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GREEN DESIGN PERFORMANCE OF MALAYSIAN BUILDING PROJECTS- DESCRIPTIVE STUDY

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ABSTRACT

The aim of this work was to investigate whether the Malaysian current building projects are considered as "Green Designs". To achieve this aim a questionnaire survey was conducted. A sample of 274 respondents is covered, which included architects and engineers in the building design and consultancy sectors. WINSTEPS software is used in Rasch modeling to determine the validity and reliability of the data. Descriptive data analysis (quantitative and qualitative) is done. The results reveal that design green building performance, in general, energy efficiency, and indoor air quality requirements are considered moderate. The majority of the designed buildings are with low utilization of recycled and reused materials. Moreover, high utilization of regional materials, low consideration to water efficiency requirements and environmental innovations are also moderate. Design team attributes are the key factors to improve green design performance. Client quality play major role to enhance design team attributes. Therefore, effective Design team attributes and client's qualities may increase performance of the design green building performance in order to enhance building performance and reduce building impact on environment.

Keywords: design green building performance, green materials, energy efficiency, water efficiency, indoor air quality, Malaysia.

1. INTRODUCTION

The construction industry and its products expend a crucial amount of materials and energy sources; therefore, they are responsible for a large portion of pollution. Nowadays, there is a universal understanding that the building and construction sector is one of the most significant sectors globally with consider to a future green development [1].

Most of the papers and books that discussed 'green' buildings (GB) begin by describing the impacts of the buildings on the environment [2-5]. Environmentally speaking, the most frequent quoted figures are that the built environment and the construction industry are responsible for approximately 40% of resource consumption, 30% of the world's energy consumption and between 10% and 40 % of the world's waste generation [4-8].

1.1 Buildings impact on environment

Typical buildings consume more resources than necessary and have negative impact on environment. As much as half of all materials obtained from the earth's crust are transformed into building materials and products [7, 9], generating a large amount of waste [7, 8, 10-16] 10% - 40 % of world's waste and pollutions [7, 17-19].

Malaysia statistics showed that Malaysia is ranked 33rd in the list of international electricity consumption and 25th in the list of man-made carbon dioxide emissions [20]. Malaysian buildings account for about 12.85% of the total energy consumption and 47.5% of the country's electricity consumption. Commercial buildings consume almost a third of the country's electricity consumption. Cooling purposes proposes consuming 55%-65% of electricity used in buildings, while 25%-35% is for lightening purposes [21] [7, 9] .

Malaysian construction sector has produced as much as 28.34% of national wastes. Ganjbakhsh [22] and Begum *et al*., [19] explained in their studies that there is a bi-directional causality between energy consumption and economic growth and air quality problems in Malaysia's waste reduction during the planning and design phase to reduce the generation of waste is rarely considered.

There is an urgent need to promote a wider notion of sustainability in building in order to enhance the environmental performance, if this were the case, then the current Malaysian construction and building practices can be deemed as 'not green'.

Since buildings have considerable impacts on the environment, it has become necessary to pay more attention to environmental performance in building design. However, it is a difficult task to find better alternative design satisfying several conflicting criteria, especially, economical and environmental performance. Therefore, design is considered as one of the highest impacting areas on 'green' performance of the built environment [3]. Therefore, there is a necessity to improve the quality of the built environment, as well as the processes of its procurement design, construction, and management.

1.2 Design green building performance

Green buildings place too much emphasis on good intentions at the early design phase [8]. Major environmental impacts of a building are determined at the early design phases, especially when determining building plan shape, form and envelope characteristics [2, 23]. Moreover, as early decisions made during design stage as considered to have the greatest influence on project performance [24]. In this context, Lukumon and Thamb [25] mentioned that more than 50% of construction faults were caused by design deficiencies. Moreover, decisions made during early stage of design are considered to have the greatest influence on project performance and have the minimum related cost [24]. Hes [3] confirmed that design stage is one of the highest influencing areas on 'green' performance of building.

For instance through better design responsible selection of energy, material and water efficient solutions, the environmental impacts could be reduced [26]. Therefore, it is essential that environmental design tools be applied at this stage in order to progressively monitor the environmental implications of different iterations of design.

Therefore, this research is aimed to investigate the performance of 'design green buildings practice' in Malaysia.

2. RESEARCH METHODOLOGY

In this study, a triangulation technique was implemented, which combined quantitative and qualitative data collection approaches. The research was performed through a three main stages. The first stage was a comprehensive literature review followed by preliminary questionnaire survey. Four research variables were validated. Secondly, data collection involving semi-structured interviews was done. The main aim of this stage was to upgrade and refine the research problem and proposed theoretical framework. The last stage involved the final questionnaire survey, in which data was collected for statistical analysis purposes.

The questionnaire was divided into two parts. The first part requires respondents to provide their personal particulars including their job title, experience, number of construction projects involved, type of buildings designed by their firm. In addition, type of procurement, type of building and size of the projects they have been carried out were provided. The second part focuses on uncovering the current performance of buildings, clients, and key design team.

A survey package consisting of the detailed questionnaire, post card, pen, stamped envelope and a covering letter explaining the objectives of the study was posted to professionals in various architectural consultancy firms as well as engineering consultancy firms. They were selected from the list of architects downloaded from the Malaysian Institute of Architects (PAM) website, whereas list of engineers is provided from the organization directory of Association of Consulting Engineers Malaysia (ACEM).

The population for this study became key design team players for architects registered with the PAM and Engineers registered with ACEM practicing consultancy services. Only architects registered in PAM and Engineers registered in ACEM are selected as the research context. The target population includes architects and Engineers working in design consultancy located in Malaysia. The limiting parameters of the research considered were the minimum size of green building project, based on contract value, was set at RM 2,000,000.00 and projects handled after January 1, 2003 were included in the study. This date was chosen because it was assumed that respondent who chooses projects handled before this date may not have all project's details to complete this questionnaire.

A total of 274 survey questionnaire were distributed, 102 valid replies were received which represents a response rate of 37.1%. WINSTEPS software was used for Rasch Modeling of the Principal Performance Measures to examine data validity and reliability was analyzed. SPSS version19, computer software was used to analyze the collected data. The technique of descriptive statistics was used to describe and make sense of the data. The descriptive statistics included the frequency, mean and standard division for studied variables.

3. VALIDITY AND RELIABILITY

Prior to analysis, functioning of the 5-point Likert scale was examined according to the criteria by Linacre (2006). More than 10 observations are found in each category. Table-1 shows the rating scale category function data for DGBP suggesting no category disordering. Beside, both the observed average measures and category measure are characterized by criterion of monotonic advance. The Outfit MNSQ values, which are closed to infit MNSQ values, for each category, are all closed to 1.00 and less than 2.00, suggesting that each label was providing measurement information rather than noise in the data. The threshold estimates increase with the category label, indicating that the response categories were used in expected and intended manner. These evidences suggested that the rating scale categories are effectively satisfactory for DGBP variable.

3.1 Reliability and separation index

As shown in Table-1, the reliability of all variables item difficulty measure was very high (0.96). This suggested that the ordering of item difficulty was highly replicable with other comparable sample from similar population. The item separation index was higher than the minimum desired (2.00) and the SD was accepted estimate. The item measure RSME was 0.12, which considered as very good. Taken together, these statistics indicate good separation between items and item measures.

3.2 Dimensionality test of variables

For the DGBP with five-category response model is shown in Table-2, all items had acceptable outfit MNSQ statistics between 0.60 and 1.40, the lowest outfit was 0.67, whereas the highest was 1.37. Exception is for item 19 suggesting that it was not redundant items; with considering high values may represent a lack of homogeneity with other items in the subscale. All items had high to very high PTMEA correlations (0.46 - 0.81), which exceeded 0.20 as critical value for the correlation. Positive sign of correlation values identified that the items are systematically correlated in the same direction, measuring the same latent variable calling "DGBP", therefore, all items scored good discrimination.

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Table-1. Key reliability and validity parameters of DGBP items.

Total variance in observations		Category measures			Threshold estimates
-1.78		-3.01			-
-0.93		-1.38			-1.67
-0.16		-0.1			-0.81
0.61		1.35			0.49
1.31		3.23			1.99
Rasch principal components analysis (RPCA)					
Total variance in observations					68.80%
variance explained by measures					65.10%
Unexplained variance in 2ndcontrast					12.20%
Reliability and separation index					
	Model RMSE	**Mean**	**Adj-SD**	**Separation**	**Reliability**
Behavior measures	0.26	0.11	1.09	3.73	0.93
Item measures	0.12	0.13	0.61	4.73	0.96

Table-2. Item statistics: misfit order and item correlations.

Variables	MNSQ				PTMEA	
	Outfit		Infit			
	Lowest	Highest	Lowest	Highest	Lowest	Highest
DGBP	0.66	1.37	0.67	1.46	0.46	0.81

3.3 Appropriateness of DGBP items difficulty for sample

The person and item map for the response model showed that there was exceptional overlap between the person latent attributes and item difficulty as shown in Figure-1. Is implies that the item difficulty was suitable for the sample. In other words, the items provided sufficient information to discriminate among individuals in terms of varying levels of DGBP in present study sample.

The overall sample considered acceptable. This identified that the item difficulties are spread out widely along continuum in relation to measured variables, providing important aspect for construct validation [27]. In addition, it is suggesting that DGBP items can be divided into 5 difficulty levels which were considered to be satisfactory for all items.

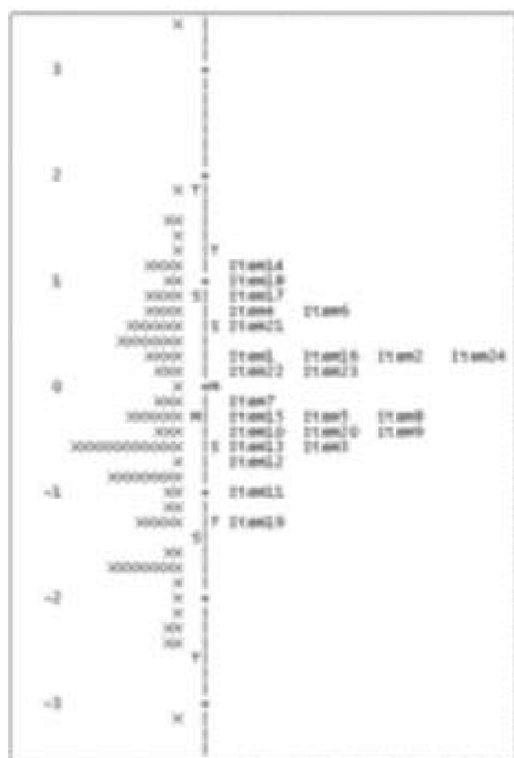

Figure-1. Items difficulty-map.

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4. RESULTS AND DISCUSSIONS

Descriptive statistics for the 24 components of DGBP were produced. A chart of the means representing the mean design performance of building projects along a variety of dimensions is shown in Figure-2. The evaluation of central tendency used was the mean. Furthermore, the mean is easily determined and interpreted and is used in other calculations.

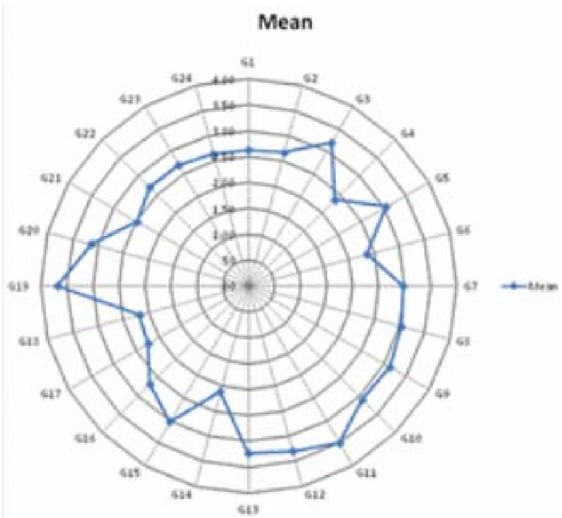

Figure-2. Mean chart.

Figure-2 summarizes these findings in simple terms. The lowest rated dimension was Green Transportation (G14), which was rated low, which implies that a Green transportation issues such as green vehicles, low impact fuel, carpool priorities were not considered during design phase. This result suggests that there is still some range for improvement in this regard.

It is expected that, with all the reports and research publications to address the poor DGBP the green issues in respect of factors like energy efficiency, water efficiency and indoor air quality would have been high with DT conscientiously striving to achieve better performance. This is clearly not the case suggesting that improvements are possible in this regards.

The aspects of Design Green Buildings (DGB) that influence overall DGBP were investigated. GBI criteria were adopted to identify design performance level. Employing the generic classifications of the factors as shown in Table-3, a general DGBP factors are discussed below.

Table-3. Summary of DGBP items levels.

Code	Items	Mean	Std division	V. low	Low	M	high	V. high
Energy efficiency								
G1	Environmental assessment tool	2.63	1.160			x		
G2	Energy management control system	2.67	1.056			x		
G3	Renewable energy concept	3.20	1.005			x		
Indoor Air quality								
G4	Clear day lighting strategy	2.35	1.149		x			
G5	Ventilation requirement	3.06	1.079			x		
G6	Carbon dioxide monitoring	2.36	1.124		x			
G7	VOC” products	2.98	1.169			x		
G8	Control of extreme humidity	3.05	1.075			x		
G9	Thermal comfort system control	3.15	1.066			x		
G10	Air change effectiveness criteria	3.11	.984			x		
G11	A daylight factor and glare control	3.51	1.079				x	
G12	Maintain internal noise levels	3.30	.993			x		
Sustainable site planning and management								
G13	Average density and community connectivity	3.24	.967			x		
G14	Green Transportation	2.11	1.080		x			
G15	Storm water management plan	3.03	1.222			x		
G16	Solar reflection index criteria	2.69	1.282			x		

Green Materials and resources								
G17	Reused materials	2.23	1.193		x			
G18	recycled materials	2.17	1.186		x			
G19	Regional materials	3.68	1.036				x	
Water efficiency								
G20	rainwater harvesting	3.13	1.183			x		
G21	Treat and recycle waste water	2.47	1.208		x			
G22	Potable water consumption	2.70	1.303			x		
Green design innovations								
G23	New Green Idea	2.70	1.159			x		
G24	Green design initiatives	2.64	1.159			x		

4.1 Energy efficiency (EE)

The extent of applying the EE criteria in building project toward achieving GD was investigated. EE in this study refers to the goal of efforts to decrease the amount of energy required to provide buildings and operations related during design stage. In terms of implementing environmental assessment tools to achieve minimum energy consumption, as shown in Figure-3, the results implies that a half (50%) of respondents were not implemented any environmental assessment tools during design process while only 23.6% of respondents were implemented environmental assessment tools during design stage.

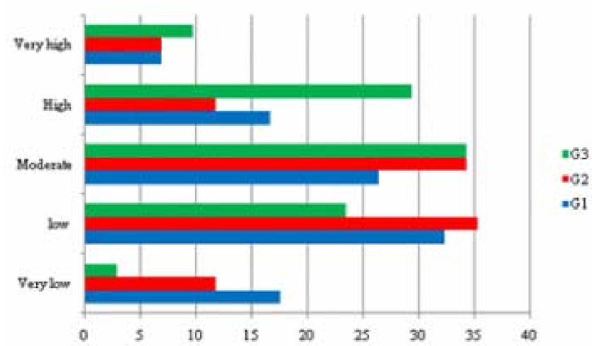

Figure-3. Energy performance levels.

The level of considering requirements of Energy Management Control System was examined. The result reveals that almost half (47.1%) of the respondents was not considered the requirements of energy management control system through their design work. On the other hand, only 18.7 % of them were considered it.

The last examined parameter, to identify the extent of employing EE features during design stage, was regarding the level of implementing renewable energy concept to total or sub electricity consumption generated. The result reveals that only 39.2% of respondents were considered renewable energy concept in their design while others were found in the range of very low (2.9%) and moderate level (23.5% and 35%). The semi-structured review with Architects and Engineers who involved in design work indicated that the EE is one of the key features of GB. Most of the interviews indicated that EE criteria were not always implemented. Environmental management control system was considered and MS1525 code in some office building projects was imposed by local authorities. The interviews agreed that the percentage of applying a renewable energy concept in Malaysia was still low and economically unfeasible. All interviews agreed that the performance of building was affected by EE.

These findings agreed with [18] and [7] concluded that buildings are responsible for more than 40% of overall energy consumption. The EE of building has major influences on the performance. In Malaysia the implementing EE criteria still relatively under expected level. Design teams implementing some environment management control system such as MS1225 if were requested from the client or local authorities.

4.2 Indoor air quality (IAQ)

The second design performance variable examined was the IAQ. Nine questions were asked to determine the extent of influence of the IAQ on the DGBP. In terms of implementing level of ventilation requirement in design aspects to achieve high Air quality performance, as shown in Figure-4, the results revealed that about one third only (34.3%) agreed that minimum requirements of ventilation rate were considered high and very high to achieve IAQ performance. Others (31.4%) agreed that the consideration of implementing ventilation requirement were low. The pattern indicates that DT members were not effectively considered on the ventilation requirements.

The semi structured interviews also revealed that most DT members stated that, to achieve better IAQ they were considered space employed, building occupants and materials that free toxic chemicals into the air. Some interviews mentioned that ventilation rate requirement and process were rarely implemented during design process.

Monitoring and Controlling of carbon dioxide level in the interior space building is one of key aspects that DT should focus on during design stage. The results

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reveal that only 12.7% and 3.9% of respondents were considered as high and very high, respectively, focused on implementing a carbon dioxide control system in during their design. On the other hand, more than half 57.9% of the respondents their implementation levels were low (31.4%) and very low (26.5).

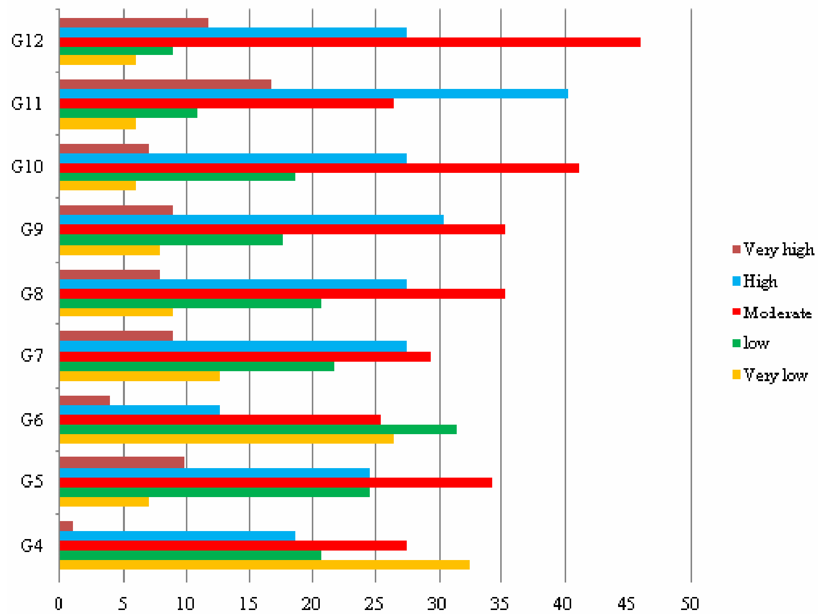

Figure-4. Performance level of IAQ.

The semi structured interviews revealed that indoor carbon dioxide concentrations can be employed to indicate specific and limited features of IAQ. There is an association between carbon dioxide control systems and ventilation system. This view was stated by [28] who mentioned that there is a relationship between carbon dioxide and outdoor air ventilation rates.

Materials selected could influence DGBP. As shown the consideration level of selecting green materials by DT is about one third 34.3%. Only 8.8% of respondents were considered Volatile Organic Compounds (VOC) during selecting building materials and 27.5% of respondents gave high consideration.

Semi-structured interviews revealed that (VOC) can be found in any indoor environment from a vast number of different sources. DT should meet minimum design requirements of IAQ which included ventilation rate in ASHRAE or local building code MS1525. Green materials are normally considered to contain less VOCs and to be healthier for human and environment. Green design teams usually pay attention for selecting suitable materials. The degree of appropriateness of selecting materials might play a major role toward enhancing GDP.

In terms of implementing extreme humidity system the results indicated that the utilization level in building projects by the respondents in their design were very high (8.8%) or high (27.5%), while 8.8% percent of projects with very low and low (20.6%) level of using humidity system. Similarly, the level of implementing control systems of thermal comfort in their design was very low and low. In addition, 7.8% and 17.6 % were considered very high level and high level of implementing thermal comfort control systems, respectively.

The semi-structured interviews revealed that thermal comfort required a comprehensive and integrated perspective that aims to the implementation of green design principles such as heating, ventilation and air conditioning. This view was stated by Sands [29] who suggested adopting strategies that minimize energy consumption of mechanical systems such as effective envelope design for natural ventilation.

The successfulness of implementing thermal comfort and extreme humidity control systems has a major influence on the building performance. This was confirmed by [30] who stated that thermal discomfort has been recognized to lead to Sick Building Syndrome symptoms. The mixture of high temperature and high relative humidity serve to decrease thermal comfort and IAQ.

Air Change Effectiveness (ACE) is the ventilation effectiveness, which is an indication to the interior airflow pattern. As shown in Figure-4 more than one third (41.2%) of the respondents were moderately considered air change effectiveness in their designs. While 27.5% and 6.90% of respondents were considered as high and very high, respectively during their designs.

In the semi- structured interviews, some of the interviewees mentioned that in order to ensure the building performance is acceptable, the design should meet a healthy indoor environment through meeting design building ventilation systems and ACE standards. This is to meet the minimum requirements specified in ASHRAE

62.1-2007, guarantee sufficient fresh air is accessible to users in the building.

In terms of implementing level day-lighting strategy during design process, result reveals that only 19.6% of respondents were adopted clear strategy for day-lighting, while more than half (53%) of the respondents were ignored implementing it. Many of the respondents (56.9%) were considered glare affects. In addition, 5.9% and 10.8% of respondents were considered very low and low level of controlling glare through their design, respectively.

In part of level of controlling internal noise, results showed that only 11.8 % of respondents agreed that implementing the noise control approaches were very high, while 27.5 % were agreed that it was high. In contrast, only 5.9% and 8.8% of respondents were agreed that noise control approaches were implemented very low and low, respectively. The rest (46.1%) of respondents were agreed that implementation of such approach is moderate.

In semi-structured interview two architects mentioned that day-lighting is a vital factor for enhancing building performance. This can be achieved by selecting right site, correct orientation, create suitable building shape, in addition to many related building performance factors, will be helpful in reducing energy consumption, heat gained to inside building, avoid discomfort of glare from natural light, user comfort and IAQ. This view was agreed by M and E interviewed engineers.

[31] agreed that using natural light and window designs will result in saving of lighting energy and a decrease in cooling energy utilization. Moreover, day-lighting improves the luminous attribute of indoor environments, improving the well being and productivity of indoor occupants. This DT should focuses on providing an effective utilization of building openings and light shades in order to get sufficient natural light.

Generally, it could be concluded that the indoor air quality criteria were insufficiently implemented during a design process. The parameters of indoor air quality obtained from the GBI rating system that is applied during design stage (where applicable), to identify the extent to which the buildings is green and suitable for measuring green design performance. IAQ could have a major influence on the building performance. DT members required to pay attention to vital elements such as air quality performance, ACE, carbon dioxide control systems, VOC, extreme humidity, thermal comfort systems, and lighting, visual and acoustic comfort.

4.3 Sustainable site and management (SM)

Consider selecting a site provided with basic requirements is essential to achieve GB. As shown in Figure-5 the results revealed that 32.4% of respondents were agreed that the high consideration level of basic services required to the site was given during site selection and 40.2 % of respondents were gave a moderately consideration. On the other hand, only 14.4 % of the respondents were agreed that the consideration was low and very low.

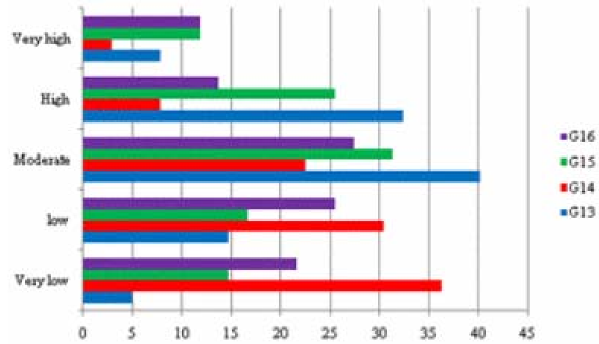

Figure-5. Performance level of sustainable site and management.

In the semi-structured review, two architects stated that mostly the site was selected by the client representatives, DT investigating site potentials to identify surrounding service available, site accessibility, good views and other function requirements. The site suitability and basic services availability have great effect on the feasibility of the project.

Considering transportation impact on environment is essential to achieve a GBP. The results reveal that 66.7% of the respondents were very low and low, respectively, considered green transportation aspects such as green vehicles priorities. Only 10.7 % of respondents were high and very high considered it in their designs.

In terms of conservation, 11.8% and 25.5% of respondents were agreed that storm water plan was very high and very high, respectively, implemented during design process. While 31.4% of respondents were agreed that implementing storm water plan was low and very low. In semi-structured interview most of the respondents were agreed that water availability in the country led to less emphasis stated on water conservation. More vegetation is necessary to avoid rain fall damage in the site. The interviewees believes that the challenge in implementing storm water plan is the feasibility of solutions, since they might design and select mechanical systems more worthy than water conservation.

Applying shades, paving materials and vegetated roofs are kind of strategies usually employed to meet solar reflection criteria. As shown in Table-3, 21.6% and 25.5% of the respondents were very low and low, respectively, implemented solar reflection index in their design. Only 11.8% and 13.7 % of the respondents were considered it as very high and high, respectively.

Although DT members believe that employing green features throughout their designs is necessary to achieve GB, the level of implementing the above mentioned aspects was low, particularly in implementing green transportation aspects.

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4.4 Green materials and resources (GMR)

Green building materials intends to reduce the negative influence of the building on the environment. The specifications of these materials and equipments could cause huge environmental influence of project performance. [32].

Implementing reused materials in buildings is one of the key factors enhancing GBP. As shown in Figure-6, almost two thirds (66.6%) of respondents were not selected recycled materials (low and very low) in their building design whereas 16.7 % of respondents were very high and high selected reused materials in their building design. The result indicates that DTs were not considered to incorporate reused materials into their designs which is affected by the availability of the reused materials, client's preferences, quality of reused materials and cost compared with other materials available.

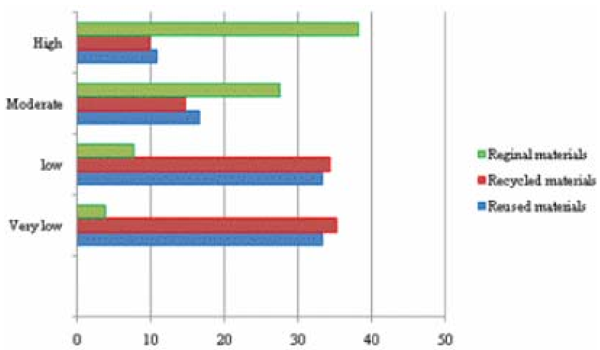

Figure-6. Performance level of green materials and resources.

In terms of selection of the level of recycled materials in their design buildings, as shown in Table-3, 69.6% of respondents were very low and low, 6.9% were used selected recycled materials, and 9.8% were high level. The result indicates that the degree of utilizing recycle materials in Malaysia is still low. This supports findings of [33] recommended that materials selection and products design must be achieved with future recycling in mind. Similarly, the results confirmed [34] who concluded that at the existing rate, material utilization and waste production is not green.

Local or regional materials are the materials that are manufactured and/or extracted within a defined radius of the building site (GBI, 2011). The result in Figure-6 reveals that the level of selecting regional materials was very high and high for 60.7% of the respondents. On the other hand, only 11.7 % of respondents were very low and low level of regional material's selection. The result indicates that almost two third of building projects in Malaysia were utilized local materials. The reminder projects, which were low, incorporated regional materials in their components. The reason might be the cost of materials were high compare to local materials or the functionality of the building required particular materials not available or the cost were compete.

In semi-structured interviews, all respondents agreed that they prefer incorporating regional materials in their design rather than imported materials, if the price and specifications were comparable. Five architects believe that till the moment the low quality of reused and recycled materials could influence building performance level. This point of view was agreed by three M and E engineers. Most of interviewees agreed that they will incorporate reused and recycled materials effectively if they found desires from the client. On the other hand, most of interviews believe that reused and recycled materials availability is the key barrier to encourage them to utilize in their projects

In general, it could be concluded that the materials and resources is an important factor influencing DGBP. The result shown in Figure-6 reveals that more than two third of respondents were not employed reused and recycled materials in their projects. On the other hand, regional materials were incorporated in more than two third of building projects in Malaysia. Materials and Resource categories in the GBI Rating system aimed at decrease the life-cycle environmental influence of materials and provide credits for material reuse, recycling and regional materials.

4.5 Water efficiency (WE)

Efficient use of water has significant influence on the overall building project performance. Water efficiency could be achieved through the employing of green building aspects [35].

The extents of rainwater harvesting consideration that lead to reduction in potable water consumption were investigated. Figure-7 implies that 13.7% and 25.5% of respondents were very high and high, respectively, considered rainwater harvesting in their project, whereas 9.8% and 20.6% of the respondents were very low and low, respectively. Results imply that only one third of projects were implemented rainwater harvesting in Malaysia. This indicated that the rainwater harvesting system in Malaysia is still not common. This result supports findings of [36] who mentioned that Malaysians are still unfamiliar with the idea of harvesting and using rainwater in building. Even though, the introduction of guidelines on the system was introduced in 1999, only a few buildings in the country implemented rainwater-harvesting system.

Recycling water is an efficient approach to achieve perfect water utilization. The degree of consideration was given to the treat and recycle waste water leading to a reduction in potable water were examined. The results revealed that more than half (54%) of respondents was not considered water treatment and recycling during their design. Almost a quarter (24.5%) of respondents was moderately considered it. In addition, 5.9% and 15.7% of respondents were very high and high, respectively, considered water treatment and recycling in their projects. The result implies that only 21.6 % of building projects in Malaysia were highly considered water treatment and recycling. This result indicates that

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the water as resource is not regarded as critical resource since the rainy season in Malaysia reveals most of the year.

The extent of consideration to reduce potable water consumption for landscape irrigation in the designed projects was examined. The result reveals that almost half (48%) of respondents was not considered reducing potable water consumption for landscape in their projects, 8.8% were considered it as very high, and 23.5%, of respondents were highly considered it. The result implies that consideration level to reduce potable water consumption in Malaysia is low. DT ignored to focus on the minimizing water conservation, since water is available in the country and the water availability was not considered as critical issue.

In semi-structured review all respondents agreed that the extent of water availability plays a major role in WE, as an influencing factor in building performance. They believed that the country is reach of water resources. Therefore, the approaches to minimize potable water and recycling water usually not asked from the client. In addition, they mentioned that the water efficiency could be achieved through effective control of water utilization by installing efficient water fittings, water meters and implementing an efficient water management system.

The result indicates that the current performance of buildings in term of water conservation and WE procedures is low. Furthermore, less consideration was given in GBI rating system to the WE compared to energy efficiency and IAQ. In GBI rating system DT has to work collectively to achieve WE in order to encourage rainwater harvesting, water recycling and minimize the landscape use of potable water supply that will lead to a reduction in potable water consumption.

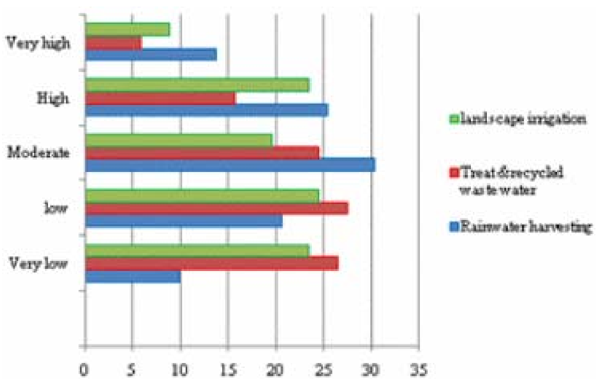

Figure-7. Performance level of water efficiency.

4.6 Environmental innovations (EI)

In the design of new buildings, the opportunity to achieve a green design should be considered from the early stage and encourage continual development by adopting innovative approaches [37]. Figure-8 showed that only 3.9% of designers were 'very high' incorporated new ideas to reduce building impact on environment in their designs and 24.5% were highly incorporated it. 29 projects were utilized moderately new ideas to decrease environmental impact of designed buildings. The rest 19.6% and 23.5% of respondents were incorporated new ideas to reduce environmental impact with very low and low average rating, respectively.

Degree of Implementing GD Initiatives (GDI) has influence on GBP. As shown in Figure-8 only 5.9% of respondents were very high implemented environmental ideas that support GBP, 18.8% were rate it as high. Almost half (47.1%) of respondents were low and very low implementation level of new ideas that enhancing GBP.

In semi-structured interviews, all architects believed that, although, the site and architectural aspects such as shape, orientation, and building envelop, still project budget that allocated by the client play a major role toward extent of green architectural innovations. On the other hand, M and E engineers mentioned that DT should be more competent to implements innovate ideas in their designs. Regarding personal initiatives most of interviewees agreed that GBD requires more initiatives from variety of DT members.

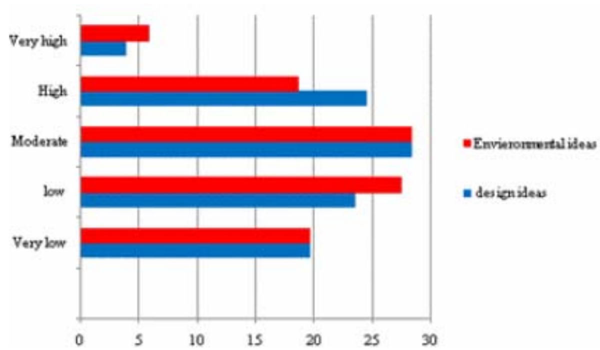

Figure-8. Performance level of environmental innovations.

The result indicates that level of implementing environmental innovations and initiatives were low in Malaysian building projects. Only about one third of building projects were moderately implemented environmental innovations and initiatives. These results agreed with Shari [16] who discovered that current initiatives performance to motivate the construction industry in Malaysia toward GB have been behind schedule.

5. CONCLUSIONS AND RECOMMENDATIONS

The core of this study is to identify performance of key design green building aspects in order to improve the overall performance level of buildings to reduce building impact on environment. To achieve this goal, the stakeholders and design team attributes are the key factors to improve green design performance. In addition, since client quality play a major role in enhancing green design performance, clients should participate effectively during design process. Therefore, effective design team attributes and client's qualities may increase performance of the design green building performance in order to enhance building performance and reduce building impact on environment.

Buildings contribute significantly to global environmental problems. Buildings in Malaysia have considerable impacts on the environment in terms of energy consumption, indoor air quality materials utilization, and water consumption .There is an urgent need to promote a wider notion of sustainability in building in order to enhance the environmental performance if this were the case, then the current Malaysian construction and building practices can be deemed as not green. Better design can reduce these impacts on the environment.

There is a lot to know about the design green buildings and there is still much study to be done, both in Malaysia and globally, on methodologies and green design development. Most design green buildings in Malaysia are considered below accepted average. Design green buildings influenced by many factors such as design teams attributes, client's qualities and governance system.

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