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Study on Mechanical Properties of Organic and Non-Organic Fibre Panel Board

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Abstract: The panel board has been more in demand in construction industry contribute to increase the wood production to make the panel board for structural and decorative purposes. Panel board produced by wood and sawdust has weaknesses such as low tensile strength and flexural load. Currently, wood and sawdust in panelboard can be replaced by fibre materials. However, various type of fibre will indicate different mechanical properties of panelboard. Therefore, the objectives of this project are to compare the elasticity and strength of different type fibre in panel board using Modulus of Elasticity (MOE) and Modulus of Rupture (MOR) test and to identify the future potential uses in different type of fibre in construction industry. The main fibre materials used in this project are banana fibre, sugarcane bagasse fibre, coconut fibre as an organic fibre while for non-organic fibre is fibreglass. There are four phases in producing panel board which are material preparation, manufacturing the panel board, sample preparation for testing and data analysis by comparing each type of fibre panel board. Based on the results, fibreglass has the highest average MOE value of 8139.67 MPa and MOR average value of 187.37 MPa compared to other fibre panel board. This finding proved that fibreglass provide better strength property and able to increase durability of panel board. Finding from the interview survey, banana fibre, coconut fibre, sugarcane bagasse fibre and fiberglass had different potential uses that can be used in construction industry such as reinforced concrete, roof tiles and wall panelling while for inorganic fibre, it can be used in fiberglass-based composites and an admixture material in making the traffic light's body. Hence, fiberglass is a better replacement material in producing panel board and all these fibres have various future potential as construction materials that can be applied in construction industry.

Keywords: Panelboard, Banana Fibre, Sugarcane Bagasse Fibre, Fibreglass, And Coconut Fibre

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1.0 Introduction

Panel board is a structural material in construction building that mostly used in making furniture and structural purposes. In construction industry, most of the panel board is using wood production such as sawdust and timber. Consequently, the wood production had become more in demand due to rapid economy in Malaysia. Currently, the conventional panel board that used in construction industry has mechanical weaknesses such as low tensile strength and flexural load. Nowadays, the main materials from panel board shifted to replacement materials that more sustainable than wood in order to produce high potential panel board in terms of durability and strength.

Hence, the aim of this project is to replace the wood and sawdust to organic fibre and non-organic fibre as a replacement material in making panel board that has potential to increase the strength and durability of the panel board. The main material in making the panel board categorized into two types which are organic fibre and non-organic fibre. The main fibre materials used in this project are banana fibre, sugarcane bagasse fibre, coconut fibre as an organic fibre while for non-organic fibre is fiberglass was chosen as a replacement material in order to produce the panel board that sustainable than conventional panel board.

Each different type of fibre materials is expected will affect the mechanical properties of panel board for strength and elasticity. The purpose of this project is to compare the mechanical properties of different type fibre panel board and identified the future potential uses in different type of fibre as a raw material in construction industry. Therefore, as to produce a good quality of panel board, it should have high value of MOR and MOE test to get panel board stronger and more elastic. In addition, the potential uses of organic and inorganic fibre as a raw material need to identify so as to apply for future use in construction industry by conducting an interview with two respondents who had experienced in construction industry using two platform which are Google Meet and by telephone. The objectives of this project are; (1) to compare the elasticity of different type fibre in panel board using Modulus of Elasticity (MOE) test, (2) to compare the strength of different type fibre in panel board using Modulus of Rupture (MOR) test, and (3) to identify the future potential uses in different type of fibre as a raw material in construction industry.

1.2 Coconut Fibre

The most well-known fibrous residue from the production of coconuts is coconut fibre. [1] found coconut husk fibres to be more durable than oil palm bark fibres, with a mean diameter of 400 m and a mean length of 103 mm. Coconut fibre is a natural fibre that is derived from the husk of an unripe coconut. The coconut is steeped in hot seawater, then the fibres are extracted from the shell by combing and crushing, similar to how jute fibre is extracted. Coconut fibre is utilised in products such as floor mats, doormats, brushes, mattresses, coarse filler material, and upholstery because of its rigidity. Coconut fibre, often known as coir, is made from the coconut's fibrous husk. It is divided into two types which is "bristle" fibre (combed, 20–40 cm long) and "mattress" fibre (random fibres, 2–10 cm long). In natural filters, it is frequently blended with hog's hair [1].

Cellulose, hemicelluloses, lignin, and other important components, which are known as the building blocks of the cell structure, are the primary elements of coconut fibre. Coconut fibre is multicellular by nature, and its diameter and length vary greatly, with the thickest part of the fibre being in the middle. When compared to other natural fibres, coconut fibre has the largest proportion of lignin by volume, making it extremely robust and stiff. This is due to the fact that lignin helps provide compressive strength to plant tissue and individual cells, as well as stiffening the cell wall of the fibre, which protects the carbohydrate from chemical and physical degradation [1]. The amount of lignin in a material affects its structure, characteristics, flexibility, and hydrolysis rate, making it appear finer and more flexible.

The dimension and arrangement of various unit cells form the fibre structure, which also influences the fibre qualities. A central hollow chamber known as lumen exists in the transverse sections of the unit cell in a fibre, and its shape and size are determined by two factors: the thickness of the cell wall and the fibre's source. Because the hollow chamber reduces the bulk density of the fibre, it acts as an acoustic and thermal insulator [1]. The amount of cellulose and non-cellulosic elements in a fibre determines its structure and properties, which effects crystalline, and moisture regain. The orientation, high degree of crystallisation, and angle of the microfibrils to the axis of the fibre are all characteristics that influence fibre elongation.

1.2 Sugarcane Bagasse

Sugarcane bagasse comes from Asia and is mainly found in tropical and subtropical areas [2]. Sugarcane fibre production was around 1900 million metric tonnes in the last five years, largely in Latin America and Asia. Sugarcane bagasse is a natural plant fibre obtained from the sugarcane plant. Bagasse is a term used to describe sugarcane fibre. Sugarcane fibre is made up of cellulose (41.0–55.0 wt percent), hemicellulose (20.0–27.5 wt percent), lignin (18.0–26.3 wt percent), and other inorganic elements (7.0 wt percent) [3]. Sugarcane fibre can be used for a variety of purposes, including the extraction of all elements such cellulose, hemicellulose, and lignin [3].

Sugarcane fibre is a fibrous material that remains after the juice has been extracted from the sugarcane. It had long finer fibres scattered randomly throughout the stem and held together by lignin and hemicellulose, while the inner component had small fibres with sucrose as the primary component. Sugarcane fibre is made up of cellulose, hemicellulose, and lignin [4]. About 40–50% of dry sugarcane is cellulose, with 25–35% hemicellulose and 17–20% lignin, as well as some wax 0.8 % and ash 2.3% [5]. Only a portion of sugarcane fibre and products that can be employed as reinforcing fillers in various polymer matrices will be covered in the next sections. Furthermore, carbonised sugar fibre can be generated by alkali treatment followed by burning in a furnace at a higher temperature than 500°C to create ashes [6]. They are comprised primarily of SiO2, AlO3, MgO, and Fe2O3 and appear solid in nature with irregular finer forms. As seen in Table 1, the chemical composition might vary. These characteristics have a significant impact on the performance of the product made from these ashes.

Table 1: Chemical composition of sugarcane bagasse ashes [7]

Composition	Value
SiO2	60-86
Al_2O_3	1-14
Fe_2O_3	1-14
TiO_2	0.2-3
CaO	2-7
MgO	0.05-2
MnO	0.1-0.5
K_2O	0.2-6
P_2O_5	0.5-3.5
SO_3	0.2-2.5
Na_2O	0.01-0.1
Cr_2O_3	0.01-0.1

1.3 Banana Fibre

The banana plant, also known as the plantain plant, produces not only delicious fruit but also textile fabric, known as banana fibre. Natural fibres offer a number of benefits, including low density, suitable stiffness and mechanical qualities, and high disposability and renewability. Furthermore, they are biodegradable and recyclable. Natural fibres in reinforcing have been the subject of extensive research. Banana fibre is a bast fibre with generally good mechanical qualities that is derived from the pseudo-stem of the banana plant in other name Musa sepientum [8]. The banana plant is a big perennial herb with pseudo stems formed from the leaf sheaths. It can grow to be 10-40 feet (3.0-12.2 metres) tall, with 8-12 huge leaves encircling it. The leaves can reach a length of 9 feet and a width of 2 feet (2.7 metres and 0.61 meter) [8].

Banana fibre has its unique physical and chemical qualities, as well as a variety of other qualities that distinguish it as a high-quality fibre. Banana fibre has a similar appearance to bamboo fibre and ramie fibre, but its fineness and spinnability are superior to both. Furthermore, cellulose, hemicellulose, and lignin make up the chemical makeup of banana fibre. It is a really tough fibre, the elongation is shorter, depending on the extraction and spinning procedure, it has a lustrous appearance, and it is lightweight. Banana fibres also has a high capacity for absorbing moisture. It absorbs and releases moisture at a rapid rate. Moreover, it is biodegradable and has no negative environmental impact, making it an environmentally friendly fabric, has a fineness of 2400 Nm on average and can be spun in a variety of ways, including ring spinning, open-end spinning, bast fibre spinning, and semi-worsted spinning, to name a few [9].

Table 2 below shows that banana fibre has their own properties which make it is a really strong, has less elongation, lightweight and other characteristics.

Table 2: Amount and properties of Banana Fibres [9]

Properties	Amount
Tenacity	29.98 g/denier
Fineness	17.15
Moisture Regain	13.00%
Elongation	6.54
Alco-ben Extractives	1.70%
Total Cellulose	81.80%
Alpha Cellulose	61.50%
Residual Gum	41.90%
Lignin	15.00%

1.4 Fiberglass

A fiberglass is a type of fibre-reinforced plastic in which the reinforced material is glass fibre. Fiberglass is also known as glass reinforced plastic or glass fibre reinforced plastic for this reason. A range of natural minerals and synthetic chemicals are used as the fundamental raw materials for fiberglass goods [10]. Before being melted into glass, the raw components must be precisely weighed and thoroughly mixed together which is process known as batching.

Fiberglass can be categorised into the following major categories based on the raw ingredients used and their proportions in the manufacturing process such as A-glass, often known as alkali glass, is a chemically resistant glass. It is utilised to make process equipment in several parts of the world, C-glass which commonly known as chemical glass, is a type of glass that has a high chemical resistance and E-glass that commonly known as electrical glass, is an excellent electrical insulator [10]. Moreover, fiberglass also has AE-glass is a glass that can withstand alkali and S-glass that often known as structural glass, is a type of glass that is noted for its mechanical characteristics .

Fiberglass is available in a variety of shapes to suit a variety of uses, the most common of which are fiberglass tape that made of glass fibre yarns, fiberglass tapes are known for their thermal insulation capabilities [10]. This type of fiberglass is commonly used to wrap vessels, hot pipelines, and other similar items. Furthermore, it also available in fiberglass cloth that is smooth and comes in a variety of varieties, including glass fibre yarns and glass filament yarns. It is commonly utilised as heat shields, fire curtains, and other applications. Lastly, fiberglass rope which is glass fibre yarns are braided into ropes that are used for packing.

There are many properties of fiberglass that make it unique. Fiberglass has mechanical strength that outperforms steel in terms of specific resistance. It has a low linear expansion coefficient. Fiberglass also comes in a variety of sizes and can be mixed with a variety of synthetic resins as well as mineral matrices like cement [11]. It is also non-rotting which make fiberglass is resistant to rot and is unaffected by rodents and insects, has a low thermal conductivity, making it ideal for use in construction and dielectric permeability which make fiberglass is suitable for electromagnetic windows because of its feature.

2.0 Methodology

According to project flowchart in **Figure 1**, selection of the methodology were required based on the project's objectives. First and foremost, for objectives 1 and 2, panel board sample and preparation were conducted by separated into two types which were organic fibre panel board and inorganic fibre panel board. For organic fibre panel board, the process started by cutting and drying process of the fibre, followed by gluing process using Urea-Formaldehyde(UF) and compacted into the mold by using hydraulic type hot and cold machine. For inorganic fibre panel board, the process started by layering, cutting, and finishing process. After that, the panel board are ready to be tested using two type of test which are Modulus of Rupture test ad Modulus od Rupture test. The results in each type of fibre panel board will be compared with conventional panel board to obtain the panel board that contained the good mechanical properties.

Meanwhile, for objective 3, the methodology for the survey interview are separated into three phases. Firstly, interview questions were developed and identification were reviewed to find the suitable respondents in order to obtain the accurate data for future potential uses in each type of fibres. After that, the respondents will be interviewed by using two instruments which are Google Meet and by telephone. During the interviewing process, transcription must be done in order to collect all the data word by word. These data for organic and inorganic fibres will be analysed.

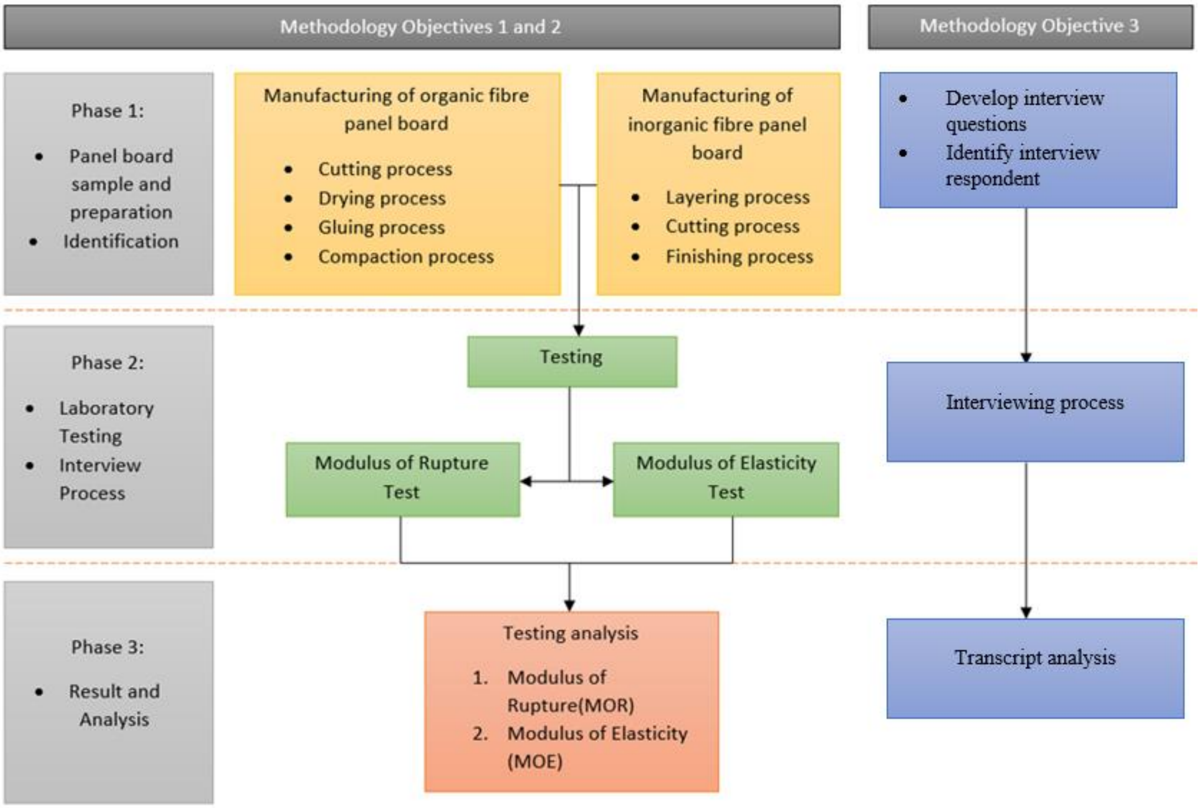

Figure 1: Flowchart of the project

2.1 Coconut fibre panel board process

The first step to produce the coconut fibre as the raw material for orgnaic fibre is to prepare the coconut fibre before undergoes the softening process to improve the flexibility and make it easier to use. The softening process would take about 24 hours by soaking underwater and then, remove the outer layer and the coconut husk were cut into smaller size. Then, the coconut husk were dried in the oven for 20 minutes with the temperature of 80℃ to remove the water content within the husk and the dried coconut husk were put into the fibre process machine to separate the coconut peat and coconut fibre. After that, the coconut fibre undergoes the grinding process using the grinding machine. Then,the grinding coconut fibre were sieved by using size of 300mm and 63mm to remove the dusk. After that, the coconut fibre and glue mixed with each other using the ratio of 70% of the coconut fibre and 30% of the glue from the mass of the panel board. Lastly, the coconut fibre mixed with glue compacted to get a thin layer of coconut fibre and cut into the desired size. **Figure 2** shown the coconut fibre panel board after compaction process.

Figure 2: Coconut fibre panel board

2.2 Banana fibre panel board process

The process in making the banana fibre panel board as shown in **Figure 3** were cutting process, drying process, grinding process and sieving process. Then, the mass of the one panel board which has been weighed was 220.2 grams. After that, the banana fibre will be mixed with the glue with the ratio of 70% of banana fibre and 30% of the glue from the mass of the panel board. Lastly, compact the banana fibre using hydraulic hot and cold machine with the temperature of 170℃ for 30 minutes to ensure the glue is evenly spreaded and then, cut into the desired size which is 200mm x 50mm x 5mm.

Figure 3: Banana fibre panel board after cutting

2.3 Sugarcane bagasse fibre panel board process

Sugarcane bagasse fibre panel board as shown in **Figure 4** are produced by compacting the fibre using hydraulic type hot or cold machine. For making the panel board, the sugarcane bagasse fibre mixed with the urea glue with the ratio of 70% of the sugarcane bagasse fibre and 30% of the urea glue from the mass of the panel board and need to be compacted to get the thin layer of the sugarcane bagasse fibre. Lastly, the panel board was cut according to test specimen's size.

Figure 4: Sugarcane bagasse fibre panel board

2.4 Fibreglass panel board process.

The main material in order to produce fibreglass panel board as shown in **Figure 5** is unsaturated polyester resin and the fibreglass mat. To prodeuce the panel board, the fibreglass mat will be mixed with the resin to ensure the strength of the fabricated item. The type of fibreglass to be used in this project is E-glass type with the thickness is less than 1m. After combining the fibreglass and resin, it will undergoes the layering process which is the process where the fibreglass mat were arranged into the mould and the resin was spread evenly with a brush to ensure there is no void in-between the fibreglass mat. After completed the layering process, the fibreglass panel board were dried under the room temperature which takes about 4 to 5 hours before demoulding from the mould.

Figure 5: Fibreglass panel board after cutting

2.5 Testing method

There are two tests that have been done which are modulus of rupture and modulus of elasticity. The sample size of modulus of rupture and modulus of elastcity are cutting into 240mm x 50mm x 10mm. Each fibre will be compared to the sawdust panel board.

The modulus of rupture also known as flexural stength is the measurement of the sample's strength before failing under the maximum stress. The bond strength of the sample can be obtained directly from the machine which is UTM Instron. Meanwhile, the modulus of elasticity also known as Young's Modulus is a measurement that related with the relationship of stress-strain of the sample. To obtain the the tensile strength of the sample, it can be obtained directly from UTM Instron as shown in **Figure 6**. The modulus of rupture(MOR) and modulus of elasticity(MOE) for the panel board can be estimated by using these formulas as shown in **Eq. 1** and **Eq. 2** as:

$$\text{Modulus of Rupture(MOR)} = \frac{3PL}{2bd^2} \qquad \textbf{Eq. 1}$$

$$\text{Modulus of Elasticity(MOE)} = \frac{Stress}{Strain} \qquad \textbf{Eq. 2}$$

Figure 6: UTM Instron

2.5 Survey Interview

The project conducted the interview process which is the instrument for third objective to gain more knowledge about the future potential uses that can be done in the construction industry. The target respondents for the project is two interviewee who experienced in the construction industry or have the knowledge about the organic and non-organic fibre. The process of interviewing will be conducted online using two platforms which is Google Meet and by telephone. Transcript process will be done during the interview by recording the audio to ensure that the data used is accurate and has no errors that could result in data corruption. These data from the transcripts will be analysed by obtaining the frequent words or codes that used during the interview. Validity and reliability are the concepts that used to consistency and accuracy of a measure. The method for validity and reliability of interview survey assessed by checking the consistent or frequent words of the data across different respondents in order to perceive whether the data that were analysed can be used in the construction for the long-term or short-term. These results shown that the validity and reliability for each type of fibres can be used in long term.

3.0 Data and Analysis

3.1 Modulus of Rupture (MOR)

Table 3 and **Figure 7** explained how to determine the Modulus of Rupture using the average MOR graph. For each type of panel board, the MOR testing involves three samples to provide the average value of MOR. The MOR value is a measurement of the ultimate strength of a specimen before it ruptures or fractures. There is a significant difference between the fiberglass panel board and coconut fiber panel board, banana fiber panel board, sugar bagasse panel board and sawdust panel board as shown in the Modulus of Rupture (MOR) test results in **Table 3** and **Figure 7**. Fiberglass panel board has the greatest MOR value of 187.37 MPa, while coconut fiber panel board has the lowest MOR value of 0.03 MPa. In comparison to panel boards with lower MOR values, panel boards with higher MOR values required greater power to bend until they shattered. Fiberglass panel board has a greater value strength than coconut fiber panel board, banana fiber panel board, sugarcane fiber panel board and sawdust panel board because fibreglass particles are smaller than those of the other fibers. Smaller particles increased the board's characteristics, resulting in a stronger internal bond. This is due to the fact that smaller particles were compressed more tightly with fewer overlapping areas, resulting in uniform homogenous cells with fewer voids [12].

Table 3: Modulus of Rupture (MOR) Result of Samples

Type of Panel Board	Average MOR, (MPa)
Coconut Fibre	0.03
Banana Fibre	9.98
Sugar bagasse	4.91
Fiberglass	187.37
Sawdust	23.97

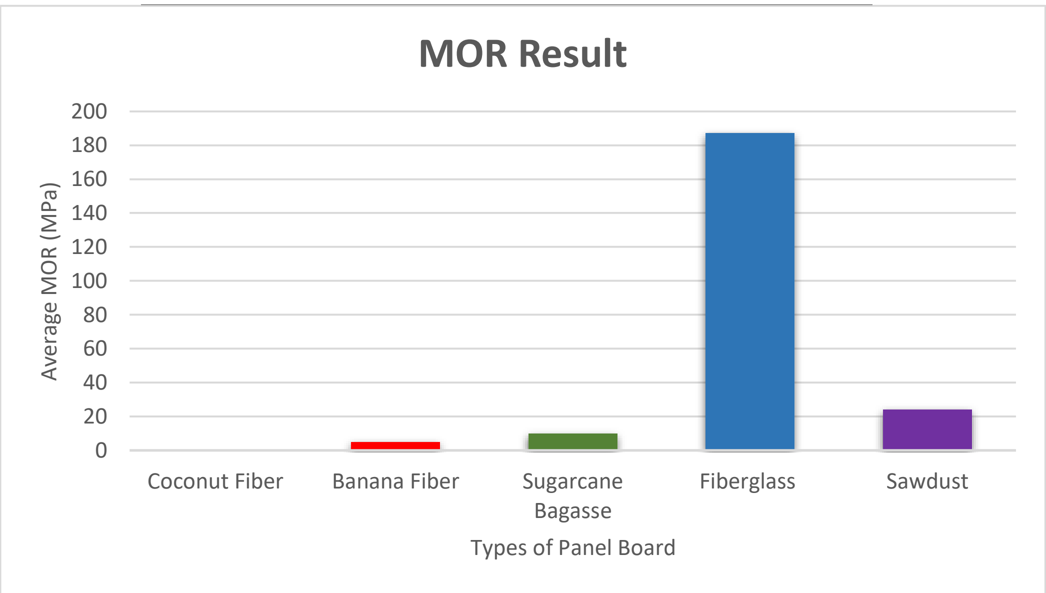

Figure 7: Modulus of Rupture (MOR) Test Result Graph

3.2 Modulus of Elasticity(MOE)

The result in **Table 4** and **Figure 8** shows that fibreglass has the highest average MOE of 8139.67 MPa when compared with the other types of panel board. Based on **Figure 8**, fibreglass panel board has the greatest average MOR value of 8139.67 MPa, while banana fibre panel board has the lowest average MOR value of 41.57 MPa. High modulus of elasticity means that the fibreglass material is more elastic as it requires more force to deform it [12]. A higher MOE value will make the panel board can return to its original shape even with higher strength given to it [13]. Because of the process from which glass fibers are formed, it develops flexibility properties. This happens when molten glass rotates spun into fibers, each fiber having the ability to bend and flex with any size and weight. It has been proven that thinner fibers are easier for each fiber to bend [14].

Table 4: Modulus of Elasticity (MOE) Result of Samples

Type of Panel Board	Average MOE (MPa)
Coconut Fibre	1721.33
Banana Fibre	41.57
Sugarcane bagasse	403.33
Fiberglass	8139.67
Sawdust	1921.80

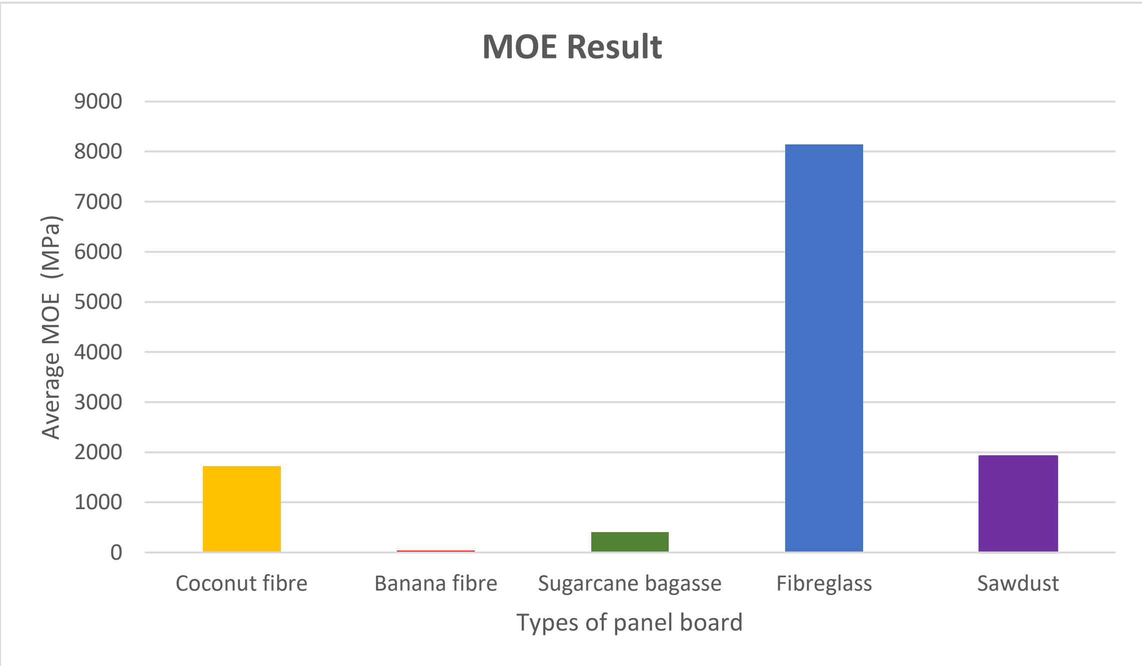

Figure 8: Modulus of Elasticity (MOE) Test Result Graph

As a summary, from the **Figure 7** show the average of the modulus of rupture of coconut fiber sample is 0.03 MPa, banana fiber sample is 9.98 MPa, sugarcane bagasse is 4.91 MPa, fiberglass sample is 187.370 MPa and sawdust panel board sample is 23.97 MPa. The fiberglass sample has the highest modulus of rupture followed by the sawdust and sugarcane bagasse sample. The fiberglass sample has the long physical appearance which will bond to each other and cause the higher strength compared to the other sample. This can proved that the modulus of rupture can determined the strength of the board. Furthermore, **Figure 8** shown the average of the modulus of elasticity of coconut fibre sample is 1721.33 MPa, banana fibre panel board sample is 41.57 MPa, sugarcane bagasse fibre sample is 403.33 MPa, fiberglass sample is 8139.67 MPa and sawdust sample is 1921.8 MPa. The higher the modulus of elasticity of the material, the greater the rigidity. The greater the rigidity of a structure, the more force must be applied to produce a given deformation.

3.3 Survey Interview

Organic and non-organic fibre is important to be implemented and applied to the construction industry due to the human population in our country become more and more and thus, it will affect the marketability of the wood and sawdust economically. Because of that, this project will be interviewed by two respondents who knowledgeable and experienced in the construction industry. Respondent A was committed to Jabatan Kerja Raya as a site engineer while for respondent B is currently works in construction company as site engineer. Hence, this project will conducted an interview with two respondents in order to know the future potential uses as well as the marketability of the organic fibre which are sugarcane bagasse fibre, coconut fibre and banana fibre meanwhile for inorganic fibre which is fibreglass.

The findings about sugarcane bagasse fibre from respondent A stated that the sugarcane bagasse can be used as a composite material for reinforced concrete manufacture and has a potential in making a furniture material such as side table, coffee table or wall frame. These is due to the fibre has high value in tensile strength that came from several features such as fibre stiffness and size distribution of the fibre which can improve the construction material[15]. Also, sugarcane bagasse fibre can reduce the cracking state if the fibre was treated chemically. Meanwhile for respondent B, the findings about the sugarcane bagasse fibre are this fibre has potential to be used in reinforcement concrete where the sugarcane bagasse fibre has high in durability which makes this fibre a good material for manufacturing the reinforcement concrete. Also, respondent B stated that this fibre can improve the performance of the bricks by using the sugarcane bagasse as an admixture material to improve in terms of durability and strength of the bricks. In terms of marketability of sugarcane bagasse fibre, the opinion of these two respondents is the same which is the price of the sugarcane bagasse fibre is in average among all the organic fibre as well as marketability. This is for the reason that the sugarcane bagasse fibre still not widely known in global market in terms of making products and structures that can be used in the construction industry. However, as the time goes on, the good characteristics of sugarcane bagasse fibre which has good potential to be used in the industry hence, it will boost the marketability of this fibre.

"... .Has potential in the use of composites in the manufacture of reinforced concrete ..... this fiber also has the potential to be used as furniture such as side tables, coffee tables or as a wall frame for the house ....I don't know much about the marketability of sugarcane bagasse fibre as it is still not known in Malaysia yet as the fibre that extracted from sugar always used as a biomass...I think it will have average price because sugarcane can be found easily and easy to produce but the sugarcane bagasse fibre has good potential to be used in the industry in near future, it can boost the marketability."

[Respondent A]

"... has the potential to be used on reinforcement concrete ... one more thing, this fiber has the potential in the manufacture of bricks to build buildings ..The marketability and price of the sugarcane bagasse fibre are in average phase because there are so many products or structures that can be found are not made from sugarcane bagasse fibre...but as the time goes on, the use of the sugarcane bagasse fibre will be used widely as it is eco-friendly materials"

[Respondent B]

Secondly, the data of coconut fibre were analysed from the findings by two respondents . As stated by respondent A, the coconut fibre can be applied on reinforcement concrete. This is because of the properties of the coconut fibre which are high durability, high in tensile strength which can improve the performance of reinforcement bar to be used as construction material**.** Besides, this fibre can be used a raw material for cement composites and for decorative purposes such as lamp body and clock wall if the material is treated with alkaline solution. According to respondent B, the coconut fibre can be used as a wall panel for decorative purposes. This is due to the characteristics of the fibre, which is lightweight, eco-friendly, and environmental-friendly. Also, this fibre can be used as soil blocks for low-cost building which the coconut fibre will mixed with cement and compacted so that it will improve the strength and durability of the building. Additionally, in terms of marketability of the coconut fibre, respondent A stated the demand of the coconut fibre is increasing over time. The growth of the demand is attributed to the popularity of the coconut fibre as well as the products and structures made from coconut fibre in the global market. Meanwhile for respondent B stated that the marketability of coconut fibre and related products in the global market will become higher due to the fact of potential future uses and the high demand in the near future.

“... has the potential in producing reinforcement for concrete .... this fiber can also be used as a spare material for cement composites .... can be used as a vintage decoration such as making a lamp body, or patterned panels such as wall clocks like that ...In global market shown that the coconut coir or fibre is in high demand cause it to be popular around the industry over time..... ”

[Respondent A]

"... this fiber can be used as a wall panel that beautifies the interior decoration of the house .... this fiber has the potential in producing soil blocks to create low -cost housing areas ...Right now, the marketability of the coconut fibre is average but in the near future, it will cause a soaring price and marketability as coconut fibre has the potential in terms of strength and durability..."

[Respondent B]

Additionally, the last material for organic fibre in this project is banana fibre. These are the data findings from respondent A which stated that the banana fibre can be carried out by using a fibre material into the reinforcement concrete. According to respondent A, the fibre material has potential to be used in the manufacture of reinforcement concrete for small buildings and also it can improve the performance of the concrete to become more stronger and more durable. Also, due to its’ low density and ecological advantages cause the natural fibre composite attracted to the industry compared to conventional composites[16]. Meanwhile for respondent B, there are a lot of potential applications that can be used in the future which are the banana fibre has potential in making roof tiles as this fibre can withstand heat within the building[16]. Moreover, it also can be used as floorboards such as vinyl due to high in tensile strength and young modulus, and it has a good fire resistance quality. Lastly, according to the conversation of respondent B, the banana fibre can be used in furniture materials such as chairs, tables, and cupboards. In terms of marketability, respondent A stated that the banana fibre still not widely known in construction industry as it still not explores in different area where banana fibre can be used yet but the banana fibre has a huge potential in the near future which can cause a high demand followed by the high marketability in global market. Meanwhile, respondent B stated that the marketability of banana fibre and related product are low as for now due to low in demand and not popular in global market yet however as time goes on, the production of banana fibre will be known as it has good characteristics such as fire resistant, high in strength and durability which can contributed the benefits of the product and thus, the marketability will become higher than before.

"... banana fiber can be used in concrete reinforcement because these organic fibres have the potential to improve the performance of concrete reinforcement ...The marketability is still not known yet in global market as it is still not popular other than textile area but in the near future, when the banana fibre become known as..it has good material potential which can boost the marketability in the market"

[Respondent A]

“... in the construction industry, this fiber has potential in the construction of roofs in residential areas ..... this fiber can also be used as a material to make floorboards such as… .vinyl. These

fiber characteristics have the potential to improve the performance of floorboards ... Similarly, the manufacture of furniture such as tables, chairs, and cupboards ...Right now, the banana fibre price is low as it is not in demand and many industries do not know how to implement this fibre. But, as shown in future potential uses, this fibre has good characteristics which can contributed the advantage and can boost the marketability "

[Respondent B]

Lastly, the findings about the non-organic fibre which is fibreglass from respondent A stated that the fibreglass can be used in the construction industry as an admixture material with asphalt layers intended to improve the quality of the roads. This is due to the fibreglass has high in water resistance which can avoid the road from damage which also can reduce the cost maintenance. On the other hand, respondent B indicated that the fibreglass has potential in making fibreglass-based composites and manufacturing in traffic light whereas the body of the traffic light substituted with fibreglass material by reasons of high in water resistant, high durability, and strength. In terms of marketability, respondent A stated that the price of the product made from fibreglass can be higher than usual if it is treated chemically but in the aspects of product term use, it will cause a fluctuation of the price. However, respondent B stated that the production in making the fibreglass cause a soaring price. This is due to high demand and the risk in making fibreglass is higher than other fibres as it will affect the worker's health such as ventilation, irritation, and skin disease if it is does not take the risks seriously.

"... in the construction industry, this fiber has potential in the construction of roofs in residential areas ..... this fiber can also be used as a material to make floorboards such as… .vinyl. These fiber characteristics have the potential to improve the performance of floorboards ... Similarly, the manufacture of furniture such as tables, chairs and cupboards ...the marketability of the fibreglass can cause a fluctuation in the aspect of product term use and if....the product is treated likes chemically and physically it will cause the marketability of the fibreglass will be higher.."

[Respondent A]

"... this fiberglass has potential in producing fiberglass-based composites .... this fiberglass also has potential in the construction of traffic lights where hmm… the plastic used to make traffic light is exchanged for fiberglass ....the fibreglass making has risks of safety in terms of health and internal damage such as lungs, eyes, nose and many more... so the price of the fibreglass will be high, and the marketability will be higher as well.."

[Respondent B]

Table 5 shown the summarizes of the future potential uses of each organic and inorganic fibre in construction industry.

Table 5: Future potential uses of organic and inorganic fibre in construction industry

Type of Fibre	Future potential uses in construction industry
Sugarcane bagasse fibre	1. Can be used as a composite material for reinforced concrete manufacture. 2. Making a furniture material such as tables, chairs, vanity and many more. 3. Using as an admixture material in making the bricks.

Coconut fibre	1. Coconut fibre can be applied in making as a fibre material for reinforcement concrete. 2. Can applied in producing wall panelling for decorative purposes. 3. Coconut fibre can be used in making a soil blocks for low-cost building manufacture.
Banana fibre	1. Banana fibre can be used as a fibre material for reinforcement concrete 2. Potential in making a roof tiles by using this fibre asa an admixture material. 3. Banana fibre has a potential in making a floorboard.
Fibreglass	1. Using fibreglass as an admixture material with asphalt layer in order to improve the quality of the road. 2. Has potential in making fibreglass-based composites. 3. Making the body of traffic light using fibreglass to reduce corrosion.

4.0 Conclusion

As the conclusion, each fibre materials in this project shown different values in MOE and MOR test. This finding show that fiberglass have a higher in MOR and MOE value compared banana fibre, coconut fibre, sugarcane bagasse fibre. Also, finding from the survey interview, main potential of fiberglass used in fibreglass-based composites and manufacturing in traffic light whereas the body of the traffic light substituted with fibreglass material by the reasons of high durability and strength. Even though the cost of fibreglass material is higher than the organic fibre such as banana fibre, sugarcane bagasse fibre and coconut fibre, it is still worth it due to the high strength of fibreglass material whereas shown in result testing which can withstand under extreme stress. In addition, this fibre has high resistance in being deformed when huge amount of stress applied to it. Panel board which has high tensile strength, and more elastic can expand into many applications that can be used in construction industry or other purposes.

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