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Exploring a Storage Concrete Rack Inspired by Sea Turtle

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Abstract: Researcher exploring a storage concrete rack inspired by sea turtles in this study as sea turtles is an endangered species and the population of sea turtles was in a serious decline. Meanwhile, public understanding and appreciation of wildlife is essential to its conservation. The objective of the research is to identify the criteria of the storage concrete rack inspired by sea turtles, to design the storage concrete rack inspired by sea turtles, and to develop a prototype of a storage concrete rack inspired by sea turtles. A questionnaire survey was conducted to 40 respondents that spent their time in a mall to collect the respondent opinion and determine the design criteria for the storage concrete rack. Progress work on this study continue with the visual research, sketches, final design and lastly mock-up process. The findings of the survey data showed the design criteria for a storage concrete rack is in concrete and wood/wood-based material, in shape square/rectangular, in origin color of concrete, with 3 storage spaces and the main features considered by the respondent of the design is its functionality. The research on this study would become a reference to those who wants to deliver the awareness and environment education to the people and public.

Keywords: Storage concrete rack, Sea turtle, Turtle, Endangered species, Awareness, Environment, Storage, Concrete

1. Introduction

Storage is a space where to put or keep things when the thing is not being used in a place where it's available and can be kept safely. Rack is a shelf which is mostly formed by bars which used to hold things such as clothes, vegetables, luggage, plates, and others. There are few rack types such as server racks, open frame racks, 2Post, transport racks, portable racks, and wall mount racks. Concrete is a material for building purposes which is made from a combination of broken stone, cement, sand, and water, which can be spread or poured into molds to form stone-like blocks when hardened.

Sea turtles are key to healthy marine ecosystems, and we need them to mitigate seafood and climate change, as well as sustain coastal communities and ecotourism. According to Connelly *et al.* (2017),

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nearly all populations have a high level of awareness of endangered and endangered species. However, their depth of knowledge may be limited. Over 80% of respondents thought they knew "little" about the terms for “Endangered Species”. In addition, the mall has changed from compulsive and quiet shopping to family entertainment and weekend hobbies (Venkateshwarlu & Ranjani, 2017). Most people come with their family and friends. Public understanding and appreciation of wildlife is essential to its conservation (Erkip, 2003). However, environmental education in many tropical countries is rarely included in public school curricula, and wildlife topics are often under-represented (Andreson *et al*., 2020). Awareness plays an important role in daily educational activities (Prasolova-Forland, 2002).

The significance of the study is to encourage everyone/the public to know the importance of saving the endangered turtle and the threats which have not been overcome nowadays. This study will provide a new experience to users themselves about the design, material, and dimension while they are using a new design of storage concrete rack inspired by sea turtles especially for sea turtle campaigns. Through the design of a storage concrete rack, it can attract the attention of the user. At the same time, it is also a new exploration for local designers to define whether the manufacture of storage concrete racks inspired by sea turtles may bring advantages and influence toward the endangered sea turtles.

2. Literature Review

Storage furniture acts as a basic physical enclosure for collections, allowing various things to be contained within a room or building. The historical continuity, purpose, organization, and how collections are utilized all influence how storage furniture is designed, although some of the storage furniture qualifies as a “container”.

Concrete is a composite material which is created using binding material (cement) followed by the mixture (including brick chips, sand and stone etc.), admixtures, water, and others according to the specific proportions. The differ proportions of the mixing will produce different strength and quality of concrete. In addition, concrete is a very useful material as its very strong and hard like a stone (Chowdhury, 2010).

Three categories were classified and found in the concrete which is cement concrete, lime concrete and reinforced cement concrete. Meanwhile, other types of concrete need different portions of main ingredients to create different applications, examples: vacuum concrete, limecrete, polymer concrete, regular concrete, and others more (Chowdhury, 2010).

Rack is a product which used for storing purposes consists of a row of spaces, small shelves, or hooks. It also been recognized as a furniture with frame or stand with slot to place or display books, decoration etc. There are few rack types such as server racks, open frame racks, 2Post, transport racks, portable racks and wall mount racks.

There are seven species of sea turtles belonging to the Dermochelyidae families (leatherback sea turtles) and Cheloniidae families (green turtles, flatback sea turtles, loggerhead sea turtles, hawksbills, and ridleys). Both families are mostly aquatic, with most species only appearing on beaches to lay eggs. However, the green turtle (Chelonia mydas) only sunbathes on land at times. Sea turtles are mostly found in tropical and subtropical oceans as adults, but youngsters of both sea turtles’ families can be found in more temperate environments (Zug, 2022).

There are few differences to be compare between the sea turtles and the land turtles. From their name, sea turtles were divided into a Chelonioidea big family, also known as living in the ocean which have two longer front flippers than two back flippers to swim, swipe and hold their food but it can’t retract their flipper into their shells. Meanwhile, land turtles were assigned to Terrapene genus (Box turtles, also related to American pond turtles) and Cuora genus (Asian box turtles), which known with

have legs with claws that can essential their leg for a long-term movement can retract into their shells that's live on the land.

Besides, the shells of sea turtles have an expansive shell to protect themselves from the sea predators as they are not able to retract their head and flipper into their shells. Most of the sea turtles' shells was in hard shell except one species of sea turtles which is leatherback turtles was leathery shell. As a contrast, land turtles have a very hard shell that can retract their head and leg into their shells as they have a unique adaption that allows them to entirely defend themselves from prospective predators by hinging their shells shut.

By the way, the diet of the four species sea turtles which is loggerhead, Kemp's ridley, olive ridley, and hawksbill turtles are omnivorous because their diet list are such as grasses, worms, fish, seaweed, sponges, decapods, and others more. There are herbivorous among the sea turtles which is leatherback turtles eat jellyfish only, hawksbill turtles eat sponges mostly, and last is the green sea turtles, they will become an herbivorous turtle as they mature. Land turtles' diet are mainly herbivorous and eat a wide variety of food since they have been observed to consume gastropods, worms, insects, fruit, and foliage.

Acrylic is a type of plastic, fabric, textile, or paint that is manufactured from acrylic acid, commonly referred to as polymethyl methacrylate (PMMA). It is a transparent thermoplastic that is used as a lightweight, durable substitute for glass. Acrylic is frequently used in sheet form to make items like mirrors and plexiglass. Extruded and cast acrylics are the two primary varieties. The advantage of being tougher to scratch is that cast acrylic is the harder of the two. This is because of how it is made. Additionally, acrylic is available in various grades to accommodate various manufacturing techniques.

3. Research Methodology

In this study, method has been separated into few parts which start from questionnaire survey, visual research, sketches, idea development, final design, mock-up, technical drawing, and fabrication prototype. A questionnaire survey was conducted to 40 respondents that spent their time in a mall. The survey form was prepared into three sections by using the Google Form; Section A on demographic respondent, Section B on opinion respondent about a storage concrete rack inspired by sea turtle, Section C on design criteria for a storage concrete rack inspired by sea turtle. Next, questionnaire survey form has been distributed via social media apps such as WhatsApp, Messenger and Instagram for data collecting purposes to determine the design criteria of the storage concrete rack.

Visual research conducted by using some certain keywords relate to the storage concrete rack for searching the images. Later, comparison among the design patterns, styles and characteristics will be conducted to analyze and observe for a better designing of the product. Thumbnail was done by using hand sketching without using ruler and is without detailing drawing parts. The numbers of the thumbnails were sketched and collected from the early ideas to record, refer, and inspire purposes later. Next, some of the ideation in thumbnails was conducted for improvement design to define better design for the upcoming process, idea development that combined the features from questionnaire survey results.

The idea development been conducted after the sketches and thumbnail stages to enhance and develop the design based on the ideation. There dimension of the storage concrete rack will be estimate and calculate to make sure the idea is logic and make sense. The final design was chosen among the idea development process. Improvement on the design and more neatly sketching with dimension was included to present the details of the product design. One of the drawings will be decided to use as the final design of the product from the idea development by the researcher to progress the work.

Mock-up process was created and built based on the final design product at scale 1:5 from the actual size of the product. The problem and weakness of the design was shown clearly through this process to help the researcher improve and solve the problem. The materials have been using in conducting this mock-up is mounting board, scissors, glue, plastic, pencil, ruler, and eraser. Technical drawing process been created by using the AutoCAD software to illustrate the visual of the storage concrete rack. There are four view of the storage concrete rack which is top view, front view, side view and isometric view will be shown in 2D wireframe and realistic visual as a referring visual and checking the dimension.

The prototype is a step of turning outcomes from plan to action after the design has been confirm and approved. The mold of concrete will be built up by using the plywood wood according to the dimension and the inner of the mold will be apply with some oil to easier the open mold process after the concrete has fix in shape. Touch up process will be progress on both fix concrete shape before assembly the acrylic on both side of storage concrete rack including the bottom part to achieve the final appearance of the design.

4. Results and Discussion

4.1 Design Criteria Identification Phase

Table 1 shows the summary of the significant results of the questionnaire with a total number of 40 respondents. According to the demographic data, most of the respondents are female (62.5%) and the rest are male respondents. Most of the respondents are Chinese respondent (72.5%) and the ages between 18-35 years old (72.5%). The current employment status of respondent is student in 60%. In addition, most of the respondents are single (82.5%) and the rest are married.

Table 1: Summary of significance questionnaire data

Section	Percentage (%)	Description
Demographic information	62.5	Female respondents
	72.5	Chinese respondent
	72.5	Ages 21-25
	60.0	Current employment status is student
	82.5	Marital status is single
Design criteria	77.5	Haven't seen a storage concrete rack inspired by a sea turtle
	42.5	Concrete and acrylic
	50.0	Origin colour of concrete
	40.0	Square or rectangular shape
	65.0	Sea turtles' characteristics need to be mentioned in design
	42.5	Prefer 3 storage spaces
	42.5	Purpose of storage concrete rack - Decoration
	55.0	Prefer functionality as main features
Opinion	57.5	Agree a storage rack with strong durability will be main consideration
	60.0	Agree appearance with some sea turtles' characteristics may help to raise awareness towards the public or visitors
	55.0	Agree sea turtle's appearance on a storage concrete rack is friendly for the public and visitors
	67.5	Agree spreading awareness through furniture is a new way nowadays

In design criteria part, there are 77.5% of the respondent have not seen a storage concrete rack inspired by a sea turtle. Most of them pick combination of concrete and acrylic (42.5%) and more prefer to have origin colour of concrete for the design (50%). Next, 40% of the respondent prefer square or

rectangular shape which contain 3 storage spaces in the design (42.5%). Therefore, characteristics of sea turtles need to be mentioned the most in this design also has been selected by respondent in 65%. Most of the respondent (42.5%) react that the purpose of storage concrete rack they use/need or saw mostly for keeping stuff/things in the mall is decoration purposes. The main features they considered the most for a storage concrete rack is functionality in 55% followed by cost in 25%, size in 17.5% and others (durability) in 2.5%.

In the opinion section, 57.5% of respondents agreed and 42.5% of respondent strongly agreed that a storage rack with strong durability will be main consideration toward furniture. Next, most of the respondent agree that the appearance of a storage concrete rack with some characteristics of sea turtles may help to raise awareness towards the public or visitors in 60% followed by strongly agree in 20%, neutral in 15% and disagree in 5%. In addition, there are respondent in 52.5% think that appearance of a storage concrete rack with some characteristics of sea turtles would be a good way to spread awareness towards the public and visitors. Meanwhile, there are 55% of respondent think a sea turtle's appearance on a storage concrete rack is friendly for the public and visitors. Lastly, most of the respondent agree that spreading awareness through furniture is a new way nowadays in 67.5%.

4.2 Design Process

Figure 1 shows the thumbnail sketches of storage concrete rack with different shapes and designs. The sketches were selected according to the design criteria from survey and marked with a red box were selected for the ideation process.

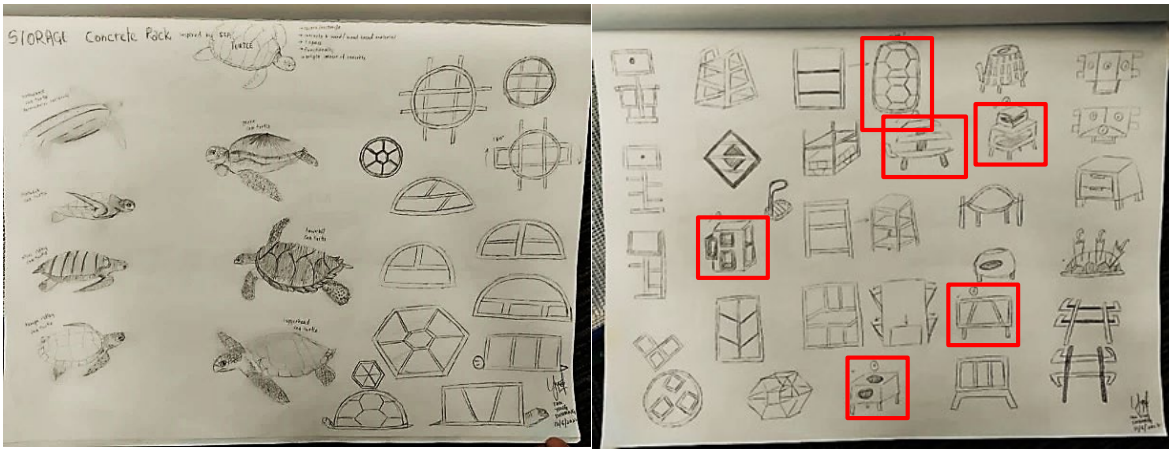

Figure 1: Thumbnails

In the ideation process, there are six ideations as shown in Figure 1 above were chosen and been illustrate in isometric view according to the sketches in two-dimensional (2D) and three-dimensional (3D). Although the six ideation has fulfill the design criteria, example: the material that's been used was concrete and wood/wood based material, colour of furniture will follow the origin colour of concrete, in square or rectangular shape, need to have 3 storage space, can be used as decoration purpose, the functionality of product is the main features, lastly is need to mention the characteristics of sea turtle, but only Figure 2 ideation as shown below been selected to use in the development process.

Next, the ideation based on Figure 2 been development further and illustrate into another six ideas. Each of the design has been develop in the material chosen to success the side cover assembly design. There are two methods been suggested in the idea development process which is in method 1 assembly a full piece of material on both side of the storage concrete rack while the method 2 is cut the pieces into small to assembly it on both side of the storage concrete rack. Material that has been suggested and consider is wood, acrylic and rattan netting.

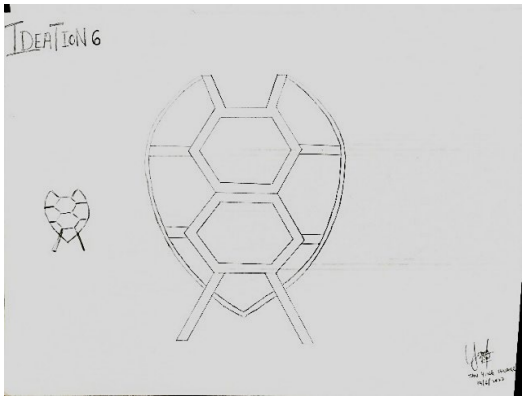

Figure 2: Ideation

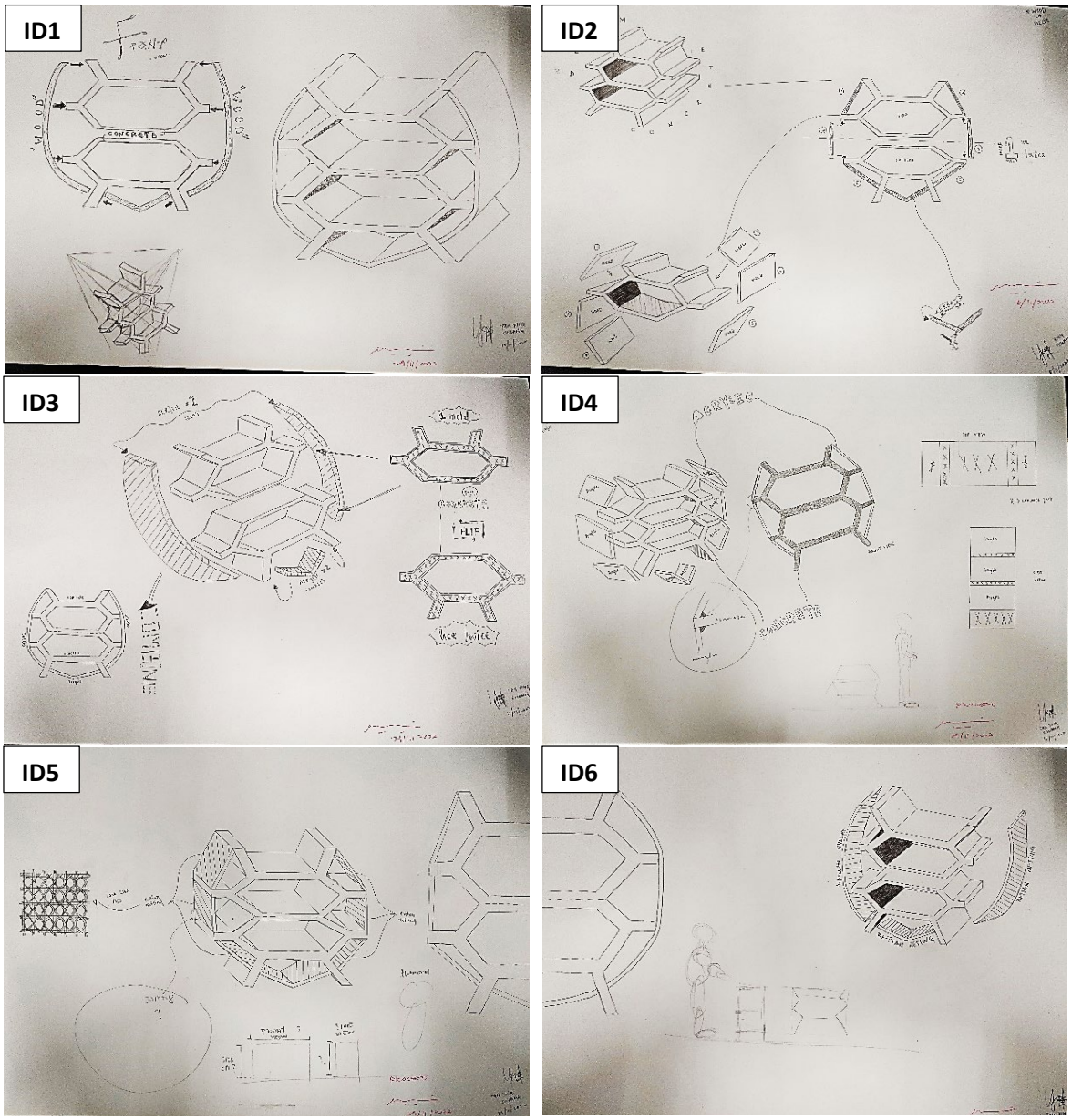

Figure 3: Idea development

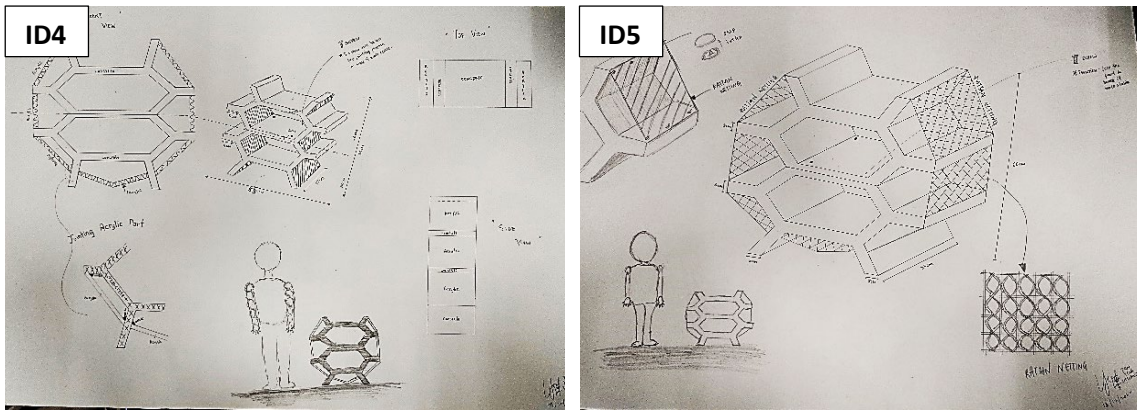

Figure 4: Details illustration based on idea development 4 and idea development 5

Later, a final design survey was conducted to choose the final design of the storage concrete rack inspired by sea turtles. Through the final design survey, the final design has slightly changed compared to the last survey due to the development of the design. Most of the respondents choosing idea development 4 as the final design for this study (Figure 5).

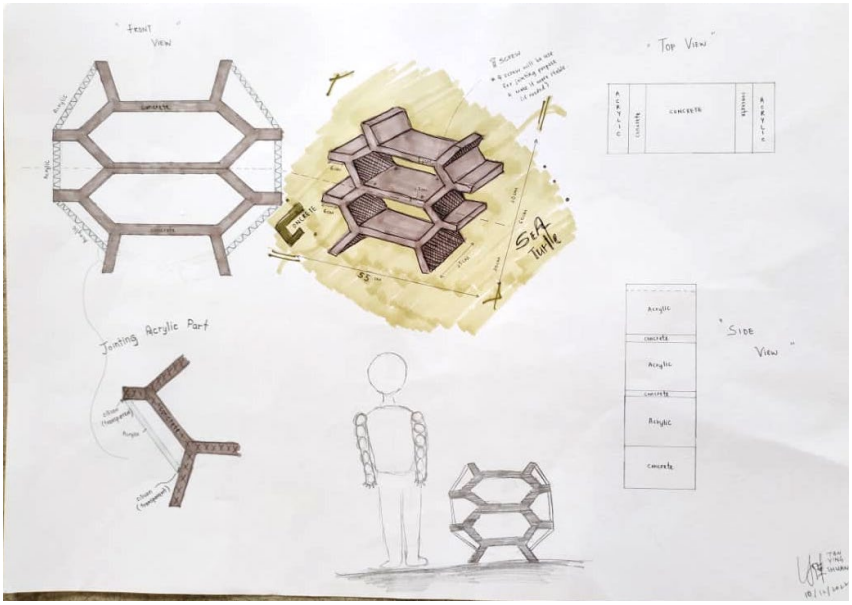

Figure 5: Final design of storage concrete rack inspired by sea turtle

4.3 Prototyping

Mock-up process will be conducted before the prototyping process to determine the measurement and its stability of the mock-up. The measurement of the mock-up will be using scale 1:5 according to the actual dimension of the storage concrete rack (Figure 6). The material of the mock-up is made by mounting board in black or grey colour represent to concrete part while the white colour part were made by cupboard pieces to replace the acrylic pieces. All the assembly part in mock-up has been conducted by using adhesive latex.

The technical drawing dimension is referred to the actual size of the storage concrete rack itself. The method to illustrate 2-dimension view, 3-dimension view, and isometric view is using AutoCAD software as shown in Figure 7. The outlook of the storage concrete rack including the dimensions can be shown clearly which may easier the process of prepare and calculate the amount of material needed. The dimension of the storage concrete rack is height 60 cm, length 55 cm, and the width is 25 cm. In addition, the final design 3D rendering drawing are shown in the Figure 8.

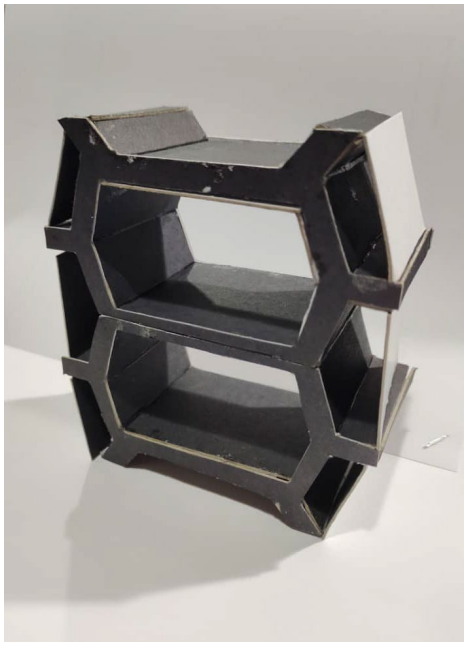

Figure 6: Mock-up of storage concrete rack inspired by sea turtle

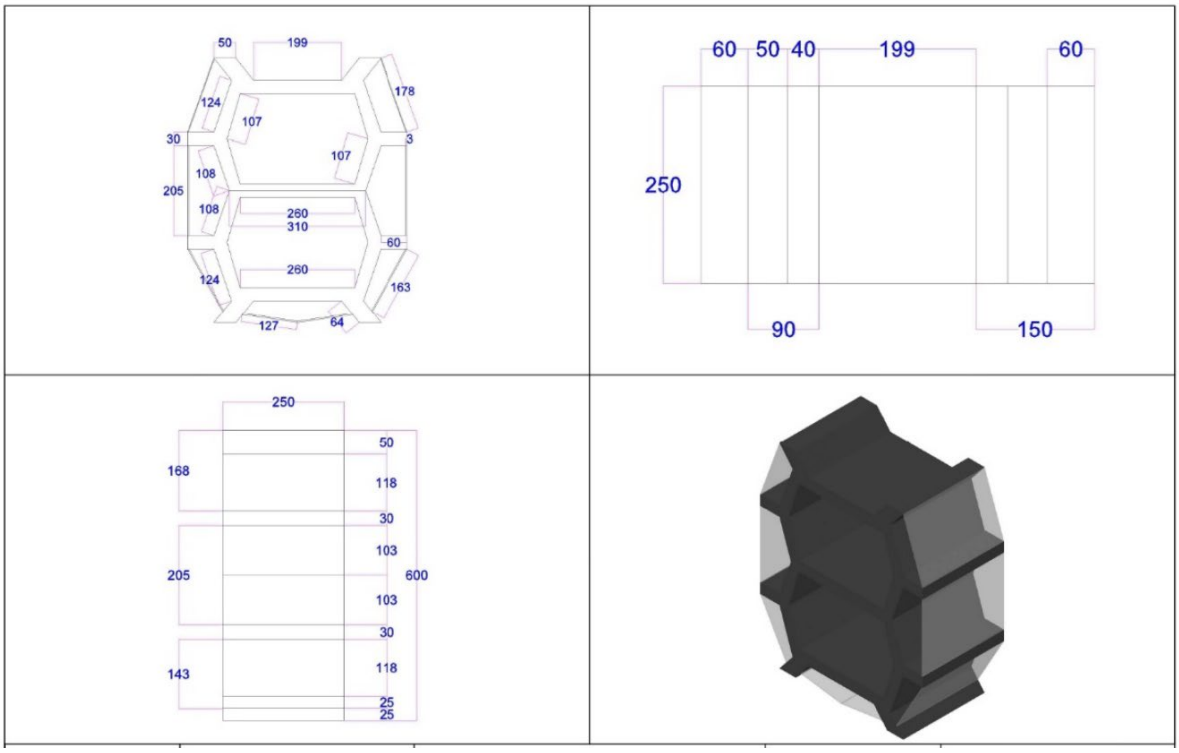

Figure 7: Orthographic and isometric views of the prototype

The fabrication prototype been constructed according to the ideation chosen by the respondent in the final design survey of exploring a storage concrete rack inspired by sea turtles. The process of fabrication process including material selection, measuring and cutting, molding, assembly and finishing. The combination of the concrete and acrylic can be found as both of this especially the concrete is the core material of this rack. The plywood has been cut into pieces according to the dimension of the storage concrete rack. The plywood pieces will be assembly together and the iron stick will be put in the mold to stable the structure of the concrete shape. Next, oil need to put inside the mold

for easy taking out of the concrete. After the concrete has been taken out, another concrete will be poured into the mold with iron stick and oil has been put inside the mold again. Touch-up process will be processed on the concrete to make sure the surface of the concrete is smooth and nice. Later, the acrylic will be cut into pieces and assembly on both side of the concrete for the final appearance. The acrylic has been using for the replacement material as an idea development on this design.

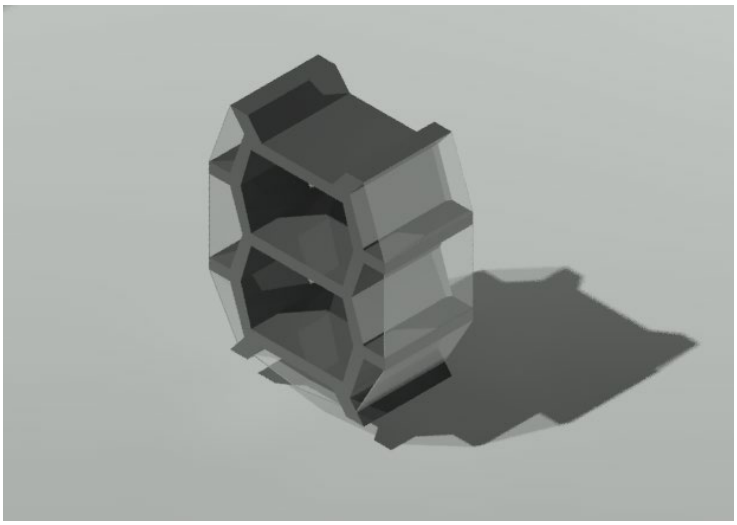

Figure 8: Rendered 3D view of the prototype

Figure 9: Prototype

5. Conclusion

In conclusion, the objective of this study which is to identify the criteria of the storage concrete rack inspired by sea turtles has been determined and achieve. Based on the data from the respondents, design criteria of storage concrete rack have been obtained were used to design the storage concrete rack inspired by sea turtles. Therefore, process to develop a prototype of a storage concrete rack inspired by sea turtles just can be proceed later to identify whether there is any hidden problem or weaknesses exist. There are 43 thumbnail, 6 ideation, 6 idea development and final design has been done. Material

of the prototype that been using is concrete with the acrylic pieces. Finishing of the product was using sanding and touch-up process. Lastly, every problem and challenge that faced in this study could be overcome by researchers all along the study journey since the suggestion and question always acts as a force that encourages researchers to learn more and keep going. At the same time, demand of the study also has been meeting and research hope that this study would become a reference to those who wants to deliver the awareness and environment education to the people and public.

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