CIVIL ENGINEERING DEPARTMENT

SESSION I: 2021/2022

DCC50194 FINAL YEAR PROJECT 2

TITLE:

SAND BRICK USING CRUSHED WASTE GLASS TO REPLACE SAND PARTIALLY

REPORT FYP 2

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COMFIRMATION OF PROJECT

The report entitled " **SAND BRICK USING CRUSHED WASTE GLASS TO REPLACE SAND PARTIALLY**" has been submitted, reviewed, and confirmed as meeting the requirements and requirements of project writing as prescribed. We acknowledge that this work is the result of our own work except for excerpts from each of which we have sourced.

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DATE: 13/12/2022

ABSTRACT

The making of a sand brick using crushed waste glass is to recycle the waste material such as glass to replace aggregate in sand brick. This project focuses on the waste material in the production of sand brick to go eco-friendlier, cheaper, and strong. The replacement of waste glass is based on the problem that occurs which is objects from glass will no longer be used and cause increased waste. The main material for making this sand brick are cement, crushed waste glass coarse aggregate, and water using the ratio of 1:6 composition of (cement: sand). The waste glass will be crushed and added into the mixture of sand brick with amounts of 0%, 10%, 15%, and 25% and it will be molded into a size 200x 100x 60 mm for 24 samples. It will have dried for 24 hours. The final product will be run with several laboratory tests such as a crushing strength test and water absorption test to determine its strength and ability. The test result of each sample will be evaluated and analyzed based on the standard for sand brick which is BS 6073-1981: Specification for Precast Concrete Masonry. Thus, we can determine the best percentage of crushed waste glass according to the strength of the brick when the load is subjected and the water-absorbing percentage which has been valued. Based on the result obtained from the strength compressive test the best value to replace crushed waste glass is 5% which gained an average of 14.8 N/mm^2. That is the highest strength value if compared to the other brick samples. Furthermore, the water absorption test shows the result that the brick containing 5% of crushed waste glass has the best average which is 7.93%. The lowest the brick absorbs the water which means the brick has good characteristics. In conclusion, the replacement of crushed waste glass in sand brick can be used in 5% and it makes the brick more durable because it shows good strength values and low water absorption rates.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Malaysia has three glass bottle facilities, each producing 600 tons of new bottles per day. Only 10% of these bottles will be returned to the factory to be used in the production of new ones. Now, some of the companies of waste management no longer accept glass bottles and jars to process them because there is no demand for recycled glass and glass has a lower value compared to other waste materials such as plastic, paper, metal, and more. Glass bottles could go as low as RM0.10/kg. Based on the search that has been made, the volume difference between glass and plastic recycling is one of the key reasons behind the imbalance. One of the reasons is glass is more expensive to transport since it is heavier and bulkier. There's also the issue of glass's limited endmarket application. Glass must be heated to 1,500 degrees to be recycled, whereas plastic does not. Also, glass can last a million years in a landfill, but plastic takes 1,000 years to decompose, depending on temperature and other factors.

Cement sand brick is produced with a mixture of cement, sand, and water according to a predetermined ratio in a set standard. The brick mixture will be moulded under pressure and cured under steam. Yet even though the production of cement sand brick is low cost but it is depending on the economic profile. The cost of the raw material might be increased due to high demand. Not only that, the use of raw materials such as fine aggregate is also likely to decrease in the near term due to insufficient natural resources. Most impact assessment methods assume that at a global worldwide scale, the stock for bulk resources, such as the sand and gravel used for concrete

manufacture is so important that it could be considered unlimited (G Habert, 2010). To avoid this thing happening many studies focus on the waste material used in construction. Due to a variety of factors, commercial production of waste-derived bricks is still quite limited (Lianyang Zhang, 2013).

The raw material of sand brick can be replaced to waste material which is environmentfriendly, strong, low-cost, and available. For environmental protection and sustainable development, extensive research has been conducted on the production of bricks from waste materials. Using glass waste in sand brick can be used as a replacement material for fine aggregate. Waste glass has a lot of potential in the concrete construction industry. While using waste glass (WG) in the concrete as aggregate improves some of the concrete properties, it also negatively affects some others (Bekir, 2003). The main material in glass is sand (silicon dioxide or, SiO_2), limestone (calcium carbonate or $CaCO_3$), and sodium carbonate (Na_2CO_3). Finding alternative methods for reusing waste glass can cut disposal costs while ensuring the longevity of landfills and natural resources (Edward, 2020).

1.2 PROJECT BACKGROUND

The production of a larger quantity of concrete causes serious problems in the construction industry. It increases the consumption of natural aggregates as the largest concrete component (Mirjana, 2010). Not only that, the consumption of natural resources is limited in terms of the raw materials used in packaging or construction. From that situation, many innovative ideas are made on bricks by using waste materials such as fine aggregate this is to reduce the consumption of natural resources in construction materials as the fast-paced urbanization and population growth have boosted construction activity around the world. So, the fine aggregate demand is getting higher day by day. As the consumption of natural resources is limited in terms of the raw materials

used in construction, there is another alternative to recreate new brick with some material that has good potential to replace the aggregate which is waste glass. Waste glass provides a readily available resource for use partially substituting coarse and fine aggregate in the sand brick mix.

1.3 PROBLEM STATEMENT

In the civil engineering construction industry, the most basic building material of houses is conventional brick. Conventional brick is one of the main components manufactured from natural resources such as sand and cement. There is an issue in producing brick especially in developing areas where manufacturers find it difficult to locate adequate sources of natural aggregate supply. As the price of sand increased, it affected the price of cement and sand bricks (Kubissa., 2015)

The production of a larger quantity of concrete causes serious problems in the construction industry. It increases the consumption of natural aggregates as the largest concrete component and creates an enormous amount of waste material from construction and demolition activities. Demolition of old and deteriorated buildings is a frequent phenomenon today (Mirjana et al.,2010)

One of the major challenges of our present society is the protection of the environment. Some of the important elements in this respect are the reduction of the consumption of energy and natural raw materials and the consumption of waste materials. These topics are getting considerable attention under sustainable development nowadays. The use of recycled aggregates from construction and demolition wastes is showing the prospective application in construction as an alternative to primary (natural) aggregates. It conserves natural resources and reduces the space required for landfill disposal (Haliza,2010).

Nowadays, glass products are largely utilized and therefore they contribute to an increase in solid waste volume. One of the glass products is glass bottles. Glass bottles have remained abandoned, and a considerable amount of them are dumped on the roadside, and bank of the river, which block the flow of water in the drain and leads to environmental problems.

1.4 OBJECTIVE PROJECT

This study aims to promote sustainable materials in brick production using crushed waste glass to replace fine aggregate. To achieve the above goals, the following objectives are outlined as follows:

1. To reduce the use of natural resources of sand brick by replacing it with crushed waste glass

2. To investigate the characteristics of sand brick containing finely crushed waste glass.

3. To investigate the durability properties of composite brick by water absorption test and strength test

1.5 ISSUE PROJECT

To achieve the objectives project, the issues the project depends on it. The following are the issues of the project:

1. Is the glass can replace the sand and achieve a high-strength sand brick?
2. Is the sand brick of the project suitable used in construction?
3. Is the sand brick of the project more durable than the normal sand brick?

1.6 PROJECT SCOPE

The engineering characteristics of cement sand brick using crushed glass waste as aggregate are the focus of this research. Sand, cement, crushed waste glass, and water are the primary ingredients in the sand brick mix. The waste glass is collected from postconsumer in the housing area and shops. Before adding to the brick mix, the waste glass is crushed manually and will be sieved and graded through a below 4.75mm sieve which is the size range between 4.75mm to 75µm. 24 samples will be made by adding 0%, 5%, 15% and 25% of the crushed waste glass into the sand brick mix. Ordinary Portland Cement (OPC) had been used as a binder in cement sand bricks. The specimen's size of the bricks is 200x100x60 mm and had been tested for engineering properties which are compressive strength and water absorption test in. The findings of the study will assist in the use of crushed waste glass as an aggregate substitute, hence improving the characteristics of sand cement bricks. This study looked at the density, and strength of the sand cement bricks when they were loaded, as well as the water absorption of the sand-cement bricks with crushed waste glass substitution. So, the result of the study will determine the desired percentage of crushed waste glass in each sample to obtain the best strength

1.7 SIGNIFICANT PROJECT

The recycling of waste in concrete is becoming ever more popular and it can lead to many environmental benefits. Normally, natural aggregates are used in producing sand cement brick, but nowadays manufacturing itself finds it difficult to obtain the sources due to the shortage of supply. In this study, a new alternative concept to reduce this problem is to utilize glass waste in the manufacturing of construction materials such as brick. The production of brick involves recycling materials from construction and demolition waste. Glass is a widely available and extremely cheap resource. In this study, this waste is used as the main material to replace natural sources in the production of composite brick.

Since the demand in concrete manufacturing is increasing day by day, the utilization of stone chips as coarse aggregate leads to the exploitation of natural resources. Recent research findings have shown that brick made with recycled glass aggregate is capable to provide better long-term strength and better thermal insulation due to the better thermal properties of the glass aggregates. The use of recycled glass as aggregate can also greatly enhance the aesthetic appeal of brick. Glass is a unique inert material that could be recycled many times without changing its chemical properties. The major aim of environmental authorities is to reduce, as far as possible, the disposal of post-consumer glass in landfills and diversion to economically viable glass product streams.

1.8 DEFINITION OF OPERATING TERMS

Waste-Glass (WG)

Waste glass is another waste material that is produced in large quantities and is difficult to eliminate.

1.8.1 Sand Brick

A type of brick made from a mixture of cement and sand, molded under pressure and cured under steam. Cement bricks apply fly ash, coal cinder, coal gangue, slag, chemical residue or natural sand, mud as raw material, and cement as a coagulant, without high temperature then form a new type of wall material.

1.8.2 Water cement ratio

The quantity of water needed in a concrete mix to give adequate moisture. If the water-cement ratio is placed with the wrong amount, a damaging swelling reaction between the reactive silica present in many common aggregates and the extremely alkaline cement paste takes place over time in concrete.

1.9 RESULTS EXPECTATIONS OF THE PROJECT

We believe that glass bottles can be processed into construction-grade cullet using any convenient mechanical method. For cullet-aggregate blends, the glass cullet can be blended with natural aggregates by any convenient mechanical method. Normal precautions should be followed to prevent segregation. Typical aggregates for construction include sands, gravels, crushed rock, and recycled concrete. The glass cullet and cullet aggregate blends should be compared with these standard specifications for each specific application. This research intends to encourage regulatory departments to amend specifications to allow glass cullet and cullet aggregate blends as an alternative to conventional aggregate in numerous applications.

We investigate the effects of using recycled glass bottles as an alternative fine aggregate. We will use recycled bottles from junkshops. These bottles will be cleaned to prevent foreign materials or chemicals from contaminating the specimens. After cleaning, they will be crushed manually and sieved to ensure uniformity in particle size. We will use Class A mix which has a 1:6:1 proportion of cement, sand, and water. Some percentage of sand will replace by crushed waste glass (0%,5%, 15%, and 25%) and a control mixture will also make available. Three specimens were collected from each mixture using 200x100x60mm of rectangular moulds and these specimens were tested for compressive strength and absorption test upon the 7th, 14th, and 28th days. Then, the results can be evaluated.

1.10 CONCLUSION

Overall, the making of sand brick using crushed waste glass to replace aggregate is an idea that can be applied to produce products that are environmentally friendly and suitable for new building materials. However, this study needs to be done by considering a lot of matters in terms of materials, method, cost, and information retrieval in detail and specifically to achieve the main objectives at the end of the study. Furthermore, this sand brick can be solved based on the statement of the problem mentioned when these bricks are successfully produced well. It also has a positive impact on consumers and the environment which can reduce production costs on the use of aggregates and can reduce the amount of waste glass.

CHAPTER 2

FIELD RESEARCH

2.1 INTRODUCTION

This chapter discusses the past research related to this project which is sand brick using crushed waste glass as aggregate as a source of reference. This literature review is done mostly on Google Scholar. The content is including specific information reviews made by past researchers. All the data from the different authors will be collected and analysed as guidance to generate an idea to solve the problem issue in this project. The data included in the literature review is about the advantages and disadvantages of using crushed waste glass in sand brick.

2.2 PREVIOUS STUDY

Waste glass may open a new path of economic and pollution-free concrete construction if desired strength can be achieved (Serniabat, 2014) waste glass can be used as a partial fine aggregate for producing concrete bricks, and it can be employed as an alternative material for waste glass management. (liza Rahim, 2014)

The influence of size in aggregate replacement (fine and coarse aggregates, separately or simultaneously); they found that the optimum replacement amounts of waste glasses as fine and coarse aggregates (separately) were 20% and 5–10%, respectively, but simultaneous replacement of waste glass as fine and coarse aggregates had the worst value. (Castro et al, 2014)

Incorporating waste glass into cement-based materials has the potential for creating a more sustainable future. Currently, trials of waste glass being used in cement-based materials on the commercial scale are limited (Edward et al, 2020)

The ground waste glass was used as aggregate for mortars and no reaction was detected with fine particle size, thus indicating the feasibility of the waste glass reuse as fine aggregate in mortars and concrete (Gautam et al, 2018)

Synthesis of alkali-activated materials using waste glass cullet is considered a potential way to reduce the negative environmental effects related to the use of OPC and natural sand (Nabi et al, 2020)

2.2.1 Brick categories

Bricks are commonly used in building construction and are also the main material for some buildings such as commercial, industrial and residential buildings. Bricks are known as strong, durable, long-last, low-cost, and completely waterproof building materials. However, the types of brick also should be considered to use for some construction. It is because all bricks have different characteristics. Bricks are classified in terms of strength, dimension, durability, average water absorption, and weight.

- *Burnt clay brick.* It is made by moulding and pressing the clay, then burning and drying it in kilns. The most popular brick is this one. When using this is necessary to do a plastering.
- *Fly Ash Brick*. This brick is created from clay and fly ash that moulded and burnt at a temperature of 1000 degrees Celsius. Fly ash has a significant amount of calcium oxide in it. This brick is self-cementing. When it comes into touch with moisture, it typically expands. Compared to clay bricks, it has smaller pores. It has a smooth surface, therefore plastering is not necessary.
- *Concrete brick.* Generally, concrete brick is made from very common materials such as cement, sand, and aggregate. It has poor quality and low compression strength. This brick can be utilized for internal brickwork, fences, and facades due to its ability to absorb sound and resist heat.

- *Sand lime brick.* It is made from sand, fly ash and lime that are combined and moulded under pressure. The mixtures are bonded by a chemical reaction that occurs during wet mixing. It produces a smoother surface and a more uniform appearance. It also does not need plastering as a result. Due to its incredible strength, it serves as a load-bearing element.

2.2.2 Waste glass in sand-brick mixed

The main ingredients in glass are sand, soda ash, limestone, and cullet. Therefore, Glass' main constituent and silica source is sand. It is generally known that the alkalis in cement paste and the silica in glass can react quite violently, causing the concrete to expand and crack (alkalisilica reaction or ASR). Glass is unstable in the alkaline concrete environment and may result in harmful alkali-silica reaction (ASR) issues. That means when glass waste is combined with concrete mixed it may change the workability, properties, and strength of the product.

2.2.3 Alkali silica reaction (ASR)

The chemical interaction between alkali cations and hydroxyl ions in the pore solution of hydrated cement paste and certain reactive silica. ASR can cause severe concrete cracking, which can cause serious structural issues and potentially necessitate the removal of a specific structure. Based on the previous study, the expansion increased with increasing glass content. ASR expansion of mortars containing waste glass as a natural fine aggregate replacement at levels of 20% and 40%, by weight showed an increase in the ASR expansion with increasing glass sand content. (Idir et al, 2009). It also reported that when partially replaced natural sand in concretes with crushed waste glass (size 4.75–0.15 mm) at levels of 0%, 10%, 15%, and 20%, by weight it will reduce the ASR expansion (Ismail, Hashmi, 2009). Based on the above, it was found that, with increasing glass

sand content, the ASR growth of glass mortars decreased. However, the ideal size of glass sand particles that showed the least amount of ASR expansion

2.2.4 Glass bottle

Generally, glass bottle is made from natural ingredients such as silica, sand, limestone, and soda ash. Sometimes, it will be mixed with another material like a cullet (recycle glass) which is the main material for O-1's glass bottles. The process of making glass bottles involve melting the raw material and will be subjected to high temperature about 1700 degrees and will be formed and shaped between 200 millimetres and 1.5 litres are the most typical. Glass bottles are frequently used for condiments, soda, cosmetics, pickling, and preservatives. These bottle types are practical and have a use in business sectors. There are types of the glass bottles that have been classified based on their chemical durability.

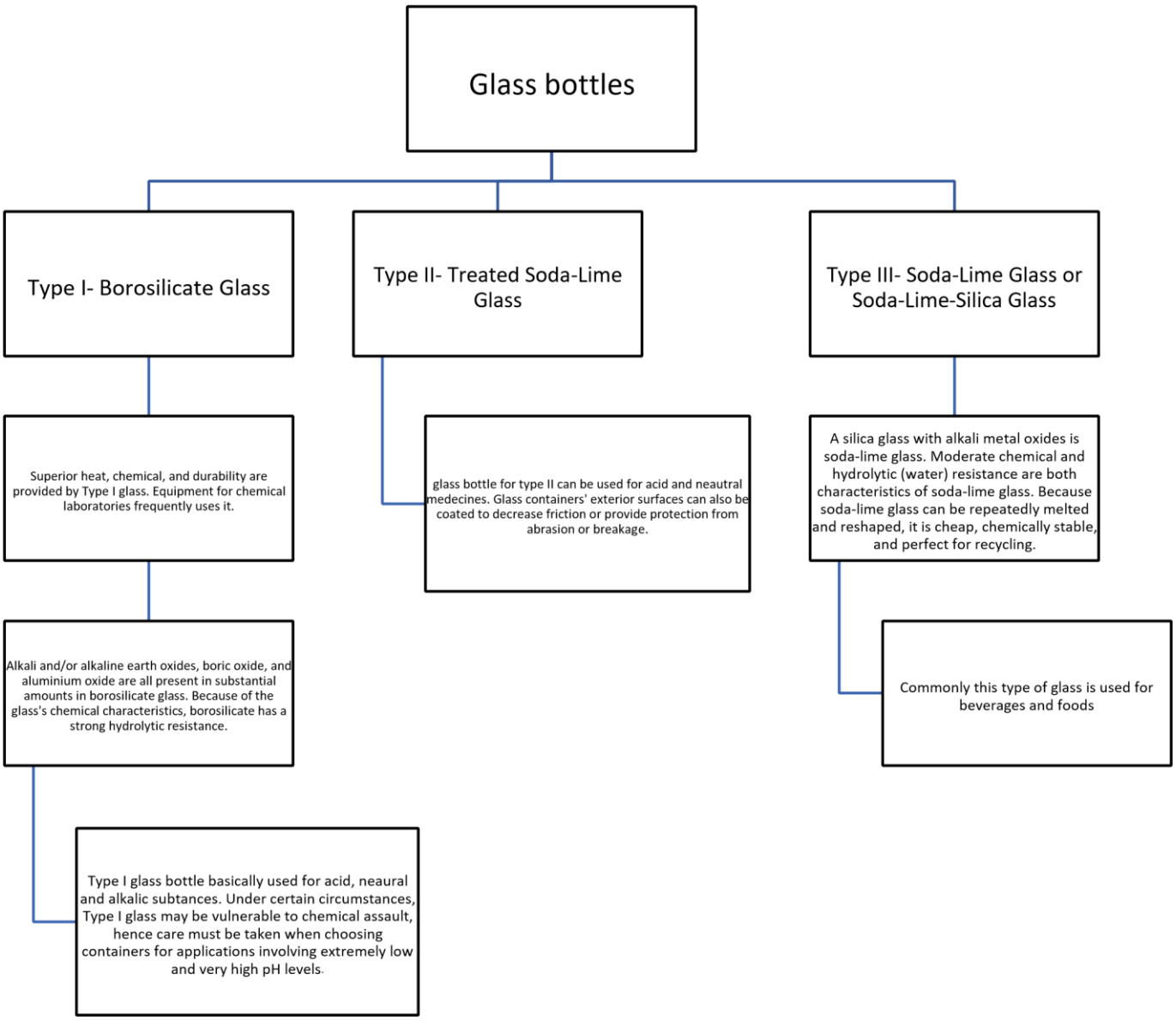

figure 2.1: A chart of the type of glass bottle

Compressive Strength

Compressive strength tests for bricks need to be done to obtain the value of brick capacity after being subjected to a load. The strength values are a way to determine whether the brick can be used safely or not. Based on BS 6073-1981 the minimum compressive strength of bricks is 7N/mm² until 40 N/mm² as shown in table 1. There is a study that reported that the replacement of glass content with concrete mixture may change its characteristics in terms of strength, expansion, air content, and tensile. It is reported that four-week-old concretes containing emerald green waste glass fine aggregates, regardless of their color, and with mixing ratios of 30%, 50%, and 70%, displayed a reduction in compressive strength (Seung et al, 2004). There is a reason stated that behavior of the sharp edges and smooth particle surfaces, leads to a poorer bond between cement mortar and glass particles (Jani et al, 2014). As a result, the compressive strength of the mortar will be reduced. In addition, concrete with a substitution level of more than 25% lost compressive strength. It should be noted that concrete with a substitution level of up to 25% showed compressive strength values larger than the reference (Terro, 2006).

However, it is clear that adding waste glass content into concrete, brick, and mar mix will give an impact on its properties. This is due to the cement matrix and waste glass are loosely connected. The high smoothness of waste glass reduces the bonding strength between the waste glass and the cement paste, causing fissures and poor adhesion between the waste glass and cement paste (Omoding et al, 2021)

The evidence above shows most previous studies have studied that waste glass mixed with concrete or cement paste will affect the strength whether it increases or decreases depending on the amount of waste glass is used.

Table 2.1: the compressive strength value for bricks based on BS 6073-1981: Specification for Precast Concrete Masonry

Blocks	Bricks
N/mm^2	N/mm^2
2.8	7.0
3.5	10.0
5.0	15.0
7.0	20.0
10.0	30.0
15.0	40.0
20.0	
35.0	

Water Absorption of Bricks content glass waste

Water absorption of brick is the weight difference between the samples exposed to distilled water and the samples that completed wetting and drying cycles was used to calculate the amount of water absorbed in the composites. The acceptable water absorption is between 12% and 20%. In this matter, what will happen to the rate of water absorption of sand brick if the waste glass is added to the sand brick mix? According to the previous study, the concrete mix with 40% waste glass content had the lowest value for water absorption (M.iqbal et al, 2013). It also reported that glass particles (less than 100 mm) had no negative effects and, in fact, enhanced the compressive and flexural strength as the water content increased when 30% and 70% of the sand mass were replaced (Corinaldesi et al, 2004). Some researchers stated that fine particles can contribute to more water absorption if compared to fine and coarse aggregate. Therefore, the percentage of cracks and voids in the concrete matrix rises as the amount of waste glass does as well (Qaidi et al 2022).

2.3 CONCLUSION

In summary, based on the previous research have been done, many opinions state that waste glass has the potential to replace fine or coarse aggregate in construction materials that are more economical and environmentally friendly. This is because waste glass is a sustainable future when compared to the sand or aggregate that is taken from natural resources which are likely to be limited in the future. However, there is criticism from past researchers who say that mixing glass waste with cement will cause an alkaline reaction that can reduce the strength and bonding between cement and other material. Yet, the previous study found out that glass waste can be used and no reaction was detected with the fine size of aggregate past researchers also determined the optimum percentage of waste glass that should be added in. Overall, waste glass can be used for sand and aggregate replacement with a certain amount and finer size as recommended by past researchers to obtain the required strength in making sand brick.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Regarding the objectives, laboratory works need to be done to obtain the data and information related to the project. The data is the reference for the study experiment that has to be done. After the discussion of study objectives in the introduction part, some experiments need to be done to achieve that objective is given such as compressive strength and water absorption. Information and material from the experiment will help to collect the information regarding the study and also can help to achieve the study objective. Several plans before laboratory work will make sure our work is more regulated nicely and systematically. The step that has to take before laboratory works such as:

- Preparing a flow chart regarding the experiment that has to be done as a reference to the laboratory keeper to facilitate a preparing regarding experiment needs.
- List all of the materials and equipment that needs in a laboratory experiment. This is important to make sure the work is complete and arrangeable.
- Inform the technician about the experiment works that have been planned to do.

3.2 PROJECT DESIGN

3.2.1 Method/ Process of Project/ Project Production Technique

In the process of producing sand bricks using crushed waste glass is shown in figure 2.1, some methods and techniques need to be taken into account. In terms of material, consumption is cement, sand, and water according to the ratio of sand brick which is 1:6, and (cement: sand). In the preparation of making sand brick, waste glass is also the main material for this project. Waste glass is collected from postconsumer usually in housing areas or shops. Those collected waste glasses will be crushed manually using a hammer with great care. While crushing the waste glass we need to wear appropriate and safe clothing and equipment to avoid any injuries. The crushed glass will go through a sieving process (4.75mm sieve and below) to determine the size and grade of the crushed particles.

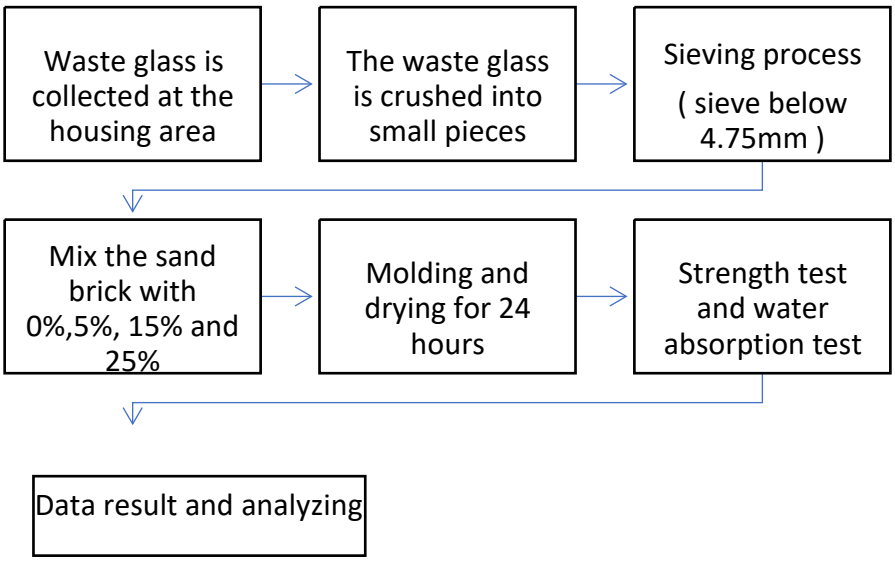

Figure 3.1: Process of making sand brick using crushed waste glass

The main material of sand brick like cement, sand is mixed together with crushed waste glass. The amount of crushed waste glass to substitute the fine aggregate is 0%, 5%,15%, and 25%. The total of bricks is 24 samples and will be molded into relevant standard brick sizes, 200 x 100 x 60 mm, and dried for 24 hours. After fully drying, 24 samples of brick will be divided into two batches which it will take into compressive strength test, and water absorption test. 12 bricks that contain 3 of 0%, 5%, 15%, and 25% will be tested for strength test and the same goes for the other brick that will be submerged in clean water for 7, 14, and 21 days. The strength and water absorption test results for each sample will be analyzed according to BS 6073.

Figure 3.2: The glass particles are separated to a certain size after the sieving process

Figure 3.3: Cement, sand, crushed waste glass and water are mixed together

Figure 3.4: The brick paste is molded and let dry for 24 hours

3.2.2 MATERIAL AND EQUIPMENT

The materials used in this study are cement, sand, crushed waste glass as a fine aggregate replacement, and water.

3.2.2.1 Cement

Ordinary Portland Cement will be used in the study is the Castle brand manufactured by YTL Cement Corporation Berhad, according to Malaysian Standard MS 522, which is based on the British standard BS 12 and European Union standard EN 196. The chemical composition of the cement is existing in the table 2 below

Table 3.1: The chemical composition is existing in cement

Chemical composition	
Oxide	**Content %**
CaO	63.17
SiO2	19.98
Al2O3	5.17
Fe2O3	3.27
MgO	0.79
SO3	2.38
Total Alkalis	0.9
L. O. I.	1.88
I. R.	1.47
L. S. F.	0.87
Main Compounds (Bogue's equations)	
C3S	59.09
C2S	12.71
C3A	8.18

C4AF	9.94

3.2.2.2 Sand

Good quality river sand will be taken in the project. The sand will be subjected to specific gravity and sieve analysis tests and the test will be carried out at the workshop of PSA. The standard size of sand is below 4.75mm and will be used in this project.

3.2.2.3 Crushed waste glass

Glass is formed by melting silica, soda ash, and lime followed by supercooling to achieve a solid which does not crystallize but rather retains the amorphous structure of the molten liquid. Silicate glasses, rich in silica are commonly referred to as “glass” in the industry. The main types of glass are soda glass, lead crystal glass, borosilicate glass, and electric glass. Broken glass or waste glass is usually referred to as a ‘cullet’. A cullet can be either internal cullet or external cullet. Internal cullet is not considered waste because they usually reject within the industry that does not meet the quality control and is absorbed as raw materials in the manufacturing process. External cullet is the waste glass that is collected and reprocessed for recycling. External cullet is further classified as preconsumer and post-consumer cullet depending upon whether the cullet is generated in the industry using glass as a component or is generated after use by the consumer.

Most of the raw glass materials that will be used in this study are clear flat glass. The first step in preparing the glass aggregate is the crushing process, which is crushed manually. The second step in preparing the glass aggregate is sieve analysis for the glass particles. The size of the sieving is 4.75mm, 2.36mm, 1.18mm, 300 µm, 150 µm, and 75 µm.

Figure 3.5: Sieving process to segregate the crushed waste glass

3.2.2.4 Water

The Water used for the concrete mix for this experiment was taken from the pipe in the laboratory in the apartment of civil engineering, Polytechnic Sultan Salahuddin Abdul Aziz Shah. The water was ensured to be clean and free from impurities or reactive agents.

3.2.3 METHOD OF DATA ANALYSIS

After the brick test is done, all the data obtained will be valued according to the British Standard for Precast concrete masonry units (BS 6073-1981). From that reference, the result obtained can be determined in terms of minimum and maximum performance permissible for compressive strength and water absorption for bricks. For the compressive strength, the test is held at RTL Lab Sdn.Bhd, Subang Jaya, 24 bricks that contain 0%, 5%, 15%, and 25% of crushed waste glass with a size specimen of 200x 100x 60 mm by using the digital compressive machine.

Figure 3.6: Digital compressive machine is used to measure the value of the compressive strength of brick

The results will be evaluated and analyzed using graphs of compressive strength (N/mm2) vs percentage of waste glass (%). According to the British Standards Institution, bricks should have a compressive strength of at least 7 N/mm2. From the resulting graph, we can determine which brick has the highest strength. To determine the percentage of water absorption, each brick will be weighed after drying and it must be submerged in clean water at room temperature for 24 hours

Figure 3.7: All the brick is fully submerged in the water for the water absorption test

The wet brick will be weighed to determine its percentage of water absorption by using this calculation:

(Wet brick mass – dry brick mass)/dry brick mass x 100

The quantity of water absorption in a good-grade brick should not exceed 20%.

3.3 CONCLUSION

Through Chapter 3, we designed the flow chart of the project and explained all the processes of the project. Seven steps need to be taken to undertake the project. All the materials and equipment that will be used in the project are also listed in chapter 3 with details explanations such as cement, aggregates, and many more. The compressive test and water absorption test are also our methods of data analysis.

CHAPTER 4

DATA RESULT AND ANALYSIS

4.1 INTRODUCTION

According back to the objectives of this study, this sand brick is made to determine its strength and water absorption rate. This is necessary because the use of new material which is crushed waste glass in making sand bricks will affect the function of the bricks in terms of their strength and the rate of absorption brick in the water. The tests that have been carried out on sand bricks are the strength test and the water absorption test. At the end of the test, the result of each test will be analyzed to determine whether the making of a sand brick using crushed waste glass is achieved based on the objective or not.

4.2 TEST RESULT/ FINDINGS

4.2.1 COMPRESSIVE STRENGTH TEST

In this study, a compressive strength test is carried out on each brick to determine the capacity for carrying loads with the help of a compression testing machine. Before testing the brick, the samples are then submerged in water for 24 hours while being kept at room temperature. The test result for samples that contain 0%, 5%, 15%, and 25% have been recorded. According to the line graph that shows in figure 4.1 the percentage of crushed waste glass versus compressive strength (N/mm^2), the sand brick mix using 5% of crushed waste glass as replacement parts as sand for each batch produced the best compressive strength value of 16.1 N/mm^2, 14.1 N/mm^2, and 14.2 N/mm^2. This is representing an improvement in strength compared to the control brick which contains 0% of crushed waste glass. Other than that, sand brick contains 15% crushed waste glass

producing good compressive strength values as well which are slightly low than brick mix with 5% of crushed waste glass but can be categorized as a good strength value.

The brick mix with 0% and 25% of crushed waste glass has the lowest performance of strength value. This shows that when the brick has no addition of crushed waste glass will decrease its strength. Yet, the higher percentage of crushed waste glass in the mixture also contributed to the low compressive strength of the bricks. So, from the result above, it is related to the previous search studied by Liza Rahim, the optimum percentage of glass waste that gives the maximum values of compressive strengths is 10%. It reported that the optimum percentage replacement was 20% (Hathaichanok et al, 2019). It also stated that ASR expansion of mortars containing waste glass as a natural fine aggregate replacement at levels of 20% and 40%, by weight showed an increase in the ASR expansion with increasing glass sand content. (Idir et al, 2009).

So, the brick test results that have been obtained in this study are the same and closely related to the statements that have been presented by previous researcher.

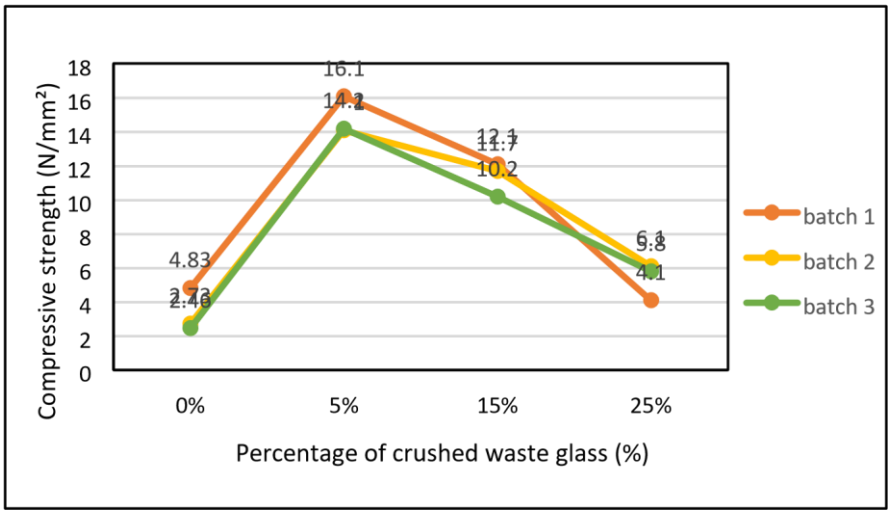

Figure 4.1: Compressive strength of the sand brick result

4.2.2 WATER ABSORPTION TEST

Referring back to the purpose of this study, the water absorption test is to determine the rate of diffusion of bricks into the water because it will indicate how much water seeps into the brick samples when they are submerged. Each brick will be weighed before submerging it into the water to get a dry mass of brick. After that, all the bricks are submerged in clean water at room temperature for 7 days, 14 days, and 21 days. The data have been recorded on 12 samples of brick that contain 0%,5%, 15%, and 25%. Based on the graph in the figure 10 shows the average water absorption has a constant trend. The brick that contains 0% of crushed waste glass obtained a normal average water absorption percentage which from sample 1 is 9.4%, sample 2 is 7.1% and sample 3 is 7.9%. This is because the brick without glass content makes brick in a completely solid state and has low pores. However, sand bricks containing 5% glass show an increase in water absorption rate in the value of 8%, 8.3%, and 7.5% for samples 1,2, and 3 because glass particles that are added into the sand brick mix led to higher water absorption. This situation is proved by the previous researchers that already mentioned the percentage of cracks and voids in the concrete matrix rises as the amount of waste glass does as well (Qaidi et al 2022). Then again, the sand brick that contains 15% of crushed waste glass is also greater than bricks at 5% of crushed waste glass. The high amount of waste glass, and the high value of water absorption. Next, the brick containing glass at 25% in sample 3, has shown a high-water absorption value of 9.4%. While sample 1 has a water absorption rate of 7.4% which is less than sample 2 which absorbs as much as 8.4%. this happens because there is damage to the brick that can cause a change in the value of the water absorption.

To conclude based on the previous study, particles in glass waste that were finer less than 10mm the water content increased when 30% and 70% of the sand mass were replaced (Corinaldesi et al, 2004). But according to the result, the sample at 25% containing crushed waste glass has begun to increase the rate of water absorption due to a higher amount of fine glass waste which the size of glass waste used was 1.18mm and 300μm.

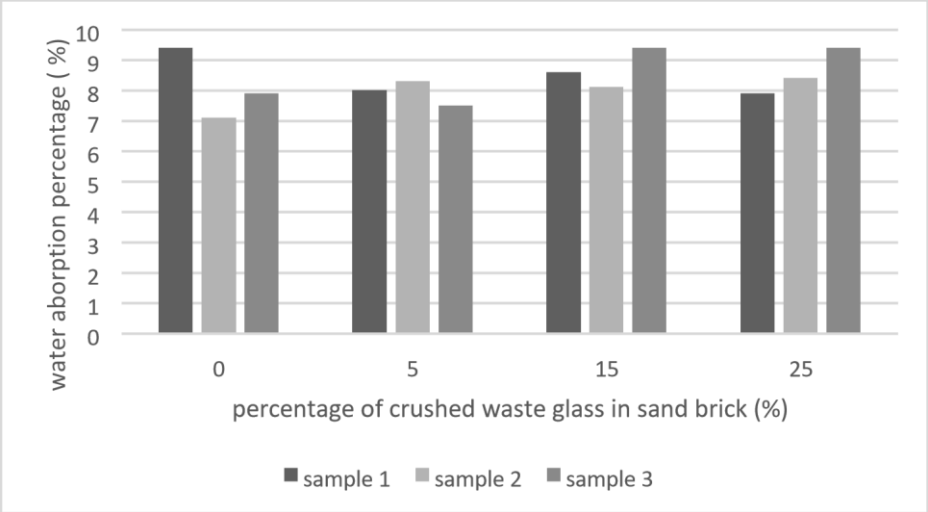

Figure 4.2: Average of water absorption of sand brick with different percentages of crushed waste glass

4.3 CONCLUSION

Based on the result obtained, the value of compressive strength has been influenced by the amount of glass in the brick. It is clear that the more glass content in the sand-brick mix the more its strength decreases. The best value for using crushed waste glass as a substitute for sand is between 5% to 15%. The sand bricks became very porous, absorbed more water, and lost some of their compressive strength when the waste glass content was increased by more than 20%.

In addition, with regard to the water absorption test on sand bricks, the result has shown that glass with small and fine sizes has the potential to have a higher water absorption rate. On top of that, the amount of glass included in the sand-brick mixture also affects the absorption of water by the bricks. Yet, the value of water absorption for every sample is good and not too high because is less than 20%.

Overall, the tests that have been carried out are based on previous studies to determine whether the data found is related to the statement presented by the researcher.

I. CHAPTER 5

CONCLUSION AND DISCUSSION

5.1 INTRODUCTION

Overall, this study has caried out several processes that require high determination to obtain quality and useful results. In this chapter, all searches for this study have been done according to the correct guidelines and references to ensure that this study is true and confirmed. In the first chapter is the initial step in carrying out a project that requires a broad and innovative level of thinking. Next, this study also needs to find previous studies to get their findings that can be used as a reference throughout the project. This is also important to make a comparison with the result of the project itself with the previous study. Furthermore, all methods and process are carried out carefully so that the results of the work can be achieved in accordance with the objectives that have been set. Finally, the result and data will be linked to previous study to be analysed. So, this study produced many new findings and as additional evidence of the project being carried out.

5.2 DISCUSSION

On a final note, this study is successfully achieved from start to finish according to the methods and processes that have been set. The making sand brick using crushed waste glass to replace sand has involved many things that need to be considered and always need to be referred back to the project objectives. This study has achieved all the objectives. Firstly, the use of sand can be reduced about 5% to 15% and replaced by the using of crushed waste glass. So that, the replacement sand partially using crushed waste glass also a good idea because it environmentally friendly and does not depend entirely on the use of sand. It has been proven that waste glass is suitable to be used as a replacement material.

Next, this study successfully investigates the characteristics of sand brick containing finely crushed waste glass. Based on the compressive strength result, the best percentage of crushed waste glass in sand brick is recommended between 5% to 15%. Referring to the value of brick strength, the average strength value of brick containing 5% crushed waste glass is 14.8 N/mm² that shows a good strength value because it reaches the standard according to BS 6073-1981: Specification for Precast Concrete Masonry, which means the strength of bricks needs more than 7N/mm². So, it can be concluded that, the characteristics of sand brick also effected by replacing with different percentage of crushed waste glass which is stronger and durable with the recommended percentage.

Therefore, the rate of water absorption by all the bricks is in a good category because the absorption is not more than 20%. Brick that containing 5% of crushed waste glass has the best performance of water absorption test which is 7.4%. The lowest the sand brick absorb the water, the more the durability of the sand brick.

5.3 RECOMMENDATION

The recommendation of this project was that during the making of sand brick the process of mixing the crushed waste glass of every size needed to determine each percentage. In this project, the amount of every size that we used crushed waste glass only adding with no specific percentage and amount. This is necessary because it will determine which size of glass give a significant effect in terms of strength on the sand brick.

Next, the process of breaking the glass is done manually causing the time taken to be too long. Resulting from that, the glass fragment is not so fine and too large to use for the sieving process. during the segregation in the sieving process, the large glass particles will remain at the largest sieving size. So, the smaller glass size gets a small amount causing the proses of crushing the glass to be repeated until the desired amount is enough. From the problem, the suggestion that can be made is that the glass-breaking process needs to be done using a machine to get a good result. In addition, it also saves

time and is safer when compared to manual methods. As a result, the size of broken glass will also be finer and easier to use in the next process.

The weakness of this project was that during the making of sand brick the process of mixing the material such as cement, sand, glass, and water was done manually using the hand. In this case, the mixing technique of the sand brick mixture may not well combine and it takes a long time to ensure the sand brick mixture is mixed evenly. If the mixing is not done well, the result of making bricks will be not good in terms of its physical because the material inside becomes separate from each other and porous. So, the quality of sand bricks will decrease. To overcome this problem, the suggestion that can be is to use a mixing machine to get the mixing of the brick material properly mixed in a short time. As a result, the bricks made will be better and the quality is good where physically the brick will well be formed.

5.4 CHAPTER CONCLUSION

At last, this project has given many benefits in creating something new and beneficial to humans. The use of waste material can be practiced to maintain the sustainability of nature. The value that can be found throughout this study is that we need to be creative and innovative to produce something of value that can be maintained for the future. With careful study of making sand bricks mostly waste material has a high potential in producing something useful and has more benefits, especially in terms of cost and being friendly to the environment. This sand brick is suitable and can be commercial and used widely in construction industry because many studied has been used glass as a replacement material in construction field. at the same time, the problem of wasted glass can be reduced because the glass can be reused as replacement material that more environmentally friendly, low-cost and sustainable.

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APPENDIX

TITLE: SAND BRICK USING

CRUSHED WASTE GLASS TO

REPLACE AGGREGATE- PROJECT

PLANNING SCHEDULE ON SEMESTER 1 (GANTT CHART)

NO	TASK	ACTIVITY/WEEK	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1			SEMESTER 1													
1.1	Project title selection	Planning														
		Actual														
1.3	Project research	Planning														
		Actual														
1.4	Discussion with the supervisor about the project	Planning														
		actual														
1.5	Defense proposal	Planning														
		Actual														
1.6	Logbook update	Planning														
		Actual														
1.7	Proposal presentation 1	Planning														
		Actual														
2	**Draft report chapters 1-3**															
2.1	Introduction	Planning														
		Actual														
2.2	Literature review	Planning														
		Actual														
2.3	Data collection	Planning														
		Actual														

2.4	Research detail about the project	Planning															
		Actual															
2.5	Research detail about material	Planning															
		Actual															
2.6	Methodology	Planning															
		Actual															
2.7	Presentation 2	Planning															
		Actual															
2.8	Proposal submission	Planning															
		Actual															

GANTT CHART- PLANNING SCHEDULE FOR FINAL YEAR PROJECT 2 ON SEMESTER 2

PROJECT: MAKING SANDBRICK USING CRUSHED WASTED GLASS TO REPLACE FINE AGGREGATE

SUPERVISOR: PUAN DALIELLA BINTI ISHAMUDDIN GROUP MEMBERS: 1. EE EN QI 08DKA20F1041 2. NUR RAIHANI BINTI MOHD SALAM 08DKA20F1059

ACTIVITY PLAN OF FINAL YEAR PROJECT 2 (SEMESTER 2)

#	Activity		WEEK > 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	INITIAL BRIEFING AND DISCUSSION															
2	COLLECTION OF THE PROJECT MATERIALS															
2.1	Buying the brick mold, cement and sand	PLANNING														
		ACTUAL														
2.2	Collect the waste glass	PLANNING														
		ACTUAL														
2.3	Preparing the required equipment	PLANNING														
		ACTUAL														
3	PRODUCTION OF BRICK															
3.1	Crushing the waste glass	PLANNING														
		ACTUAL														
3.2	Sieving process of crushed glass	PLANNING														
		ACTUAL														
4	BRICK MIXING															
4.1	Sample 1	PLANNING														
		ACTUAL														
4.2	Brick curing 1	PLANNING														
		ACTUAL														
4.3	Sample 2	PLANNING														
		ACTUAL														
4.4	Brick curing 2	PLANNING														
		ACTUAL														
4.5	Sample 3	PLANNING														
		ACTUAL														
4.6	Brick curing 3	PLANNING														
		ACTUAL														
5	BRICK TESTING															
5.1	WATER ABSORBPTION TEST															
5.1.1	Sample 1	PLANNING														
		ACTUAL														
5.1.2	Sample 2	PLANNING														
		ACTUAL														
5.1.3	Sample 3	PLANNING														
		ACTUAL														
5.2	STRENGTH TEST															
5.2.1	Sample 1	PLANNING														
		ACTUAL														
5.2.2	Sample 2	PLANNING														
		ACTUAL														
5.2.3	Sample 3	PLANNING														
		ACTUAL														
6	DRAFT REPORT FOR THE PROJECT RESULT															
6.1	WATER ABSORBPTION TEST															
6.1.1	Introduction	PLANNING														
		ACTUAL														
6.1.2	Project result	PLANNING														
		ACTUAL														
6.1.3	Discussion	PLANNING														
		ACTUAL														
6.1.4	Summary	PLANNING														
		ACTUAL														
6.2	STRENGTH TEST															
6.2.1	Introduction	PLANNING														
		ACTUAL														
6.2.2	Project result	PLANNING														
		ACTUAL														
6.2.3	Discussion	PLANNING														
		ACTUAL														
6.2.4	Summary	PLANNING														
		ACTUAL														
7	DRAFT REPORT FOR CONCLUSION AND SUGGESTION															
7.1	Introduction	PLANNING														
		ACTUAL														
7.2	Conclusion	PLANNING														
		ACTUAL														
7.3	Suggestion	PLANNING														
		ACTUAL														
7.4	Summary	PLANNING														
		ACTUAL														
8	REPORT SUBMISSION															

Cost Project

Material and Equipment	**Price**	**Unit**	**Total price**
Cement	RM20/Bag	1	RM 20
Rent machine compressive test	RM 7/ brick	12	RM 84
Brick mould	RM 13 /pc	3	RM 39
TOTAL			RM 143

Reliable
Testing Laboratory

TEST FORM
(MASONRY)

BIL LAB SDN. BHD.
PRELIMINARY TEST RESULTS
(SUBJECT TO CONFIRMATION)
page : ___ of ___

Type of Test : Compressive Strength of Masonry Unit
BS EN 772-1:2011

Section A : Testing Items & Client's Information

Client	: POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH	Supplier	:
Project	: FINAL YEAR PROJECT	Type of Masonry	: SAND BRICK
Ref. No.	:	Job No.	:
Location	:	Report No.	:

Section B : Testing Data

Method of Conditioning : Air dry condition / Oven dry condition / 6% moisture content / Immersion

Date Received : 9/11/22 Date Test : 9/11/22 Quantities : 3

Specimen No.	Specimen Dimension (mm)						Weight (g)	Maximum Load (kN)	Compressive Strength (N/mm²)
	Length		Width		Height				
1	200.0	200.0	100.0	100.0	60.0	60.0	2253.4	96.6	4.83
	200.0		100.0		60.0				
2	198.0	198.0	100.0	100.0	60.0	60.0	2163.7	54.1	2.73
	198.0		100.0		60.0				
3	200.0	200.0	100.0	100.0	59.0	59.0	2146.7	49.1	2.46
	200.0		100.0		59.0				

Balance ID : UB-003 CTM ID : CTM-001 Caliper / Ruler ID : SR-001
Oven ID : N/A

Tested by :
Name : FAZWAN
Date : 9/11/22

Reviewed by :
Name : SITI AZLIN
Date : 9/11/22

Witnessed by :
Name : NUR RAIHANI
Date : 9/11/22

Compressive strength result for brick 0% of crushed waste glass

ST REPORT
(ASONRY)

Reliable Testing Laboratory

RTL-QR-CSM-01
Revision: 1.0
Issue: 2 August 2019

Type of Test : Compressive Strength of Masonry Unit
BS EN 772-1:2011

Section A : Testing Items & Client's Information

Client : Nur Raihani Binti Mohd Salam
Project : Final Year Project (FYP)
Ref. No. : N/A
Location : N/A

Supplier : N/A
Type of Masonry : Sand Brick (5%)
Job No. : 22TA1079
Report No. : RTL/MS/KL21116/22TA1079

The testing was conducted at RTL Lab Sdn. Bhd.

Section B : Testing Data

Method of Conditioning : Air-Dry Condition (Clause 7.3.2)
Date Received : 02/11/2022 **Date Test** : 02/11/2022 **Quantities** : 3 units

Specimen No. & Weight (g)	Specimen Dimension (mm)						Maximum Load (N)	Compressive Strength (N/mm²)
	Length		Width		Height			
1	200.0	200.0	100.0	100.0	60.0	60.0	322800	16.1
2214.9	200.0		100.0		60.0			
2	200.0	200.0	100.0	100.0	60.0	60.0	282100	14.1
2390.2	200.0		100.0		60.0			
3	196.0	196.0	100.0	100.0	60.0	60.0	277800	14.2
2302.6	196.0		100.0		60.0			

Balance ID : WB-003 **CTM ID** : CTM-001 **Ruler ID** : SR-001 **Oven ID** : N/A

Notes : The results only related to the as-received item(s) tested.

Approved By :

RTL Lab Sdn. Bhd. (1316699-D)

Name : Ir. Lim Kah Seng
Date : 03/11/2022

RTL Lab Sdn. Bhd. (1316699-D)
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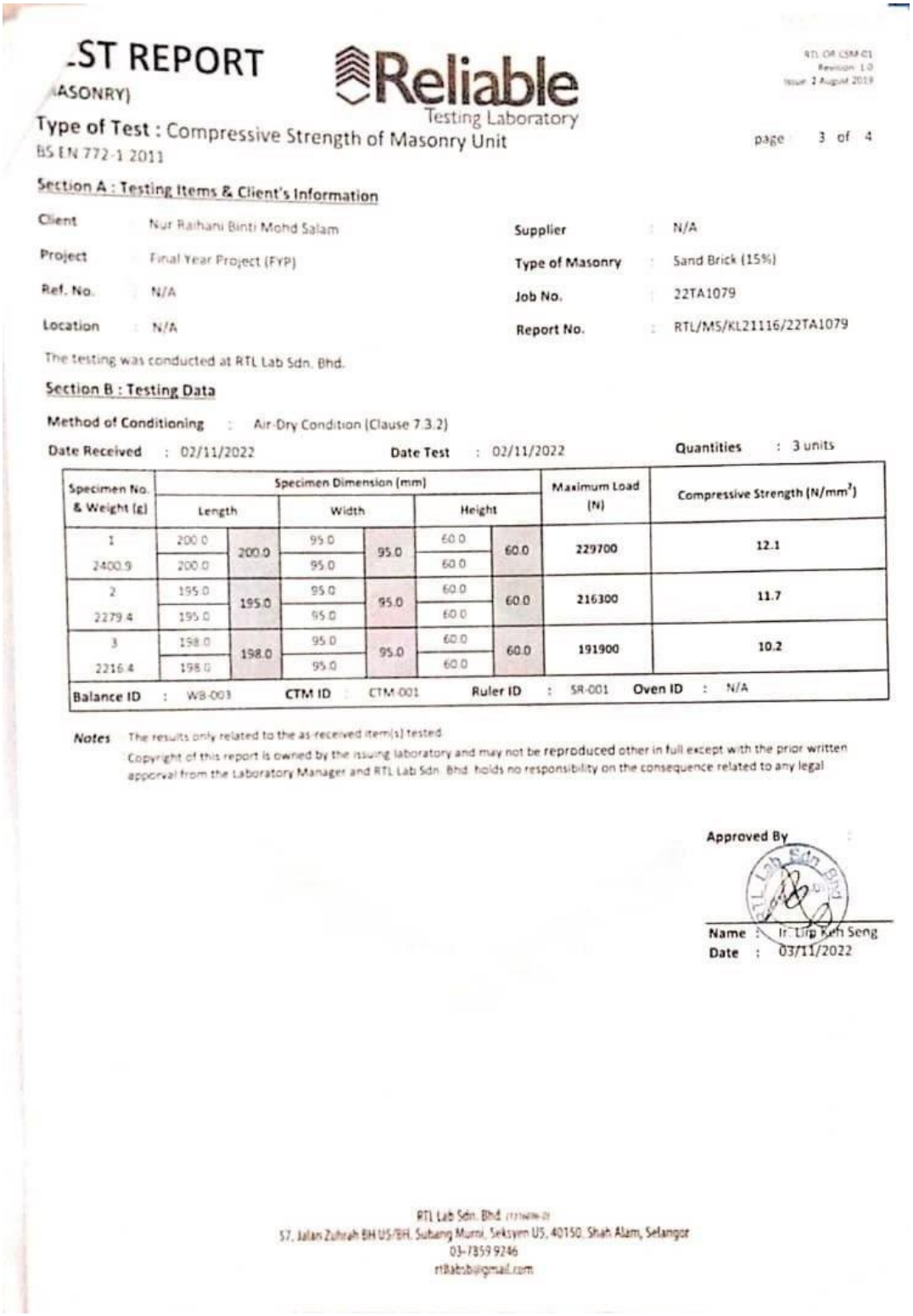
03-7859 9246
rtllabsb@gmail.com

Compressive strength result for brick 5% of crushed waste glass



-ST REPORT
(ASONRY)

Reliable
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RTL QR (SM-01)
Revision 1.0
Issue 2 August 2019

Type of Test : Compressive Strength of Masonry Unit

page 3 of 4

BS EN 772-1 2011

Section A : Testing Items & Client's Information

Client	: Nur Raihani Binti Mohd Salam	Supplier	: N/A
Project	: Final Year Project (FYP)	Type of Masonry	: Sand Brick (15%)
Ref. No.	: N/A	Job No.	: 22TA1079
Location	: N/A	Report No.	: RTL/MS/KL21116/22TA1079

The testing was conducted at RTL Lab Sdn. Bhd.

Section B : Testing Data

Method of Conditioning : Air-Dry Condition (Clause 7.3.2)

Date Received : 02/11/2022 Date Test : 02/11/2022 Quantities : 3 units

Specimen No. & Weight (g)	Specimen Dimension (mm)						Maximum Load (N)	Compressive Strength (N/mm²)
	Length		Width		Height			
1	200.0	200.0	95.0	95.0	60.0	60.0	229700	12.1
2400.9	200.0		95.0		60.0			
2	195.0	195.0	95.0	95.0	60.0	60.0	216300	11.7
2279.4	195.0		95.0		60.0			
3	198.0	198.0	95.0	95.0	60.0	60.0	191900	10.2
2216.4	198.0		95.0		60.0			

Balance ID : WB-003 CTM ID : CTM-001 Ruler ID : SR-001 Oven ID : N/A

Notes The results only related to the as-received item(s) tested.

Approved By :

Name : Ir. Lim Kah Seng
Date : 03/11/2022

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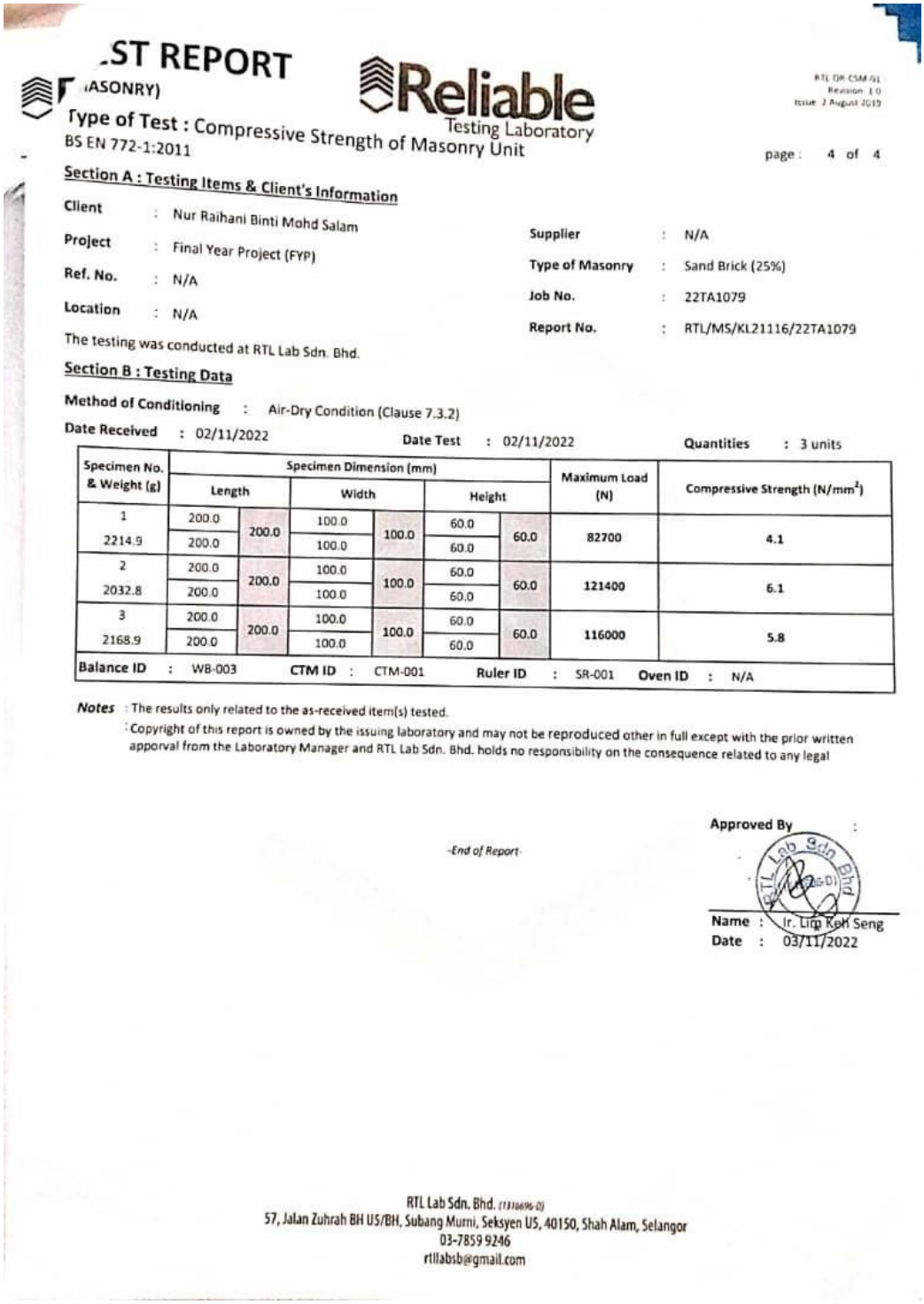
Compressive strength result for brick 15% of crushed waste glass



.ST REPORT

(ASONRY)

Reliable Testing Laboratory

RTL QF CSM 01
Revision 1.0
Issue 2 August 2019

Type of Test : Compressive Strength of Masonry Unit
BS EN 772-1:2011

page : 4 of 4

Section A : Testing Items & Client's Information

Client : Nur Raihani Binti Mohd Salam
Project : Final Year Project (FYP)
Ref. No. : N/A
Location : N/A

Supplier : N/A
Type of Masonry : Sand Brick (25%)
Job No. : 22TA1079
Report No. : RTL/MS/KL21116/22TA1079

The testing was conducted at RTL Lab Sdn. Bhd.

Section B : Testing Data

Method of Conditioning : Air-Dry Condition (Clause 7.3.2)
Date Received : 02/11/2022 Date Test : 02/11/2022 Quantities : 3 units

Specimen No. & Weight (g)	Specimen Dimension (mm)						Maximum Load (N)	Compressive Strength (N/mm²)
	Length		Width		Height			
1	200.0	200.0	100.0	100.0	60.0	60.0	82700	4.1
2214.9	200.0		100.0		60.0			
2	200.0	200.0	100.0	100.0	60.0	60.0	121400	6.1
2032.8	200.0		100.0		60.0			
3	200.0	200.0	100.0	100.0	60.0	60.0	116000	5.8
2168.9	200.0		100.0		60.0			

Balance ID : WB-003 CTM ID : CTM-001 Ruler ID : SR-001 Oven ID : N/A

Notes : The results only related to the as-received item(s) tested.
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Approved By :
Name : Ir. Lim Keh Seng
Date : 03/11/2022

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Compressive strength result for brick 25% of crushed waste glass

Mass of sand brick before submerging into the water and mass of sand brick after submerging into the water after 7,14 and 21 days and an average of water absorption test

Samples	Before submerging (kg)	7 days (kg)	14 days (kg)	21 days (kg)	Average (%)
0%					
1	1.71	1.86	1.87	1.88	9.4
2	1.82	1.94	1.95	1.96	7.1
3	1.78	1.91	1.92	1.93	7.9
5%					
1	2.00	2.15	2.16	2.17	8
2	1.92	2.07	2.08	2.09	8.3
3	1.86	1.99	2.00	2.01	7.5
15%					
1	1.97	2.13	2.14	2.15	8.6
2	1.98	2.13	2.14	2.15	8.1
3	1.92	2.09	2.10	2.11	9.4
25%					
1	1.90	6.8	7.4	7.9	7.4
2	1.91	7.9	8.4	8.9	8.4
3	1.81	8.8	9.4	9.9	9.4

BORANG INVENTORI PROJEK PELAJAR

<table>
<tr><th>PERKARA</th><th>MAKLUMAT</th></tr>
<tr><td>Program:</td><td>DIPLOMA KEJURUTERAAN AWAM</td></tr>
<tr><td>Jabatan:</td><td>JABATAN KEJURUTERAAN AWAM</td></tr>
<tr><td>Semester/ Tahun:</td><td>1: 2022/2023</td></tr>
<tr><td>Tajuk Kajian/Projek:</td><td>SAND BRICK USING CRUSHED WASTE GLASS TO REPLACE SAND PARTIALLY</td></tr>
<tr><td>Jenis Kajian/Projek:</td><td>KAJIAN NYATA</td></tr>
<tr><td>Kategori Kluster Penyelidikan:</td><td>Tanda “ / ” pada yang berkenaan:
<table>
<tr><td></td><td>Sains Tulen</td><td></td><td>Sains Sosial</td></tr>
<tr><td></td><td>Sains Gunaan</td><td></td><td>Sastera & Sastera Ikhtisas</td></tr>
<tr><td>/</td><td>Teknologi & Kejuruteraan</td><td></td><td>Warisan Alam & Budaya</td></tr>
<tr><td></td><td>Sains Kesihatan & Klinikal</td><td></td><td>ICT</td></tr>
</table></td></tr>
<tr><td>Ahli Kumpulan:</td><td>1. Nama: NUR RAIHANI BINTI MOHD SALAM
No. Pendaftaran Pelajar: 08DKA20F1059
2. Nama: EE EN QI
No. Pendaftaran Pelajar: 08DKA20F1041</td></tr>
<tr><td>Penyelia:</td><td>Nama: PN. DALIELA BINTI ISHAMUDDIN
No. Kad Pengenalan: 820122025606</td></tr>
</table>

Penyelia Bersama:	1. Nama: No. Kad Pengenalan: 2. Nama: No. Kad Pengenalan:
Multi-Disiplin:	
Kolaborasi: (Industri/Komuniti)	*Nyatakan maklumat lengkap industri/komuniti yang terlibat dalam pembangunan projek berserta peranan dan sumbangan pihak industri.*

Objektif Kajian/Projek:	1. To reduce the use of natural resources of sand brick by replacing it with crushed waste glass 2. To investigate the characteristics of sand brick containing finely crushed waste glass. 3. To investigate the durability properties of composite brick by water absorption test and strength test.

PERKARA	**MAKLUMAT**

Skop Kajian/Projek:	The engineering characteristics of cement sand brick using crushed glass waste as sand are the focus of this research. Sand, cement, crushed waste glass, and water are the primary ingredients in the sand brick mix. The waste glass is collected from post-consumer in the housing area and shops. Before adding to the brick mix, the waste glass was to investigate the characteristics of sand brick containing finely crushed waste glass is crushed manually and will be sieved and graded through a below 4.75mm sieve which is the size range between 4.75mm to 0.075mm. 18 samples will be made by adding 0%, 5%, 15%, and 25% of the crushed waste glass into the sand brick mix. Ordinary Portland Cement (OPC) had been used as a binder in cement sand bricks. The specimen's size of the bricks is 200x100x60 mm and had been tested for engineering properties which are compressive strength and water absorption test in. The findings of the study will assist in the use of crushed waste glass as an aggregate substitute, hence improving the characteristics of sand cement bricks. This study looked at the density, and strength of the sandcement bricks when they were loaded, as well as the water absorption of the sand-cement bricks with crushed waste glass substitution. So, the result of the study will determine the desired percentage of crushed waste glass in each sample to obtain the best strength.
Penglibatan Pelajar: (merujuk kepada skop kajian/projek)	

Abstrak Kajian/Projek:	The making of a sand brick using crushed waste glass is to recycle the waste material such as glass to replace partial sand in sand brick. This project focuses on the waste material in the production of sand brick to go eco-friendlier, cheaper, and strong. The substitution of waste glass as the sand in the sand brick is based on the problem that occurs which is objects from glass will no longer be used and cause increased waste. The main material for making this sand brick is cement, crushed waste glass, sand, and water using the ratio of (1:1:6) composition of (water: cement: sand). The waste glass will be crushed and added into the mixture of sand brick with amounts of 5%, 15%, and 25% and it will be molded into a size 200x 100x 60 mm for 24 samples. It will have dried for 24 hours and cured for 7, 14, and 21 days. The final product will be run with several laboratory tests such as a crushing strength test and water absorption test to determine its strength and ability. The test result of each sample will be evaluated and analyzed based on the standard for sand brick which is BS 6073-1981: Specification for Precast Masonry. Thus, we gained the best average value of crushed waste glass from the compressive strength test which is 14.8N/mm² from the sand brick that contains 5% of crushed waste glass. For the water absorbing test, the best average percentage that we obtained which is the lowest percentage that sand brick absorb is 7.93% which is also the sand brick that contains 5% of crushed waste glass. In conclusion, all the data on the sand bricks we obtained in the test passed the standard normal sand brick value especially 5% of crushed waste glass in the sand brick, which is categorized as a high-quality sand brick.

Infografik Kajian/Projek:	

Peringkat: *(sekiranya ada menyertai pertandingan)*	Jabatan
No. Pendaftaran Harta Intelek (*jika ada*)	

Disemak oleh: Tandatangan Penyelaras Kursus Projek Nama dan Cop:	Disahkan oleh: Tandatangan Penyelaras Projek Pelajar Jabatan Nama dan Cop: DALIELA BINTI ISHAMUDDIN Pensyarah Jabatan Kejuruteraan Awam Politeknik Sultan Salahuddin Abd Aziz Shah

Nota: *Borang ini perlu diisi oleh pelajar dan dihantar kepada Penyelaras Kursus Projek/Jabatan dalam bentuk salinan keras (hardcopy) dan salinan lembut (softcopy) (Borang LAMPIRAN J dan gambar hasil projek dalam format jpeg/bitmap) bersama Laporan Akhir dan hasil projek.*