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**THE STUDY OF INDOOR ENVIRONMENTAL PERFORMANCE ON LOW
COST HOUSING PROJECT OF FAST TRACK WALL SYSTEM**

WONG CHIN LIANG

**A report submitted in partial fulfillment of the
Requirements for the award of the degree of
Bachelor of Civil Engineering**

**Faculty of Civil Engineering
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MAY 2009

I declare that this thesis entitled “**The Study of Indoor Environment Performances On Low Cost Housing Project of Fast Track Wall System**” is the result of my research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Date : **04 MAY 2009**

Dedicated specially

To my beloved Father, Mother and Siblings

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ABSTRACT

According to the population statistics from the Department of Statistics Malaysia 2007, the Malaysian population is 27,170,000 and 3.6 percent of the overall population is in the lower income group. To meet housing needs and improve urban services, the government will build approximately 43,800 units of low-cost houses through the "Program Perumahan Rakyat Malaysia" in the Ninth Malaysia Plan (2006 – 2010). The Malaysian government will ensure that all low-income groups living in good and healthy indoor environmental conditions in low-cost housing. Therefore, a new technology construction such as the Fast Track Wall (FTW) System can be used to build low-cost houses with less construction duration, labour cost, and management cost. The aim of the study is to investigate the indoor environmental performance of low-cost housing projects using the new technology of the FTW System towards sustainable construction. In-situ measurements were conducted to identify the elements of indoor environmental performance of the FTW system low-cost house at Kesang Laut, Muar, Johor. A comparison method was also made to a low-cost house constructed with conventional construction located nearby the FTW system low-cost house. The results of the study will be compared in terms of their indoor environmental performances in August (Dry season) and December (Northeast Monsoon season). In conclusion, the results from the comparison of both low-cost houses may contribute to the suitable extension of FTW system buildability in future construction. Recommendations of sustainability elements expected can be made to improve FTW system houses.

ABSTRAK

Berdasarkan kepada maklumat statistik populasi daripada Jabatan Statistik Malaysia 2007, populasi rakyat Malaysia adalah 27,170,000 dan 3.6 peratus adalah golongan berpendapatan rendah. Memandangkan peningkatan keperluan isi rumah, kerajaan merancang untuk membina sejumlah 43,800 unit rumah kos rendah melalui “Program Perumahan Rakyat Malaysia” dalam Rancangan Malaysia ke-9. Kerajaan Malaysia telah menetapkan bahawa setiap rumah kos rendah yang dibina dapat memberi kualiti persekitaran dalaman yang baik kepada penghuninya. Maka, Universiti Teknologi Malaysia dengan inisiatifnya telah memperkenalkan satu pembaharuan teknologi pembinaan melalui sistem “Fast Track Wall”. Sistem ini berjaya menghasilkan rumah kos rendah yang mana dapat mengurangkan kos tempoh pembinaan, kos tenaga kerja dan kos pengurusan. Matlamat kajian ini adalah menentukan kualiti persekitaran dalaman rumah kos rendah sistem “Fast Track Wall” ke arah pembangunan mampan. Kajian ini dilakukan melalui pengukuran in-situ persekitaran dalaman rumah kos rendah sistem “Fast Track Wall” di Kesang Laut, Muar, Johor. Satu kaedah perbandingan dijalankan untuk membandingkan kaedah tradisional pembinaan rumah kos rendah yang dibinakan berhampiran dengan rumah kos rendah sistem “Fast Track Wall”. Maklumat daripada kajian ini, dibandingkan dari segi kualiti persekitaran dalaman pada musim kering iaitu pada bulan Ogos dan musim peralihan monsun iaitu pada bulan Disember 2008. Kesimpulannya, hasil kajian dari kedua-dua rumah kos rendah ini akan menyumbang kepada pasaran yang luas penggunaan sistem “Fast Track Wall” dalam industri pembinaan di Malaysia. Cadangan pembaikan yang difikirkan perlu bagi meningkatkan unsur mampan dalam pembinaan rumah sistem “Fast Track Wall” ini dicadangkan dalam kajian ini.

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LIST OF ABBREVIATIONS

$\mu\text{g}/\text{m}^3$	-	microgram per meter cube
9MP	-	Ninth Malaysia Plan
API	-	Air Pollution Index
BRI	-	Building Related Illness
C	-	Carbon
CH_4	-	Methane
CIB	-	Agenda 21 of Sustainable Construction
CO	-	Carbon Monoxide
CO_2	-	Carbon Dioxide
DoE	-	Department of Environment
EPA	-	Environmental Protection Agency
FTW	-	Fast Track Wall system
Ha	-	Hectares
HCl	-	Hydrogen Chloride
HNO_3	-	Acid Nitric
IAQ	-	Indoor Air Quality
IEP	-	Indoor Environmental Performance
mg	-	milligram
mg/m^3	-	Milligram per meter cube
NH_3	-	Ammonia
NMHC	-	Nonmethane hydrocarbons
NO	-	Nitrogen Oxides
NO_2	-	Nitrogen Dioxide
O_3	-	Ozone
OSHA	-	Occupational Safety and Health Association
PAN	-	Peroxyacetyl Nitrate

PBR	-	Program Bantuan Rumah
PM10	-	Particulate Matter
ppm	-	parts per million
PPR	-	Program Perumahan Rakyat
RH	-	Relative Humidity
RMAQG	-	Recommended Malaysia Air Quality Guideline
SBS	-	Sick Building Syndrome
SIAQG	-	Singapore Indoor Air Quality Guideline
SO ₃	-	Sulfur Trioxide
SO _x	-	Sulfur oxide
SPM	-	Suspended Particulate Materials
TSP	-	Total Suspended Particulate
UTM	-	University of Technology Malaysia
WHO	-	World Health Organisation

CHAPTER 1

BACKGROUND AND INTRODUCTION

1.1 Background of Research

The world's economic and technology changes continue to grow creating an increased need for more houses and buildings. The proportion of urban population to total population in Malaysian has risen steadily with 26% in 1965 to 70% by 2020 (Noor Yasmin, 2004). According the population statistics from Department of Statistics Malaysia 2007, Malaysian population is 27,170,000 and there was 3.6 percent of overall is lower income group. Therefore, Malaysian Government will continue to ensure sufficient quality and affordable housing for those in the lower income group. According the Ninth Malaysia Plan (9MP 2006-2010) Housing Needs and Improving Urban Services Meeting, the government will build approximately 43,800 units of low cost house through Program Perumahan Rakyat Malaysia.

The Budget 2009 Speech by our Prime Minister and Minister of Finance, during the period 2004 to 2008, more than 100,000 units of low cost houses have been built by various agencies nationwide. In 2009, an allocation of RM330 million is provided to Jabatan Perumahan Negara to complete 4,400 units of Program

Perumahan Rakyat (PPR) Disewa, 1,500 units of PPR Bersepadu and 600 units of PPR Dimiliki. In addition, Syarikat Perumahan Negara Berhad will build 33,000 low cost houses.

Due to the needs of sufficient quality of low cost house, Malaysian Government adopts the “Sustainable Concept” through the construction industry in order to maintain the healthy and comfort living houses. Sustainable building is essentially in providing design and construction methods and materials that are resource efficient and there will not compromise the health of the environment or the associated health and well-being of the building’s occupants and in the same time sustaining global issue of human health for future generations.

In brief, a number of strategies and policies had been arises in order to achieve the sustainable construction which can be defined as the way of creation responsibilities management in order to achieve healthy built environment. By understanding this, it is the goal of the sustainability to reduce the use of resources and works toward the ultimate goal for sustainable construction. Therefore, the technology that purpose to sustain is vital to be applied in construction industry. Such as the new construction technology Fast Track Wall (FTW) system are developed using materials that will help to reduce the wastages in the construction industry by minimising the conventional usage of timber. FTW system can be used for build low cost houses in Malaysia with less construction duration and less management cost. FTW system is a formwork system using a panel of plastic material. It can help to produce smooth wall finish; hence, no plastering is required. Besides, FTW system has led to an improving quality and strength in the construction industry. It is can also take lateral force such as high velocity of wind and earthquake. Thus, that is a technology has been applied to the five units of low cost houses in Muar, Johor under Ministry of Rural and Regional Development, built by Universiti Teknologi Malaysia (UTM).

According to the CIB Agenda 21 Report (1999), sustainable development for building should be defined in such a way that a quality indoor environment is a primary component. During this same period, indoor air quality has declined because of energy conservation, decreased ventilation and the introduction of many new materials and sources of indoor pollution (Leong Siew Meng, 2007). Many people around the world have become aware that producing healthy is dependent on a good indoor environment. An important dimension in the application of sustainable development principles to the building sector is that which concerns health risks as they relate to the occupation of buildings.

Indoor Environment Performance (IEP) has become more important for health and comfort during recent years. CIB Agenda 21 Report by Luc Bourdeau (1999) stated that people remain indoors for approximately 90% of the time, the quality of indoor air is even more important for health than outdoor air. Airborne pollutants are present all the time and everywhere in the form of gases, odors, and particulate matter. In developed countries, an average working person spends over 90% of his or her lifetime indoors (Yuanhui Zhang, 2005). Indoor Environment Performance is influenced simultaneously by several factors in terms of temperature, ventilation, humidity, noise quality and air qualities such as Nitrogen Dioxide (NO₂), Sulfur Trioxide (SO₃), Acid Nitric (HNO₃), Carbon Monoxide (CO), and Ozone (O₃).

Health effects due to interior Indoor Environment Quality are of profound societal importance factor behind the high prevalence of airways infections especially among children and of lung cancer (Luc Bourdeau, 1999). The complexity of a real environment makes it very difficult to evaluate a single parameter on human performance and environmental condition (Leong Siew Meng, 2007).

1.2 Problem Statement

Since Industrial Revolution, our country has witness incalculable technologies achievement, population growth steadily and corresponding increase in resource use. Developing countries have learned that the housing provision cannot be left to the influence of market force alone. After the Seventh Malaysia Plan (1996-2000) and Eight Malaysian Plan (2001-2005), Malaysian Government still continue to ensure the adequate, affordable and sufficient quality housing for all Malaysian in the lower income group under the Ninth Malaysian Plan (2006-2010). During the Ninth Malaysian Plan period, continuous efforts will be undertaken to ensure that Malaysians of all income levels will have access to adequate, quality and affordable homes, particularly the low-income group.

The Malaysian Government is concentrating in providing solution for the indoor environmental quality housing for all low income groups. Equally important is the value of good housing to the well being of the community, in terms of good health, good social environment and environmental performances. Nevertheless, the indoor environment quality of low cost housing is not always given concern by the developer to the poor design or construction. Poor indoor environment quality may caused the house often fail to meet the human satisfaction in terms of indoor air quality, thermal comfort and noise quality (Asif, 2006).

Thus, that is a need to help in reducing the internal effecton of indoor environmental quality of low cost house by speed up and improve the construction, materials and technology. Hence, Fast Track Wall (FTW) system is a new construction technology has been applied on low cost housing project accordance to “Program Bantuan Rumah (PBR)” for lower income group under Ministry of Rural and Regional Development Malaysia. This new construction technology can be used to solve the design problems in making good performance of Indoor Environment Quality on low cost housing construction. So far, this new construction technology of Fast Track Wall system that has been applied to the five units of low cost houses in

Muar, Johor, built by Universiti Teknologi Malaysia. Therefore, this study will identify the elements of Indoor Environment Performance on this new construction technology of Fast Track Wall system shall be continuous use in the future generation building construction in Malaysia.

1.3 Aim of Research

The aim of this study is to investigate the indoor environmental performance on low cost housing project of new construction technology of Fast Track Wall (FTW) system towards a sustainable construction industry.

1.4 Objective of the Research

The objectives for this case study are stated as follow:

- (i) To identify elements of indoor environment performance.
- (ii) To measure healthy and comfort indoor environmental elements on low cost housing specific to fast wall track system.
- (iii) To determine the indoor environmental performance and conditions on low cost housing of fast track wall system.

1.5 Scope of Research

The study will measure the indoor environmental performance in low cost housing project of fast wall track system in Muar, Johor as a case study. The results will be compared to conventional low cost housing which has been develop with cement bricks.

1.6 Expected Findings

- (i) Fast track wall (FTW) system house is expected providing significant level of comfort in indoor environmental performance than others conventional construction system.
- (ii) Result from the comparison may contribute the suitable extension of fast track wall buildability.
- (iii) The suitable recommendation of sustainability elements expected can be made to improve Fast Track Wall (FTW) system house.