

## The Influence of Sustainable Building Materials in Malaysia

Nurulhuda Hashim<sup>1</sup>, Pei Ying Tay<sup>1\*</sup>

<sup>1</sup> School of Architecture Building and Design, Taylor's University, Malaysia

\* peiying27@hotmail.com

The increased in population growth entails more houses and buildings worldwide. These activities utilize materials, land and thus had resulted in the depletion of natural resources. Hence, the evolution of building material has shifted towards less sustainable manmade materials which has open the gateway to a massive carbon footprint where world leaders are trying to address today. Over the past decade, there have been signs that global climate change is occurring rapidly and might be accelerating too. The climate change had brought significant changes that are catastrophic to the environment and had disrupted the daily lives of humans. Thus, community awareness and concern for the environment have emerged amongst humans to incorporate environmental sustainability practices especially in the construction industry. This increased attention drives the Malaysia's government and professional organizations to be more aggressive on the adoption of sustainable construction. The purposed of the research is to promote a more extensive usage of sustainable building materials towards a more sustainable approach of the construction industry in Malaysia by identifying what are the available sustainable building materials in the country, understanding why it is important to use such materials and by finding out what are the challenges in using these green building materials. The methodology used for this research is quantitative research as the target population of the study is large. Questions are being established in the questionnaire surveys through Google survey forms and then distribute it to the target respondents to obtain primary data. Based on the findings, it indicates that cost issue is the main concern of the challenges faced by architects in Klang Valley. In conclusion, the study found out that the challenges in implementing sustainable building materials outweigh the benefits of using these materials.

**Keywords:** Global Climate Change, Sustainable Approach, Sustainable Building Materials, Architects Klang Valley

### 1. INTRODUCTION

Structures are being built as shelter by mankind to meet social needs and to protect from weather and other predators such as wild animals. As the lifestyle of human changes over time, since the last century, buildings are constructed for many different purposes including to meet the growing economic needs of the population. In fact, many buildings are also built for investment purposes and to meet corporate objectives. As new and more improved technologies are being invented and discovered, standards of living have changed gradually to what it is today. Leaves and

branches were first to be the most primitive source of the building materials, as time goes by, synthetic materials like plastics, metal and concrete were used instead [10]. Buildings were then slowly evolved to ever higher buildings like apartments and condominiums.

New technologies and materials are items that are created to bring convenience to our daily life. But, along the way, mankind has taken all these for granted, becoming more demanding and either forgotten or choose to ignore that these materials have and will continue to impact the environment negatively, causing permanent and irreversible damage and destruction to the

environment. Building waste is a major by-product of the construction industry. Often, we see so much waste that are produced and it appears as if there are more waste than the actual materials used for the erected buildings. Eventually, in a long run, slowly but surely, all the resources will run out and go extinct.

Green product standards started appearing in the 1980s and escalated in the 1990s. According to the World Green Building Council, a “green” building is a building that creates positive impacts and at the same time diminish the negative impacts on our environment during the whole construction stage [41]. With that being said, choices to be made in utilizing sustainable building materials play an important part in determining whether the buildings are “environmentally friendly” or otherwise. This decision must made at the planning stage so that the design and construction will both complement each other in achieving sustainability features such as the use of materials are low wastage, low energy consumption and low maintenance (overall most economical life cycle cost).

## 2. PROBLEM STATEMENT

The construction activities have created numerous types and a huge amount of waste since decades ago. 202.8 million tonnes of waste are being generated based in the United Kingdom during 2014 and construction, excavation and demolition had stand 59% of that number [39]. To some, this number might not be surprising, however, it would be unimaginable if all the countries across the world created waste as much as this amount - or even much more over the years and into the future. As the construction industry continue to expand, the depletion of natural resources issues has been one of the concerns for the industry leaders. According to World Watch Institute, 40% of the world’s usage in raw stones, gravel, and sand and 25% of its virgin wood is being dominated by the construction industry for each year [42]. As years pass by, eventually, the world will run out of these resources.

Architects, as a skilled professional who plan and design buildings in the construction industry play a major role in designing the spaces and environment specifying suitable building materials to achieve the design and project objectives. They evaluate products and make materials selection decisions most of the time. During the design phase, architects usually weigh the cost and performance of the building materials

when selecting them. Building materials that are chosen often fits into the criteria of low cost, easily accessible, manufactured and transported, and able to last the harsh climate.

## 3. RESEARCH OBJECTIVES

The objectives of this study are:

- To study the types of sustainable building materials available in Malaysia
- To identify the importance of using building materials that are sustainable in the construction industry
- To establish challenges in implementing the use of sustainable building materials

## 4. LITERATURE REVIEW

Conventional building is constructed by using conventional methods which are still widely practised in the construction industry of Malaysia. As compared to green building, conventional building is not as efficient in reducing the amount of energy required for the buildings to operate. According to Lin et al., 2016, p. 11, it has been indicated that conventional buildings use an average of 21% higher energy than green buildings [31]. A green building is a building that is being constructed with eco-friendly strategies during the design, construction, and operation of building projects. Undeniably, in the industrial era where various kinds of pollutions, with the growth in environmental awareness and increase in corporate social responsibility among the companies, green buildings which offer environmentally friendly features and many benefits, will have a higher demand compared to the conventional buildings [18].

### 4.1 GREEN BUILDING INDEX (GBI)

In Malaysia, as of May 2021, there are at least 389 building projects that are registered as green building under the Green Building Index (GBI) projects [17]. GBI rating system was established to analyse and rate the environmental performance and the incorporation of sustainable development in the building. According to GBI, there are six types of assessment to be carried out based on different categories which are Energy Efficiency (EE), Materials & Resources (MR), Water Efficiency (WE), Indoor Environment Quality (EQ), Sustainable Site Planning & Management (SM), and Innovation (IN).

## **4.2 SUSTAINABLE BUILDING MATERIALS IN MALAYSIA**

In accordance with the framework being set up by GBI to analyse the building, one of the important criteria is the materials used in the building. Building materials are the critical aspect to be considered in developing buildings that are eco-friendly. Fortunately, there is a wide range of sustainable building materials that can be used in the market where they play an important role in having minimum adverse impacts on the built and natural environment [24].

### **4.2.1 BAMBOO**

Bamboo's species adaptability in different ecological environments, in other words bamboo can grow in various area ranging from tropical lowland to highland and others [4]. Therefore, bamboo is a good option of sustainable product since it is available in abundance, widely and easily available especially in Malaysia. Bamboo, as a building material, exhibits high flexibility, strength and versatility which is suitable to be used as flooring, walls, and roofs of the building when it is treated and manufactured properly. It can be suitably used to replace conventional materials like mild steel as it is light in weight but at the same time it is sturdy and comparatively low in cost. Auwalu indicates that even though bamboo structures are lightweight, it somehow possesses forms of resistance against natural disaster, for example, earthquakes [6].

### **4.2.2 LIGHTWEIGHT REINFORCED CONCRETE**

Globally, concrete is the second most consumed element (after water) and is the commonly used construction material [34]. Reinforced concrete always plays an important role as the structural component in buildings as it has tensile strength (steel reinforcement) and compressive strength at the same time [8]. According to Kuppusamy (2019), she stated that lightweight reinforced concrete is one of the sustainable materials for construction. Lightweight reinforced concrete offers many benefits like reduced dead load due to its low-density features, lower transport, handling cost and good thermal conductivity [29]. Lo and Cui also mentioned that lightweight reinforced concrete is 20-25% lighter than normal concrete will aid in reduced handling and transportation

costs which makes it an environmentally friendly material [33].

### **4.2.3 TIMBER**

With the use of in-situ reinforced concrete, traditionally, timber formwork has also been the complementary "partner". The function of wood and timber is not only for formwork, but hardwood can also be used as a structural beam and softwood can be used for furniture [35]. Timber is known as a renewable material, and it is eco-friendly that does not contain any health hazards [23]. Timber has a high strength to weight ratio and even when only basic technologies and procedures are available work with it, it is easy to build and construct [5]. It is more fire resistant when compared to steel, as timber has good insulating layer which helps to protect the inner core of the material [3]. The use of timber helps to reduce environmental impact of a building which is the reason why it is being used in Traditional Longhouses in Sarawak, Malaysia.

### **4.2.4 FLY ASH BRICK**

1.5 billion non-sustainable moulded bricks are fired in kilns every year worldwide with the use of burning coals that leads to black carbon emissions [12]. Hence, sustainable bricks such as fly ash bricks were being invented to help reduce carbon emissions. Fly ash bricks are a mixture of fly ash, lime, gypsum cement, sand, and water [37]. Freeda Christy also indicates that fly ash bricks are classified to be high quality building materials which significantly reduce some of the negative environment impacts [16].

### **4.2.5 STEEL**

Steel is one of the sustainable building materials in the world and is often found in structural components of the buildings such as beam, columns, or shear walls. As a building material that is sustainable, steel can be recycled or reused many times without the need of comprising its properties in strength, ductility, or formability, thus extending their lifespan. Steel buildings can be easily dismantled at the end of life and reassembled at another development project during certain circumstances. Aye et al. (2012) concluded that 81.30% of initial embodied energy can be saved when reusing the prefabricated elements of the main structure in another new building [31].

### **4.2.6 TRIPLE GLAZED WINDOW**

As a renewable, 100% recyclable material, glass helps to reduce greenhouse gas (GHG) emissions and conserves limited natural resources. It is made from natural raw materials such as sand, soda ash and limestone. When compared to well-turned daylighting control through blinds, triple-glazed windows save over 26% of lighting energy and around 20% of peak cooling loads in warmer climates like California, USA [21]. Besides that, due to the additional insulation features, a triple-glazed system decreases the thermal transmittance of the windows, making it more advanced in terms of thermal performance [21]. Triple glazed windows are superior because of the thickness of the three-layer glazed window; whereby as the window layers grow, the thermal conductivity of the window decreases.

#### **4.3 IMPORTANCE OF BUILDING MATERIALS THAT ARE SUSTAINABLE**

The adaptation of green building material has provided the benefits of energy conservation and make use of the resources efficiently. According to Vanakuru, in comparison to a normal building, a green building may decrease energy use in half [40]. Eco-friendly materials are being obtained from natural, renewable resources which helps to protect the ecosystem from pollution. These materials can be adapted in other buildings which saves the energy to create new elements. Besides that, due to the natural characteristics of green building materials, less polluting elements are being emitted during their manufacture, extraction, use or disposal. These materials improve overall quality of life by reducing environmental and health consequences such as use of materials with low off-gassing.

Other than environmental benefits, using these building materials also offers economic benefits. Eichholtz pointed out that green buildings have an 11 percent greater occupancy rate than non-rated buildings in terms of occupancy [15]. Therefore, the property value will increase as the demand is high, but the supply is low. The types of sustainable building materials used in green building can influence the property value to be increased.

When a building is constructed using environmentally friendly materials, the retail value is higher due to the advantageous factors of green building materials such as low maintenance fees, low energy used in a long term, contain non-

toxic components and a healthy environment for occupants to stay. Research that is carried out from the University of Texas at Austin indicated that homes constructed to Leadership in Energy and Environmental Design (LEED) standards between 2008 and 2016 increased in value by 8%, while homes built to a broader range of green standards increased by 6% during the same period [13].

Moving on, eco-friendly buildings are built with materials that are renewable, with energy saving features, good insulation performance of windows and low emissions that result from the manufacturing process of the materials. Some sustainable materials might be expensive due to its low quantity of supply which are often have to be imported from overseas. However, within an acceptable payback period, the energy conservation alone typically outweighs any design and building costs [41].

Green buildings are also a huge global investment opportunity, accounting for most of the \$231 billion energy efficiency industry [19]. The green economy still is a new issue and concept in Malaysia; hence the government has a significant role to play in the green growth policy in Malaysia [32]. Other than the environmental and economic benefits brought by the implementation of the sustainable materials into the construction project, the social benefits are also widely known. The permaculture which is a physical benefit that can easily be seen in the construction project that is using the sustainable building material [30]. This kind of living culture can only be achieved by implementing sustainable element into the construction industry. Therefore, sustainable building materials play an important role in creating a balanced ecosystem and enhancing the quality of life.

According to Heng (2019), he stated that the sickness among the human circle has been entangled for decades because of the construction industry [22]. As an example, according to Dulux Paint, they stated that the traditional paint containing volatile organic compounds (VOC) will contribute towards a series of negative consequences to the end user and the Earth by emitting compound that cause air pollution and decreasing indoor air quality (IAQ). However, by adopting the paint which contain low VOC paint, it will highly reduce the risk of such negative potential health issues of the end user or the occupants.

The indoor environment quality is not limited to air quality only but includes lighting, thermal conditions and ergonomics which are parameters that must be measured as they have a very important effect to the end user of the property. According to the United States Green Building Council, better indoor environment quality is not only protecting the health of the users but also improving the quality of life and reducing stress that can have other health repercussions [13]. The construction industry contributes around three to five percent to the gross domestic product (GDP) of Malaysia [25]. Therefore, by encouraging and promoting the green industries in the construction industry, it will have a high probability in increasing the employment rate for the construction industry [32]. As mentioned, the development of sustainable technology and sustainable material requires skilled labours that have the capabilities to work on the specification of the sustainable building materials and technologies.

#### **4.4 CHALLENGES IN IMPLEMENTING THE USE OF SUSTAINABLE BUILDING MATERIALS**

Despite the adoption of sustainable building materials in buildings have provided many benefits to the environment, N.Z Abidin stated the implementation of sustainable development in Malaysia is still at moderate level [2]. Institutional challenges have always been the main factor of the challenges in implementing sustainable building materials in Malaysia. First of all, the lack of enforcement by the government or legislative bodies are the main issue affecting the construction industry. This is evidenced by the lack of or negligible improvement in sustainable development or green building development for the past few decades. Shari (2012) stated that the lack of political will, legislation and enforcement have been serious barriers where she found that 18 percent of her research population agreeing that this barrier will continue to cause a setback to the sustainable development of the construction industry [38].

Abidin (2013) stated that other than the enforcement of policies and legislation from government, lack of incentives from related organizations or government bodies are also the reason that Malaysia was not able to widely apply the sustainable building material into the construction industry [2]. According to CIDB, the

adoption of IBS system in public and private projects in Malaysia have improved from 2015 to 2020 after the incentives are being implemented as part of the 11th Malaysian Plan [11].

Other than the government and legislative institutions, educational institution is also an important institution as they are nurturing the future generation of playmakers for the construction industry. Abidin (2013) also stated that the educational institution should be able to produce graduates that can apply the concept of sustainable construction into future construction projects [2]. He suggested that the higher education in Malaysia should inculcate knowledge about sustainable building materials so that students are able to understand the importance of using the sustainable building materials.

On the other hand, internal factors are as important in promoting and initiating use of sustainable building materials. During the design process of a building projects, design professionals who have limited knowledge about availability of sustainable materials in the market or available green options in the industry, would not be able to identify the most suitable green materials. Hayles (2008) also addressed that this issue is not limited to the design professionals who are unable to specify such materials, but the person-in-charge may also not be able to gain approval for new technologies due to building codes and regulatory barriers to adopt these new technologies and labour [20].

Lack of knowledge about green building and sustainable materials among the skilled labour is the greatest deterrent for the industry to develop the sustainable materials in their construction project [20]. This issue is similar to the barriers affecting professional designers. The main reason is time factor as it would consume too much time for the labours to study the new specification of the sustainable building material and adopt new technologies. The reason of lower adoption of construction development involving sustainable materials in Malaysia also means that there will be less referenced projects in the industry [14]. Therefore, it will lead to the construction industry having less knowledge on the way to refer or benchmark a project.

Limited understanding from stakeholders is also an important factor that affect the low adoption rate for sustainable building materials for the construction projects [14]. Without an

adequate level of understanding to the sustainable materials, players of the industry might be prevented from using the sustainable materials because there is a certain level of risk by adopting something which is new to the industry. Internal action challenges might be one of the possible challenges faced in the construction industry. One of the internal action challenges faced is the sustainability practices are not required by client. Chan (2014) indicates that many developers in Malaysia are usually profit-driven when they plan to build construction projects [9]. Their intention is to develop and earn money from the construction project, therefore the benefits of using green building materials would not be in their consideration.

As mentioned above, developers are profit-driven, they would target construction projects that has market values and can dominate the industry. He also stated that buildings that is being certified by green certification, for example Green Mark, will cost at least 10% of the project's total cost. Besides, many developers have satisfactory responses from their business marketability and thus they are reluctant to change from the use of traditional methods construction in the industry as they think that it will be time and cost consuming to introduce a new technology or skill [2]. Other than that, according to Klufallah (2019), lack of technical understanding from the project team members is also one of the possible challenges in implementing the sustainable building materials [27]. He stated that professionals, i.e., architects in the construction industry often have low knowledge and awareness in sustainability.

Klufallah (2019) stated that there is a wide gap of knowledge and awareness among the players pertaining to sustainable building practices field in the Malaysian construction industry [27]. There is much more knowledge and awareness must be gained to increase the adaptation of sustainable material. For example, lack of strategy to promote green buildings, management commitment, functional issues, financial, technical, information, managerial and organizational. These factors can be summarized as the root cause why players in the industry are progressing so slowly in the development of sustainable practice.

In addition, lack of awareness of the end user is also a major factor that discourages the industry from developing the sustainable materials [1]. This is due to how the market works such as the supply and demand trend. Therefore, when there

is no demand for sustainable development, there will be no supply. The lack of demand is attributable to lack of awareness. The public does not understand the huge benefits brought about by the sustainable building materials in construction projects as compared to the conventional construction method.

Lack of awareness by the student is one of the factors that will affect the future development of the sustainable building materials [1]. He stated that the higher education institutions (HEI) are lacking in courses or subjects that include sustainable building materials content. Faculty of built environment in many HEIs have been using the same content for the courses for a long time without updating the syllabus and content. Cost is always the main concern to parties in the construction industry. Client must ensure that their assets and investments are fully utilised, and the contractor has to ensure that the rate of material, plant and labour will not be affected by the inflation. However, financial constraint has been a serious barrier stopping the development of sustainable practice in Malaysia [9].

Next, Klufallah stated that the higher final price has caused the slow development in sustainable building materials in Malaysia [27]. Chan stated that not all developers have the financial capability to adopt sustainable development [9]. Large sized developers are more capable in pursuing the sustainable practices compared to the smaller sized developers. Finally, sustainable materials cannot be obtained easily in certain places, which result in higher delivery cost [38]. Shari also stated that some of the products, relevant systems, and materials are not available in the certain locations causing these items more costly to acquire and the overall cost to be higher compared to the conventional method and traditional building materials.

## 5. RESEARCH METHODOLOGY

Quantitative methodology is being implemented in this study. Questionnaire survey was being constructed by using the Google Form and distribute it to the registered architects with at least of one year working experience in the Klang Valley. The target population in the Klang Valley are being distinguished through the Lembaga Arkitek Malaysia (LAM) website. To get the sampling population and size, both stratified and simple random method is implemented to choose the participants and the calculation formula introduced by Krejcie and Morgan (1970) is used

to determine the sample size needed for my research [28].

As for data collection, there are mainly two types of data collection used in this research to accumulate data that is in relation to the study topic, which are primary data and secondary data. Primary data is the information collected from the respondents that have face the issue which are being addressed on the research problem. Questionnaires, experiments, online surveys, and others are being constructed and utilised as a medium to collect real time data within the target population. As for secondary data, it is the information that is already obtained from past researchers or other individuals that are related to the study. Secondary data can be sourced from articles, journals, magazine, newspaper, and any other reliable sources.

## 6. RESEARCH FRAMEWORK

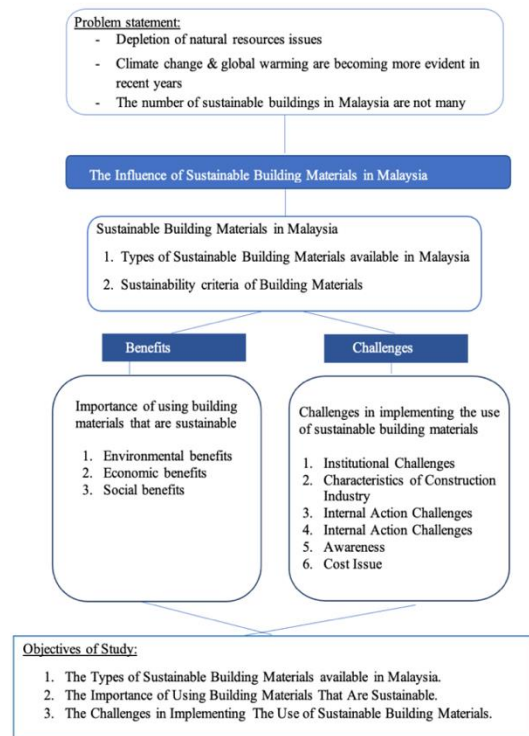


Figure 1: Research Framework

According to **Figure 1**, the depletion of natural resources, climate change and global warming issues are being identified as the problem and the purpose to carry out this study. During the writing of literature review, types of sustainable building materials, the benefits of

using these materials and the challenges in implementing them were being captured and successfully determine the gap. To tackle the gap, three objectives were formed. These objectives then lead to the findings for this research.

## 7. KEY FINDINGS

Key findings in Objective 1

Table 1. Analysis result on objective 1

	II (Mean)	Ranking
<b>Sustainable Timber</b>	4.10	1
<b>Bamboo</b>	4.01	2
<b>Triple Glazed Window</b>	3.98	3
<b>Fly Ash Brick</b>	3.88	4
<b>Lightweight Reinforced Concrete</b>	3.84	5
<b>Steel</b>	3.49	6

**Table 1** presents the results of each material in the questionnaire survey. The respondents were asked to rate whether these 6 building materials are sustainable in his or her point of view. According to **Table 1**, the median of the result is 3.88 which means that the architects' understanding on these materials are around the middle line of somewhat agree or disagree. Sustainable timber is being ranked as 1st and the mean response from the respondents are agree. 39 respondent response to strongly agree and 35 respondent response to agree that timber acts as a sustainable construction material in a building as shown on figure 4.9. However, there are 6 respondents pick disagree as an answer and 17 respondents voted somewhat agree or disagree. Clearly, the construction projects on sustainability are still at pioneering stage [1].

Key findings in Objective 2

Table 2. Analysis result on objective 2

	II (Mean)	Ranking
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Less Pollution	4.33	1
Energy Conservation	4.24	2
Increase in Green Investment	4.20	3
Health and Well-being Occupants	4.10	4
Increased Property Values	4.02	5
Higher Indoor Environment Quality	4.01	6
Permaculture Operation and Maintenance	3.98	7
Savings	3.96	8
Increased Retail Sales	3.81	9
Improve Employment Rate	3.49	10

**Table 2** displays less pollution is being ranked as 1<sup>st</sup> in all three aspects of benefits. Among 97 respondents, 52 voted (54%) for agree on energy conservation and 48 (49%) voted strongly agree on less pollution. The findings on less pollution are also further supported by Lee et.al (2008) that green building materials release fewer pollutants than traditional construction materials [26]. The comparison of economic benefits is being carried out, and among the 4 of them, increase in green investment is being ranked 1<sup>st</sup> with the highest mean. 44 respondents agree and 38 responses to strongly agree that the use of eco-friendly materials could increase green investment in society, and thus influences many individuals on the use of sustainable building materials. As for social benefits, health and well-being occupants is being ranked as 1<sup>st</sup> among the 4 social benefits by the respondents. This statement is in line with the Dulux Paint Company, they mentioned that the implementation of sustainable building materials will reduce the risk of negative potential health issues of the end user.

Table 3. Comparison between environmental, economic & social benefits

Importance of	Total	Number	Average	Ranking
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using sustainable building materials	Mean	of benefits	Mean	
Environmental Benefits	8.57	2	4.28	1
Economic Benefits	15.99	4	3.99	3
Social Benefits	16.52	4	4.13	2

Based on the average mean of the three aspects of benefits, it is being conclude that there are differences among them, and that environmental benefits have the highest score of average mean. In other words, the use of eco-friendly materials will contribute most advantages to the environment (as highlighted on **Table 3**) when compare with economic and social benefits.

#### Key findings in Objective 3

Table 4. Analysis result on objective 3

	II (Mean)	Ranking
Lack of Material in Certain Areas Resulting in the Cost to be Higher	4.46	1
Higher final price	4.43	2
Limited understanding from stakeholders	4.42	3
Financial Constraint	4.36	4
Lack of demonstration projects	4.34	5
Reluctant to change from the use of traditional methods	4.32	6
Lack of Incentives from Government	4.28	7
Education Institution	4.25	8
Lack of Enforcement from Government	4.23	9
Lack of technical understanding from the project team members	4.22	10
Lack of Awareness by Stakeholders	4.21	11
Lack of Awareness by End User	4.19	12



<b>Sustainability Not Required by Client</b>	4.18	13
<b>Lack of Awareness by Students</b>	4.02	14
<b>Construction Process</b>	3.99	15
<b>Design Process</b>	3.86	16

**Table 4** illustrates the analysis on objective 3. Among the institutional challenges (lack of enforcement from government, lack of incentives from government, education institution), lack of incentives from government is being ranked as 1<sup>st</sup> among the three with a mean of 4.28. Many respondents strongly agree that the lack of incentives from government hinders the implementation of the green building materials. Abidin (2013) also further argued that the lack of incentives from government is one of the reasons that these building materials are not able to apply into the Malaysian construction industry [2].

Besides, internal factors such as the characteristics of construction industry (design process, construction process, lack of demonstration projects, limited understanding from stakeholders) are also critically analyzed. Limited understanding from stakeholders is being ranked as 1<sup>st</sup> when compared to the design process, construction process, lack of demonstration projects. This finding is in line with Durdyev (2018) as he also mentioned that the limited understanding from the stakeholders is one of the contributing factors that affects the low adaptation rate of eco-friendly materials [14].

Moving on to internal action challenges (sustainability not required by client, reluctant to change from the use of traditional methods, lack of technical understanding from the project team members), among them, reluctant to change from the use of traditional methods is being ranked as 1<sup>st</sup> by the respondents as they believed that these methods has been ingrained in their mind for some time. As for the awareness (lack of awareness by stakeholders, end user & students), lack of awareness by stakeholders is being ranked as 1<sup>st</sup> with a mean of 4.21. Klufallah (2019) indicates that the public does not understand the benefits of using sustainable building materials [27]. Other than the above aspects, cost issue is one of the highlighted barriers that affects the adoption of these materials. Lack of material in certain areas resulting in the cost to be higher is the main concern from the respondents. Shari (2012) mentioned that some materials are not available in certain locations causing these items

to be more costly to be obtained and the overall cost to be higher [38].

Table 5. Comparison between the 5 Aspects of Challenges

<b>Challenges in implementing the use of sustainable building materials</b>	<b>Total Mean</b>	<b>Number of factors</b>	<b>Average Mean</b>	<b>Rank</b>
<b>Cost issue</b>	13.26	3	4.42	1
<b>Institutional challenges</b>	12.75	3	4.25	2
<b>Internal action challenges</b>	12.72	4	4.15	4
<b>Characteristics of construction industry</b>	16.61			
<b>Awareness</b>	12.41	3	4.14	5

Based on the 5 aspects of challenges as shown on **Table 5**, we can conclude that cost issue has the highest average mean. This finding is consistent with Klufallah (2019) indicating that higher final price of the construction causes the sustainable development to be slow [27]. Adding on, some developers do not have the financial capability to adopt sustainable building materials in their project [9].

## 8. CONCLUSION

This study has identified the benefits of using sustainable building materials and establish the challenges in implementing these building materials in the construction industry. Based on the survey results, the challenges in implementing these building materials outweigh the benefits of using them. Many of the construction industry players are concern of the cost issue in the construction project. The difficulty to obtain

green building materials causes the materials to be higher in price and hence affect the final price of the project. Thus, government and private organizations play an important role in dealing with this issue such as by providing more incentives to solve the challenges faced by the construction industry playmakers. Private institutions for example universities also plays an important role in nurturing sustainable related knowledges in their course of studies.

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