Available online at
http://journal.uitm.edu.my/ojs/index.php/BEJ

e-ISSN: 2637-0395

Built Environment Journal 21(Special Issue) 2024, 79 – 92.

Built Environment Journal

The Implementation of Green Building Index (GBI) towards Green Township in Cyberjaya

Nur Fariza Abd Hadi[1], Nasyairi Mat Nasir[2*], Suzana C. Alih[3], Mahanim Hanid[4]

[1]*Pembinaan Purcon Sdn Bhd, Seri Kembangan, Selangor, Malaysia*
[2,3]*Studies of Quantity Surveying, School of Construction & Quantity Surveying, College of Built Environment, UiTM Shah Alam, 40450 Shah Alam, Selangor, Malaysia*
[4]*Department of Quantity Surveying, Faculty of Built Environment, Universiti Malaya, Malaysia*

ARTICLE INFO

Article history:
Received 26 July 2024
Revised 30 August 2024
Accepted 30 August 2024
Online first
Published 30 September 2024

Keywords:
Green buildings
Green township

DOI:
10.24191/bej.v21iSpecial Issue.2439

ABSTRACT

The Green Building Index (GBI) is Malaysia's industry-recognized green rating tool for building to promote sustainability in built environments among the developers, architects, engineers, contractors, and public on the environmental issue. The GBI-rated green building in Cyberjaya as a subject of this study is the factor that leads Cyberjaya towards the green township label in Malaysia. In achieving a green township, there are several classifications of the building that contributes to green and environmentally sustainable conditions. The aim of this research is to determine the influence of implementation of Green Building Index (GBI) rated buildings in Cyberjaya towards achieving green township. The objective of this research is to identify the user's satisfaction level of green buildings in Cyberjaya, examine significant elements that benefit green building applications in Cyberjaya and to evaluate the implementation of GBI-rating certified buildings in Cyberjaya towards meeting a green township. Data findings for this study has been collected through method of questionnaire among 122 respondents from three (3) classification of green buildings in Cyberjaya which are commercial building: MCMC Tower 1, institutional building: Cyberjaya Hospital and assembly building: Raja Haji Fi Sabilillah Mosque. Therefore, through this study, the researchers would like to know how the implementation of Green Building Index (GBI) can lead to green township in Cyberjaya.

INTRODUCTION

Green building is an integrated framework of design, construction, operations, and demolition practices toward the environmental, economic, and social impact of buildings. According to MRM Hussian (2018), evaluating the building's performance, the landscape design has become a major part of the overall Green Building Index (GBI) assessment through the criteria of open spaces, landscaping, and heat island effect. This study focuses on the implementation of the GBI Rating System towards three (3) classifications of the building in Cyberjaya, Malaysia. The green building chosen are MCMC Tower 1, Cyberjaya Hospital, and

[2*] Corresponding author. *E-mail address*: *nasya168@uitm.edu.my*
https://doi.org/10.24191/bej.v21iSpecial Issue.2439

Raja Haji Fi Sabilillah Mosque. These building completes the purpose of Cyberjaya as a green township with a positive environmental goal of a green city and design. In addition, the features and characteristics of these three (3) buildings will be studied along with users' satisfaction level towards the building.

These certified buildings were purposedly selected because of the insightful information it fulfils towards green building principles and aligns with the efficiency and positive environmental goals of green design and at the same time cost operating reduction by reducing energy consumption. Besides, green building criteria that were implemented according to the GBI rating system will be studies such as energy efficiency (EE), indoor environmental quality (EQ), material and resources (MR), sustainable site and planning (SM), and innovation (IN) due to beneficial results offered to the building. Issue that arises from this study is the satisfactory level of building conditions may affect users' comfort and therefore doubt the effectiveness of implementing green buildings practices, uncertainty in the decision-making on the elements of the green building, and the lack of environmental awareness of sustainability and green practice building in a community may lead to unconducive living in the long term. Hence, this study seeks to identify the users' satisfaction level with green buildings in Cyberjaya, examine significant elements that benefit green building applications in Cyberjaya and to evaluate the implementation of GBI-rating certified buildings in Cyberjaya towards meeting a green township.

LITERATURE REVIEW

Rating System of Green Building Index (GBI)

The Green Building Index (GBI) is Malaysia's first comprehensive rating system for evaluating the environmental design and performance of Malaysian buildings based on the six (6) primary criteria of Energy Efficiency (EE), Indoor Environment Quality (EQ), Sustainable Site Planning & Management (SM), Materials & Resources (MR), Water Efficiency (WE), and Innovation (IN). Specifically, GBI was created with the Malaysian tropical weather, environmental and developmental context, and cultural and social needs in mind. Its assessment considers two (2) major types of buildings: residential and non-residential.

Table 1. GBI rating classification (GBI, 2022)

POINTS	GBI Rating
86 to 100 points	Platinum
75 to 85 points	Gold
66 to 75 points	Silver
50 to 65 points	Certified

Pandey (2018) mentioned GBI considers building into these seven (7) categories in particular: residential new construction (RNC), non-residential new construction (NRNC), non-residential existing building (NREB), township, industrial new construction (INC), industrial existing building (INB), industrial existing building (IEB) and interiors (ID). Points will be awarded under the GBI assessment framework for achieving and incorporating environmentally friendly features that exceed current industry standards. Based on the criteria determined by the GBI body, buildings are awarded either Platinum, Gold, Silver or Certified ratings (see Table 1, Table 2, and Table 3 for the ratings and criteria of GBI).

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

Table 2. Assessment criteria for residential new construction (RNC) (GBI,2022)

Part	Item	Maximum Points	Score
1	Energy Efficiency	23	
2	Indoor Environment Quality	12	
3	Sustainable Site Planning & Management	37	
4	Materials & Resources	10	
5	Water Efficiency	12	
6	Innovation	6	
	Total Score	100	

Table 3. Assessment criteria for non-residential new construction (NRNC) (GBI,2022)

Part	Item	Maximum Points	Score
1	Energy Efficiency	35	
2	Indoor Environment Quality	21	
3	Sustainable Site Planning & Management	16	
4	Materials & Resources	11	
5	Water Efficiency	10	
6	Innovation	7	
	Total Score	100	

Implementing Energy Efficiency (EE) has become mandatory for all industries and sectors, especially in developing countries like Malaysia. This worldwide issue is largely caused by the building industry, which uses up to 40% of the world's energy, 12% of its water, and 40% of the waste that ends up in landfills. (GBI Malaysia, 2009 as cited by Chew, 2016). Yang & Jiang (2018) stated EE is a significant component of government policy as addressed in both the Ninth Malaysia Plan (2006-2010) and the Tenth Malaysia Plan (2011-2015), due to the initiatives contributes to most cost-effective measures that can reduce greenhouse-gas emissions.

Cheng (2003) mentioned that water shortage and pollution are quickly becoming two (2) of the world's most pressing issues. The GBI system introduced a rainwater harvesting system to reuse rainwater and grey-water process of recovering and cleaning water that would otherwise be directed to the waste system. Additionally, the type of plant used for redesigning, such as native and flexible plants, could also contribute to water reduction. Moreover, water efficiency considers the use of water efficient fixtures and appliances in a building. Installing low-flow appliances including water-saving faucets, keep users comfortable while consuming less water. In another aspect, under the water efficient criteria, implement greywater recycling systems to treat and reuse water from sources. In a way to implement this in a building or private properties need to adhere to local guidelines and regulations for greywater reuse (Oh et al, 2018).

The extent to which open space and habitat are created and preserved is the most important factor in minimising the disturbed area (Algburi et al. 2016). The premise of redevelopment is site planning for renewal projects, which is linked to the success of future developments said Wang et al. (2014). Additionally, efficient site planning and management activities should be carried out in such a way as soil loss, and stormwater sedimentation by implementing an Environment and Sediment Control (ESC) Plan. The other crucial aspects that need to be considered in building sustainable site planning and management is promoting sustainable transit choices. Buildings that are planned and situated to be accessible by public transit, have cycling lanes, and encourage pedestrian-friendly surroundings contribute to the advancement of sustainable mobility (Hagen et al. 2021).

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

Abdulaali et al. (2020) stated the quality of the indoor environment can be improved through building design. Moisture management and thermal performance are improved because of green building envelope design and construction. Improving the utilisation of natural resources, such as low volatile organic compound material usage, and air filtration quality can improve indoor environment quality (IEQ). Usually, the green-rated building is required to meet the minimum ventilation rate requirements in the indoor air quality (IAQ) process of ASHRAE 62.1 or local building code. The main goals are to specify the minimum ventilation rate that will be accepted by human occupants and to minimise the potentially harmful health influences (Algburi et al. 2016).

According to Marhani & Muksain (2018), to meet MR's requirements, it is essential to choose materials with green characteristics components without affecting the project's quality. The advantages were reduced project costs, minimal building maintenance, and improvements to the environment. Furthermore, the application of the 3R concept in improving systematic construction waste management plays vital role in reducing the negative impact on the environment. The GBI rating system includes innovation criteria as the process of developing innovative ideas from the design phase while improving GBI adaptation. The specifications ought to highlight the objectives of sustainable design to improve its efficiency (Marhani & Muksain, 2018).

Green Township

A township is a combination of multiple communities whereas a community in turn is a combination of multiple sectors (Singh et al., 2018). A sustainable environment can be achieved at different steps and level in the urban development from the inside out of the interiors and the buildings, neighbourhood or township and cities. Yaman et al. (2018) argued that the understanding of its buildings, communal spaces, public infrastructure, promotion of management principles, and collaboration among its components are all necessary to improve neighbourhood or township sustainability.

A green township can be envisioned as an integrated planned habitat that prioritises the protection, use, and recycling of natural resources while also promoting public health, safety, and the general well-being of urban residents (BCiS, 2015). Sustainable townships are achieved through a balanced approach to environmental, social, and economic issues. Planning a green neighbourhood or township entails developing a vision, establishing policy directions, and developing guidelines that describe all aspects required for a green neighbourhood to achieve its set of goals. As the plan implemented, making a commitment to neighbourhoods designs that promote a low-emission lifestyle for all residents involve enlisting the broadest possible range of stakeholders and community support to ensure ongoing improvements and refinements (Green Township Policy Initiatives in Malaysia, 2011).

Tan (2016) stated that one of the preserving the urban environment is the main objective of developers of housing and urban planners. Over time, a variety of indicators have been created to evaluate the effectiveness of a variety of residential circumstances. According to the findings of the assessment of green township, people can benefit from the opportunity to invest in eco-friendly developments that provide a higher quality of life. Green townships improved Malaysians' access to healthcare, public transportation, electricity, and water.

Green Building

Olubunmi et al. (2016) state that the term "green building" describes a structure and the use of resource- and environmentally conscious procedures at every stage of a building's life cycle, including design, construction, operation, maintenance, and demolition. A swift and comprehensive sustainable

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

transition in land, energy, buildings, transportation, and cities will be necessary to meet global carbon reduction goals. Buildings account for nearly 40% of global energy-related CO^2 emissions and will play a critical role in achieving a sustainable transformation. Green buildings that have been certified are a global solution for cities, communities, and neighbourhoods.

The actual benefits may not be immediately apparent to tenants or visitors, but throughout their life cycle, green buildings are able to reduce carbon emissions, energy, and waste by conserving water, prioritising safer materials, and lowering our exposure to toxins through sustainable design, construction, and operations (U.S. Green Building Council, 2018). The international market for green commercial buildings is gaining traction in the design and construction sectors; however, private sector development and investment remains limited (Reed & Wilkinson, 2005). According to Davis (2001), he classified the most significant barriers to green building development into three (3) categories such as builders' incentives product information, and sourcing.

Design Concept and Construction of Green Building

Wang et al. (2006) mentioned the greatest opportunities for integrating green design strategies occur at the conceptual design stage. The decisions taken at the conceptual stage affect the building's performance in a variety of ways. Building performance can be impacted in a variety of ways, including energy efficiency, cost, and aesthetics, since the shape of the building influences the size and direction of the outside envelope exposed to the outside environment. According to GBI (2021), there are several assessment criteria for green building adopted in Malaysia. The adoption encompasses the entire lifecycle of a building, from site selection and design to construction, operation, and decommissioning. It emphasises efficiency with the goal of creating structures that benefit both the local community and the environment as well as their occupants.

Certified Green Rated Buildings in Cyberjaya

Malaysian Communications and Multimedia Commission (MCMC) Tower 1

Fig 1. MCMC Tower 1

The Malaysian Communications and Multimedia Commission (MCMC) Tower 1, as the first research materials located at Shaftsbury Square in Cyberjaya where's a place of fusion of art, culture, enterprise & comfortable living for its occupants has been certified with a Gold Rating by the Green Building Index (GBI). Under the building category of Non-Residential New Constriction (NRNC), the validity of the certificate is from 14 March 2017 to 13 March 2020. This 22-storey building is an iconic green building owned by the Ministry of Communications and Multimedia with the preceding agency, Malaysian Telecom Department. The MCMC Tower 1 is a representation of Malaysia's dedication to environmental awareness and sustainable development in the communications and multimedia sector. To continue the commitment

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

to sustainable development and green building initiatives, MCMC Tower 1 has put much effort into assuring better use of resources while reducing the building's impact on human health and the environment during the building's lifecycle.

The building is adapting various sustainable features such as low-E glass façade, solar panels, wind turbines, automated lighting sensors, rainwater harvesting systems, recyclable materials, a rooftop garden, auto-stop eco faucets, etc. As an office building, it is essentials to provide the users with these facilities as they can bring comfort, functionality and flexibility while having social interaction. For instance, indoor facilities such as meetings and conference rooms create an environment that promotes focus and productivity. Additionally, the outdoor facilities provided by this building is a rooftop garden that is widely recognised due to its unique feature of having garden equipped with solar panels and a wind turbine. There are numerous benefits gained from the rooftop garden. Moreover, it promotes environmental sustainability by lowering heat absorption and enhancing temperature control. Also, it has the potential to produce clean, renewable energy on-site while assisting in the transition towards a low-carbon energy system.

Cyberjaya Hospital

Fig 2. Cyberjaya Hospital (Source: Harian Metro Portal)

Cyberjaya is one of the cities that have a consistently growing its population in Malaysia. More healthcare facilities are being built to accommodate the expanding population's healthcare needs. The RM508.8 million hospital is the first platinum-rated government hospital under the GBI certification that emphasise sustainability and energy efficiency in its concept design. With a capacity of 288 beds, Cyberjaya Hospital is expected to benefit approximately 282,000 residents in the Sepang district. The government initiatives to make the hospital for the public is to prioritise the M40 group and citizens who are unable to afford private hospital fees while receiving top-notch services in the private hospital.

The building is equipped with green building design such as an energy management system, building orientation and layout, building opening, landscaping work, solar energy and rainwater harvesting, ultraviolet germicidal irradiation (UVGI) air handling unit (AHU) system, green vehicle preference, and CO^2 monitoring system. This function assists in reducing climate change, protecting ecosystems, and maintaining natural resources. The use of functional heating, ventilation, and air conditioning (HVAC) systems, high-performance windows, energy-efficient lighting, and effective insulation may all help reduce energy use, greenhouse gas emissions, and dependency on fossil fuels. Other than the expertise and health services rooms that are available for the building users of Cyberjaya Hospital, they also provided outdoor facilities that meet the SM criteria from the GBI rating system, such as a well-planned outdoor amenities and multilevel parking structures. The purpose is mainly to create functional and comfortable spaces for occupants. These services applied the EE, WE, and EQ of the GBI rating system to enhance building occupants' general functionality and well-being

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

Raja Haji Fi Sabilillah Mosque

Fig 3. Raja Haji Fi Sabilillah Mosque

The development of Cyberjaya has been driven by innovation, and the city is now home to hundreds of local and international multinational corporations. As the city's population has been proliferating, a location for the Muslims to gather was set aside on about 17 acres of land due to the city's rapid growth and rising population. The final research material, The Raja Haji Fi Sabilillah Mosque, named after a decorated Bugis warrior who lost his life in a conflict with the Dutch in Telok Ketapang, Melaka, in 1784. Following being inspired by his name, the design work for the mosque commenced in 2012 and was completed in time for the National Mosque's Golden Jubilee in 2015 with a Platinum rating. Although the date of issuance of the GBI is certification valid from 18th December 2014 to 17th December 2017, the mosque still holds the Certified GBI rating up to this day.

Constructed on a 17.5-acre site with a total built-up area of 120,107 sq. ft, the design complies with the Green Building Index (GBI) standard's highest rating level, the Platinum rating, that incorporates recyclable materials and energy-efficient equipment to minimize energy usage and save operating costs. It will be among the first mosques in the world to generate electricity from solar panels and sign up for a Feed-in Tariff (FIT) program. By including well-designed outdoor and indoor facilities, the mosque embraces sustainability, improves safety and security, and encourages occupants' comfort while adapting to the changing needs of the building. This overall has included all the GBI rating system from the inception stage of construction until project handover. Furthermore, before the main prayer building that was situated inside of the Raja Haji Fi Sabilillah Mosque, there is a tall signature tree that serves to provide natural lighting and ventilation to the levels above.

Fig 4. Signature tree of Raja Haji Fi Sabilillah Mosque

METHODOLOGY

The study adopted both quantitative and qualitative data collection methods via criterion sampling that has been selected to meet some criteria as primary data. Primary data sources are often selected and amended to meet the needs or requirements for certain research. Judgment sampling was used to select suitable respondents as the users of the MCM Tower 1 building, Cyberjaya Hospital and the Raja Haji Fi Sabilillah Mosque. Open-ended, long-form questions offer the respondent the ability to elaborate on their thoughts.

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

Since questionnaires provide a quick, effective, and affordable way to acquire a lot of data from substantial sample sizes, questionnaires are a common research approach (QuestionPro, 2018; Research, 2022).

Questionnaires were distributed via post, email, or hand. A total of 122 responses were received. The primary tool used in the questionnaire is the Likert Scale, which consists of five (5) ordinal measurements that range in agreement from one (1) to five (5). Formula (1) was used to get each question's average index.

$$\text{Average index} = \frac{\sum \mu X n}{n} \quad (1)$$

ANALYSIS AND FINDINGS

The data was collected through the questionnaires survey, where the questionnaires were distributed to the users and management of the respective green building, MCMC Tower 1, Cyberjaya Hospital and Raja Haji Fi Sabilillah Mosque. Respective green buildings show that most of the questionnaire from MCMC Tower 1 building were male primarily aged from 25 to 35 years old. Also, most of the respondents have a degree as their academic qualification, which could produce a better quality of discussion and better results for this research. It is found that most of the respondents visit the building few times a week to work or for studies. Besides, most of the respondents spend between three (3) to five (5) hours in the building.

Level of Understanding and Knowledge on The Concept of Green Township and Green Building

Most of the respondents understand that green buildings and townships could be more beneficial to prevent deterioration in urban environments. Green townships provide an emphasis on environmental sustainability by including green spaces, fostering biodiversity, and setting together sustainable infrastructure. Data from the research findings were ranked according to their average index score. It was found that the first ranking with the highest mean value is at 4.45 for the knowledge of respondents towards the concept of green township in Cyberjaya. Respondents' understanding of current developments of green building projects and the awareness of Cyberjaya moving towards green township by 2025 ranked second and third with 4.33 and 3.93 mean value respectively.

Table 4. Concept of Green Township

Concept of Green Township	Mean Value	Std. Deviation	Ranking	Classifications
Rate your knowledge of the concept of Green Township in Cyberjaya	4.45	1.21	1	Excellent
How much do you know about the current development of green building projects in Cyberjaya?	4.33	0.95	2	Good
How much do you aware that Cyberjaya are moving towards green township by 2025?	3.93	0.79	3	Good

The highest mean value is at 4.45 for the knowledge of respondents towards the concept of green township in Cyberjaya. Respondents' knowledge on current developments of green building project and the awareness on Cyberjaya moving towards green township by 2025 ranked second and third with 4.33 and 3.93 mean value respectively.

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

Table 5. Concept of Green Building

Concept of Green Building	Mean Value	Std. Deviation	Ranking	Classifications
Rate your knowledge on the concept of Green Building in Cyberjaya	4.45	0.97	1	Excellent
How much do you know about the green concept of the building that you chose?	4.21	0.90	2	Good
How much do you aware that the building you chose uses green building design concept?	4.16	0.88	3	Good

According to Zhou & Lowe (2003), while green buildings may have higher initial costs than conventional buildings, in long-term energy savings, operational cost savings, and increased property value makes green buildings a financially viable and sustainable option. The highest mean value is at 4.45 for the knowledge of respondents towards the concept of green building in Cyberjaya. Respondents' knowledge on the concept of green building that they choose as in Section A and the awareness of respondents on green building has mean value of 4.21 and 4.16 respectively.

Table 6. User's Level of Understanding on The Benefits of Green Township

User's Level of Understanding on The Benefits of Green Township	Mean Value	Std. Deviation	Ranking	Classifications
To keep the urban environment from deteriorating	4.54	0.92	1	Excellent
Able to attract new businesses and residents	4.42	0.77	2	Good
Encourage a caring society and community well-being	4.42	0.87	3	Good
The design intended to resist and recover from natural disasters	4.27	0.74	4	Good
Able to balance their ongoing production and consumption of energy	4.11	0.69	5	Good

The highest mean value obtained from the variables 4.54 respondents understand that green township able to keep the urban environment from deteriorating. Able to attract new business and residents on green township and encourage caring society and community well-being has the same mean value of 4.42, however attract new businesses have the least standard deviation value of 0.77 and 0.87 respectively. With the second lowest mean value of 4.27, respondents understand green building design intended to resist and recover from natural disasters and the lowest mean value of 4.11 can balance the ongoing production and consumption energy.

Table 7. User's Level of Understanding on The Benefits of Green Building

User's Level of Understanding on The Benefits of Green Building	Mean Value	Std. Deviation	Ranking	Classifications
To reduce energy consumption and associated costs	4.51	0.98	1	Excellent
High initial cost but offer long term cost benefits	4.36	0.89	2	Good
Produce less waste during construction and designed to be easily disassembled	4.33	0.88	3	Good
To improve physical health and well-being	4.12	0.92	4	Good
Offers proper ventilation and the use of non-toxic building materials	4.08	0.76	5	Good

Level of Acceptance on The Respective Green Building in Cyberjaya

According to Business Today (2023), along with Malaysia's Prime Minister Datuk Seri Anwar Bin Dato' Ibrahim on his ambitions of Malaysia Madani, Cyberview, a developer for Cyberjaya's Tech Hub, makes the unique suggestion of partnership to build floating solar power in Cyberjaya. They will examine the viability of this creative initiative and exchange information and materials to make it happen. Hence,

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

showing the highest percentage of 80.3% of respondents strongly agree with the ongoing green building project in Cyberjaya.

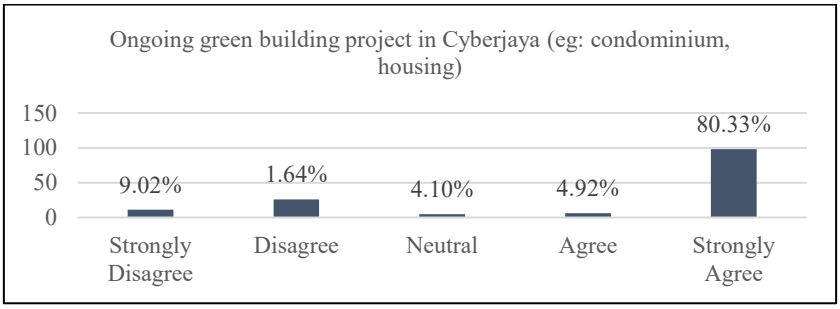

Fig 5. Ongoing green building project in Cyberjaya (e.g.: condominium, housing)

In addition, the majority percentage of 67.2% of respondents agree on past completed green building projects in Cyberjaya. In Malaysia, green construction needs to apply the assessment audit system in order to be awarded Grade A by the Malaysian Institute of Planners (MIP), Malaysia Carbon Reduction and Environmental Sustainability Tool (MyCREST), MyHijau, Green Building Index (GBI) and Green Real Estate (GreenRE). Significantly, inn Cyberjaya, other green buildings that have been awarded by GBI such as The Place @ Cyberjaya Tower 2, SOHO @ Cybersquare, Setia Eco Glades, and Cyberjaya Community Recycling and Collection Centre.

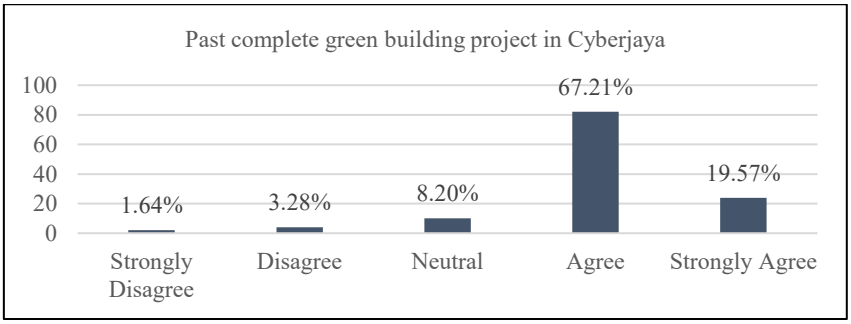

Fig 6. Past complete green building project in Cyberjaya

Level of Satisfaction of Users and The Management on The Respective Green Building in Cyberjaya

Analysis shows that the highest mean value obtained from the variables (4.52) of respondents delighted with the high-quality building material choices while the others with satisfied such as good orientation of building that improve thermal comfort inside the building with 4.47 mean value, efficient lightning 4.45 mean value, excellent building envelope of building 4.41 mean value, and good waste management system rated with 4.39 mean value.

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

Table 8. Green Building Design

Green Building Design	Mean Value	Std. Deviation	Ranking	Classifications
High quality building material choices	4.52	0.82	1	Strongly Satisfied
Good orientation of building that improve thermal comfort inside the building	4.47	1.20	2	Satisfied
Efficient lightning	4.45	0.82	3	Satisfied
Excellent building envelope of building	4.41	0.87	4	Satisfied
Good waste management system	4.39	1.02	5	Satisfied

The highest mean value obtained from the variables (4.54) of respondents are strongly satisfied with the sufficient signs and symbol in the green building. Additionally, under the same category similar mean value of 4.52 for 2 variables which are good information on design bulletin boards and the design and arrangement of tables and seats in the building gained standard deviation value of 0.77 and 1.04 respectively. Additionally, quality, appearance, presentation of the building interior finishes, materials, and colours ranked at no 4 with 4.21 mean value while quantity and quality of fixed furniture in the building have the mean value of 4.00 stated that both under the satisfied category.

Table 9. Furniture

Furniture	Mean Value	Std. Deviation	Ranking	Classifications
Sufficient signs and symbol	4.54	0.67	1	Strongly Satisfied
Good information on design bulletin boards	4.52	0.77	2	Strongly Satisfied
Design and arrangement of tables and seats in the building	4.51	1.04	3	Strongly Satisfied
Quality, appearance, presentation of the building interior finishes, materials, and colours	4.21	0.63	4	Satisfied
Quantity and quality of fixed furniture in the building	4.00	0.64	5	Satisfied

The analysis on the satisfaction level towards safety, security, and health in each respective green building chose by the respondents indicates the highest mean value obtained from the variables (4.63) of the respondents are strongly satisfied with the clearly marked signs of emergency exit. Followed by fire safety and smoke detectors adequately distributed with the mean value of 4.52. Moreover, similar variable under the satisfied category rated by respondent starting with high-quality indoor air inside the building with the mean value of 4.46, closed-circuit television (CCTV) functions well to protect against crime with mean value of 4.40 and no noise produce from HVAC system (4.61).

Table 10. Safety, security, and health

Safety, security, and health	Mean Value	Std. Deviation	Ranking	Classifications
Emergency exit clearly marked with signs	4.63	0.88	1	Strongly Satisfied
Fire safety and smoke detectors adequately distributed	4.52	0.78	2	Strongly Satisfied
High-quality indoor air inside the building	4.46	0.75	3	Satisfied
CCTV functions well to protect against crime	4.40	0.85	4	Satisfied
No noise produced from HVAC system or lighting fixtures (bulbs and lamps)	4.22	0.67	5	Satisfied

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

Respondent's Recommendation to Improve the Performance of Green Building and Facilities Provided

Analysis shows that the highest mean value obtained from the variables (4.54) of respondents strongly agree to use smart parking ticket system for easier and more modern followed by providing building sign directory for easy searching in the building with the mean value of 4.53. Respondents rated agree with to have more comprehensive master plan to improve life's quality in Cyberjaya with 4.46 mean value, improving green design of the building for more sustainable environment with 4.43, and government funding the developer with 4.32 mean value.

Table 11 Building performance and facilities that need to improve

Building performance and facilities that need to improve	Mean Value	Std. Deviation	Ranking	Classifications
Use smart parking ticket system for easier and more modern	4.54	0.67	1	Strongly Agree
Building sign directory for easy searching in the building	4.53	1.17	2	Strongly Agree
Have more comprehensive master plan to improve life's quality in Cyberjaya	4.46	0.73	3	Agree
Improve green design of the building for more sustainable environment	4.43	0.82	4	Agree
Government should fund the developer to let them develop more green building in Cyberjaya	4.23	0.78	5	Agree

Based on the data analysis for the open-ended questions, most of the respondent stated their opinion on other recommendations to improve performances of these green building. Starting with the category of awareness towards the development of green building, mostly suggests focusing on minimising the negative environmental effects. People can appreciate the value of sustainable development due to increased awareness. Followed by energy efficiency criteria which is considered as the key pillar of green building development such as grid integration and solar-powered water purification. Overall, the recommendation by respondents proves that green building practices could lessens the negative effects on the environment and operational expenses while simultaneously enhancing the comfort, efficiency, and

CONCLUSION

The implementation of Green Building Index (GBI) towards green township in Cyberjaya that the users of MCMC Tower 1, Cyberjaya Hospital and Raja Haji Fisabilillah Mosque in Cyberjaya has achieved the users' satisfaction very well. Although no dissatisfaction occurs, the users may not overall fully satisfy with the element of green building provided. Additionally, under the most satisfied components that the users chose in terms of green building design is high quality of materials choices. Despite these buildings served different functions, they achieved the objectives towards green township in Cyberjaya considering they used the same GBI rating system that allows to achieve the goals. Therefore, Cyberjaya may develop into a green township by implementing GBI ratings in buildings. Although the implementation of Green Building Index (GBI) has been widely used in Malaysia, the act of sustaining and its awareness of benefit gains from green building should be further highlighted so that it become the focus in the construction industry nowadays.

Moreover, where Malaysia is now inclined to follows the Sustainable Development Goals (SDG) that began in late 2014, suggestions have been made for this study to enforce further the implementation of using GBI rating system in Malaysia. Initially, the implementation of GBI need to be at the highest GBI rating system, platinum rating. The use of platinum rating building could be a step stone for other construction projects moreover in Cyberjaya to build more green building while moving towards green township. Furthermore, acquire views from construction players specifically Architect that are involve in

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

implementing of GBI rating system could provide a better view based on their experience in the construction industry. Finally, the government should be able to fund developers and their design team to improve the efficiency of green elements in a building. These subsidies can partially reduce the additional costs associated with green building projects. By investing in sustainable building practices, governments can drive progress toward a more sustainable, and economically vibrant future.

ACKNOWLEDGEMENTS/FUNDING

The authors gratefully acknowledge the support of Universiti Teknologi MARA (UiTM), Shah Alam, for providing the facilities and resources essential for conducting this research.

CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted without any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

AUTHORS' CONTRIBUTIONS

Nur Fariza Abd Hadi carried out the research, wrote and revised the article. Nasyairi Mat Nasir conceptualised the central research idea and provided the theoretical framework. Nasyairi Mat Nasir and Suzana C. Alih designed the research, supervised research progress; Nasyairi Mat Nasir anchored the review, revisions and approved the article submission.

REFERENCES

Abdulaali, H. S., Hanafiah, M. M., Usman, I. M., Nizam, N. U. M., & Abdulhasan, M. J. (2020). A review on green hotel rating tools, indoor environmental quality (IEQ) and human comfort. *Int. J. Adv. Sci. Technol, 29*(3), 128-157.

Algburi, S. M., Faieza, A. A., & Baharudin, B. T. H. T. (2016). Review of green building index in Malaysia; existing work and challenges. *International Journal of Applied Engineering Research, 11*(5), 3160-3167.

BCiS (2015). Building Consumption Input System (BCiS). Retrieved December 3, 2022, from Greentownship.my website: http://www.greentownship.my/v2/index.php/home/pages/48

Cheng, C. L. (2003). Evaluating water conservation measures for Green Building in Taiwan. Building and Environment, 38(2), 369-379. Cheng, C. L. (2003). Evaluating water conservation measures for Green Building in Taiwan. *Building and Environment, 38*(2), 369-379. https://doi.org/10.1016/S0360-1323(02)00062-8

Chew, B. C., Syaiful Rizal, A. H., Azri, A., & Mohd Hafizzudin, M. (2016). Implementation of Energy Efficiency (EE) system according to the Green Building Index (GBI): A case study on Panasonic Industrial Devices Semiconductor Malaysia (PIDSCMY). *International Journal of Business and Technopreneurship, 6*(3), 31-53.

Davis, A. (2001). Barriers to Building Green. Retrieved from https://www.greenbiz.com/blog/2001/11/01/barriers-building-green

Green Building Index (2021). Green Building Index. Retrieved December 2, 2022, from Greenbuildingindex.org website: https://www.greenbuildingindex.org/

https://doi.org/10.24191/bej.v21iSpecial Issue.2439

Green Township Policy Initiative in Malaysia. (2011). Green Township Policy Initiative in Malaysia: Towards Sustainable Development. Dept of Environment Malaysia.

Hagen, O. H., & Rynning, M. K. (2021). Promoting cycling through urban planning and development: a qualitative assessment of bikeability. *Urban, planning and transport research, 9*(1), 276-305.. https://doi.org/10.1080/21650020.2021.1938195

Marhani, M. A., & Muksain, M. A. S. (2018). GBI assessment checklist: Level of awareness of the contractors in the Malaysian construction industry. *In IOP Conference Series: Earth and Environmental Science* (Vol. 117, No. 1, p. 012024). IOP Publishing. https://doi.org/10.1088/1755-1315/117/1/012024

Oh, K. S., Leong, J. Y. C., Poh, P. E., Chong, M. N., & Von Lau, E. (2018). A review of greywater recycling related issues: Challenges and future prospects in Malaysia. *Journal of Cleaner Production, 171*, 17-29. https://doi.org/10.1016/j.jclepro.2017.09.267

Olubunmi, O. A., Xia, P. B., & Skitmore, M. (2016). Green building incentives: A review. Renewable and Sustainable Energy Reviews, 59, 1611-1621. https://doi.org/10.1016/j.rser.2016.01.028

Pandey, S. (2018). Impact of green building rating systems on the sustainability and efficacy of green buildings: case analysis of green building index, Malaysia.

Press: Benefits of green building | U.S. Green Building Council. (2018). Usgbc.org. https://www.usgbc.org/press/benefits-of-green-building

Reed, R. G., & Wilkinson, S. J. (2005). The increasing importance of sustainability for building ownership. Journal of Corporate Real Estate. https://doi.org/10.1108/14630010510700831

Tan, T. H. (2016). Neighbourhood satisfaction: responses from residents of green townships in Malaysia. International Journal of Housing Markets and Analysis.

Wang, H., Shen, Q., Tang, B. S., Lu, C., Peng, Y., & Tang, L. (2014). A framework of decision-making factors and supporting information for facilitating sustainable site planning in urban renewal projects. *Cities, 40*, 44-55. https://doi.org/10.1016/j.cities.2014.04.005

Wang, W., Rivard, H., & Zmeureanu, R. (2006). Floor shape optimization for green building design. *Advanced Engineering Informatics, 20*(4), 363-378. https://doi.org/10.1016/j.aei.2006.07.001

Yang, W., & Jiang, X. (2018). Evaluating sustainable urbanization of resource-based cities based on the Mckinsey matrix: case study in China. *Journal of Urban Planning and Development, 144*(1), 05017020. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000423

https://doi.org/10.24191/bej.v21iSpecial Issue.2439