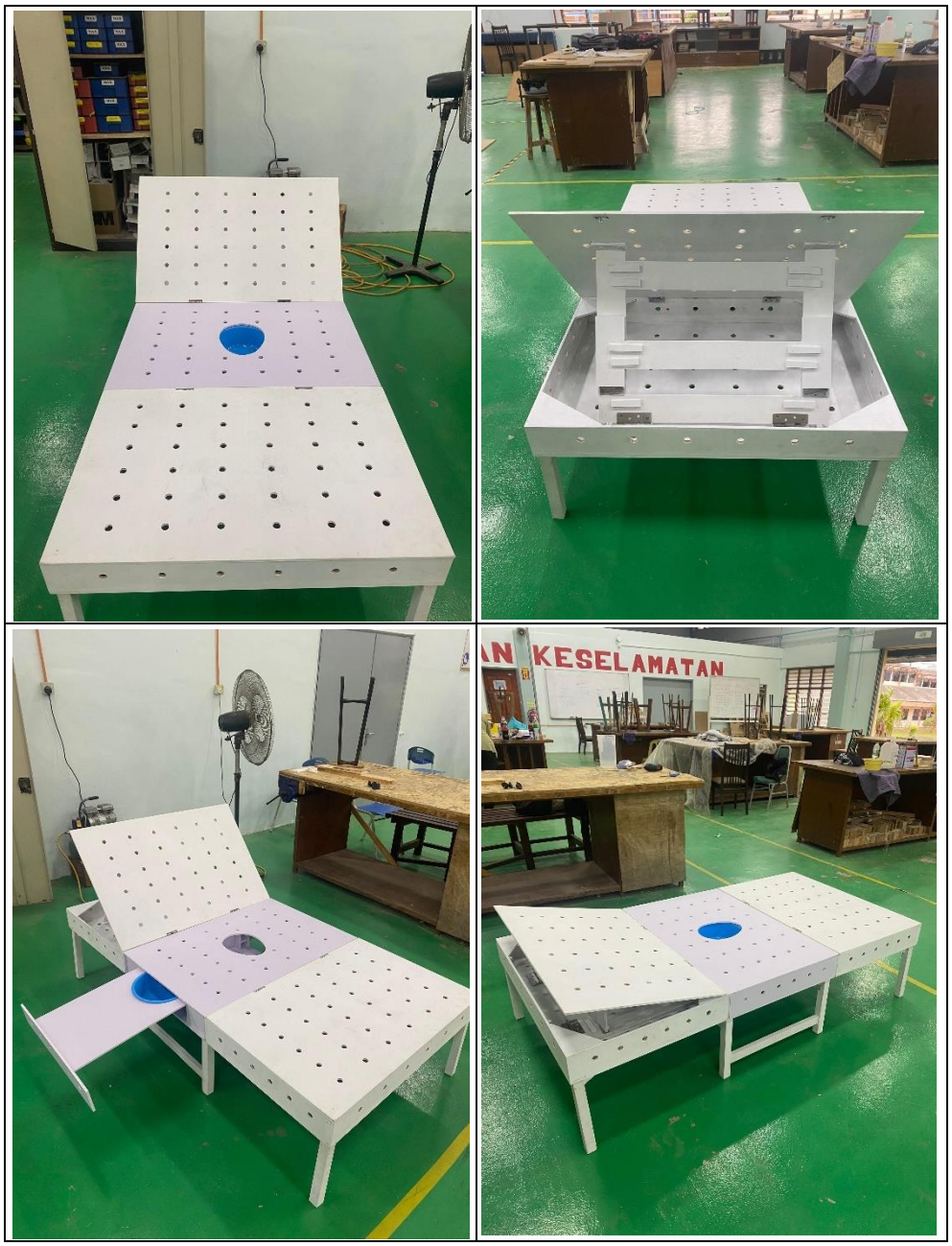


***Figure 3. 23**: Fourth model of SANiBED*

3.8 CUTTING LIST FOR SANiBED

Table 3. 1: Cutting list for SANiBED

Parts	Description	Quantity	Dimensions (mm)
Body(partA&C)	Face&Bottom	4	990*635*8
	Front&back side	4	990*101*8
	Lipping (F&B side)	4	990*8*8
	Left&Right side	4	603*101*8
	Lipping (L&R side)	8	101*8*8
	Lipping (L&R side bottom)	4	619*8*8
	Back rest (L&R)	2	499*78*8
	Back rest (M)	3	78*500*8
	Back rest (L&R)	2	199*78*8
	Triangle support	8	110*174*8
	Lipping triangle support	8	115*8*8
		8	194*8*8
Middle part	Face	1	990*635*9
	Front&back side	2	990*107*9
	Left&Right side	2	617*107*9
	Based support	2	200*635*9
	Based support	1	300*635*9
Slider	Slider face	1	666*363*9
	Slider Support	2	972*89*9
		2	972*8*9
	Structure support	8	127*107*9
Leg	Leg	8	408*51*51
	Front&Back	2	896*25*51
	Left&Right	2	571*25*51
	Cross	2	2065*25*51

3.9 BILL OF MATERIALS FOR SANiBED

Table 3. 2: Bill of materials for SANiBED

BILL SHEET OF ONE			BILL OF MATERIALS							
Part No.	Part per article	Part name	Finish			Rough			Species	Parts per R.blank
			L	W	T	L	W	T		
Body (partA&C)	4	Face&Bottom	990	635	8				Ply wood	
	4	Front&back side	990	101	8				Ply wood	
	4	Lipping (F&B side)	990	8	8				Yellow Meranti	
	4	Left&Right side	603	101	8				Ply wood	
	8	Lipping (L&R side)	101	8	8				Yellow Meranti	
	4	Lipping (L&R side bottom)	619	8	8				Yellow Meranti	
									Ply wood	
	2	Back rest (L&R)	499	78	8				Ply wood	
	3	Back rest (M)	78	500	8				Ply wood	
	2	Back rest (L&R)	199	78	8				Ply wood	
									Ply wood	
	8	Triangle support	110	174	8				Ply wood	
	8	Lipping triangle support	115	8	8				Yellow Meranti	
	8		194	8	8				Yellow Meranti	
Middle part	1	Face	990	635	9				Foam Board	
	2	Front&back side	990	107	9				Foam Board	
	2	Left&Right side	617	107	9				Foam Board	

	2	Based support	200	635	9				Foam Board	
	1	Based support	300	635	9				Foam Board	
Slider	1	Slider face	666	363	9				Foam Board	
	2	Slider Support	972	89	9				Foam Board	
	2	Slider Support	972	8	9				Foam Board	
	8	Structure support	127	107	9				Foam Board	
Leg	8	Leg	408	51	51				Nyatoh	
	2	Front&Back	896	25	51				Nyatoh	
	2	Left&Right	571	25	51				Nyatoh	
	2	Cross	2065	25	51				Nyatoh	

3.10 ESTIMATED COSTING FOR SANiBED

***Table 3. 3**: Estimated costing for SANiBED*

No.	Items	Units (mm)		Cost (RM)	
				Per/Unit	Total
A	Face&Bottom	990*635*8	4	10.20	40.80
	Front&back side	990*101*8	4	1.62	6.48
	Lipping (F&B side)	990*8*8	4	0.20	0.80
	Left&Right side	603*101*8	4	1.00	4
	Lipping (L&R side)	101*8*8	8	0.02	0.16
	Lipping (L&R side bottom)	619*8*8	4	0.12	0.48
	Back rest (L&R)	499*78*8	2	0.63	1.26
	Back rest (M)	78*500*8	3	0.63	1.89
	Back rest (L&R)	199*78*8	2	0.25	0.50
	Triangle support	110*174*8	8	0.31	2.48
	Lipping triangle support	115*8*8	8	0.02	0.16
		194*8*8	8	0.04	0.32
	Face	990*635*9	1	41.24	41.24
	Front&back side	990*107*9	2	6.95	13.9
	Left&Right side	617*107*9	2	4.33	8.66
	Based support	200*635*9	2	8.33	16.66
	Based support	300*635*9	1	12.50	12.50
	Slider face	666*363*9	1	15.86	15.86
	Slider Support	972*89*9	2	5.68	11.36
		972*8*9	2	0.51	1.02
	Structure support	127*107*9	8	0.90	7.20
	Leg	408*51*51	8	8.16	65.28
	Front&Back	896*25*51	2	3.50	7
	Left&Right	571*25*51	2	2.22	4.44
	Cross	2065*25*51	2	8.03	16.06
				Total(RM):	280.51
B	Nail f-20	100	1	0.007	0.7

	Wood glue	1	100g	3	3
	White paint	1	1L	50	50
	Top coating	1	1L	20	20
				Total(RM):	73.70
				A+B :	354.21

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

In the results and discussion, we discuss the manufacture of our product, SANiBED. Among the key points highlighted in this chapter are our findings on the statistics we took from mysidc.statistics.gov.my . The statistics is about "Number of Disabled Persons Registered by Type of Disability, Malaysia, 2002-2021.". The reason we looked up for the statistics is to see whether our product is relevant or not to be manufactured and distributed all around the country. Based on the statistics, we noticed that people who are suffering with physical disability are drastically increasing each year. Physical disabilities are defined as a long-term condition that limits a person's ability to move, function, or perform daily activities. Bedridden individuals are also categorised in physical disability.

4.2 DATA ANALYSIS

the data that obtained from mysidc.statistics.gov.my about "Number of Disabled Persons Registered by Type of Disability, Malaysia, 2002-2021."

Jadual 13.5.3: Bilangan kumulatif orang kurang upaya (OKU) yang berdaftar mengikut jenis kecacatan, Malaysia, 2002 - 2021

Table 13.5.3: Number of cumulative registered persons with disabilities (PWD) by type of disability, Malaysia, 2002 - 2021

Jenis kecacatan *Type of disability*	Tahun/*Year*																		
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015a	2016a	2017a	2018a	2019a	2020	2021
Jumlah *Total*	**79,047**	**83,315**	**150,617**	**172,916**	**197,519**	**220,250**	**248,858**	**283,577**	**314,247**	**359,203**	**445,006**	**494,074**	**531,962**	**365,677**	**409,269**	**453,258 0**	**486,529**	**542,916**	**586,558**	**621,248**
Penglihatan *Visually impaired*	14,738	14,154	15,364	16,211	18,258	20,039	22,856	26,158	27,840	31,924	40,510	46,307	50,827	32,807	36,692	40,466	43,711	48,353	52,111	55,112
Pendengaran *Hearing*	21,981	22,728	24,712	26,660	29,522	31,715	34,580	37,735	39,824	43,788	53,357	58,706	62,153	29,636	31,937	34,280	35,669	38,404	40,319	41,819
Fizikal *Physical*	41,311	45,356	51,090	58,371	66,250	73,559	83,070	94,346	105,020	123,346	148,461 b	162,215 b	174,795 b	125,491 b	142,600 b	159,674 b	175,958 b	196,388 b	213,716 b	227,032 b
Masalah pembelajaran *Learning disability*	-	-	57,483	66,906	76,619	85,812	96,246	109,743	120,109	134,659	165,281	178,800	188,911	129,550	143,334	157,714	165,261	186,416	201,355	213,592
Cerebral palsy	-	-	34	176	887	1,787	2,890	4,071	4,068	-	-	-	-	-	-	-	-	-	-	-
Pertuturan *Speech*	-	-	-	-	-	-	-	-	334	725	1,734	3,677	3,988	1,827	2,104	2,355	2,510	2,786	2,996	3,204
Mental	-	-	-	-	-	-	-	-	3,663	8,927	14,990	19,914	24,263	29,403	33,518	37,537	40,348	45,080	48,644	51,599
Lain-lain *Others*	1,017	1,077	1,934	4,592	5,983	7,338	9,216	11,524	13,389	15,834	20,673	24,455	27,025	16,963	19,084	21,232	23,072	25,489	27,417	28,890

Sumber: Jabatan Kebajikan Masyarakat Malaysia

Source: Department of Social Welfare, Malaysia

***Nota**/Notes:*

- **Tiada/*Nil***

a **Data disemak semula dengan pembersihan data bagi kes-kes yang telah meninggal dan sebagainya**
Revised data with cleansing data for dead cases and others

b **Termasuk Cerebral Palsy**
Includes Cerebral Palsy

***Diagram 4. 1**: Number of cumulative registered person with disabilities*

4.3 RESULTS

The data in this table from Malaysia's Department of Social Welfare shows an increase in the number of registered individuals with physical disabilities over the years, reaching 227,032 in 2021. This rising number highlights a growing need for accessible solutions to improve the quality of life for those with limited mobility.

The SANiBED project, which we developed as an affordable sanitary bed for bedridden individuals, could directly benefit people with physical disabilities. Many with severe physical impairments rely on caregivers, and SANiBED's features, such as its waste management system and adjustable backrest, can provide both convenience and comfort. By addressing the sanitation and caregiving challenges faced by bedridden individuals, SANiBED can meet some of the essential needs within this population, potentially easing the strain on caregivers and enhancing the dignity and quality of life for individuals with physical disabilities.

4.4 DISCUSSION

In the discussion section, the table provides essential insights into the increasing demand for products that assist people with physical disabilities in Malaysia. The data from the Department of Social Welfare indicates a steady rise in the number of registered individuals with physical disabilities over the past two decades, with the count reaching 227,032 in 2021. This significant number underlines a large and growing target population that could benefit from specialized assistive products like SANiBED.

The first discussion is about the relevance of SANiBED. The increasing population of people with physical disabilities highlights a critical need for innovative solutions that address mobility limitations and facilitate daily care. Many physically disabled individuals, especially those who are bedridden, face challenges in maintaining hygiene and comfort due to prolonged immobility. Caregivers often struggle to provide effective care due to the lack of suitable assistive devices. SANiBED, designed as an affordable sanitary bed with features specifically catering to bedridden individuals, provides solutions to these issues. Its adjustable backrest, integrated waste management system, and storage options make it easier for caregivers to manage hygiene needs while ensuring the user's comfort.

The next discussion is about market demand and potential impact. The data reflects a clear demand for products that cater to this demographic. As the number of people with physical disabilities rises, the relevance and marketability of SANiBED increase proportionally. The bed's design aligns with the needs of bedridden individuals, making it a practical product for homes and care centres. Manufacturing and distributing SANiBED in Malaysia could fill a gap in the market, providing an affordable and effective option for both private and institutional caregivers.

In conclusion, based on the data, SANiBED is not only relevant but essential for addressing the growing need for specialized care products in Malaysia. Its production and distribution could significantly impact the lives of people with physical disabilities and their caregivers, ultimately improving their quality of life and easing the caregiving process.

CHAPTER 5

CONCLUSION

5.1 INTRODUCTION

The objective of this project was to improvise existing innovations by applying the golden ratio principle. Another goal was to establish SANiBED as a practical aid for caregivers, including family members and healthcare providers, to facilitate daily care for bedridden individuals. This chapter summarises the key findings, limitations, and recommendations based on our research and development process.

5.2 CONCLUSION

In conclusion, SANiBED successfully fulfilled its intended purpose as a practical sanitary bed for bedridden individuals. The data collected throughout the testing process showed that both caregivers and users found it to be a comfortable and functional aid for daily care needs. The design refinements, particularly around the mattress, storage spaces, and waste management system, significantly improved the product's usability and hygiene. Overall, SANiBED has achieved its objectives.

5.3 RECOMMENDATIONS

For the SANiBED, a change from wood to a combination of plastic and C-channel steel could enhance durability and hygiene, as high-strength plastic materials like ABS or HDPE are lightweight, easy to clean, and resistant to moisture and bacteria, while the C-channel steel frame provides strong support and is rust-resistant for long-term use. Also, for the bed foot need to make some design adjustment for current design (figure 3.4) to make it easy to carry anywhere by small car. The design adjustment such as the X, it consumes more space and here is the design adjustment (Appendix C). For the mattress, using a medical-grade, high-density foam such as memory foam or gel-infused foam with an increased thickness of 4-5 inches would improve comfort, helping prevent bedsores for bedridden patients. To ensure the bedsheet remains cool and comfortable, opting for a breathable and moisture-wicking fabric, such as a cotton blend or bamboo fiber, would help regulate body temperature. Additionally, bedsheets with anti-microbial properties could maintain cleanliness and withstand frequent washing, offering both comfort and practicality for the user.

5.4 LIMITATIONS

The SANiBED project faced several limitations. First, the initial prototype's dimensions did not accommodate all body types comfortably, limiting its versatility. Additionally, the mattress thickness was insufficient for extended use, leading to discomfort for some users. The materials used, while affordable, may not be durable enough for long-term, heavy-duty use. Finally, the sliding drawer mechanism for waste management, though functional, requires further refinement to ensure ease of use and minimize the risk of spills. These limitations highlight areas for improvement in future development of SANiBED.

5.5 SUMMARY

We look forward to future improvements with new perspectives gained from data collection through interviews and surveys. We also plan to manage our time better to gather regular feedback from the sample group, allowing us to gain deeper insights. While working to achieve our objectives on time, we aim to balance efficiency and effectiveness. Additionally, we will consider the recommendations provided by us sample group to enhance SANiBED further. By acknowledging the limitations, we have learned to approach the project from all perspectives, and we hope to make continuous improvements in the future.

5.6 CLOSING

We would like to express our highest gratitude and thanks to our supervisor, Mr. Teo Eng Yeaw, Mr. Dickson Wong (SANiBED inventor), Politeknik Sultan Salahuddin Abdul Aziz Shah, and In Cube Customize Sdn Bhd for their unwavering support and commitment in making this final year project a success. Their contributions of ideas, insights, and guidance have not only enriched the outcome of this project but have also opened doors to more creative and innovative thinking in producing quality work.

Mr. Teo Eng Yeaw, as our dedicated supervisor, has provided invaluable guidance and support throughout this process. Politeknik Sultan Salahuddin Abdul Aziz Shah has served as the main platform that allowed us to explore new knowledge and skills. We would also like to extend our thanks to In Cube Customize Sdn Bhd for generously sharing valuable ideas that were instrumental in shaping the concept and foundation of this project.

We deeply appreciate the contributions, effort, and dedication given by everyone involved in the success of this project. Without the guidance and cooperation from Mr. Teo Eng Yeaw, Politeknik Sultan Salahuddin Abdul Aziz Shah, and In Cube Customize Sdn Bhd, the success of this project would not have been possible. Our heartfelt thanks go to all for the support, inspiration, and guidance that have been provided.

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APPENDIX A

DECLARATION OF DISTRIBUTION OF REPORT WRITING

Tew Shi Hong

- Produce product drawing and detail
- Writing Chapter 3

Muhammad Kamal Irfan bin Kamal Badrin

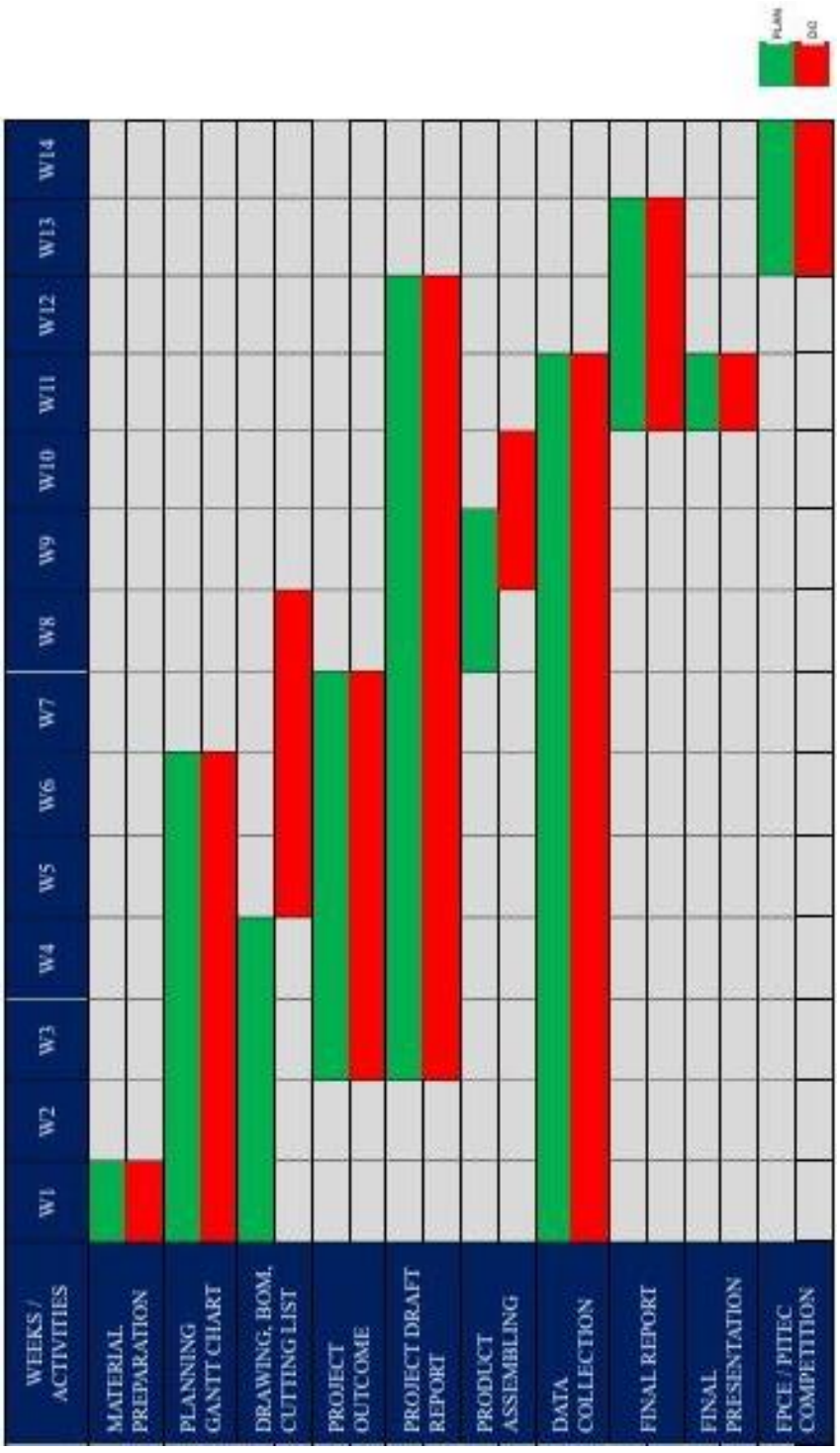
- Writing Chapter 1 to Chapter 5
- Collecting data (references, take project moment)

Muhammad luqman hafiz bin Muhd Akhtar

- Arranging full document

APPENDIX B

SANIBED GANTT



APPENDIX C

FIRST FIELD VISIT REPORT FOR SANIBED PROTOTYPE TESTING

Date: 2nd July 2024

Location: Rawang, Selangor

INTRODUCTION

As part of our final year project, we developed SANiBED, an affordable, portable sanitary bed designed for bedridden individuals. Our goal was to create a solution that could be placed on existing beds, saving space while offering comfort and ease of use for both patients and caregivers. On 2nd July 2024, we conducted a field test with a bedridden volunteer, Khadijah binti Talib, who live in Rawang, Selangor to evaluate the prototype's functionality and practicality.

PATIENT BACKGROUND

Our volunteer, Khadijah binti Talib, is a 70-year-old woman who has been bedridden for four years due to high blood pressure and stroke. She lives with her husband, Razali bin Omar, a former army member. They rely entirely on Zakat for their living expenses. Khadijah's husband had tried sending her to a nursing home, but the poor conditions and high cost (RM2500/month) forced him to withdraw her. He also hired a maid, but due to negligence and poor care, the maid was dismissed after just a week.

INITIAL TESTING

We brought the first prototype of SANiBED to Khadijah's home. The prototype was designed to fit on existing hospital beds, ensuring it could be easily integrated into most households. However, upon arrival, we encountered two major issues:

1. **Size Mismatch**: The prototype was too long for the existing hospital bed in Khadijah's house, making it impossible to use effectively.

2. **Drawer Access Blocked**: The side rails of the hospital bed obstructed the SANiBED's built-in drawer, rendering it unusable.

Due to these issues, we had to bring the prototype back to Politeknik for modifications. We adjusted both the bed's length and the positioning of the side drawer to accommodate the hospital bed's features.

REVISED PROTOTYPE

The following day, we returned to Khadijah's house with the modified SANiBED. This time, the bed fit perfectly on the hospital bed, resolving the earlier space concerns. The SANiBED's design, which allows it to be placed on existing beds, worked as intended. However, a few days later, we received feedback from Khadijah's husband, Razali, stating that the bed was still uncomfortable due to the mattress being too thin. Khadijah experienced back pain after using the bed, which meant the prototype failed to meet its primary goal of providing comfort for bedridden individuals.

CONCLUSION

Despite our initial enthusiasm, the first prototype of SANiBED did not perform as expected during the field test. While we successfully resolved the size and drawer issues, the thin mattress caused discomfort for the patient, leading to the failure of our first attempt. This experience has provided us with valuable insights into the practical challenges faced by bedridden individuals and their caregivers. Moving forward, we will focus on improving the mattress quality and overall comfort of SANiBED to better meet the needs of patients like Khadijah binti Talib.

SECOND FIELD VISIT REPORT FOR SANIBED PROTOTYPE TESTING

Date: 15th August 2024

Location: Cheras, Kuala Lumpur

INTRODUCTION

As part of the continuous development of our final year project, SANiBED, we conducted another field visit on 15th August 2024 to evaluate the needs of a new volunteer who was willing to test our portable sanitary bed. The purpose of this visit was to assess the patient's condition and environment before bringing the SANiBED prototype for testing. This allowed us to ensure that any necessary modifications could be made beforehand.

PATIENT BACKGROUND

Our second volunteer is a 20-year-old male named Iman Sharif bin Suleiman from Myanmar who has been living in Malaysia for five years. In December 2023, he sustained serious injuries after allegedly falling from a 25-foot-high roof, which resulted in paralysis of his lower limbs. He is fully dependent on his older brother for daily care. His brother is unable to work due to the need to constantly care for him, and they rely on assistance from the United Nations (UN) for their living expenses.

ASSESSMENT AND MODIFICATIONS

During our visit, we observed that transferring the patient between his bed and wheelchair was particularly challenging for his brother, who manages his care on his own. After carefully considering their needs, we decided to modify our SANiBED prototype in two key ways:

1. **Height Adjustment**: We added a leg to the SANiBED prototype to adjust its height to match the level of the patient's wheelchair. This modification was made to ensure smoother and more effortless transfers between the bed and the wheelchair, which would significantly reduce the physical strain on the patient's brother.

2. **Mattress Upgrade**: Learning from our previous experience with a thin mattress causing discomfort for our first volunteer, we opted to upgrade the mattress for this test. We purchased and modified an aftermarket "multipurpose foldable mattress" from the company Goodnite. This mattress was chosen for its enhanced comfort and support, ensuring the patient would not experience the same issues of back pain that arose with the earlier prototype.

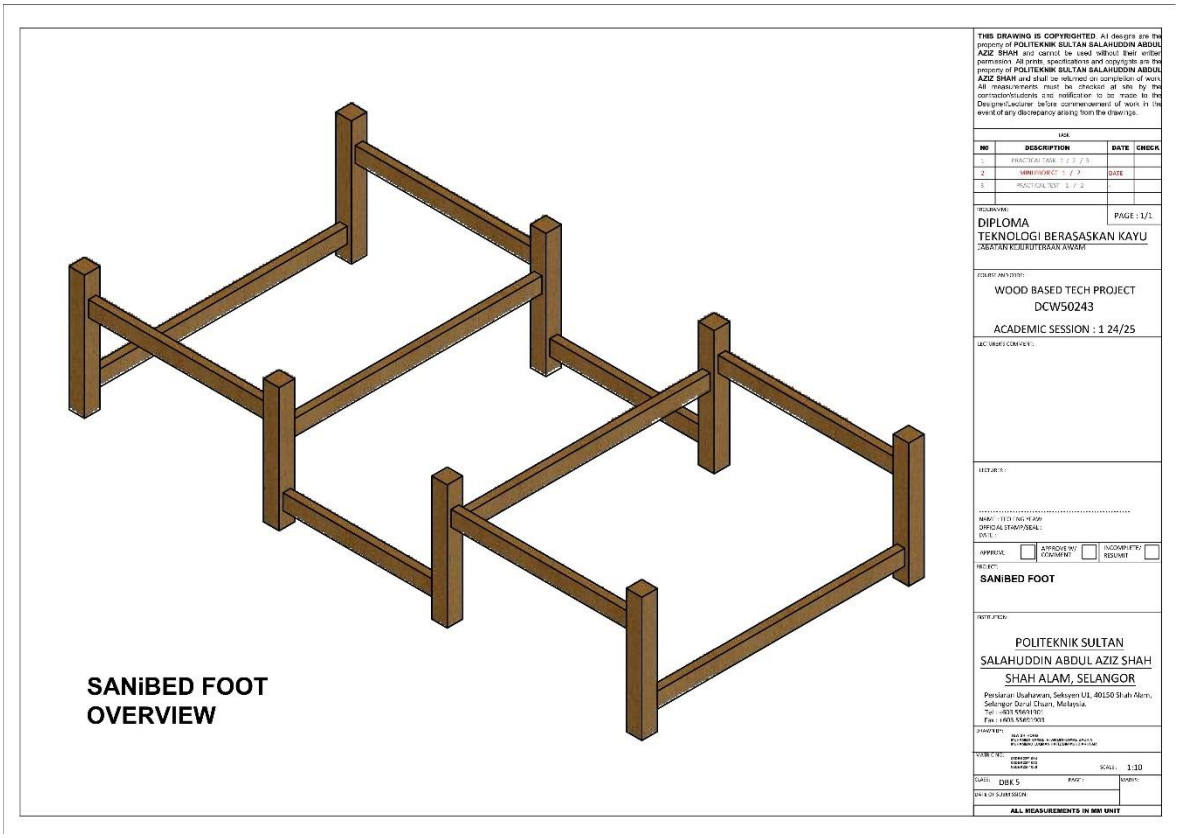
On 13th September 2024, we delivered the modified SANiBED to the patient's home and tested the setup. The bed height aligned well with the wheelchair, and the upgraded mattress offered improved comfort compared to the earlier prototype. Both the patient and his brother responded positively to the changes, noting that the transfers between the bed and wheelchair were easier, and the mattress felt significantly more comfortable.

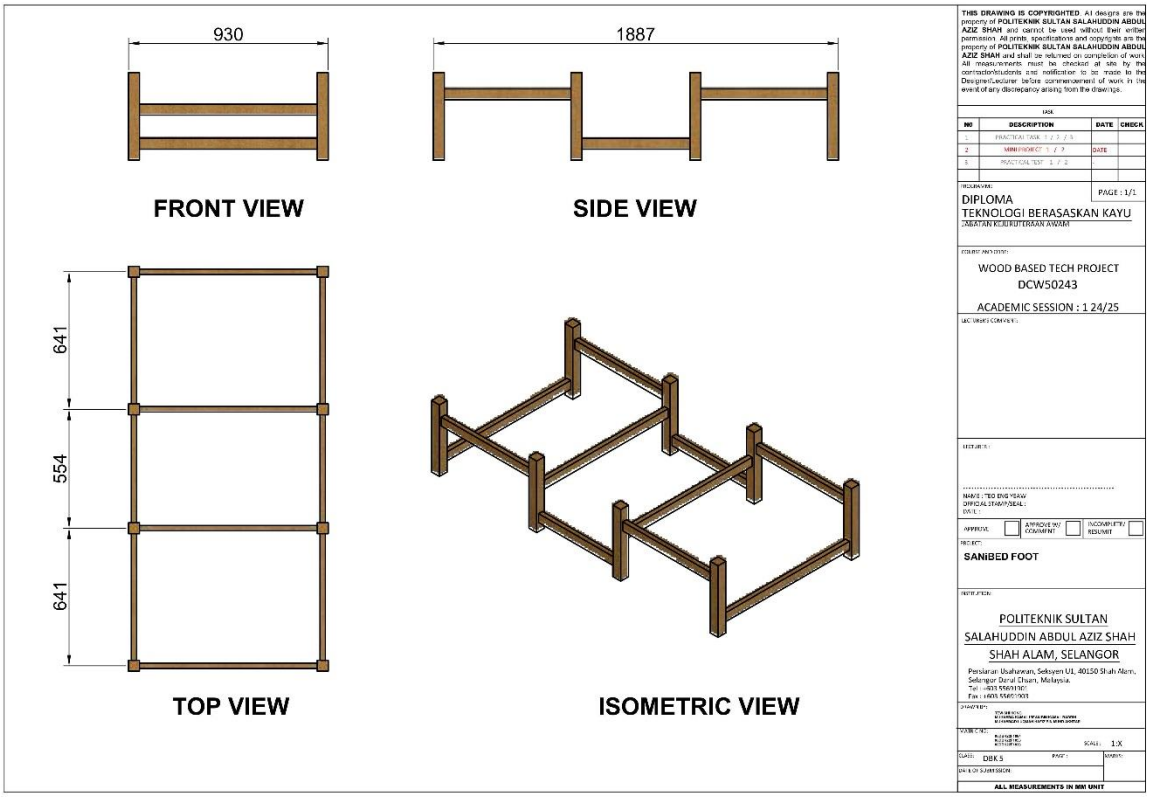
CONCLUSION

The modifications to the SANiBED prototype, particularly the height adjustment and mattress upgrade, addressed the key challenges identified during our earlier visit. This test represents a successful iteration of the product, showing that the adjustments we made enhanced the usability and comfort of the bed for both the patient and his caregiver. The positive feedback from this test provides valuable insight as we continue refining SANiBED to better serve bedridden individuals and their families.

APPENDIX D

New design suggestion for the SANiBED foot. For the new design the overall structure is one not like current design. So, here is the new design with some details.




930
1887
FRONT VIEW
SIDE VIEW
641
554
641
TOP VIEW
ISOMETRIC VIEW
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TASK
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DIPLOMA
TEKNOLOGI BERASASKAN KAYU
JABATAN KEJURUTERAAN AWAM
WOOD BASED TECH PROJECT
DCW50243
ACADEMIC SESSION : 1 24/25
SANiBED FOOT
POLITEKNIK SULTAN
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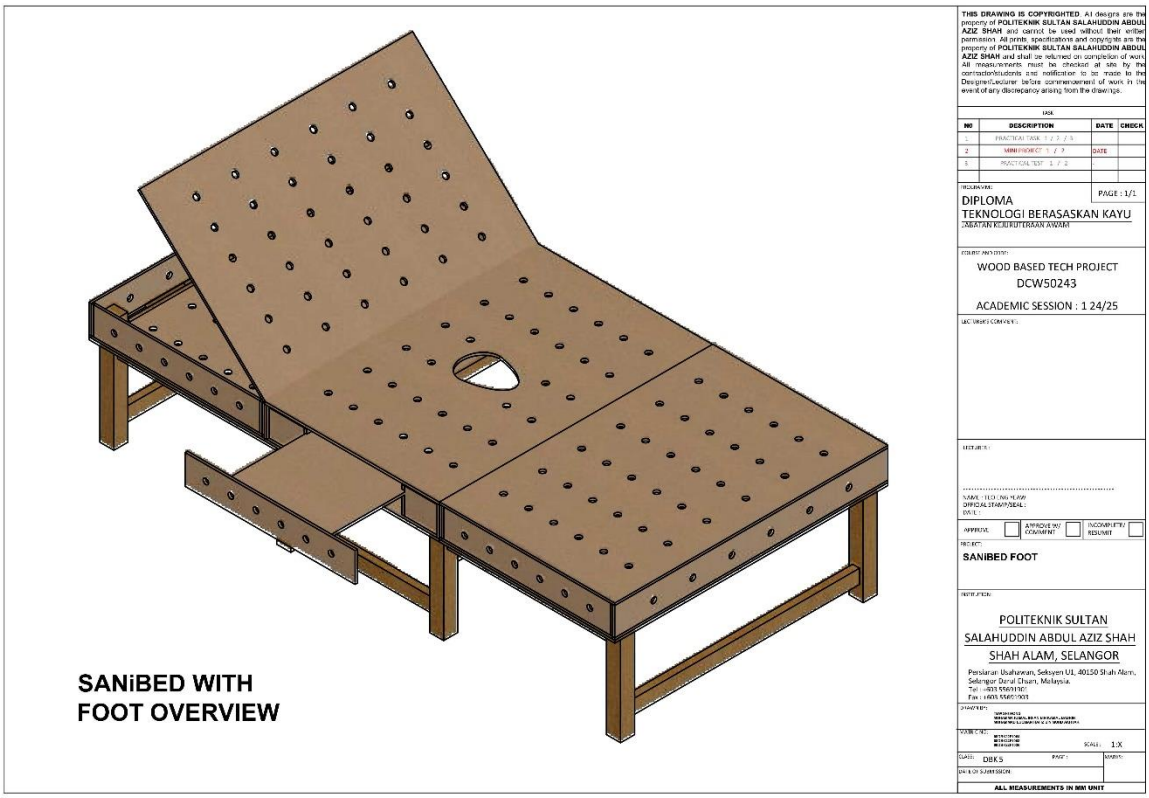
SHAH ALAM, SELANGOR
Persiaran Usahawan, Seksyen U1, 40150 Shah Alam, Selangor Darul Ehsan, Malaysia.
SCALE : 1:X
DEKS
ALL MEASUREMENTS IN MM UNIT


SANiBED WITH
FOOT OVERVIEW
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SCALE : 1:X
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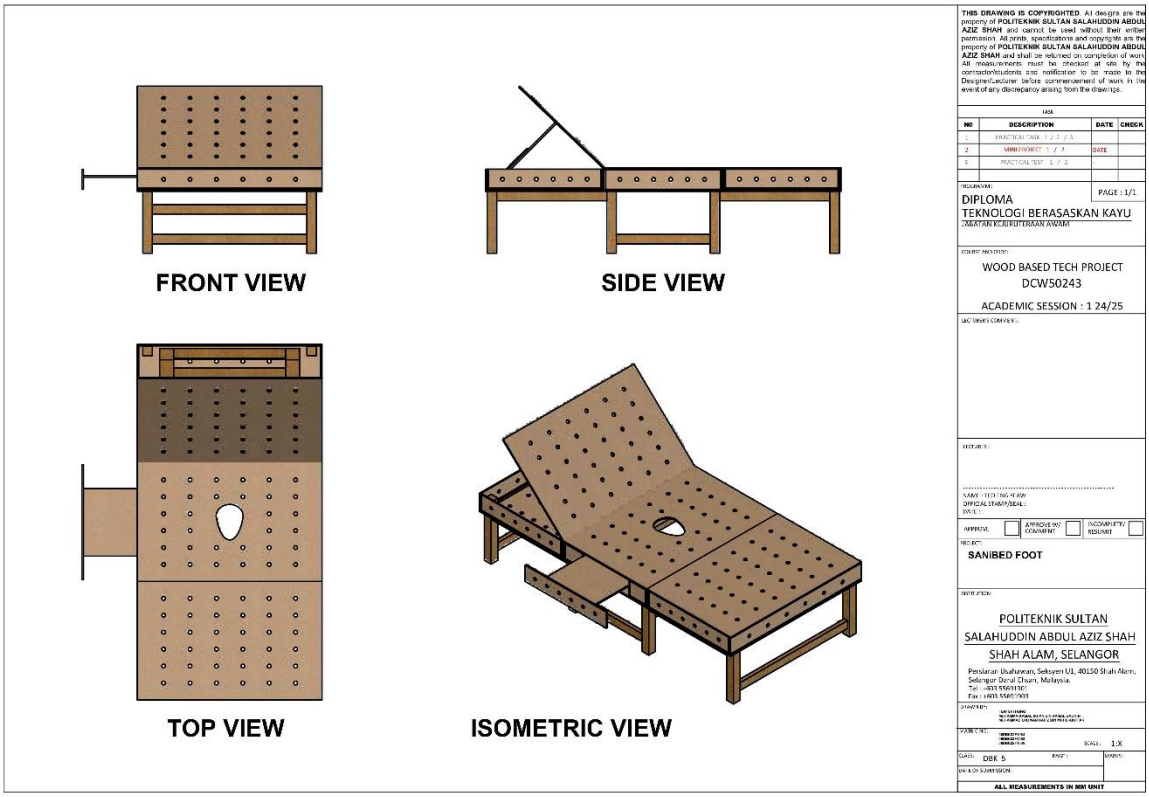
FRONT VIEW
SIDE VIEW
TOP VIEW
ISOMETRIC VIEW
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SALAHUDDIN ABDUL AZIZ SHAH
SHAH ALAM, SELANGOR
DBK 5
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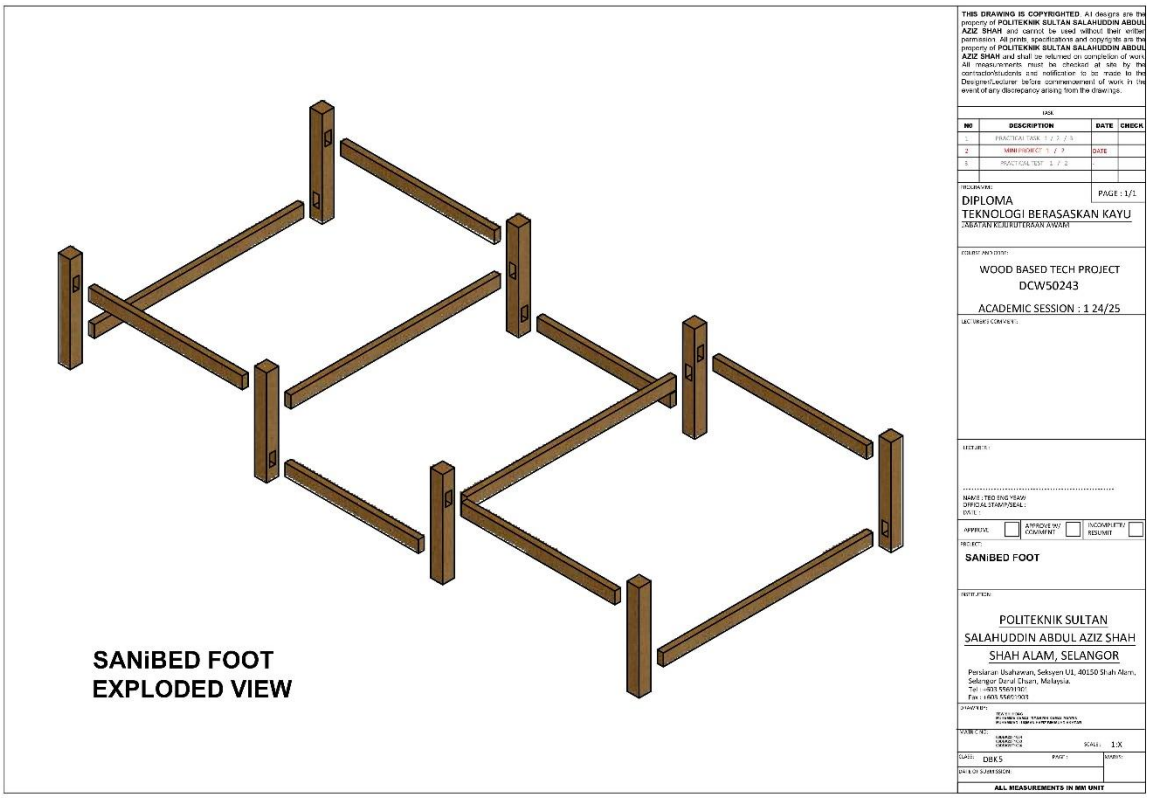
SANiBED FOOT
EXPLODED VIEW
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POLITEKNIK SULTAN
SALAHUDDIN ABDUL AZIZ SHAH
SHAH ALAM, SELANGOR
DBK5
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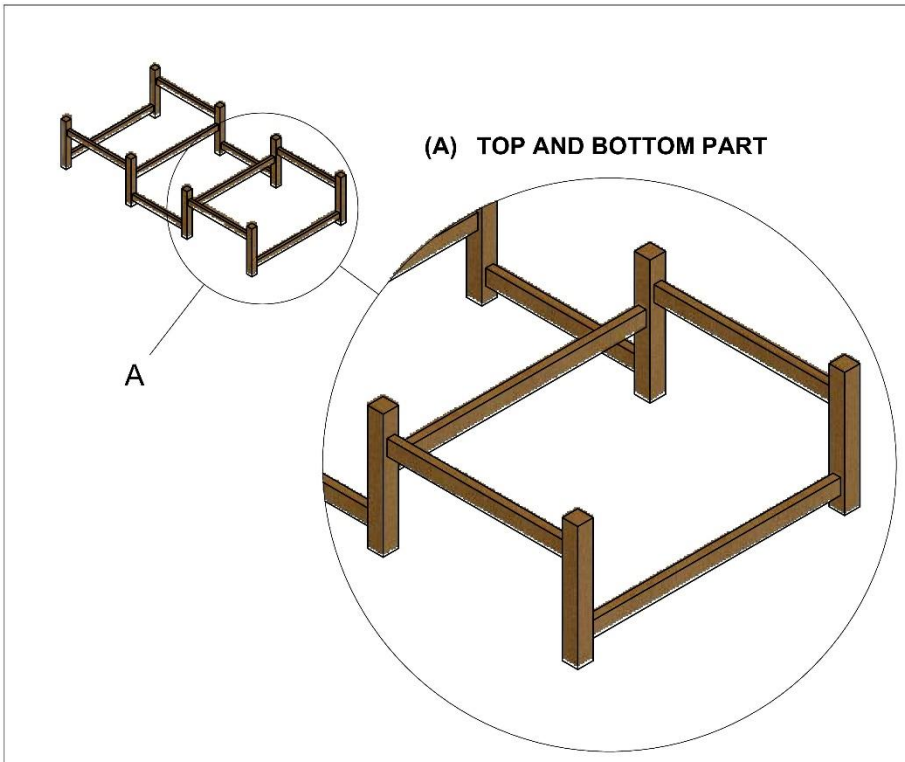

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2	MINI PROJECT 1 / 2	DATE	
3	PRACTICAL TEST 1 / 2	-	

PAGE : 1/1

DIPLOMA
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SCALE : 1:X

CLASS : DBK 5

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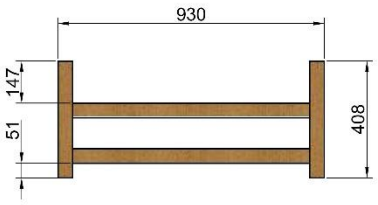

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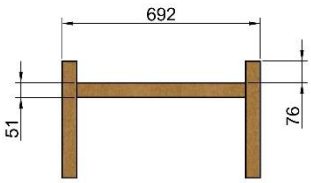

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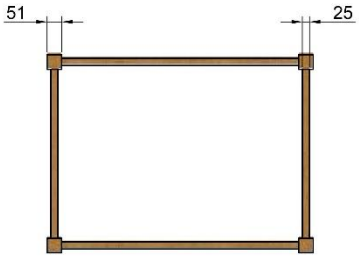
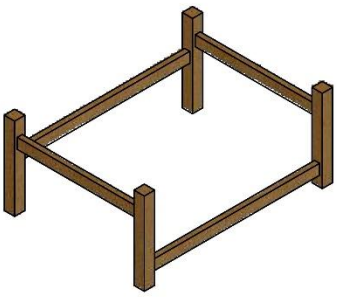


TOP VIEW



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PAGE : 1/1

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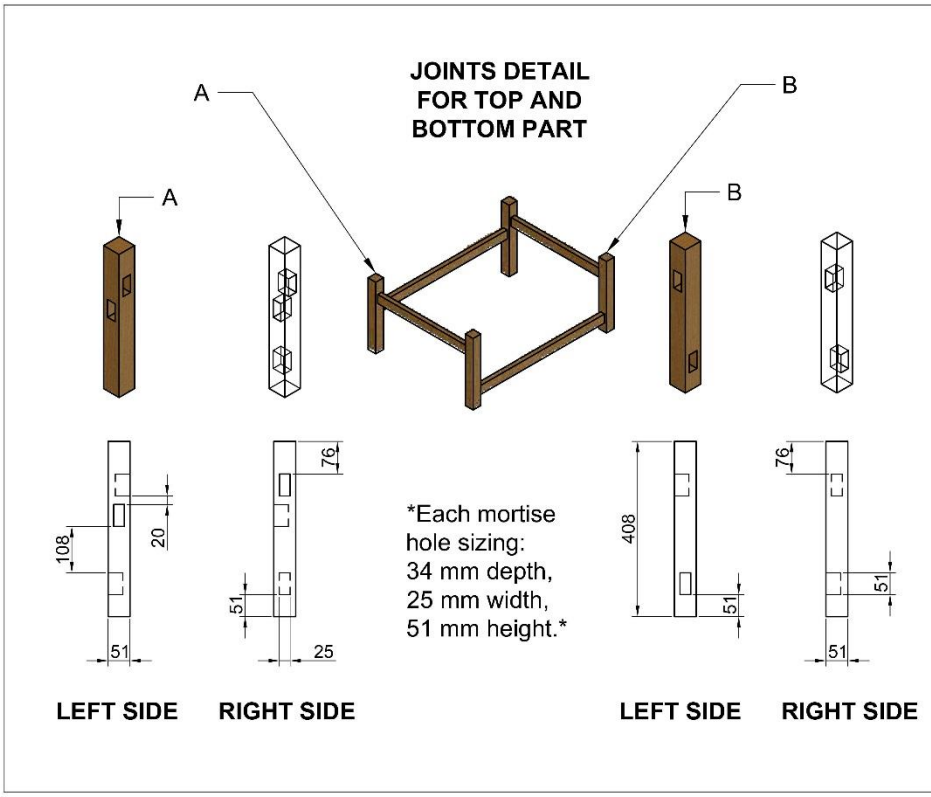

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PAGE : 1/1

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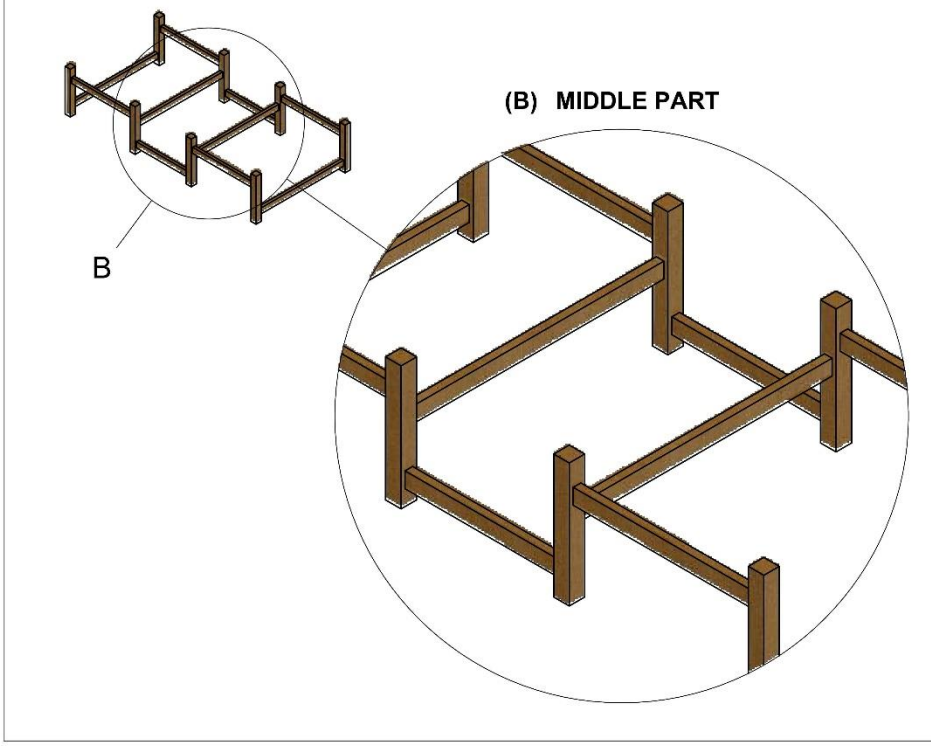

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PAGE : 1/1

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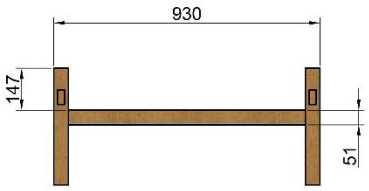

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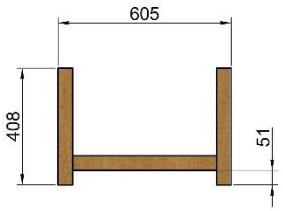

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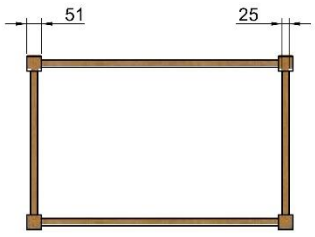

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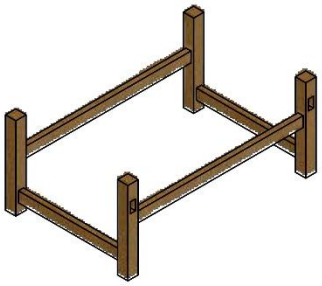

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3	PRACTICAL TEST 1 / 2	-	

PAGE : 1/1

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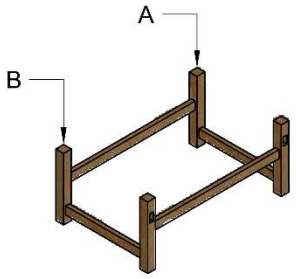
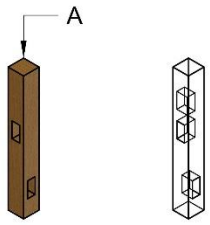
JOINTS DETAIL
MIDDLE PART





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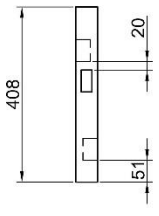
*Each mortise
hole sizing:
34 mm depth,
25 mm width,
51 mm height.*



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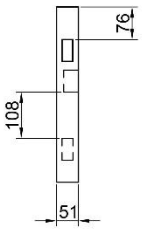

RIGHT SIDE

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PAGE : 1/1

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