

ACKNOWLEDGEMENT

The highest appreciation is extended to the management of Kolej Kemahiran Tinggi MARA Pasir Mas for their unwavering support in making this innovation project a success. The facilities, equipment, and infrastructure provided by the college have played a crucial role in ensuring the success of the research related to the Kenaf Interlocking Universal Brick. Without the assistance and collaboration provided, the success of this project would have been difficult to achieve.

This support not only fosters a culture of innovation and research among lecturers and students but also strengthens the institution's role as a driver of technological development relevant to the needs of the construction industry. We are truly grateful for the commitment shown.

Additionally, heartfelt thanks go to our families, colleagues, and students for their continuous support and encouragement. Your unwavering dedication and cooperation have been instrumental in making this project a success.

Abstract/Synopsis

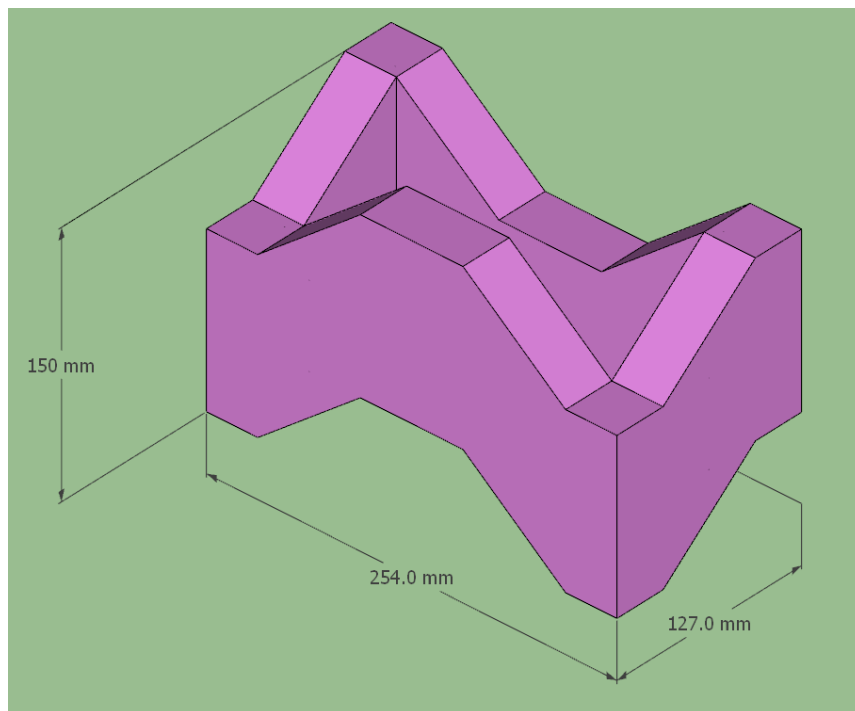
The Kenaf Interlocking Universal Brick (KIUB) is an innovative sustainable building material designed to integrate modern design, cost-effectiveness, and high-performance capabilities, using kenaf core as the primary material. The brick features a unique interlocking design that enhances the ease and efficiency of installation while ensuring strong structural stability. KIUB is designed which emphasizes structural efficiency and mechanical durability, making it suitable for a wide range of applications in the construction sector. Extensive studies were conducted to determine the optimum ratio of kenaf core, cement, sand, and other additives. This material composition ensures a balance between mechanical strength, water resistance, and thermal insulation, making the block well suited for use in various climatic conditions, particularly in tropical environments. Cost analysis reveals that the use of kenaf core (locally available material) reduces raw material expenses while supporting local industries, positioning the brick as both economical and sustainable. The Kenaf Interlocking Universal Brick underwent rigorous compressive strength and water absorption tests to evaluate its durability and resistance to moisture. Results demonstrate excellent performance, ensuring the brick's reliability under different environmental conditions. Installation tests confirmed that the interlocking design streamlines the construction process, reducing time and increasing overall efficiency. Additionally, heat tests showed that the block provides significant thermal insulation, contributing to improved thermal comfort in buildings located in hot climates. Overall, the Kenaf Interlocking Universal Brick is a groundbreaking solution that addresses the demand for sustainable and high-performing building materials. It offers a blend of durability, cost-effectiveness, and superior thermal performance, making it a valuable innovation in the construction industry and a significant step towards promoting eco-friendly and sustainable development.

ABSTRAK/SIPNOPSIS

Bata Kenaf Interlocking Universal (KIUB) adalah bahan binaan mampan yang inovatif, direka untuk menggabungkan reka bentuk moden, keberkesanan kos, dan keupayaan prestasi tinggi dengan menggunakan teras kenaf sebagai bahan utama. Bata ini menampilkan reka bentuk saling mengunci yang unik, yang meningkatkan kemudahan dan kecekapan pemasangan sambil memastikan kestabilan struktur yang kukuh. KIUB direka dengan penekanan pada kecekapan struktur dan ketahanan mekanikal, menjadikannya sesuai untuk pelbagai aplikasi dalam sektor pembinaan. Kajian mendalam telah dijalankan untuk menentukan nisbah optimum teras kenaf, simen, pasir, dan bahan tambah lain. Komposisi bahan ini memastikan keseimbangan antara kekuatan mekanikal, ketahanan air, dan penebatan haba, menjadikannya sesuai untuk digunakan dalam pelbagai keadaan iklim, terutamanya di persekitaran tropika. Analisis kos menunjukkan bahawa penggunaan teras kenaf (bahan tempatan yang mudah diperoleh) mengurangkan kos bahan mentah sambil menyokong industri tempatan, menjadikan bata ini ekonomi dan mampan. Bata Kenaf Interlocking Universal telah menjalani ujian kekuatan mampatan dan penyerapan air yang ketat untuk menilai ketahanan dan keupayaannya terhadap kelembapan. Keputusan menunjukkan prestasi yang sangat baik, memastikan kebolehpercayaan bata ini dalam pelbagai keadaan persekitaran. Ujian pemasangan mengesahkan bahawa reka bentuk saling mengunci mempercepatkan proses pembinaan, mengurangkan masa, dan meningkatkan kecekapan keseluruhan. Selain itu, ujian haba menunjukkan bahawa bata ini memberikan penebatan haba yang signifikan, menyumbang kepada keselesaan haba yang lebih baik dalam bangunan yang terletak di kawasan beriklim panas. Secara keseluruhan, Bata Kenaf Interlocking Universal adalah penyelesaian inovatif yang memenuhi permintaan terhadap bahan binaan yang mampan dan berprestasi tinggi. Ia menawarkan gabungan ketahanan, keberkesanan kos, dan prestasi haba yang unggul, menjadikannya inovasi yang bernilai dalam industri pembinaan serta langkah penting ke arah pembangunan yang mesra alam dan mampan.

1.0 INTRODUCTION

Kenaf Interlocking Universal bricks (KIUB) are the new propose building material to be exposed to building construction environment. It is designed with a special shape to make it very simple product and easy to install as the D.I.Y concept. KIUB is seen as an eco-friendly building material for building construction because it can be produced by local people with simple tools using locally available resources such as kenaf core as main element of raw material which renewable resources that will reduce air pollution of manufacturing process of existing construction materials such as conventional brick. KIUB is an alternative building material and technology to replace the use of fired bricks and concrete building blocks for building construction that will significantly reduce the use of non-renewable raw material such as sand which is important for environmental degradation control concern. The significant different of the KIUB compared to existing interlock brick is in term of its size and shape, material and weight. KIUB has the bigger size that approximately 65% bigger compared to existing interlocking brick which provide faster installation process. This size factor will expedite construction time of a project and indirectly effect to the overall construction cost. The use of kenaf core produce lightweight feature of KIUB for easy handling.



1.1 Problem statement

1.1.1 Cost of Production

Issue: The initial cost of manufacturing interlocking bricks can sometimes be higher than traditional bricks, due to the specialized moulds and machinery required for production. This can increase the overall project cost, especially if large quantities are needed.

1.1.2. Impact on Structural Load

Issue: Interlocking bricks typically weigh more than traditional clay or concrete bricks, depending on the material used. This increased weight can affect the overall load on the foundation, especially in multi-story buildings. Inadequate foundation design may lead to settling or structural failure over time.

1.1.3. Increased Labor and Handling Difficulty

Issue: The heavier weight of interlocking bricks can make manual handling and placement more difficult for workers, especially during the construction of walls. This can lead to higher labor costs and a longer construction time.

1.1.4. Environmental Impact of Heavier Bricks

Issue: The heavier weight of interlocking bricks may contribute to a higher environmental impact during the construction process, particularly in terms of energy usage for manufacturing and transportation. This could potentially reduce the sustainability benefits of using interlocking bricks as a building material.

1.1.5. Risk Of Pest Infestation

Issue: Pest infestation in walls made of interlocking bricks can be a concern due to the minor gaps or fissures between the bricks. These gaps can become breeding grounds for pests like ants, wasps, and beetles

1.1.6. Need A Lot Type of Brick Shape

Issue; IBS Brick come in variety type of shape that has it own purposes. This will make the estimation and calculations cost of the project will be more harder and also effects of the transportation as some type of brick is more heavier and bigger.

1.2 Objective

Objective of carrying out this research are as follows

- i. Produce Kenaf Interlocking Universal Brick (KIUB) which economy, sustainable and environmentally friendly.
- ii. Determine physical properties of KIUB
- iii. Apply the KIUB to construction of small building.

1.3 Scope

Seeking to the renewable resources of kenaf core to be utilized in making construction materials. Kenaf core, derived from the kenaf plant (*Hibiscus cannabinus*), is gaining attention in the construction industry as a renewable and sustainable material.

Our innovation offers significant benefits to both contractors and buyers by streamlining processes, improving efficiency, and reducing costs. For contractors, it enhances project management, minimizes delays, and optimizes resource allocation. For buyers, it ensures higher quality, faster delivery, and greater transparency, ultimately leading to a more cost effective and satisfactory experience.

The scope of this study cover following elements of

- conduct survey to the industry players, public organization, private organization and community.
- Produce design of KIUB which economy, sustainable and environmentally friendly by incorporating kenaf core in the making of the product, preparing unique shape design for structural integrity and aesthetic value and lightweight feature for easy handling.
- Carrying out physical test (strength, water absorption and fire resistance)
- Construction small scale building wall and planter box in Pasir Mas area
- Promoting the use of KIUB among industry player, public and private organizations and community.

1.4 Expected Outcome

- **Carbon Footprint Reduction:** By using renewable natural materials like kenaf, it is expected to reduce the use of high carbon-emission construction materials like cement. This will contribute to mitigating climate change.
- **Reduction in Non-Renewable Material Use:** KIUB reduces dependency on traditional materials that have a larger environmental impact, such as clay or bricks produced through high-energy processes.
- **Time and Cost Savings in Construction:** The interlocking design allows for faster and easier brick installation without the need for mortar. This can save both time and labor costs during construction.
- **Easier Installation and Less Dependence on Skilled Labor:** The interlocking system, which is simple and intuitive, can simplify installation without requiring highly skilled workers, thus reducing errors during construction.
- **Durability Against Environmental Factors:** It is hoped that KIUB made from kenaf will result in more durable buildings, especially if the treatment of kenaf materials is optimized to improve resistance to moisture and pests.
- **Better Thermal and Acoustic Insulation:** KIUB offers better thermal, and sound insulation compared to traditional bricks, which can improve comfort within buildings and reduce energy costs for heating or cooling.
- **Wider Market Acceptance:** With further research, development, and standardization, it is expected that KIUB will gain wider acceptance among builders, developers, and consumers.
- **Innovation in the Construction Sector:** The use of kenaf and interlocking bricks could be an example of innovation in sustainable construction, leading to the adoption of new technologies in the industry.
- **Job Creation:** The expansion of the kenaf industry could create more employment opportunities in cultivation, production, and processing, particularly in rural areas.
- **Increased Environmental Awareness:** The adoption of KIUB could raise awareness among the public about the importance of using sustainable and eco-friendly construction materials.

2.0 LITERITURE REVIEW

2.1 Brick in General

A brick is a versatile and durable building material that has been used for centuries in construction. It is typically a small, rectangular block made from natural raw materials such as clay, shale, or concrete. The production of bricks involves either shaping the raw material into a mould or cutting it into the desired shape, followed by firing it in a kiln (in the case of clay bricks) or curing it through a drying process (for concrete bricks). This process hardens the material, giving bricks their strength and ability to withstand various weather conditions and physical stresses.

Bricks have been a staple in construction due to their numerous benefits, including durability, fire resistance, and excellent thermal mass, which helps in regulating indoor temperatures. They are commonly used in building structures like walls, foundations, roads, and pavements. In addition, bricks can provide aesthetic value to a project, as they come in various shapes, sizes, and colors, offering a natural and timeless appearance.

Due to their long lifespan, low maintenance requirements, and the fact that they are often made from abundant natural resources, bricks are considered a sustainable building material. Whether in residential, commercial, or industrial applications, bricks continue to be a preferred choice for construction, offering a balance of strength, energy efficiency, and aesthetic appeal.

2.2 Types of Brick

Today there are already a lot type of brick in the market with different building and many types of shape. As an example, in Malaysia now there is an IBS Brick that has a shape and method of installation like Lego. This brick was innovated in Thailand and now already entering Malaysia market

The traditional sand-cement bricks, also known as concrete bricks, were first introduced in the early 20th century. They gained popularity in the 1920s and 1930s as an alternative to traditional clay bricks due to their durability, ease of production, and cost-effectiveness. The combination of sand, cement, and water offered a more affordable and versatile building material that became widely adopted in construction around the world.

2.2.1 Sand Cement Brick

A sand-cement brick, also known as a concrete brick or cement brick, is a type of building material made from a mixture of sand, cement, and water. The ingredients are blended and then formed into blocks or bricks, which are typically cured through a drying or setting process rather than being fired like clay bricks.

The composition of sand and cement provides the brick with durability, strength, and resistance to wear and weathering. Sand-cement bricks are often used in the construction of walls, pavements, and other structures.

2.2.1.1 Characteristics of sand cement brick

Sand-cement bricks have several key characteristics that make them a popular choice in construction:

- **Durability:** These bricks are strong and durable, providing good resistance to weathering, wear, and tear. They are suitable for use in a variety of construction projects, from residential to commercial.
- **Affordability:** Sand-cement bricks are generally less expensive than fired clay bricks, making them a cost-effective option for building projects. The raw materials (sand and cement) are widely available and inexpensive.
- **Ease of Production:** The manufacturing process of sand-cement bricks is simpler and requires less energy compared to the firing process for clay bricks, making them easier and quicker to produce.

2.2.1.2 Advantages and Disadvantages of Sand Cement Brick

Sand-cement bricks offer several advantages that make them a popular choice for construction. These include:

- **Cost-Effectiveness:** Sand-cement bricks are generally more affordable than clay bricks due to the lower cost of raw materials (sand and cement) and simpler manufacturing processes, making them a budget-friendly option for large construction projects.
- **Consistency:** Sand-cement bricks are uniform in size and shape, which makes them easy to handle, stack, and lay, ensuring precision in construction.
- **Versatility:** These bricks can be used for a wide range of construction applications, including walls, pavements, foundations, and even decorative features, offering flexibility in design and function.

While sand-cement bricks offer many advantages, they also come with some disadvantages that need to be considered when choosing building materials. These include:

- **Lower Thermal Insulation:** Sand-cement bricks generally offer poorer thermal insulation compared to clay bricks or other specialized materials. This can result in higher energy costs for heating and cooling in buildings, as they do not effectively regulate indoor temperatures.
- **Prone to Cracking:** If not properly mixed or cured, sand-cement bricks can be prone to cracking over time. External factors like temperature changes, moisture, and improper handling during construction can exacerbate this issue.
- **Higher Water Absorption:** These bricks typically absorb more water than other types of bricks, especially if the mix is not balanced or properly cured. This can lead to moisture retention in walls, causing potential structural damage or issues like mould and mildew growth.

2.2.2 IBS Brick

IBS Brick material of this brick are water, cement, red soil, sand and stone dust.

2.2.2.1 Characteristics of IBS Brick

The characteristics of IBS Brick that makes them popular in Malaysia now are:

- Dimension: IBS Brick has a bigger dimension than a regular brick.
- Unique Design: IBS Brick has aesthetic looks compare to a regular brick.

2.2.2.2 Advantages and Disadvantages of IBS Brick

IBS (Industrialized Building System) bricks offer several advantages, particularly in modern construction methods that prioritize speed, efficiency, and sustainability. Here are some key benefits of IBS bricks:

- Nice Finishing: This brick has a nice that does not need plastering job
- Easy and Faster Installation: Installation are faster than traditional brick and does not need high skilled person.
- Low Temperature: Has a low temperature compared to other brick

3.0 PRODUCT ACHIEVEMENT

We are proud to announce that KIUB has been awarded industrial design registration certification by MyIPO. Our design is officially registered under the number MY 23-01167-0101. This certification represents a major recognition of our product design's uniqueness and innovation. We are grateful for the support we have received and are excited to continue offering top-quality products. Figure 13 shows certification of industrial design of KIUB.

We are pleased to share our achievement that KIUB has been awarded a Research and Development (R&D) collaboration grant for the year 2023. We have been granted RM120,000 to carry out R&D of the innovation project entitled “Kenaf Interlocking Universal Block” (KIUB). This exciting opportunity will enable us to further our research and development efforts in creating innovative applications for kenaf-based products. Figure 14 shows offer letters of the Research and Development (R&D) collaboration grant emailed by Lembaga Kenaf dan Tembakau Negara (LKTN) personnel to my email address.



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Title of Work : **UNIVERSAL INTERLOCKING BRICK (UIB)**
Category of Work : **LITERARY**
Date of Application : **13 JUNE 2023**

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Offer Letter for Collaboration



Surat Kami: 100-IIESM(16/5)
Tarikh: 21 September 2023

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KM 6, Lebuhraya Pasir Mas Rantau Panjang
Bandar Baru Pasir Mas
17000 Pasir Mas
Kelantan

YBrs. Tuan.,

Assalamualaikum wbt.,

JALINAN KERJASAMA UITM DAN KKTm PASIR MAS BAGI PROJEK *UNIVERSAL INTERLOCKING BLOCK* (UIB)

Dengan segala hormatnya perkara di atas adalah dirujuk.

- Untuk makluman pihak tuan, Institute of Infrastructure Engineering and Sustainable Management (IIESM) bersama pihak tuan yang diwakili oleh Tuan Mohd Hanizan Bahari telah memulakan kerjasama dalam menjalankan kajian Universal Interlocking Block (UIB).
- Pihak IIESM menyokong penuh aktiviti kajian ini dan amat berharap kerjasama ini akan berterusan dalam meningkatkan lagi penghasilan kajian sehingga kepada pencapaian optimum dan kebolehpasaran produk.

Terima kasih di atas jalinan ini. Semoga menjadi pemangkin untuk kolaborasi yang lebih baik di masa hadapan.

Sekian. Terima kasih.

"MALAYSIA MADANI"
"BERKHIDMAT UNTUK NEGARA"



Lot 2154, Kg. Banggol Beta,
Jln Besar, 16210 Tumpat, Kelantan.
Tarikh: 11 Oktober 2023

PENGARAH

Kolej Kemahiran Tinggi MARA Pasir Mas
KM 6, Lebuhraya Pasir Mas Rantau Panjang
Bandar Baru Pasir Mas
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Kelantan.

YBrs. Tuan.,

Assalamualaikum wbt.,

JALINAN KERJASAMA VCI IBS SDN. BHD. DAN KKTm PASIR MAS BAGI PROJEK *KENAF INTERLOCKING UNIVERSAL BLOCK* (KIUB)

Dengan segala hormatnya perkara di atas adalah dirujuk.

- Untuk makluman pihak Tuan, bahagian Kajian dan Penyelidikan (*Research and Development Department*) Syarikat kami bersama pihak Tuan yang diwakili oleh Tuan Mohd Hanizan Bahari telah memulakan kerjasama dalam menjalankan kajian Kenaf Interlocking Universal Block (KIUB).
- Pihak kami menyokong penuh aktiviti kajian ini dan amat berharap kerjasama ini akan berterusan ke tahap yang lebih maju sehingga menghasilkan produk berkualiti dan potensi komersial yang luas di masa akan datang.

Terima kasih di atas jalinan ini. Semoga menjadi pemangkin untuk kolaborasi yang lebih baik di masa hadapan.

Award



4.0 TRL

TRL KIUB

- | | |
|---|--|
| 1 | Interlocking feature similar to existing Interlock Brick System (IBS) brick use to construct building beam, column and wall system but with difference shape, material and physical characteristic such as strength, water absorption and density. |
| 2 | Design of KIUB taken consideration of several factor such as lightweight for easy handle, adaption of renewable raw material to provide sustainable construction material, bigger size to faster the installation process |
| 3 | <ul style="list-style-type: none">• Carrying out test to determine strength, water absorption and fire rating KKTm• Carrying out installation test |
| 4 | Carrying out test to determine strength, water absorption and fire rating at Megalab |
| 5 | <ul style="list-style-type: none">• Construct wall at plumbing bay KKTm Pasir Mas |
| 6 | <ul style="list-style-type: none">• Construct planter box at KKTm Pasir Mas• Construct planter box at villager house in Pasir Mas area |
| 7 | <ul style="list-style-type: none">• Construct wall at plumbing bay KKTm Pasir Mas• Construct planter box at KKTm Pasir Mas• Construct planter box at villager house in Pasir Mas area |
| 8 | <ul style="list-style-type: none">• Construct wall at plumbing bay KKTm Pasir Mas• Construct planter box at KKTm Pasir Mas• Construct planter box at villager house in Pasir Mas area• Carrying out test to determine strength, water absorption and fire rating at Megalab |

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- Carrying out fire test at KKTM Pasir Mas

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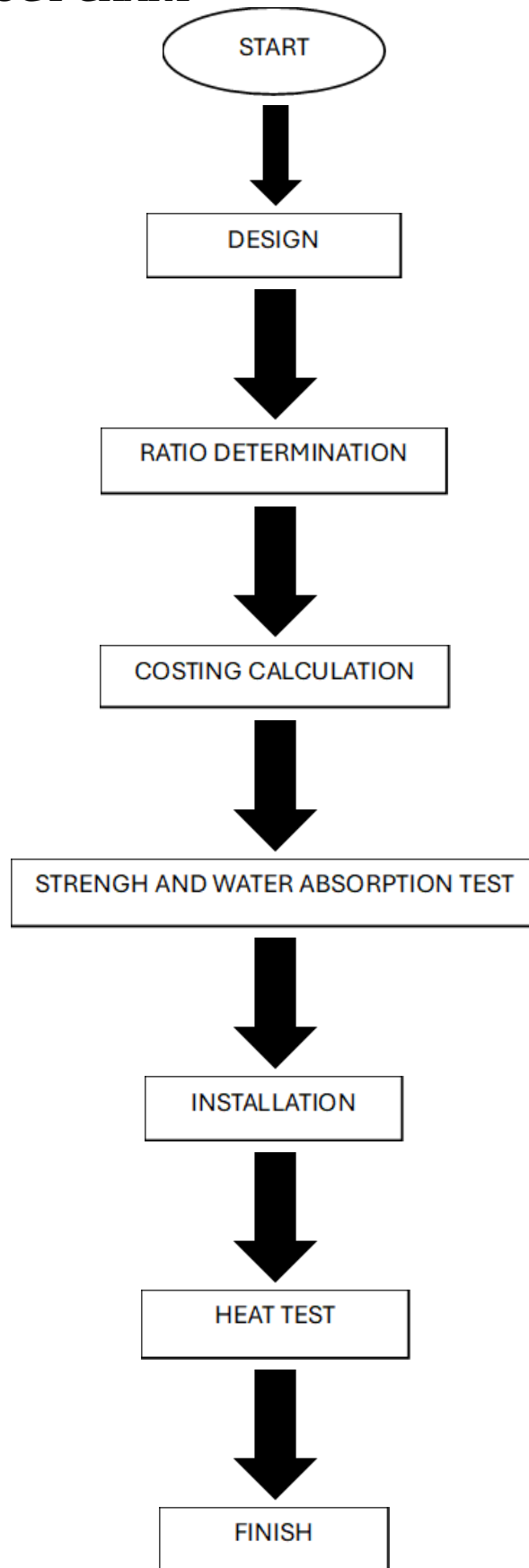
- Able to be used to construct building

5.0 SDG

Sustainable Development Goal (SDG)	Kenaf Brick Sustainability Elements	How Kenaf Bricks Contribute to the SDG
SDG 1: No Poverty	Affordable Construction Material	Kenaf bricks are cost-effective, which can help provide affordable housing solutions for low-income communities and in emergency situations.
SDG 2: Zero Hunger	Sustainable Crop Utilization	Kenaf can be grown in poor soil conditions and used for multiple purposes, including food security through agricultural diversification.
SDG 6: Clean Water and Sanitation	Efficient Resource Use	Kenaf cultivation requires less water compared to many other crops, which helps conserve water resources.
SDG 7: Affordable and Clean Energy	Efficient Building Material	Kenaf bricks provide thermal insulation, which can reduce the energy needed for heating and cooling buildings.
SDG 9: Industry, Innovation, and Infrastructure	Innovative Building Material	The development of kenaf bricks represents innovation in sustainable building materials, contributing to the growth of green technologies in the construction industry.

SDG 11: Sustainable Eco-Friendly Cities and Communities	Construction Solution	Kenaf bricks are a sustainable building material that supports the creation of green, resilient urban environments.
SDG 12: Sustainable Responsible Consumption and Production	Sustainable Practices and Production	Kenaf bricks are made from a renewable resource, contributing to responsible production practices and reducing reliance on non-renewable materials.
SDG 13: Climate Action	Carbon Sequestration	Kenaf plants absorb CO ₂ from the atmosphere, and the use of kenaf bricks helps store carbon in building materials.
SDG 15: Life on Land	Promotes Sustainable Agriculture	The cultivation of kenaf supports sustainable agricultural practices and helps restore degraded land.

5.0 METHODOLOGY CHART



During design stage we must ensure that the design of brick is essential to consider both the aesthetic appeal and functional requirements of the project, ensuring that the shape complements the overall architectural style while providing the necessary strength and durability.

The ratio determination of brick ingredients, such as sand, cement, kenaf and water, is crucial to ensure the proper strength, durability, and workability of the final product, meeting the specific requirements of the construction project.

Accurate costing calculation for making a brick involves factoring in the costs of raw materials, labor, equipment, and energy, ensuring that the production process remains cost-effective while maintaining the desired quality and standards.

The strength and water absorption test of a brick are essential to evaluate its durability and performance, ensuring it meets the required standards for compressive strength and resistance to moisture infiltration in construction applications.

Installation processes are done to test the KIUB is meeting its objective such as faster installation time than other brick.

A heat test on brick is conducted to assess its ability to withstand high temperatures without cracking, warping, or losing strength, ensuring it is suitable for use in fire-prone areas or environments with extreme heat exposure.

6.0 DISCUSSION

In the present day, there are already many types of brick in the market, but our objective is to produce KIUB which is economically friendly, sustainable and environmentally friendly, to say our KIUB offers the most low price other than IBS Brick and traditional sand cement brick. The table below shows the comparison for building 50 meter square wall.

			
	KIUB PXLXT	BATA IBS PXLXT	BATA SIMEN
	250X180X127	250X100X125	225X115X75
	1M ² =32	1M ² =40	1M ² =60
	50M ²	50M ²	50M ²
BRICK WIDTH/M ²	0.038	0.025	0.017
NUMBER OF BRICKS/1M ²	32	40	60
WALL WIDTH/M ²	50	50	50
NUMBER OF BRICKS/50M ²	1600	2000	3000
PRICE /UNIT BRICK	RM2.10	RM2.50	RM0.50
TOTAL PRICE OF BRICKS/50M ²	3360	5000	1500
INSTALLATION PERIOD /1M ²	30	40	68
INSTALLATION TIME 50M ²	1500	2000	3400
TOTAL INSTALLATION HOURS	25	33.33	56.67
NUMBER OF DAYS 8 HOURS/DAY	3.13	4.17	7.08
WAGE/DAY	RM100	RM100	RM100
TOTAL WAGES	RM312.50	RM416.67	RM708.33
PLASTER COST/1M ²	-	-	10
TOTAL PLASTER COST/100M ²	-	-	1000
OVERALL TOTAL COST	RM312.50	RM416.67	RM708.33
% ADDITIONAL COSTS	0%	40%	85%

Kenaf bricks offer various sustainability elements that align with the United Nations Sustainable Development Goals (SDGs). Here's a detailed analysis of how kenaf bricks contribute to specific SDGs, supported by examples and explanations of their impact.

The usage of Kenaf is giving environmentally friendly as it can be renewable sources. Kenaf is considered environmentally friendly for several reasons:

- i. **Fast Growth:** Kenaf is a fast-growing plant, typically reaching maturity within four to six months. This rapid growth cycle allows for quicker biomass production, reducing the need for long-term land use and contributing to the efficient use of agricultural space.
- ii. **Low Water and Chemical Requirement:** Kenaf requires relatively low water and fewer chemical inputs (such as pesticides and fertilizers) compared to other crops, making it less resource-intensive and reducing the environmental impact of its cultivation.
- iii. **Carbon Sequestration:** Like other plants, kenaf absorbs carbon dioxide from the atmosphere as it grows, helping to offset greenhouse gas emissions and combat climate change. Its high biomass production makes it an effective carbon sink.

These characteristics make kenaf a sustainable alternative for various industries, contributing to environmental protection and helping to reduce dependency on non-renewable resources.

Three types of tests have been done to our KIUB to make sure that it will follow the specification according to Jabatan Kerja Raya (JKR).

Strength Test

A strength test on brick is conducted to measure its compressive strength, which is the ability of the brick to withstand pressure without breaking or deforming. This test involves applying a gradually increasing load to the brick until it fractures, allowing engineers to determine the maximum load the brick can bear. The results help assess whether the brick meets the required strength standards for the specific construction project. A reliable strength test ensures that the brick will provide the necessary structural integrity and durability, making it suitable for use in load-bearing walls, foundations, and other critical building elements. The result of the test shows that the best ratio to use is 1:2:3 (cement: sand: kenaf). The table below shows the strengths of the KIUB.

Days	7			28		
No.	1	2	3	1	2	3
Surface Area(mm²)	3375000			3375000		
Weight (Kg)	5.765	5.895	5.715	5.915	5.935	5.870
Load (kN)	55.5	51.8	51.8	73.8	53.9	67.6
Compressive Strength (N/mm²)	2.46	2.30	2.30	3.28	2.39	3.00
Average Strength (N/mm²)	2.35			2.89		

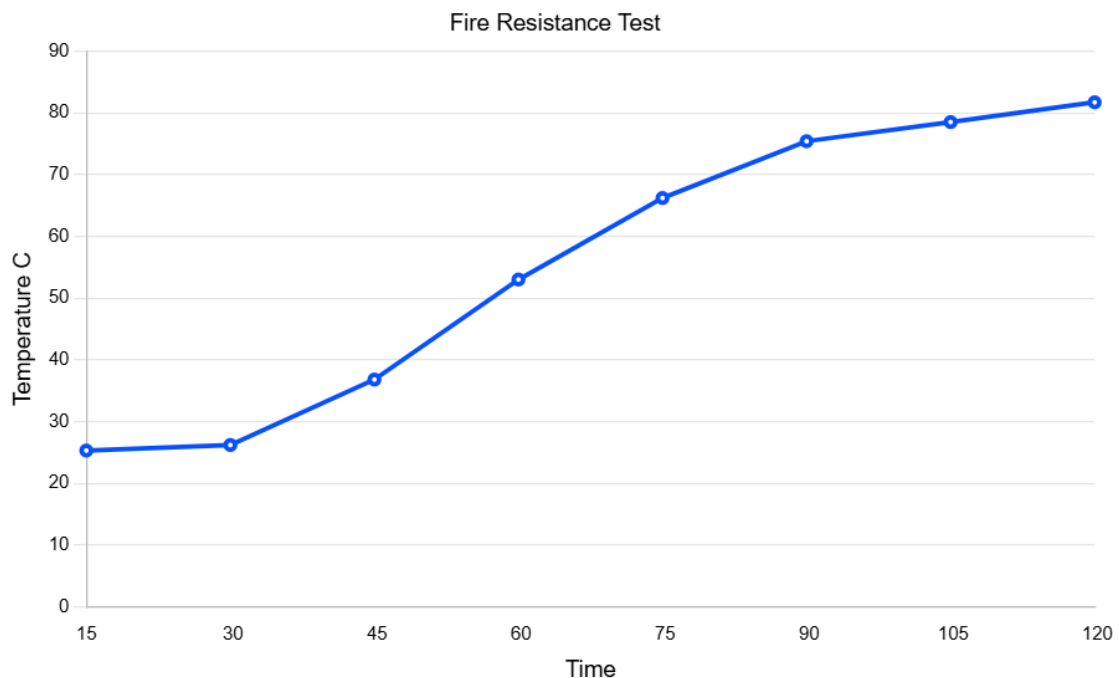
Water Absorption Test

A water absorption test on bricks is performed to determine how much water the brick can absorb when submerged for a specific period of time. This test is essential for evaluating the brick's porosity and its ability to resist moisture infiltration, which can affect the durability and structural integrity of a building. During the test, a brick is weighed, submerged in water for a set duration, then weighed again to calculate the amount of water absorbed. Bricks with high water absorption may be more susceptible to damage from freeze-thaw cycles, efflorescence, or mold growth. The test ensures that the brick meets the required standards for moisture resistance, making it suitable for various construction environments. Next for the water absorption test ratio 1: 2: 3 again comes out with the best result. The table below shows the results of the water absorption test.

Ratio	1			2			3		
Sample	1	2	3	1	2	3	1	2	3
Weight of dry sample (kg)	3.54	3.44	3.24	2.96	2.98	2.92	4.54	4.02	4.32
Weight of wet sample (kg)	4.44	4.28	4.10	3.94	4.00	3.90	5.30	4.80	5.14
Water absorption (%)	25.42	24.42	26.54	33.11	34.23	33.56	16.74	19.40	18.98
Average water absorption	25.46			33.63			18.37		

Fire Resistance Test

A fire resistance test on brick is conducted to evaluate its ability to withstand high temperatures without losing its structural integrity or strength. During the test, the brick is exposed to extreme heat, typically simulating fire conditions, for a specific period. The brick's performance is assessed based on how well it retains its form, does not crack, and maintains its load-bearing capacity under these conditions. This test helps determine the brick's suitability for use in fire-resistant construction, ensuring that it provides adequate protection in the event of a fire and helps to prevent the spread of flames. The graph below shows the temperature of the back of the brick after been burned for 2 hours.

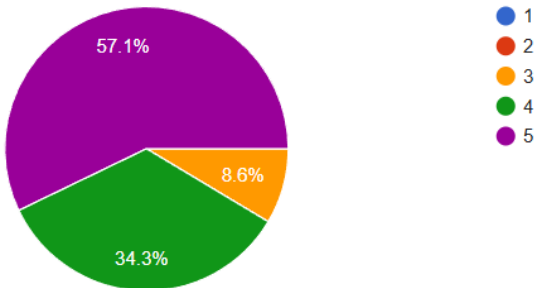


Survey Form

This product is easy to handle and use.

 [Copy chart](#)

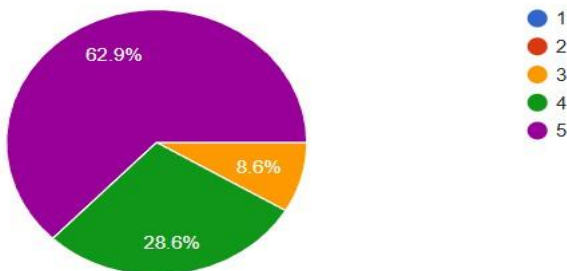
35 responses



This product is suitable for wall brick construction.

 [Copy chart](#)

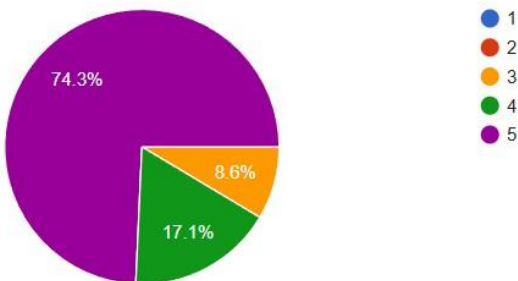
35 responses



This product is easier to install

 [Copy chart](#)

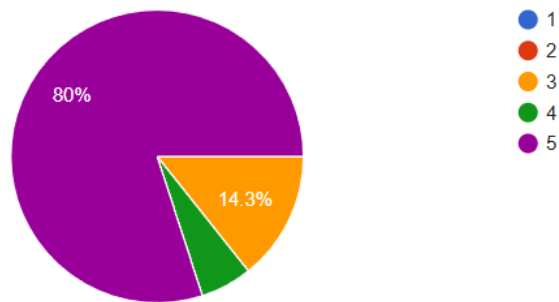
35 responses



This product has a unique shape

35 responses

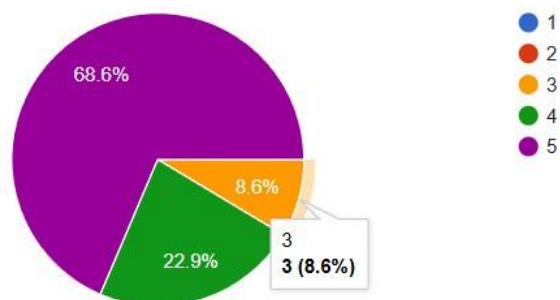
 [Copy chart](#)



This product saves installation time due to its large size and interlocking features.

35 responses

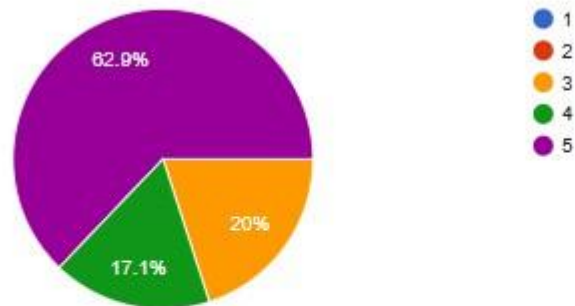
 [Copy chart](#)



This product reduces labor costs.

 Copy chart

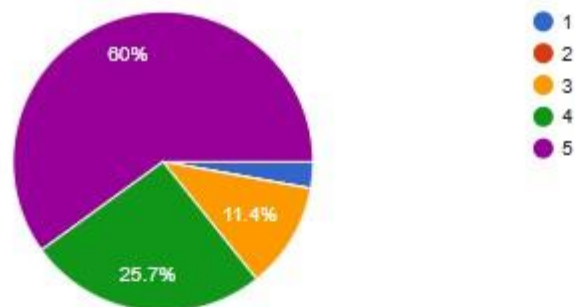
35 responses



This product provides good thermal insulation.

 Copy chart

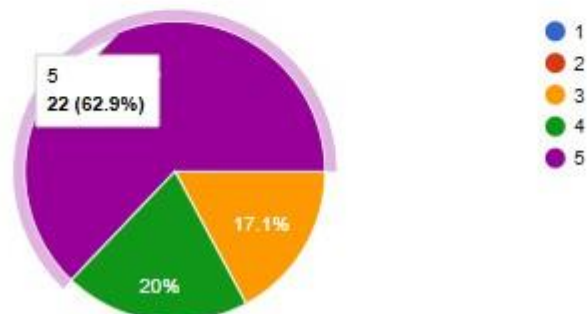
35 responses



This product can contribute to low consumption energy.

 Copy chart

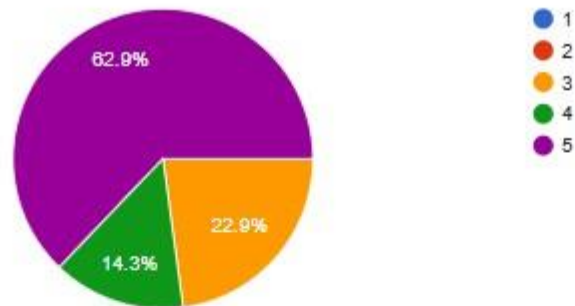
35 responses



This product is very helpful for contractors or users in construction.

 [Copy chart](#)

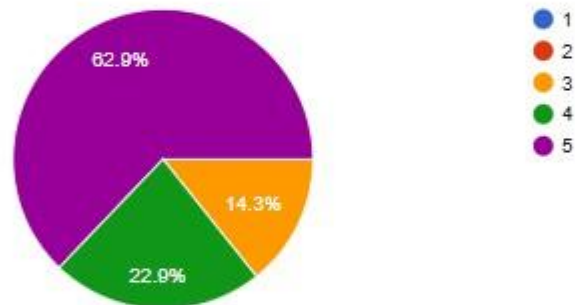
35 responses



This product is lightweight.

 [Copy chart](#)

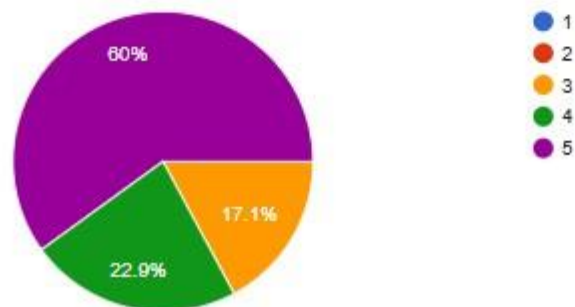
35 responses



This product does not require a large building frame structure.

 [Copy chart](#)

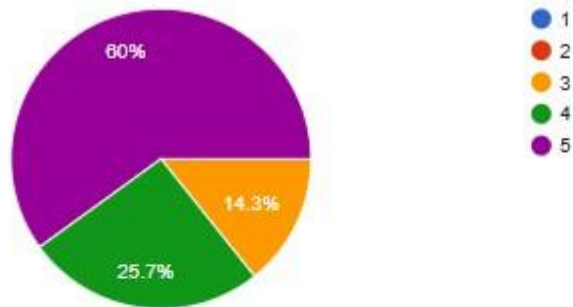
35 responses



I am very interested in this product

35 responses

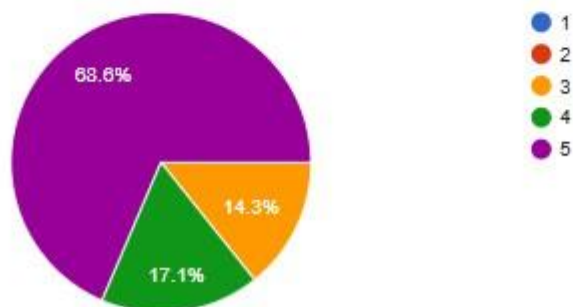
 Copy chart



Does this product have the potential to be marketed?

35 responses

 Copy chart



Suggestions for improvement.

35 responses

Potential innovation product

Good innovation. Congratulations to the team.

PRODUCTION MUST BIG SCALE TO REDUCE COST

Good Innovation

Pelbagaikan saiz dan mengambilkira kekuatan produk

Very good product

FINISHING NOT LOOKING GOOD, CAN IMPROVED FOR MORE ATTRACTION ESPECIALLY FOR MARKETING

Perlu ada pengelasan brick mengikut bentuk2 yang sama semasa pemasangan supaya lebih cepat dan menjimatkan masa pekerja

CONTRIBUTE TO THE COMMUNITY





SUGGESTION

Strength

Enhance the strength of the Kenaf Interlocking Universal Block (KIUB) to meet the stringent standards set by the Jabatan Kerja Raya (JKR).

4.3.5 Compressive Strength

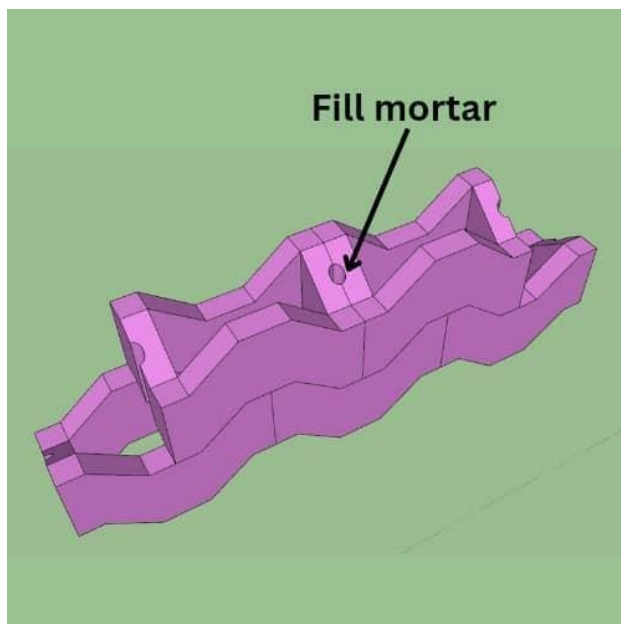
The minimum permissible average compressive strength shall be 5.2N/mm sq. for bricks and 2.8 N/mm sq. for hollow blocks per 10 samples taken at random from the Contractor's stock pile of 1000 or part thereof. All rejected or condemned bricks shall be removed from the Site at the Contractor's expense.

KIUB Size

To make a bigger size for faster installation process. The new size will weigh 5 KG using following the lightweight hollow block and have a dimension 200 mm x 100 mm x 600 mm.

Groove

To make a groove beside the KIUB to prevent the risk of pest infestation.



SUMMARY

Num	Question	1	2	3	4	5
1	This product is easy to handle and use			8.3%	36.1%	55.6%
2	This product is suitable for wallbrick construction			11.1%	27.8%	61.1%
3	This product is easier to install			8.3%	19.4%	72.2%
4	This product has a unique shape			13.9%	8.3%	77.8%
5	This product saves installation time due to its large size and interlocking features.			11.1%	22.2%	66.7%
6	This product reduces labor cost			22.2%	16.7%	66.1%
7	This product provides good thermal insulation	2.8%		13.9%	25%	58.3%
8	This product can contribute to low consumption energy			19.4%	19.4%	61.1%
9	This product is very helpful for contractor or user in construction			25%	13.9%	61.1%
10	This product is lightweight			16.7%	22.2%	61.1%
11	This product does not require a large building frame structure.			19.4%	22.2%	58.3%
12	I am very interested in this product.			16.7%	25%	58.3%
13	Does this product have the potential to be marketed.			16.7%	16.7%	66.7%

REFERENCE

- Singh, R., & Kumar, S. (2018). Cost Analysis of Interlocking Bricks in Construction Projects. *Journal of Construction Economics*.
- Patel, K., & Desai, M. (2020). Economic Viability of Interlocking Bricks for Low-Cost Housing. *International Journal of Sustainable Development*.
- Yadav, R., & Soni, M. (2020). Impact of Material Weight on Structural Load in Interlocking Brick Construction. *Journal of Structural Engineering*.
- Gupta, S., & Rani, S. (2020). Labor Handling and Placement of Heavy Interlocking Bricks: Solutions and Challenges. *Journal of Construction Technology*.
- Singh, D., & Tiwari, A. (2019). Effects of Brick Weight on Labor Efficiency in Interlocking Brick Construction. *International Journal of Construction*
- Reddy, A., & Mehta, S. (2019). Environmental Impact of Heavy Interlocking Bricks in Sustainable Construction. *Journal of Environmental Impact and Sustainability*.
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APPENDIX

MEGA LAB SERVICES
LOT 1857-B8, JALAN KUALA KRAI RT 12
KETTEREH, 16450 KOTA BHARU

Part One
CONCRETE CUBE TEST

Contract No: _____ Date: 18/12/24
Name of Contractor: _____ Weather: _____
Contractor's Ref: _____ JKR Ref: _____
Location of Concrete in Work: _____
Mix Proportion / Grade: _____ Method Used for Compaction: _____
Material used: _____

Material	Type of material Used	Source	Quantity per Batch
Sand			
Coarse Aggregate			
Cement			
Water			
Admixture			

Specified Workability (Slump / Compacting Factor): _____
Minimum Cube Strength Specified at 7 days: _____ N/mm², 28 days: _____ N/mm²

Cube Mark	Date Cast	Date to be Tested	Cube Size	Workability Slump / Compacting Factor	Remark
1	18/12/24	19/12/24	150x150x150		
2	18/12/24	19/12/24	"		
3	18/12/24	19/12/24	"		

Cube submitted by (S.O's Site Rep): _____ (Name & Designation)

Part Two
(Detailed of result required)

Cube Mark	Date Cast	Date to be Tested (days)	Date Tested	Age on Date of Test	Weight of Cube (kg)	Density (kg/m ³)	Loss (kg)	Comp. Strength (N/mm ²)	Remark
1	18/12/24	19/12/24	19/12/24	1	5.85	2340	0.6	0.6	
2	"	"	"	"	5.110	2140	0.4	0.4	
3	"	"	"	"	5.195	2150	0.5	0.5	

Test Conducted by: WAN MUHAMMAD SUKRI
BIN JUSOH
(Name & Designation)

Witnessed by: _____
(Name & Designation)

Checked & Verified by: _____
(Name & Designation)

MEGA LAB SERVICES
LOT 1857-B8, JALAN KUALA KRAI RT 12
KETTEREH, 16450 KOTA BHARU

Part One
CONCRETE CUBE TEST

Contract No: _____ Date: 18/12/24
Name of Contractor: _____ Weather: _____
Contractor's Ref: _____ JKR Ref: _____
Location of Concrete in Work: _____
Mix Proportion / Grade: _____ Method Used for Compaction: _____
Material used: _____

Material	Type of material Used	Source	Quantity per Batch
Sand			
Coarse Aggregate			
Cement			
Water			
Admixture			

Specified Workability (Slump / Compacting Factor): _____
Minimum Cube Strength Specified at 7 days: _____ N/mm², 28 days: _____ N/mm²

Cube Mark	Date Cast	Date to be Tested	Cube Size	Workability Slump / Compacting Factor	Remark
2	18/12/24	19/12/24	150x150x150		
3	18/12/24	19/12/24	"		
4	18/12/24	19/12/24	"		

Cube submitted by (S.O's Site Rep): _____ (Name & Designation)

Part Two
(Detailed of result required)

Cube Mark	Date Cast	Date to be Tested (days)	Date Tested	Age on Date of Test	Weight of Cube (kg)	Density (kg/m ³)	Loss (kg)	Comp. Strength (N/mm ²)	Remark
2	18/12/24	19/12/24	19/12/24	1	5.190	2140	0.4	0.50	
3	"	"	"	"	5.270	2170	0.4	0.38	
4	"	"	"	"	5.005	2100	0.0	0.00	

Test Conducted by: WAN MUHAMMAD SUKRI
BIN JUSOH
(Name & Designation)

Witnessed by: _____
(Name & Designation)

Checked & Verified by: _____
(Name & Designation)

MEGA LAB SERVICES
LOT 1857-B8, JALAN KUALA KRAI RT 12
KETTEREH, 16450 KOTA BHARU

Part One
CONCRETE CUBE TEST

Contract No: _____ Date: 18/12/24
Name of Contractor: _____ Weather: _____
Contractor's Ref: _____ JKR Ref: _____
Location of Concrete in Work: _____
Mix Proportion / Grade: _____ Method Used for Compaction: _____
Material used: _____

Material	Type of material Used	Source	Quantity per Batch
Sand			
Coarse Aggregate			
Cement			
Water			
Admixture			

Specified Workability (Slump / Compacting Factor): _____
Minimum Cube Strength Specified at 7 days: _____ N/mm², 28 days: _____ N/mm²

Cube Mark	Date Cast	Date to be Tested	Cube Size	Workability Slump / Compacting Factor	Remark
2	18/12/24	19/12/24	150x150x150		
3	18/12/24	19/12/24	"		
5	18/12/24	19/12/24	"		

Cube submitted by (S.O's Site Rep): _____ (Name & Designation)

Part Two
(Detailed of result required)

Cube Mark	Date Cast	Date to be Tested (days)	Date Tested	Age on Date of Test	Weight of Cube (kg)	Density (kg/m ³)	Loss (kg)	Comp. Strength (N/mm ²)	Remark
2	18/12/24	19/12/24	19/12/24	1	5.765	2340	0.46	0.46	
3	"	"	"	"	5.695	2310	0.30	0.30	
5	"	"	"	"	5.775	2310	0.30	0.30	

Test Conducted by: WAN MUHAMMAD SUKRI
BIN JUSOH
(Name & Designation)

Witnessed by: _____
(Name & Designation)

Checked & Verified by: _____
(Name & Designation)

MEGA LAB SERVICES
LOT 1887 BK, JALAN KUALA KRAI BT 12
KETEREH, 16400 KOTA BHARU

Part One **CONCRETE CUBE TEST**

Contract No. _____ Date _____
Name of Contractor _____ Weather _____
Contractor's Ref. _____ JKR Ref. _____
Location of Concrete in Work _____
Mix Proportion / Grade _____ Method Used for Compaction _____
Material used _____

Material	Type of material used	Source	Quantity per Batch
Sand			
Coarse Aggregate			
Coarse Water			
Admixture			

Specified Workability (Slump / Compacting Factor) _____
Minimum Cube Strength Specified at 7 days _____ N/mm², 28 days _____ N/mm²

Cube Mark	Date Cast	Date to be Test	Cube Size	Workability Slump / Compacting Factor	Remark
1	2/12/24	10/12/24	150 x 150 x 150		
2	2/12/24	10/12/24			
3	2/12/24	10/12/24			

Cube submitted by (S/O's Site Rep) _____ (Name & Designation)

Part Two
(Detailed of result required)

Cube Mark	Date Cast	Date Tested	Age on Date of Test	Weight of Cube (kg)	Density (kg/m ³)	Load (kN)	Comp. Strength (N/mm ²)	Remark
1	2/12/24	10/12/24	24 h	5.542	2050	2.92		
2	2/12/24	10/12/24	24 h	5.542	2050	2.92		
3	2/12/24	10/12/24	24 h	5.542	2050	2.92		

Test Conducted by: _____ Witnessed by: _____ Checked & Verified by: _____
S/O's Site Rep (Name & Designation) _____ (Name & Designation) _____
BERNABAGU/SHAH BIN MUHAMMAD
Laboratory Assistant
Mega Lab Services

MEGA LAB SERVICES
LOT 1887 BK, JALAN KUALA KRAI BT 12
KETEREH, 16400 KOTA BHARU

Part One **CONCRETE CUBE TEST**

Contract No. _____ Date _____
Name of Contractor _____ Weather _____
Contractor's Ref. _____ JKR Ref. _____
Location of Concrete in Work _____
Mix Proportion / Grade _____ Method Used for Compaction _____
Material used _____

Material	Type of material used	Source	Quantity per Batch
Sand			
Coarse Aggregate			
Coarse Water			
Admixture			

Specified Workability (Slump / Compacting Factor) _____
Minimum Cube Strength Specified at 7 days _____ N/mm², 28 days _____ N/mm²

Cube Mark	Date Cast	Date to be Test	Cube Size	Workability Slump / Compacting Factor	Remark
1	2/12/24	10/12/24	150 x 150 x 150		
2	2/12/24	10/12/24			
3	2/12/24	10/12/24			

Cube submitted by (S/O's Site Rep) _____ (Name & Designation)

Part Two
(Detailed of result required)

Cube Mark	Date Cast	Date Tested	Age on Date of Test	Weight of Cube (kg)	Density (kg/m ³)	Load (kN)	Comp. Strength (N/mm ²)	Remark
1	2/12/24	10/12/24	24 h	5.542	2050	2.92		
2	2/12/24	10/12/24	24 h	5.542	2050	2.92		
3	2/12/24	10/12/24	24 h	5.542	2050	2.92		

Test Conducted by: _____ Witnessed by: _____ Checked & Verified by: _____
S/O's Site Rep (Name & Designation) _____ (Name & Designation) _____
BERNABAGU/SHAH BIN MUHAMMAD
Laboratory Assistant
Mega Lab Services

MEGA LAB SERVICES
LOT 1887 BK, JALAN KUALA KRAI BT 12
KETEREH, 16400 KOTA BHARU

Part One **CONCRETE CUBE TEST**

Contract No. _____ Date _____
Name of Contractor _____ Weather _____
Contractor's Ref. _____ JKR Ref. _____
Location of Concrete in Work _____
Mix Proportion / Grade _____ Method Used for Compaction _____
Material used _____

Material	Type of material used	Source	Quantity per Batch
Sand			
Coarse Aggregate			
Coarse Water			
Admixture			

Specified Workability (Slump / Compacting Factor) _____
Minimum Cube Strength Specified at 7 days _____ N/mm², 28 days _____ N/mm²

Cube Mark	Date Cast	Date to be Test	Cube Size	Workability Slump / Compacting Factor	Remark
1	2/12/24	10/12/24	150 x 150 x 150		
2	2/12/24	10/12/24	150 x 150 x 150		
3	2/12/24	10/12/24	150 x 150 x 150		

Cube submitted by (S/O's Site Rep) _____ (Name & Designation)

Part Two
(Detailed of result required)

Cube Mark	Date Cast	Date Tested	Age on Date of Test	Weight of Cube (kg)	Density (kg/m ³)	Load (kN)	Comp. Strength (N/mm ²)	Remark
1	2/12/24	10/12/24	24 h	5.542	2050	2.92		
2	2/12/24	10/12/24	24 h	5.542	2050	2.92		
3	2/12/24	10/12/24	24 h	5.542	2050	2.92		

Test Conducted by: _____ Witnessed by: _____ Checked & Verified by: _____
S/O's Site Rep (Name & Designation) _____ (Name & Designation) _____
BERNABAGU/SHAH BIN MUHAMMAD
Laboratory Assistant
Mega Lab Services