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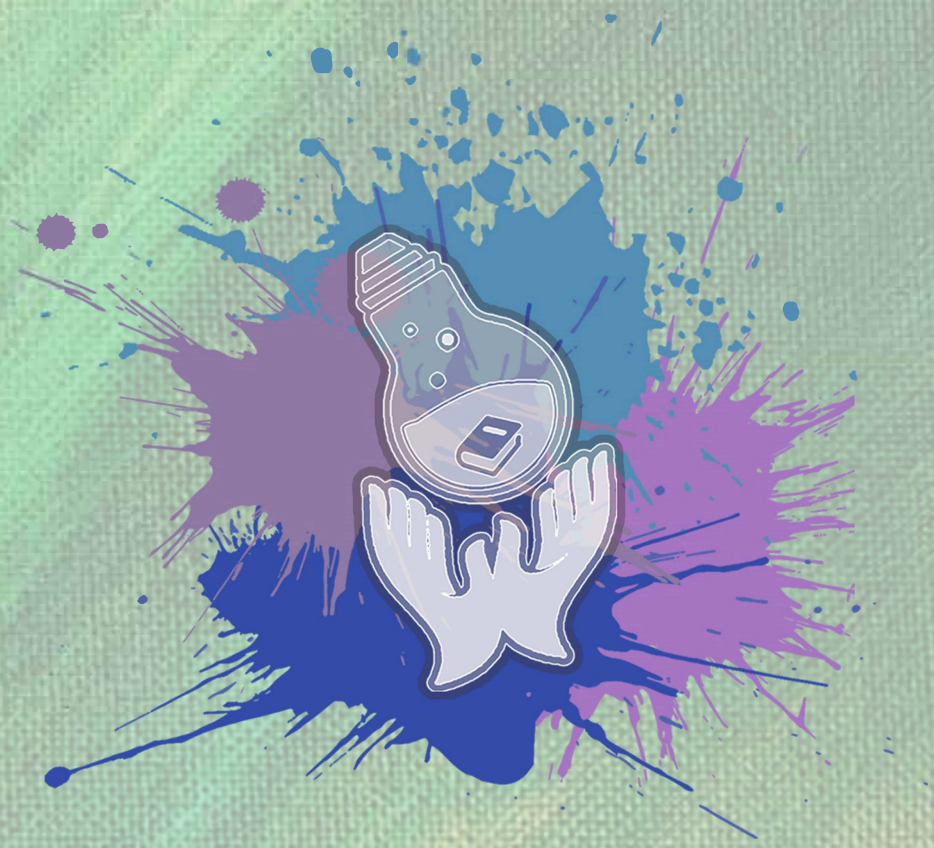

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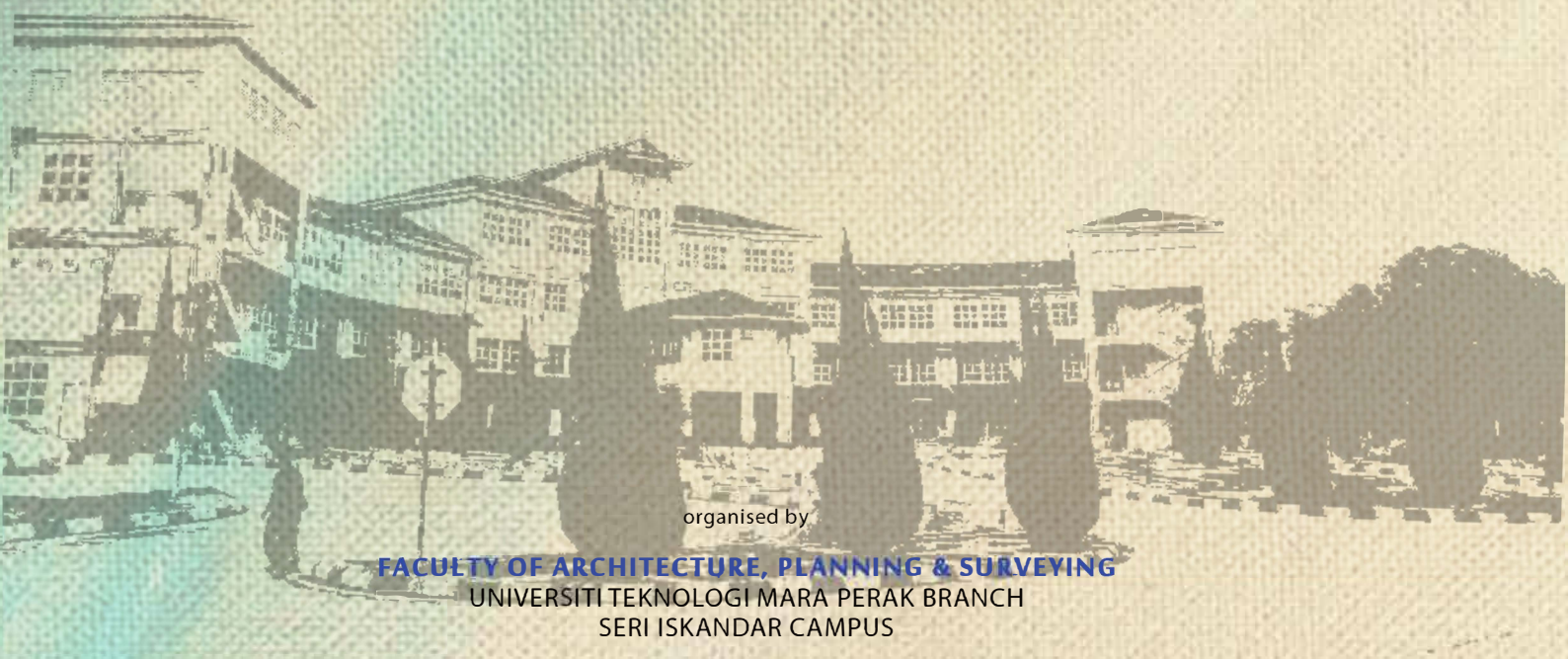

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RETROFITTING MODEL FOR EXISTING HOSPITAL BUILDING TO IMPROVE ENERGY EFFICIENCY TOWARDS SUSTAINABILITY

Aisah Rustan[1], Horace Mui K.W[2], Zainal Abidin Akasah[3] & Nik Mohd Zaini[4]
[1 3 4] Department of Architectural and Design Engineering, Faculty of Civil and Environmental Engineering, Universiti Tun Hussein Onn Malaysia, 86400, Johor
[2] Dept. Of Building Services Engineering. PolyU Hong Kong
Email: ashrstn@gmail.com[1], zainal59@uthm.edu.my[3]

Abstract:
The construction industry is crucial to the Malaysian economy and its growth. Retrofitting such of existing buildings presents can gives the largest potential for the incorporation of renewable energy technologies and energy efficiency measures into buildings. The main purpose of this study is to identify the problem of energy efficiency towards green building sustainability and to analyse the problem that is causing the inefficiency and to develop the retrofitting models to improve the energy efficient for selected existing hospital buildings. In order to carry out this research, a comprehensive literature review was done to gather the information and to help in designing the research questionnaire that will be conducted at Sultanah Nora Ismail Hospital building in identifying the potential improvement. The essential elements in GBI from all aspects under energy efficiency need to be emphasized in order to recognise sustainable buildings.

Keywords:
Retrofitting; hospital building; energy efficiency

1.0 INTRODUCTION

Under Conference of Parties Malaysia, former Malaysian prime minister stated on adopting an indicator of voluntary reduction of up to 40% in terms of emissions intensity of GDP (gross domestic product) by the year of 2020. According to Saidur, et.al. (2010), energy use in commercial and residential buildings has steadily increased by between 20% and 40% for the last decade in developed countries. Besides, according to (CIDB Malaysia, 2015), Malaysia required more on energy-efficient and higher quality buildings, infrastructure and cities under CITP in (2016 – 2020), the large amounts of energy consumption for commercial buildings are hospitals and they utilise high energy levels through air conditioning systems, lighting, medical and office equipment. By improving energy efficiency in buildings can reduce carbon dioxide (CO2) emission and the most cost effective measured (Moghimi *et al.*, 2014; Radwan *et al.*, 2016). This study was conducted to identify the problem of energy efficiency that Sultanah Nora Ismail Hospital have and which building has the potential in retrofitting in order to improve the energy efficiency towards sustainability in the building.

2.0 LITERATURE REVIEW

In Malaysia, evaluation of the environmental design and performance of Malaysian buildings are based on six criteria. Each of these criteria will contribute different points to receive a green building rating. Retrofitting is where a process of mounting something and making changes to internal system inside the building after the building completely build to allow significant reductions in energy and their usage. Sultanah Nora Ismail Hospital (HSNI), as one of the public government hospitals has the potential in retrofitting to reduce electricity consumption since hospital operate 24/7 a year and due to the importance of some equipment, they must be supplied with electricity all the time.

2.1 Energy Efficiency in Hospital Building

Factors affecting the building's energy consumption can be divided into two categories, they are, non-design factors and passive design factors. The number of energies used will be affected by the number of people, since the higher number of people will have high energy demand. Energy consumption larger

challenges that architects and engineers are faced with in building design process and the hospitals building utilize high energy levels through air conditioning systems, lighting, medical and office equipment, and so on due to the 24/7 energy uses.

2.2 Concept of Retrofitting

According to (Yasin *et al.*, 2017), retrofitting is improving the performance of the existing buildings and it is one way to remodel or to modify an existing building towards green building to reduces carbon footprint to environment. A sustainable retrofit can consist of several phases and each of the phases start with setting a retrofit scope then setting up he vision for design purposes. Afterwards, several alternatives are developed to settled up the strategy of retrofit.

3.0 METHODOLOGY

In this research, a questionnaire related to the research title of retrofitting to meet the energy efficiency in order to improve towards sustainability will be developed. Quantitative research will be used, and respondent will answer the provided questionnaire by using Likert scale to justify their selected agreement. Sample size are determined based on population and a background of academic and non-academic will be selected respondent. The questionnaire is divided into three section that consist of section A, B and C to know in detail regarding the study issues and to achieve the study objectives. A pilot study will be used as a standard tool to validate the questionnaire by the experts before distributing it. The number of populations targeted for the questionnaire depends on the sample size of the HSNI. To analyse the data collection, an average index analysis will used as a formula to calculate information after the questionnaire survey finished.

4.0 ANALYSIS AND FINDINGS

A research-based energy efficiency on an existing hospital building in Malaysia was stated as below. TNB (Tenaga Nasional Berhad) were the main source supplier of energy in the hospital building.

Table 1 : Electricity consumption based on their section on an existing hospital building in Malaysia

Sections	**Consumption (kW)**			**Percentage of total (%)**	
Air conditioning	Main central system, (chillers, pumps, mini chillers)	19,323,977	25,663,203	46.7	62.0
	AHU	3,361,624		8.1	
	CHU	621,842		1.5	
	Split unit	1,172,791		2.8	
	Ceiling fans	30,660		0.1	
	Exhaust fans	1,152,309		2.8	
Lifts	552,664				1.3
Lighting	8,513,900				20.6
Equipment and others	6,649,345				16.1
Total	41,379,113				100

Source: Moghimi et al. (2014).

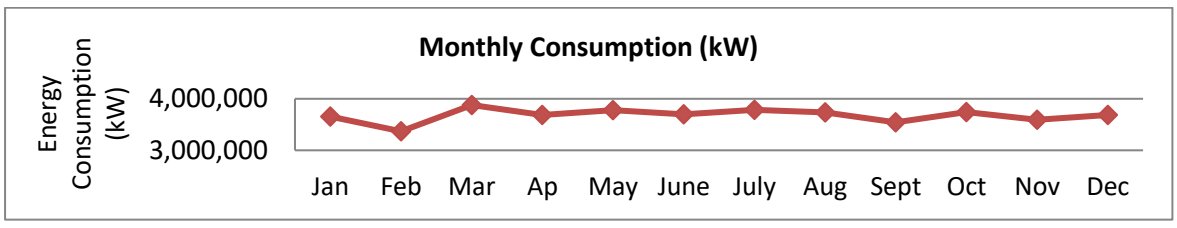

Figure 1: Annual electricity consumption over 3 year from 2009 – 2011
Source: (Moghimi et al., 2014)

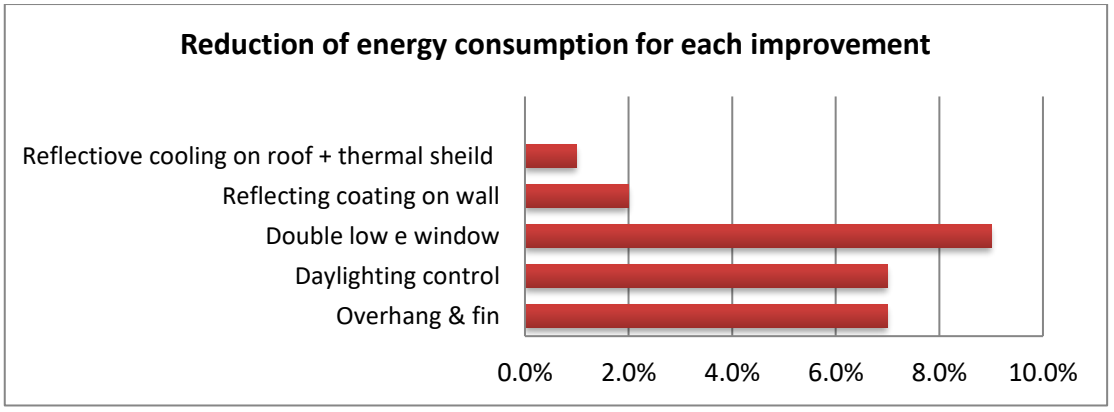

Figure 2: Reduction of energy consumption of each improvement method
Source: (Imran, 2011)

Table 1 and figure 1 shows the annual energy consumption based on literature review of (Moghimi *et al.*, 2014), it was calculated based on 31 days. The monthly electricity usage is almost the same throughout the year. Nevertheless, March has the highest electricity consumption and February has the lowest, due to the minimal difference in seasonal cooling demand. Table 1 shows the electricity consumption based on their section and the highest consumption is air conditioning with 62%. Figure 4.3 shows energy reduction for each improvement and how they compare to double low e glazing high performance. High performance was observed when using double low e glazing where more than 9% of energy reduction could be achieved with this option alone.

5.0 CONCLUSION

Due to the importance of energy efficiency, this study was carried out on existing hospital in Malaysia. Besides, existing building are a type of high energy consuming building and need energy efficiency improvement which this issue is included on one of the CITP thrust in year of 2016 – 2020. Furthermore, a better understanding towards of each element and criteria on what caused the inefficiency of energy efficient design to a building and advancement of knowledge on how to meet the compliance to environmental sustainability are very important to people nowadays. At the end of this research study, hopefully a proposed model of retrofitting on existing hospital building will be develop and used by contractors for further development.

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