UNIVERSITI PUTRA MALAYSIA

BUILDING MAINTENANCE PROBLEMS IN INDUSTRIALISED BUILDING SYSTEM AND CONVENTIONAL CONSTRUCTED BUILDING IN STUDENT ACCOMODATION IN A MALAYSIAN PUBLIC UNIVERSITY

AHMAD HAFIZD BIN HITAM

FRSB 2015 10

BUILDING MAINTENANCE PROBLEMS IN INDUSTRIALISED BUILDING SYSTEM AND CONVENTIONAL CONSTRUCTED BUILDING IN STUDENT ACCOMODATION IN A MALAYSIAN PUBLIC UNIVERSITY

By

AHMAD HAFIZD BIN HITAM

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

December 2015

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

BUILDING MAINTENANCE PROBLEMS IN INDUSTRIALISED BUILDING SYSTEM AND CONVENTIONAL CONSTRUCTED BUILDING IN STUDENT ACCOMODATION IN A MALAYSIAN PUBLIC UNIVERSITY

By

AHMAD HAFIZD BIN HITAM

December 2015

Chair: Zaiton Ali, PhD
Faculty: Design and Architecture

Building maintenance is now associated with investment return and value of the building itself. The larger the capital needed to construct a building, the greater return is expected. Maintenance costs of a building over its lifespan can cope with the cost of construction for a new building. Therefore, the maintenance is a very important aspect that needs attention and focus as early as its planning stage. Decision making at the level of planning, design and construction methods will have effect on the costs and maintenance works for the building lifespan. The main goal of maintenance is to reduce and minimize the failures and defects of the elements and building equipment effectively and systematically. Indirectly, all aspects of safety and comfort will be guaranteed not only to consumers but also to the owners and organizations. The method of construction and materials used are able to avoid the cost of periodic maintenance especially in a long term period.

One of the contemporary debated methods is an integrated construction, known as the Industrialized Building System (IBS). This study is carried out to identify the maintenance activities that occurred to buildings constructed with different methods, which is IBS and conventional delivery. Therefore two buildings were selected as the case studies for this research, namely Thirteenth College representing IBS construction, while Kolej Pendeta Za'ba as a conventional method of construction.

The scope maintenance activities investigated includes structural defects, design defects, construction defects, internal fixtures, electrical installation, plumbing and drainage system. This study used survey and interview methods for data collection. A total of 150 questionnaires were distributed to the residents of each college. The questionnaires were distributed to the students of each building in order to get the overall perception regarding the maintenance activities, whereas the interviews were conducted among the industry practitioner in order to get the professional point of view regarding the subject matter. For data analysis, this research used descriptive analysis and Independent Samples T-Test to evaluate which building system is more efficient in tackling the maintenance problems. The results showed that defects

in the building do occur at each building and there are no significance differences between the two. In conclusion, the selection method of construction of a building either IBS or even conventional does not affect the defects of the building.

The findings from this research may benefit to government agencies, constructions player and future researchers on development of the residents building in order to minimize the maintenance activities.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

MASALAH PENYELENGGARAAN BANGUNAN BAGI SISTEM BINAAN BERSEPADU (IBS) DAN KAEDAH PEMBINAAN KONVENSIONAL DI BANGUNAN PENGINAPAN PELAJAR DI UNIVERSITI AWAM MALAYSIA

Oleh

AHMAD HAFIZD BIN HITAM

Disember 2015

Pengerusi: Zaiton Ali, PhD
Fakulti: Rekabentuk dan Senibina

Penyelenggaraan bangunan kini dikaitkan dengan pulangan pelaburan dan nilai bangunan itu sendiri. Semakin besar modal yang diperlukan untuk membina bangunan, pulangan yang lebih besar dijangka. Kos penyelenggaraan bangunan lebih jangka hayatnya dapat menampung kos pembinaan untuk bangunan baru. Oleh itu, penyelenggaraan adalah aspek yang sangat penting yang memerlukan perhatian dan tumpuan seawal peringkat perancangan. Membuat keputusan di peringkat perancangan, rekabentuk dan kaedah pembinaan akan mempunyai kesan ke atas kos penyelenggaraan dan kerja-kerja untuk jangka hayat bangunan. Matlamat utama penyelenggaraan adalah untuk mengurangkan dan meminimumkan kegagalan dan kecacatan elemen bangunan dan peralatan yang berkesan dan sistematik. Secara tidak langsung, semua aspek keselamatan dan keselesaan akan dijamin bukan sahaja kepada pengguna tetapi juga untuk pemilik dan organisasi. Kaedah pembinaan dan bahan yang digunakan dapat mengelakkan kos penyelenggaraan berkala terutamanya dalamj angka masa yang panjang.

Salah satu kaedah kontemporari yang dibahaskan adalah pembinaan bersepadu, yang dikenali sebagai Sistem Bangunan Perindustrian (IBS). Kajian ini dijalankan untuk mengenal pasti aktiviti-aktiviti penyelenggaraan yang berlaku kepada bangunan yang dibina dengan kaedah yang berbeza, iaitu IBS dan pembinaan konvensional. Oleh itu dua bangunan telah dipilih sebagai kajian kes untuk kajian ini, iaitu Kolej Tiga Belas mewakili bangunan yang menggunakan system IBS, manakala Kolej Pendeta Za'ba sebagai bangunan yang dibina secara konvensional.

Skop aktiviti penyelenggaraan disiasat termasuk kecacatan struktur, kecacatan rekabentuk, kecacatan pembinaan, kelengkapan dalaman, pemasangan elektrik, paip dan sistem perparitan. Kajian ini menggunakan kaji selidik dan kaedah temubual untuk

pengumpulan data. Sebanyak 150 soal selidik telah diedarkan kepada penduduk di setiap kolej. Soal selidik telah diedarkan kepada pelajar setiap bangunan untuk mendapatkan persepsi keseluruhan mengenai aktiviti-aktiviti

penyelenggaraan, manakala temubual telah dijalankan dalam kalangan pengamal industry untuk mendapat pandangan professional terhadap perkara ini. Untuk data analisis, kajian ini menggunakan analisis deskriptif dan Sampel Bebas T-Test untuk menilai sistem bangunan yang lebih berkesan dalam menangani masalah penyelenggaraan. Hasil kajian menunjukkan bahawa kecacatan dalam bangunan itu boleh berlaku di setiap bangunan dan tidak ada perbezaan yang signifikan antara kedua-dua system pembinaan. Kesimpulannya, pembinaan sesebuah bangunan samaada menggunakan sistem IBS atau pembinaan secara konvensional tidak menjejaskan kecacatan bangunan.

Hasil daripada kajian ini boleh memberi manfaat kepada agensi-agensi kerajaan, mereka yang terlibat dalam sektor pembinaan dan penyelidik akan datang dapat merubah penghuni bangunan dalam usaha untuk menguruangkan aktiviti penyelenggaraan.

ACKNOWLEDGEMENTS

Bismilahhirrahmannirrahim. In the name of Allah, the Most Gracious and the Most Merciful.

Alhamdulillah, all praises to Allah for the strengths and His blessing in completing this thesis. Special appreciation goes to my supervisor, Dr. Zaiton Ali from Faculty of Economics and Management UPM, for her supervision and constant support. Her invaluable help of constructive comments and suggestions throughout the thesis have contributed to the success of this research. Without her guidance and persistent help this dissertation would not have been possible.

I would also like to thank Professor Dr. Hajjah Rahinah Ibrahim from Faculty of Design and Architecture UPM for her knowledge and assistance for this study, without her support it would not have been successful.

Sincere thanks to all dear friends, for sharing the literature and invaluable assistance, to those who had given assistances and advices in this study, either directly or indirectly, yet their names are not written here, they deserve my greatest gratitude with a word thanks.

Last but not least, my love and gratitude to my beloved parents; for their endless support, prayers, and encouragement throughout my studies. Thank you very much.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Zaiton Ali, PhD
Senior Lecturer
Faculty of Economic and Management
Universiti Putra Malaysia
(Chairman)

Rahinah Ibrahim, PhD
Professor
Faculty of Design and Architecture
Universiti Putra Malaysia
(Member)

BUJANG BIN KIM HUAT, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any other institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software.

Signature: _____ Date: _____

Name and Matric No.: Ahmad Hafizd Bin Hitam (GS28484)

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: _____
Name of Chairman of Supervisory Committee: Dr. Zaiton Ali

Signature: _____
Name of Member of Supervisory Committee: Professor Dr. Rahinah Ibrahim

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

UPM	Universiti Putra Malaysia
K13	Thirteenth College
KPZ	Kolej Pendeta Zaaba
IBS	Industrialised Building System
CIDB	Construction Industry Development Board
MMC	Modern Method of Construction
OSP	Off-site Production
OSM	Off-site Manufacturing
OSC	Off-site Construction

CHAPTER 1

INTRODUCTION

1.1 Introduction

"Another Flaw in the human character is that everybody wants to build and nobody wants to do maintenance" – Vonnegurt (1922-2007), Hocus Pocus"

Quotation above clearly concludes the actual situation in the construction industry in the world. It clearly shows how important the aspects of building maintenance in the construction industry can create a variety of positive effects on a building in broad aspects especially the main functionality of the building itself. There is no denying the importance of the maintenance of a building. Form the smallest building up the large buildings, each of it will require a periodic maintenance to keep the building in it optimal condition. Effective maintenance can reduce the costs, especially for long periods of time not to mention that it can create a conducive and comfortable lifestyle. Until recently, many parties in construction sector concerned toward reducing the cost of construction, but only a few of them are focusing on maintenance and operation costs of buildings and, more importantly, to the reduction of lifecycle costs.

The building is considering as an asset. The value of the building is based on the quality of maintenance which was invested into to building. Proper maintenance will increase the value. Most countries were involved with the building maintenance activities. In the United Kingdom, It is estimated that currently accounts for spending approximately £20 billion (Technology Foresight Construction Sector Panel, 1995). In accordance with, any reduction in resources used for maintenance of the building will have an impact that can be seen on the national economy.

1.1.1 World Scenario

According to Mitropoulous and Howell (2002), 35 % of total turnover in the construction sector investing in the United States, were comprised modification projects and renovations. In Canada, the activities of maintenance (US $ 104 billion), are greater to compare with the new constructions cost (US $ 100 billion), Vanier (201). Expenditure in UK on repair, overhaul and maintenance, covering 50 % more than of all annually activities of construction (DETR, 2000; Baldry, 2002; Olubodun, 1996; Torrance, 1997; and Sun, 2003b) compare this to the period between 1970 1980, increasing maintenance division until now. Since the late 70's and early 80's, it has been more than 40 % (singer & Swallow, 1996).

1.1.2 Malaysia Scenario

Between year of 2006 to 2010 (Ninth Malaysia Plan), there are about 3.5 per cent per annum of construction sector was predicted by the government. In addition to infrastructure projects in the civil engineering, the construction sector is expected to be a major contributor to this growth. The Government has injected nearly 19 billion Ringgit Malaysia within five years started 2006 to 2010. These allocation included provisions for maintenance and repairs activities. The provisions of the development plan for improvement and maintenance work up from RM296 million in the Eighth Malaysia Plan to RM1, 079 million in the Ninth Malaysia Plan (Malaysia, 2006). Therefore, maintenance and repairs works in the future expected will become important

According to Construction Industry Development Board, CIDB (2007), in 2006, 16 percent the total of construction output in Malaysia is maintenance works. However, maintenance and repair work carried unreported, particularly those undertaking by homeowners who make illegally renovations works. Hence, if the case is calculated into account, the real numbers of the maintenance and repair work in Malaysia would be way higher.

Malaysian government stated the total of 709,400 housing units will be constructed under the Ninth Malaysia Plan. The supply and total amount for maintenance and repair works were estimated increased in line (Government of Malaysia, 2006).

1.2 Statement of Problem

In Malaysia, There are many new buildings erected each day to fulfill the needs as developing country. Both public and private sectors are in high demand every day. Many construction projects have been started because of robust demand from the construction industry today. For that demand, various initiatives have been undertaken. Furthermore, with a very limited time constraints, various methods of construction are introduced and practiced. The methods of building construction are also diversifying with the help of both science and technology.

In the world of building construction, building defects are things that cannot be excluded. It often happens no matter on conventional building or buildings IBS. The selection of construction methods can not necessarily prevent the occurrence of defects. Malfunctions and defects obstinate become a contributor to the high maintenance. IBS is not just a trend and it is prove by its various advantages in many aspects that have been shown in previous studies. However, there is no detailed study being done in maintenance-related aspects of buildings, constructed using IBS. Therefore, this study is to identify the comparative maintenance problems that often occur in between the buildings constructed using traditional methods and buildings constructed using IBS method. To meet the objectives of the study, two students accommodation in Universiti Putra Malaysia was chosen as the unit of analysis, which are

Thirteenth College (K13) that representing the IBS and Kolej Pendeta Za'ba (KPZ) that represent the conventional methods.

1.3 Research Question

The main research question for this study is: which building system are fewer defects, better in enhancing quality of student accommodation in Universiti Putra Malaysia UPM, Malaysia. It followed by three sub research question (sub RQ) which are:

1. What are the maintenance issues / problem on Thirteenth College and Kolej Pendeta Za'ba Universiti Putra Malaysia?
2. How the IBS and conventional building system tackle / react to the maintenance problem?
3. Which building system is more efficient in tackling the maintenance problems?

1.3.1 Key Words

Conventional Delivery, IBS Technologies, Maintenance, Student Accommodations

1.4 Components of Research

The components of this research include, theoretical proposition, unit of analysis, linking data to the proposition, and criteria for interpreting the findings.

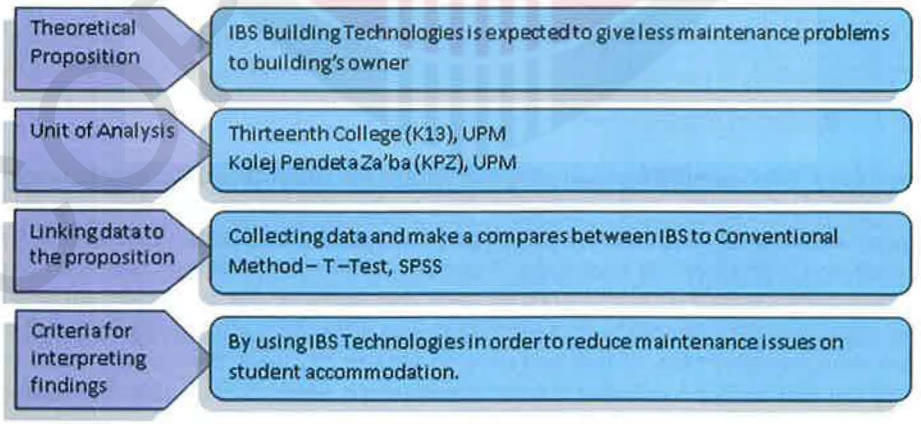

Figure 1.1 Component of Research

1.5 Aim and Objectives of Study

The aim of this study is to understand and evaluate the maintenance issues between two buildings which were constructed by using different delivery methods which are IBS and conventional method. To achieve the above aim, there are three objectives that have been identified in Table 1.0.

Table 1.1 Eagle Research Design Framework Table

DESCRIPTION OF RQ CONSTRUCTS	SUB RQ	RESEARCH OBJECTIVES	RELATED INQUIRY STRATEGY
[what] Building System [how] Enhance Quality [who] High Rise Residential Apartment	S1	R1: To identify which building system applied on student's accommodation building in UPM	Literature Review
	S2	R2: To understand the implementations of building system in order to settle maintenance issues	Case Study Survey & Guided Interview
	S3	R3: To evaluate which building system is more efficient in tackling the maintenance problems	Data Analysis

1.6 Scope of Study

This study is to identifying maintenance problems often faced by two buildings from different construction methods. The units of analysis for this research consist of student's residential building in Universiti Putra Malaysia, which are Thirteenth College (K13) and Kolej Pendeta Za'ba (KPZ). Apart from that, the maintenance-related assessments to seek the value of the university students who represent the residents of the building are done through survey forms. The most obvious limitation of this study is to test or to proof the construction by using the IBS is more efficient for the construction work in Malaysia nowadays. IBS building technologies is expected to give lower life cycle cost (LCC) to the building's owner.

1.7 Significant of Study

In construction industry, maintenance activity is of the interest that should be emphasized to prolong the lifespan of the building and to avoid long term unnecessary spending. Efficient maintenance should be taken in to account as early as the building is constructed including the building's design and construction materials used. This study was undertaken to assess the building maintenance issues that apply to buildings constructed with different methods. Through this study, issues related to maintenance of buildings, especially on building methods using IBS can be peeled and discussed. Findings may help in the improvement of IBS system and support the government's intention to implement IBS extensively in building construction projects in Malaysia which are expected to grow by 6.6% per annum and make a construction to become a major contributor towards economic development in the country. At the same time, certain parties in collaboration with the public sector can adopt the IBS to strengthen the country's construction industry as well as dictating the direction of the construction industry in the future in order to ensure they can be internationally competitive, innovative, technologically equip and knowledgeable.

By having a sufficient system, it also helps the industry to face the challenges ahead and address the existing weaknesses. Some of the weaknesses and negative assumptions identified in the construction sector is the quality and low productivity of the construction, delays due to bureaucracy, racism, lack of data and information, and skills shortages. With this study, a model of construction methods for IBS can be generated and IBS was certified pros. maintenance issues is not an obstacle to the implementing IBS in the construction industry. Moreover, the findings were documented to be used as a reference written material for the contractors appointed to implement the IBS system in development projects.

As an overall, benefits of the study will facilitate, support and improving IBS in reducing maintenance problem of housing project. Besides that, the findings also give an idea to promote a sustainability of building life-cycle as well as building operation and maintenance.

1.8 Thesis Overview

This thesis contains five chapters. The summary of each chapter described as below.

Chapter 1 gives a brief and an overview the scenario and trend of construction industry all over the world including Malaysia. The aim, objectives, and justification of the study are specified. It includes also the overall content of the whole thesis.

Chapter 2 includes a literature review in the field of construction method, the definition, implementation towards the industry, and also the advantages and disadvantages of each method. A second part of literature review is focusing

on building's maintenance issues. In addition, types of building maintenance are also included.

Chapter 3 discussed the methodology applied during this study. The design and implementation of questionnaire survey and selection of case studies are explained. The analytical methodology adopted is also briefly described.

Chapter 4 is the outcome of analysis; result and discussion for the building systems are presented and discussed. The comparisons of result between two different buildings were showed in a table and chart form.

Chapter 5 presents a summary of the findings and conclusion drawn from this research and also the recommendations for future research.

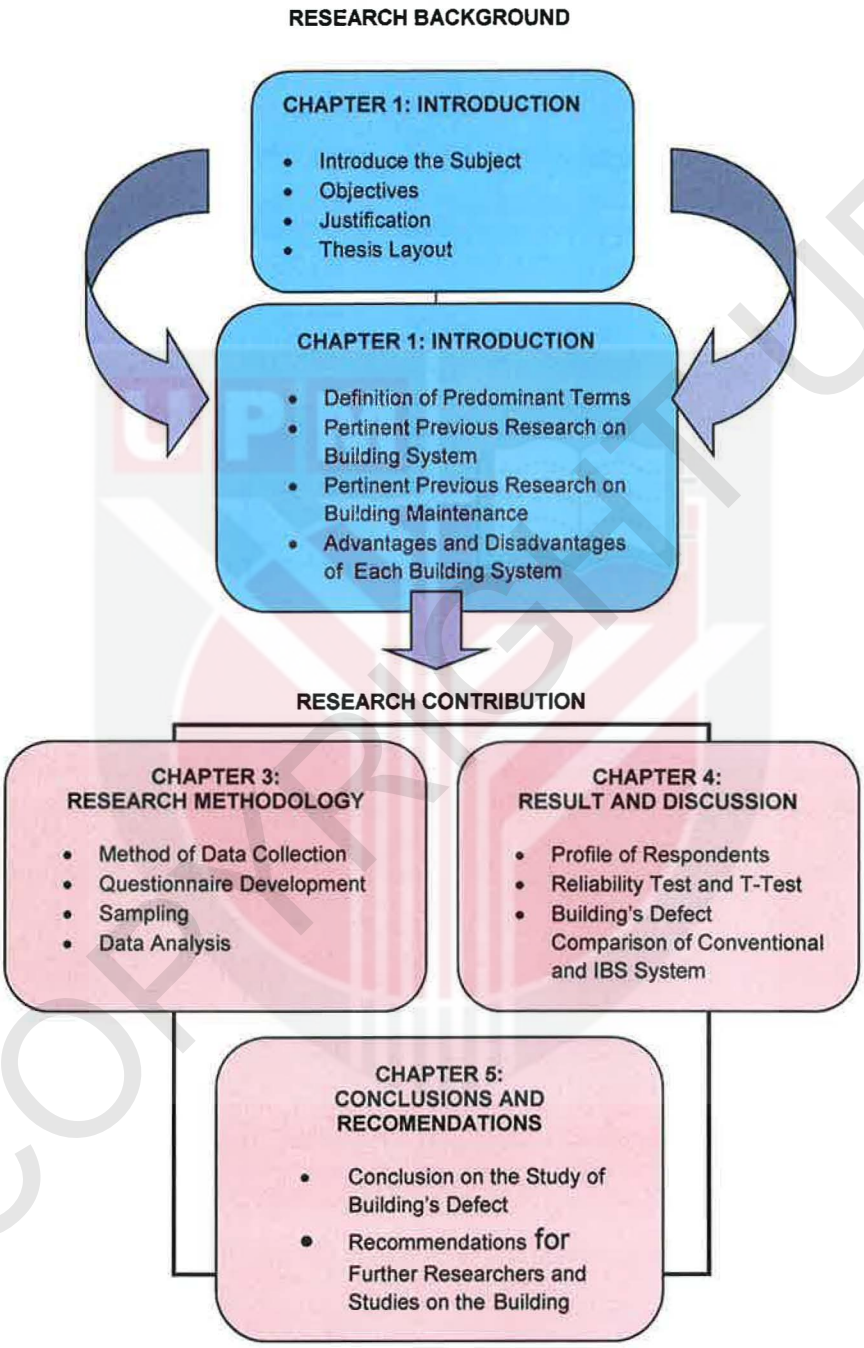

Figure 1.2 Thesis Layout

1.9 Summary

This current chapter will discuss statement of problem, objectives of the research, the significance, limitation or scope and layout and framework of the thesis. This is the main background or overview of the research study, the next chapter will review and discuss the field of building system and building maintenance.

REFERENCES

Abang Abdullah, A. A., A. S. Abdul Azizi, and A. T. Waleed (1998), "*An Overview of Industrialised Building System"*, Colloquium on Industrialised Building System, Kuala Lumpur, Malaysia.

Trikha, D. N. (1999), "*Industrialised Building System Prospects in Malaysia*,. Proceeding of the World Engineering Congress (WEC)", Kuala Lumpur, Malaysia.

CIDB. (1997), "*Guide to Precast Concrete and Pre-fabricated Reinforcement for Buildings"*, Construction Industry Development Board Report. Malaysia.

Andres, C. K., and R. C. Smith. (1998), "*Principal and Practices of Heavy Construction*", 5th Edition. New York: Prentice Hall.

Kamar, K.A.M, Alshawi, M and Hamid, Z (2009), *"Barriers to Industrialised Building (IBS): The Case Of Malaysia"*, Proceeding in BuHu 9th Postgraduate Research Conference (IPGRC), 29-30 January 2009, at Salford, United Kingdom.

Kamar, K.A.M, Egbu,C, Arif,M, Hamid, Z.A, Zin, M.Z.M, Ghani. M.K and Rahim, A.H.A. (2009*), "Submission to Construction Industry Development Board (CIDB), IBS Centre Malaysia and IBS Technical Committee"*, Proceeding of 1st CIDB/CREAM IBS Roundtable Workshop (IRW01), 29 July 2009, Grand Season Hotel, Kuala Lumpur, Malaysia.

Kamar, K.A.M, Hamid, Z.A.H, Sani. S.F.A, Ghani. M.K, Zin, Rahim,A.H and Karim, A.Z.A (2010), *"The Critical Success Factors (CSFs) for the Implementation of Industrialised Building System (IBS) in Malaysia",* Proceeding 3rd IBS Roundtable Workshop (IRW03) CIDB/CREAM IBS Survey 2010.

Abdullah, M.R, Kamar, K.A.M, Nawi, M.N.M, Haron, T and Arif, M. (2009),, *"Industrialized Building System: A Definition and Concept"*, Proceeding in ARCOM Conference, 7-9 September 2009, Nottingham, United Kingdom.

Chung, L. P.& Kadir, A.M. (2007), *"Implementation strategy for Industrialised Building System"*, PhD thesis, University Teknologi Malaysia (UTM), Johor Baru, Malaysia.

Azman, M. N. A., Ahamad, M. S. S., Majid, T. A. & Hanafi, M. H. (2011a),. "*Status of Industrialized Building System Manufacturing Plant in Malaysia"*, UNIMAS e-Journal of Civil Engineering, 2.

Azman, M. N. A., Majid, T. A., Ahamad, M. S. S. & Hanafi, M. H. (2011b), *"A study on the trend of the use of IBS components and the setting UP of IBS manufacturing factories in the malaysian construction industry"*, Malaysian Construction Research Journal, 9, p.p 18-30 .

Badir, Y. & Razali, A. (1998), *"Theory of Classification: its Application and Badir-Razali Building System Classification"*, Journal of the Institute of Engineering, Malaysia (IEM) .

Badir, Y. F., Kadir, M. R. A. & Hashim, A. H. (2002), *"Industrialized Building Systems Construction in Malaysia"*, Journal of Architectural Engineering, 8, p.p 19-23 .

Badir, Y.F., kadir, M.R.A. and hashim, A.H. (2012), "Industrialised Building System Construction in Malaysia", Journal of Architectural Engineering, Vol. 8, No.1, p.p 12-16 .

Badir, Y. F., M. R. A. Kadir, and A. A. A. Ali. (1998), "*Theory of Classification* and Badir-Razali, *Building Systems Classification*", Buletin Bulanan IJM, JURUTERA, Vol. Oct, p.p 50-56 .

Begum, R. A., Satari, S. K. & Pereira, J. J. (2010), *"Waste generation and recycling: Comparison of conventional and industrialized building systems"*, American Journal of Environmental Sciences, 6, p.p 383-388 .

Kadir, M. R. A., Lee, W. P., Jaafar, M. S., Sapuan, S. M. & Ali, A. A. A. (2006), *"Construction performance comparison between conventional and industrialised building systems in Malaysia"*, Structural Survey, 24, p.p 412-424 .

Kamar, K. A. M. & Hamid, Z. A. (2011), *"Supply chain strategy for contractor in adopting industrialised building system (IBS)"*, Australian Journal of Basic and Applied Sciences, 5, p.p 2552-2557.

Thanoon, W. A. M., Peng, L. W., Abdul Kadir, M. R., Jaafar, M. S. & Salit, M. S. (2013), *"The Essential Characteristics of Industrialised Building System"*, Proceeding On IBS Seminar, UPM, MALAYSIA, 2003. *In:* International Conference on Industrialised Building Systems, 2003 Kuala Lumpur, Malaysia .

Ministry of Housing and Local Government, Malaysia. http://www.kpkt.gov.my. Officially Website of Ministry of Housing and Local Government. Accessed on 2nd March 2009 .

Nuzul Azam Haron, Salihuddin Hassim. Mohd Razali Abd Kadir, Mohd Saleh Jaafar (2015), *"Building Cost Comparison Between Conventional and Formwork System"*, Journal Teknologi, Universiti Teknologi Malaysia, 43(B). Dis. 2015, p.p 1-11 .

Yousre F. Badir, M.R. Abdul Kadir, Ahmed H. Hashim (2012), *"Industrilized Building System Construction in Malaysia",* Journal of Architectural Engineering, March 2002, p.p 19-23 .

M.R. Abdul Kadir, W.P. Lee, M.s Jaafar, S.M. Sapuan, A.A.A. Ali (2016), *"Construction Performance Comparison between Conventional and Industrialized Building System in Malaysia".* Emerald Group Publishing Limited, Structural Survey; Volume 24 Number 5. p.p 412-424 .

Construction Industry Development Board Malaysia (CIDB) (2003), *"IBS Survey 2003: Survey on the Usage of Industrialised Building System (IBS) in Malaysia Construction Industry"*, Kuala Lumpur: Construction Industry Development Board (CIDB) .

Construction Industry Development Board Malaysia (CIDB) (2003),. *"Industrialised Building System (IBS): Roadmap 2003-2010"*, Kuala Lumpur: Construction Industry Development Board (CIDB) .

Construction Industry Development Board Malaysia (CIDB) (2007),. *"Construction Industry Master Pelan: Malaysia 206-2015"*, Kuala Lumpur: Construction Industry Development Board (CIDB) .

Construction Industry Development Board Malaysia (CIDB) (2010), "IBS Policy Implementation in Malaysia: The Chronology of Events" , IBS Digest, Malaysia .

Construction Industry Development Board (CIDB) Malaysia (2003a), *"IBS Roadmap 2003-2010"*, Construction Industry Development Board (CIDB), Kuala Lumpur.

Chung, L. P. & Kadir, A. M. (2007), *"Implementation Strategi for Industrialized Building System",* Master thesis, Universiti Teknologi Malaysia (UTM),, Johor Bharu, Malaysia .

Waleed A. Thanoon, Mohd. Peter Daviz, Abdul Aziz Samad, Mohd Razali Abd. Kadir and Abang Abdullah Abang Ali, (1997*), "Industrialised Building System",* Seminar on Affordable Quality Housing, Housing Research Centre, Universiti Putra Malaysia, Malaysia .

Rahman. A.B.A, Omar, W. (2006), *"Issues and Challenges in the Implementation of IBS in Malaysia",* Proceeding of the 6th Asia-Pacific Structural Engineering and Construction Conference (ASPEC 2006), 5-6 September 2006, Kuala Lumpur Malaysia .

Mohamed, N.W, (2010), " Road Maintenance Management System : Case Study At Public Work Department", Master Thesis Universiti Teknologi Malaysia (UTM), Johor Baru, Malaysia .

Kamar, K.A.M, hamid, Z.A.H, Sani, S.F.A, Ghani, M.K, Zin, Rahim and Karim, A,Z.A (2010), *"The Critical Success Factors (CSFs) for the implementation of Undistrilised Building System (IBS) in Malaysia", Proceeding 3rd Roundtable Workshop (IRW03)",* CIDM/CREAM IBS Survey 2010 .

Diah, A.B.M, Majid, T.A Nawawi. N.M, Ismail, S., Zain, M.Z.M and Hassan, R. (2009), *"Development Through IBS Integration", Proceeding International Seminar on IBS in Malaysia International Exibition (MIIE 2009)"*, at CIDB Convention Centre, Malaysia .

Kamar. K.A.M, Alshawi, M and Hamid, Z.A, Zin, M.Z.M, Ghani. M.K and Rahim, A.H.A (2009), *"Submission to Construction Industry Development Board (CIDB), IBS Cenre Malaysia and IBS Technical Committee"*, Proceeding of 1st CIDB/CREAM IBS Roundtable Workshop (IRW01). 29 January 2009, At Salford United Kingdom .

Majid, T. A., Azman, M. N. A., Zakaria, S. A. S., Zaini, S. S., Yahya, A. S., Ahamad, M. S.S. & Hanafi, M. H. (year), *"The Industrialized Building System (IBS) Survey Report 2008 - Educating the Malaysian Construction Industry", In:* Computer Research and Development, 2010 Second International Conference on, 7-10 May 2010, p.p 615-619 .

Majid, T. A., Azman, M. N. A., Zakaria, S. A. S., Yahya, A. S., Zaini, S. S., Ahamad, M. S.S. & Hanafi, M. H. (2011), *"Quantitative analysis on the level of IBS acceptance in the Malaysian construction industry", Journal of Engineering Science and Technology*, 6, p.p 179-190 .

Mirsaeedie, L. (2012), *"Application of industrialized building systems (IBS) in rural settlements towards sustainability", World Applied Sciences Journal*, 16, p.p 729-733 .

David Arditi, Member, ASCE, Manop Nawakorawit (1999), *"Issues in Building Maintenance: Property managers' Perspectives"*, Journal of Architecture and Engineering, December, p.p 117-131 .

Richard, R.-B. (2005), *"Industrialised building systems: reproduction before automation and robotics"*, Automation in Construction, 14, p.p 442-451.

Crawford, I.M. (1990) "*Marketing Research* Centre for Agricultural Marketing Training in Eastern and Southern Africa. Harare Zimbabwe".

Nemoto, T., & Beglar, D. (2014). *"Developing Likert-scale questionnaires. In N. Sonda & A. Krause (Eds.)"*, JALT2013 Conference Proceedings. Tokyo: JALT, p.p 8.

McNamara, C. (2009), *"General guidelines for conducting interviews".* Retrieved January 11, 2010, from http://managementhelp.org/evaluatn/intrview.htm

Chenail, R.J. (2009), *"Interviewing the investigator: Strategies for addressing instrumentation and researcher bias concerns in qualitative research".* The Weekly Qualitative Report, 2(3), p.p 14-21.

Thousand Oaks, CA: Sage. Gall, M. D., Gall, J. P., & Borg, W. R. (2003), "Educational research: An introduction (7th ed.)". Boston, MA: A & B Publications.

CREAM and CIDB (2010), *"Industrialised Building System (IBS) Construction Research And Information"*, Retrieved from :http://ibsresearch.blogspot.com/2010/04/history-of-ibs-adoption-in-malaysia.html

Zulkefli Ismail (2011), "IBS Manufacturer in Malaysia: Historical Chronology of Housing Project", Retrieved from :http://ibsresearch.blogspot.com/2011/04/ibs- manufacturer-in-malaysia-historical.html

Dyna Lynn Driscoll, Allen Brizee (2010) "Creating good Interview Questions", Retrieved from: https://owl.english.purdue.edu/owl/resource/559/06/