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Attaining Points for Certification of Green Building through Choice of Paint

Yakubu A. Dodo[a], Raja Nafida*[a], Amamata Zakari[b], Abbas S. Elnafaty[a], Bemgba B. Nyakuma[c], Faizah M. Bashir[a]

[a]Department of Architecture, Centre for the Study of Built Environment in the Malay World (KALAM) Institute for Smart, Infrastructure and Innovative construction (IS&IC) 81310 Johor, Universiti Teknologi Malaysia, Malaysia
[b]Department of Estate Management, Federal Polytechnic Bauchi, Post-office Mail Box 0231 Bauchi - Nigeria
[c]Institute of Future Energy, Centre for Hydrogen Energy, Universiti Teknologi Malaysia, 81310 Johor Bharu, Malaysia
jesz199@yahoo.co.uk

Scientists predict that anthropogenic carbon dioxide (CO_2) and other greenhouse gases (GHG) emissions will raise global temperatures by 2 °C this century. More importantly, buildings account for a significant proportion of global greenhouse gas (GHG) emissions. Therefore, the concept of green building is currently considered one of the best strategies for addressing the challenges of global climate change and energy efficiency. Green building technologies can be integrated into existing technologies to ensure substantial reductions in energy consumption and CO_2 emissions. The Malaysian Green Building Index (GBI) is a novel rating initiative designed to assess buildings using six criteria (with a total of 100 points) required to attain certification. This study presents an analytical case study of Nippon Paint in Selangor, Malaysia with a range of green products using GBI criteria for Non- Residential New Construction buildings (NRNC). The results demonstrate that by considering the choice of paint of the built form, 12 points could be earned by a building, cutting across the six criteria of the GBI rating. Therefore, the use of green materials in buildings rated under the index can contribute to substantial reductions in energy consumption and CO_2 emissions.

1. Introduction

Scientists predict that anthropogenic greenhouse gas (GHG) emissions will raise global temperatures by 2°C this century due to the effects of global warming and climate change on the environment (National Research Council, 2010). According to the United States Environmental Protection Agency (EPA) residential and commercial buildings are the 6th largest contributor of GHGs into environment (EPA, 2013). In general, the environmental burden of buildings occurs in notably through energy consumption and the emission of greenhouse gases - GHGs (Winistorfer et al., 2005).

Consequently, buildings typically accounts for nearly 20 – 40 % of the total energy consumption in advanced countries (Juan et al., 2010) and up to 80 % of total building energy consumption during its operational life cycle (Ihm et al., 2009). Furthermore, direct energy-related CO_2 emissions of the building sector are about 3 Gt/y and are projected to increase to 11.1 $GtCO_2$ emissions in 2020 and 14.3 $GtCO_2$ in 2030. However, there exists a number of accessible and cost-effective technologies that can be potentially adapted to decrease GHG emissions and improve energy efficiency in buildings. These measures for reducing greenhouse gas (GHG) emissions from buildings can be broadly categorized into three classes: reducing energy consumption in buildings, use of low-carbon fuels such as renewables, or monitoring non-CO_2 GHG emissions (Metz et al., 2007).

In addition, the use of sustainable building materials in buildings presents a viable for GHG abatement (González and Navarro, 2006). Furthermore, the application of low carbon emission techniques for energy efficiency such as: orientation, self-shading, building form, height-to-floor-area ratio and strategies of resolving effective passive ventilation and cooling has been explored (Nikpour et al., 2012). Furthermore,

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the use of specially designed paints and coatings for energy savings and GHGs emissions reductions has been reported in literature (Shen et al., 2011). Furthermore, the study by (Azemati et al., 2013) showed that the choice of paint can play improve thermal insulation and prevent waste heat thereby resulting in a 14 – 17 % decrease in overall energy consumption.

In Malaysia, Building Energy Index (BEI) ratings of 200 - 300 kWh/m^2/y have been achieved in office buildings (Mohd-Zin et al., 2011). Consequently, the integration of energy efficiency in buildings by architect at the early design stages can play a significant role in CO_2 reduction strategies (Mohd Nawi et al., 2014). This is aimed at reducing the impact of buildings on human health, safety and the environment during the building's life cycle.

The building industry is a key sector worldwide due to its role in the current economic climate. This has encouraged sector awareness and sustainable practices through energy efficiency, environmental sustainability and life cycle analysis - LCA (Aivazidou et al., 2013). Furthermore, the practice of environmental building performance assessment has emerged as a key dynamic due to the significance of buildings on environmental sustainability (Ortiz et al., 2009), GHG emission reductions and land use (Zimmermann et al., 2005). This can be achieved by employing the Green Building Index (GBI) to rate green buildings in Malaysia. According to the Malaysian Green Building Index (GBI), the integration of novel technologies into green buildings can ensure substantial reductions in energy consumption and CO_2 emissions.

However, there have been no studies on adoption and utilization of innovative paint or coating technologies on Malaysian Green Buildings as a strategy for energy savings and GHG mitigation. Therefore, this study aims to evaluate the potential energy savings attainable from green building through the choice of environmentally friendly paints. It will present an overview of the Malaysian Green Building Index (GBI) for certifying environmentally friend buildings and estimate the potential energy savings from utilizing Nippon Paint technologies.

2. Green Building Materials and Certification

Green buildings are designed and developed with greater consideration for full life-cycle compared to conventional buildings. The target is to minimise construction impacts, use less resources and safe operation aimed at ensuring waste minimisation and recycling (Spirandelli, 2008). In addition, the concept of green building focuses on increasing the efficiency of energy, water, and material utilization by reducing its impact on human health, safety and the environment.

2.1 Green Building Materials

The design and management of green buildings have a range of features in which specification of lower environmental impact building materials are inclusive with paint been one of them (Shiers, 2000), First, it reduces the ecological load and energy consumption of the chemical synthesis material. Second, it reduces the production of energy and resource consumption by recycling. Third, using natural material and low volatile organic building material may reduce the danger of synthesis material. Green Building material is a kind of building material which would not cause damage to human body.

2.2 Certification of Buildings

There are many resources available for incorporating sustainable design principles into a building life cycle. Sustainable building rating systems are used to examine the performance or expected performance of a 'whole building' and translate performance assessment into a tool that can be used to compare the building performance of other buildings or a performance standard. Over the past decade, there has been an enormous growth in building evaluation tools, programs, systems and standards focused on sustainable building and product development (Fowler and Rauch, 2006). The certification of Buildings varies from region to region and because of the varying nature of climatic condition most countries developed their own building certification system. In the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) in used, In the UK Building Research Establishment Environmental Assessment Method (BREEAM), in Singapore the Building and Construction Authority Green Mark (BCA GREEN MARK) while in Malaysia the Green Building Index (GBI) is used for rating buildings.

2.3 The Malaysian Green Building Index (GBI)

The GBI rating system was developed by the Malaysian Institute of Architects (Pertubuhan Arkitek Malaysia, PAM) in collaboration with the Association of Consulting Engineers Malaysia (ACEM) (Lee 2009). The system aims to promote sustainability and environmentally friendly practices among stakeholders in the Malaysian property industry (Habibullah et al., 2012). The GBI is six criteria rating system based on existing rating tools derived from the Green Mark Singapore and the Australian Green

Star system. This has been achieved by considering the tropical weather, environmental context and social needs of Malaysia. Hence, the GBI is Malaysia's first comprehensive rating system for evaluating the environmental design and performance of Malaysian buildings (Yusoff and Wen, 2014). It is based on the six main criteria namely: (i) Energy Efficiency (EE), (ii) Indoor Environmental Quality (EQ), (iii) Sustainable Site Planning and Management (SM), (iv) Material and Resources (MR), (v) Water Efficiency (WE) and (vi) Innovation (IN) (GBI, 2009) as shown in Table 1 each criterion is awarded points with energy efficiency having the maximum points of 35 and innovation 7 for GBI point allocation chart for Non-Residential New Construction (NRNC). In the GBI rating system the rating is divided into Platinum with 86 points and above; Gold 76 – 85 points; silver 66 – 75 and certified scores ranging from 50 - 66 as shown in Table 2.

Table 1: GBI point allocation chart for Non-Residential New Construction (NRNC)

Part	Item	Symbol	Maximum Point
1	Energy Efficiency	EE	35
2	Indoor Environmental Quality	IEQ	21
3	Sustainable Site Planning &Management	SM	16
4	Material & Resources	MR	11
5	Water Efficiency	WE	10
6	Innovation	IN	7
	Total Score		100

Source: Green Building Index (GBI) Malaysia 2009

Table 2: Green Building Index Classification

	Points	GBI Ratings
1	86+ Points	Platinum
2	76 to 85 Points	Gold
3	66 to 75 Points	Silver
4	50 to 65 Points	Certified

Source: Green Building Index (GBI) Malaysia 2009

Nippon Paint was established in 1881 as a pioneer in Japan's paint industry. The Malaysia office was incorporated on 21 December, 1967. Today, Nippon Paint is equated with high quality and innovative product breakthroughs, making it the number one paint brand in the Asia Pacific region. Over the years, Nippon Paint has perfected its products using advanced paint technologies with emphasis on innovation and eco-friendliness. Its products are developed with emphasis on environmental friendliness and low pollutant emissions such as volatile organic compounds (VOC). Furthermore, Nippon Paint creates highly functional products and systems that keep bacteria and paint odour at bay and reduce the number of coating processes to save energy. By incorporating advanced paint technologies, Nippon range of high-end textures for exteriors and interiors can last for more than a decade. Formulated with the wellness of the environment and users health in mind, the Nippon Paint Green Choice Series consist of water-based, non-added lead and mercury as well as near-zero VOC coatings. It has the following features; Environmental-friendly, Breathability, Heat Reduction, Bacteria Resistant and Durability (Nippon Paint, 2015a).

3. Methodology

The methodology involved a 3 stage an analytical case study of the range of green products of Nippon Paint in Selangor, Malaysia and using GBI criteria for Non- Residential New buildings (NRNC). Firstly, a critical review on the GBI rating system was carried out to highlight the areas that require the use of the Nippon green choice products. Next, an assessment of Nippon Paints was carried out to determine functional benefits of the products for green certification. Lastly, an evaluation of the products was carried out using the six main GBI criteria to understand what points could be earned. The first stage of the method also involved a visit to the Nippon factory in Shah Alam, Selangor where various process of making different types of paint were documented through lecture series delivered by various experts at Nippon Paint 4. Nippon Paint Analysis

The results demonstrate that by considering the choice of paint of the built form, a total of 12 points could he results demonstrate that by considering the choice of paint of the built form, a total of 12 points could be earned from a maximum of 100 points as calculated from the total score of GBI rating index. Sections 4.1-4.3 present an overview of the selected paints evaluated using the six criteria of Malaysian GBI rating index. In the NRNC only four criteria out of six criteria point have the tendency for attaining certification points; EE, EQ, SM, and MR while points could not earned from the criteria Water efficiency (WE) and innovation IN as shown in figure 3. The figure shows only sub criteria from the main criteria that possible paint points could be earned.

PART	CRITERIA	ITEM	GBI POINT	TOTAL	PAINT POINT
1	EE	ENERGY EFFICIENCY			
	Design				
	EE1	Minimum EE Performance	1		1
	Verification & Maintenance				
	EE8	EE Verification	2		
	EE9	Sustainable Maintenance	3		3
				35	
2	EQ	INDOOR ENVIRONMENTAL QUALITY			
	Air Quality				
	EQ1	Minimum IAQ Performance	1		1
	EQ4	Indoor Air Pollutants	2		2
	EQ5	Mould Prevention	1		1
				21	
3	SM	SUSTAINABLE SITE PLANNING & MANAGEMENT			
	Design				
	SM12	Greenery & Roof	2		2
				16	
4	MR	MATERIALS & RESOURCES			
	Reused & Recycled Materials				
	MR2	Recycled content materials	2		1
		Sustainable Resources			
	MR3	Regional Materials	2		2
				11	
5	WE	WATER EFFICIENCY			
					0
				10	0
6	IN	INNOVATION			
				7	0
				100	12

Figure 3: Possible paint points that can be achieved using Nippon paints from NRNC Green Building Index Assessment Criteria Score Summary (modified from GBI 2009)

4.1 Nippon Insulcoat WB100

This is a water based wall coating formulated from elastomeric styrene based polymers for exterior thermal insulated applications. It is specifically formulated to retard heat flow while simultaneously permitting flexibility to hairline cracks. It is recommended for use as an intermediate coat before the application of exterior masonry walls, concrete slab roof tiles, brick works, and hard or soft boards. With Nippon insulcoat WB100, an approximate reduction of 2 °C is achievable in coherent with the rise of temperature throughout the day. This yields 3 points in GBI EE9 (sustainable maintenance) and SM12 (greenery and roof) (Nippon Paint, 2015b).

4.2 Nippon Fibrecote

It is an acrylic water based paint with no added lead and mercury specially formulated for fibre cement surfaces giving it a natural wood appearance. This product has good surface adhesion and high resistance to weathering and microbial attack from fungi and algae. It is well suited for the decoration and protection of both the indoor and outdoor used for fibre cement and composite board. It can also be used for bare cement and brick surfaces to prevent water penetration. It is a “Breathable” paint film with UV and weather resistance Anti-fungus properties for interior and exterior environments. This paint could be used to achieve 1 point for GBI EQ1 (Minimum Indoor Air Quality Performance) points and 2 points for EQ4 (Indoor Air Pollutants) (Nippon Paint, 2015c).

4.3 Nippon Water Repellent Solution

This is a solvent-based clear coating based on silane/siloxane mixture. It is used as a high quality clear coat for exterior or interior concrete protection and impregnating masonry substrates. It reduces the capillary water absorption of water based salts without blocking their pores and capillaries without affecting diffusion permeability. Consequently, water vapour can be released unhindered from the masonry, drying damps in the process (Nippon Paint, 2015c).

4.4 Possible Certification Points from Paint Choice

As can be observed in Table 3, a total of 12 points can be earned from 4 of GBI index criteria namely; Energy Efficiency – EE; Indoor Environmental Quality – EQ; Sustainable Site Planning and Management - SM and Materials and Resources - MR. By applying the selected Nippon paints, 1 point can be achieved from MR2 (Recycled content materials) as well as EQ5 (Mould Prevention) while the entire painting solution which is manufactured in Malaysia would equally earn 2 points from MR3 (Regional Materials) materials around Malaysia. Overall a total of 12 points can be achieved from GBI by integrating novel paint technologies or coatings to Green Buildings in Malaysia. A summary of Green Building Index, assessment criteria, and score summary for the Nippon Paints evaluated in this study is presented in Table 3.

Table 3.Green Building Index Assessment Criteria Score Summary for Paint

Part	Criteria	Item	GBI Point	Nippon insulcoat WB100	Nippon Fibrecote	Nippon water repellent solution	Possible Paint Points
	Verification & Maintenance						
EE	EE9	Sustainable Maintenance		2		1	3
	Air Quality						
EQ	EQ1	Minimum IAQ Performance			1		1
	EQ4	Indoor Air Pollutants			2		2
	EQ5	Mould Prevention					1
	Design						
SM	SM12	Greenery & Roof		1		1	2
	Reused & Recycled Materials						
MR	MR2	Recycled content materials				1	1
	Sustainable Resources						
	MR3	Regional Materials				2	2
	Total		100				12

In general, the use of green materials such as paints in buildings rated under the index can contribute to reductions in energy consumption and CO_2 emissions. In addition, the practice of recycling paints and waste products at Nippon presents significant reduction in embodied energy or the total amount of energy required for manufacturing the product. For years environmental advocates have been promoting the recycling of various domestic and industrial waste to reduce waste accumulation, GHGs emissions and energy consumption. All of these benefits hold true for recycled paint which is one of the practice of Nippon paints.

5. Conclusions

The paper presents an analytical case study of a selected range of green products from Nippon Paint in Selangor, Malaysia using GBI criteria for Non- Residential New Construction buildings (NRNC). The Malaysian Green Building Index (GBI) is a novel rating initiative designed to assess buildings using six criteria (with a total of 100 points) required to attain certification. The results demonstrate that by considering the choice of paint of the built form, a total of 12 points can be earned by a building, cutting across the six criteria of the GBI rating.

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