UNIVERSITI PUTRA MALAYSIA

APPLICATION OF CONSTRUCTABILITY CONCEPTS IN THE INDUSTRIALISED BUILDING SYSTEM FOR THE MALAYSIAN CONSTRUCTION INDUSTRY

MOSTAFA BABAEIAN JELODAR

APPLICATION OF CONSTRUCTABILITY CONCEPTS IN THE INDUSTRIALISED BUILDING SYSTEM FOR THE MALAYSIAN CONSTRUCTION INDUSTRY

By

MOSTAFA BABAEIAN JELODAR

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

May 2009

DEDICATION

To my beautiful country Iran the land of fine arts, culture, passion, knowledge and the greats

To my parents for their guidance, love, care, dedication and affection

and finally

To my beloved wife for her love, patients, support and devotion

Abstract of thesis presented to the senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree Master of Science

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May 2009

Chairman: Associate Professor Mohammad Razali B Abd Kadir, PhD

Faculty: Engineering

Constructability is generally reducing the problems of construction by incorporating the construction knowledge into the design of a construction project. The Malaysian construction industry is attempting to promote and use Industrialized Building systems (IBS) for better construction practice with more effectiveness and efficiency, but in terms of constructability and research into the application of constructability concepts for IBS little work has been done. In fact the Malaysian construction industry is still not applying the concepts of constructability in totality and there is lack of constructability research in Malaysia. In this research the application status of constructability concepts which have been previously defined for Malaysia are examined and assessed within the Malaysian IBS industry. The ease of constructability application of IBS and conventional building methods are investigated and finally the concepts that are not being applied up to their potential level in IBS construction and resemble possible

problems in the process of application are identified. A survey is used to obtain the essential data needed for the research from the active IBS industry participants of Malaysia. It was found that the IBS contractors are applying constructability more than the designers and suppliers and also the early constructability concepts gained a higher application score than other concepts. Using information technology and the innovative concepts of the field operation phase were the most difficult concepts to apply and generally the application of constructability concepts in IBS construction is easier compared to the conventional building systems according to the IBS industry participants.

Abstrak tesis ini dikemukakan kepada Senat Universiti Putera Malaysia sebagai memenuhi keperluan untuk memperolehi ijazah Master Sains

APLIKASI KEBOLEHBINAAN UNTUK SISTEM BINAAN BERINDUSTRI (IBS) DI MALAYSIA

Oleh

MOSTAFA BABAEIAN JELODAR

Ogos 2008

Pengerusi: Profesor Madya Dr. Mohammad Razali B Abd Kadir, PhD

Fakulti: Kejuruteraan

Kebolehbinaan secara umumnya mengurangkan masalah pembinaan dengan menggabungkan pengetahuan ke dalam reka bentuk projek pembinaan. Industri pembinaan di Malaysia kini dalam usaha mempromosi dan menggunakan sistem binaan berindustri (IBS) untuk praktis pembinaan yang lebih baik, efektif dan efisien. Namun, tidak banyak usaha dijalankan dalam melihat aplikasi dan konsep keupayaan penstrukturan untuk Sistem Binaan Industri (IBS). Industri pembinaan di Malaysia masih tidak menggunakan konsep kebolehbinaan secara total dan terdapat kekurangan dalam penyelidikan di Malaysia. Dalam kajian ini, status aplikasi konsep kebolehbinaan yang telah banyak digunakan di Malaysia telah diuji dan dinilai dalam industri IBS Malaysia. Kemudahan aplikasi kebolehbinaan dalam IBS dan sistem pembinaan konvensional dinilai dan akhirnya konsep yang tidak diaplikasikan sepenuhnya pada paras yang sepatutnya dalam pembinaan IBS dan masalah yang mungkin muncul dalam

proses pengaplikasian dikenal pasti. Kajian digunakan bagi memperoleh data penting yang diperlukan dalam kajian daripada peserta aktif Sistem Binaan Berindustri (IBS) di Malaysia. Dapatan kajian menunjukkan kontraktor IBS mengaplikasikan kebolehbinaan lebih daripada pereka bentuk dan pembekal. Dapatan kajian juga menunjukkan konsep kebolehbinaan memberikan skor aplikasi yang lebih tinggi berbanding konsep lain. Penggunaan teknologi dan konsep inovatif dalam lapangan fasa operasi merupakan konsep yang paling sukar untuk diaplikasikan dan secara amnya aplikasi kebolehbinaan dalam pembinaan IBS adalah lebih mudah dibandingkan dengan sistem binaan konvensional dengan peserta industri IBS.

ACKNOWLEDGEMENT

The writer first would like to express his gratitude to the chairman of the committee Associate Professor Dr. Mohammad Razali B Abd Kadir and also the committee members Associate Professor Dr. Mohd Saleh B Jaafar and Dr Farah Nora Aznieta Binti Abdul Aziz for their guidance support and inspiration.

The writer would also like to thank all the organizations and companies which took part in this study and dedicated their time and consideration along with the sources of the data collected for the research specially the CIDB's IBS base.

At the end the writer would like to thank all the authorities and staff of the engineering faculty of University Putra Malaysia for providing assistance and support for the accomplishment of this research.

I certify that an Examination Committee has met on **29 May 2009** to conduct the final examination of Mostafa Babaeian Jelodar on his Master of Science thesis entitled "Constructability Application for Industrialized Building Systems in Malaysia" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the relevant degree.

Members of the Examination Committee were as follows:

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

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HASANAH MOHD. GHAZALI, PhD
Professor and Dean
School of Graduate Studies
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Date: 11 September 2009

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at University Putra Malaysia or at any other institution.

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Mostafa Babaeian Jelodar

Date: 10 September 2009

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APPLICATION OF CONSTRUCTABILITY CONCEPTS IN THE INDUSTRIALISED BUILDING SYSTEM FOR THE MALAYSIAN CONSTRUCTION INDUSTRY

By

MOSTAFA BABAEIAN JELODAR

May 2009

Chair: Associate Professor Mohammad Razali B Abd Kadir, PhD

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Constructability is generally reducing the problems of construction by incorporating the construction knowledge into the design of a construction project. The Malaysian construction industry is attempting to promote and use Industrialized Building systems (IBS) for better construction practice with more effectiveness and efficiency, but in terms of constructability and research into the application of constructability concepts for IBS little work has been done. In fact the Malaysian construction industry is still not applying the concepts of constructability in totality and there is lack of constructability research in Malaysia. In this research the application status of constructability concepts which have been previously defined for Malaysia are examined and assessed within the Malaysian IBS industry. The ease of constructability application of IBS and conventional building methods are investigated and finally the concepts that are not being applied up to their potential level in IBS construction and resemble possible problems in the process of

application are identified. A survey is used to obtain the essential data needed for the research from the active IBS industry participants of Malaysia. It was found that the IBS contractors are applying constructability more than the designers and suppliers and also the early constructability concepts gained a higher application score than other concepts. Using information technology and the innovative concepts of the field operation phase were the most difficult concepts to apply and generally the application of constructability concepts in IBS construction is easier compared to the conventional building systems according to the IBS industry participants.

LIST OF CORRECTIONS

NAME: Mostafa Babaeian Jelodar
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PROGRAM: Masters
APPROVED FIELD OF STUDY: Project Management
FACULTY: Engineering
SUPERVISOR: ASSOCIATE PROFF DR. MOHD. RAZALI ABDUL KADIR
SUGGESTED THESIS TITLE: APPLICATION OF CONSTRUCTABILITY CONCEPTS IN THE INDUSTRIALIZED BUILDING SYSTEM INDUSTRY IN MALAYSIA
(Report: Chairman)

NO.	COMMENTS FROM THE EXAMINATION COMMITTEE	CORRECTIONS MADE	PAGE NO.
1	The title of the thesis should be modified to " Application of Constructability Concepts in the Industrialized Building System Industry in Malaysia" to better reflect the candidates work, which was found to be an extension of work done by other researchers on constructability, but with a difference that this work focuses on the Industrialized Building System(IBS) industry in Malaysia.	APPLICATION OF CONSTRUCTABILITY CONCEPTS IN THE INDUSTRIALIZED BUILDING SYSTEM INDUSTRY IN MALAYSIA	
2	The literature review is acceptable but as presented lack critical discussion. The review did not effectively cover the IBS experience overseas, although it is well known that IBS appears under different such as prefab or off-site systems in other countries.	A detailed report on the IBS practice in overseas and Malaysia has be included plus elaborations on the differences with the appropriate justifications. Issues such as the IBS technology used, what made IBS successful in other places, the differences and defects of IBS industry in Malaysia and its justification, how much the construction industry in Malaysia willing to accept IBS, the connections of the IBS to the issue of constructability and ect. Through out the literature review useful research work and reports for the current research have been stated	17-23 33, 35, 45, 47, 50, 53

		and a more critical and elaborate approach has been adopted in stating them. In the concluding remarks the connection of the literature which has been covered with the problem statement is emboldened and the difference of the current work with previous similar research in the area is denoted.	 55
3	The research gap has not been properly stated. The objectives have to be combined and rewritten with proper keywords or focus. The scope of work should highlight the limitations of this research work.	1) The problem statement has been corrected and more effective statements has been included. Constructability is a knowledge based program which insists on incorporating construction knowledge and experience into different phases of the project and it becomes apparent that one of the problems of the IBS industry is lack of knowledge and experience. Therefore the applicability of constructability concepts as a mean of integrating construction knowledge and experience for different IBS elements and construction systems should be discussed and appropriate feed back should be given to the industry for better practice of this beneficial program. 2) The research objectives are rewritten with adjustments so they can be more clear with a better focus. Objective 1: To determine the current status of constructability application in the Malaysian Industrialized Building Systems (IBS) construction. By status the study intends to verify how much the proposed constructability	3 4 4 5 5

		concepts are being utilized and which constructability concepts are relevant to the role of each group (suppliers, designers and contractors) involved in IBS.	
		Objective two: To identify and compare the ease of application for each constructability concept applied in IBS and conventional methods of construction.	6
		Objective three: To identify the gaps between potential and actual ease of application for constructability concepts applied in the Malaysian IBS construction this indicates possible barriers and problems of application.	6
		3) The scope with the limitations of the research has also been corrected.	7-8
		The participants in the study are the designers, contractor, manufacturer and supplier firms active in Malaysian IBS construction industry. The lists of all the active firms and companies in Malaysian IBS industry in the year 2007 was provided by the CIDB's IBS section in Kuala Lumpur. The reason that the mentioned groups were selected for the study is because they are the most practically involved parties in IBS projects and are in the front line of the construction process, they possess valuable information and experience. It also has to be mentioned that the owners are also a major group involved in IBS, however because constructability is not a common and well structured program featuring in Malaysian construction the owners are unlikely to have much information on the subject because they are less practically involved in the projects. The research was conducted in 2008	

		and the most recent data and information were obtained from CIDB's 2007 profiles and the firms selected for this study are the well experienced corporations involved in civil, industrial, general building and residential construction projects because these projects are the most common consumers of IBS products and techniques.	
4	The methodology need t be explained in the thesis. This chapter needs rewriting to be in line with the objectives. The candidate must explain the process of the adoption of the questionnaire.	The chapter has been rewritten with revision. The research framework has been elaborated and the research phases were completely explained. Based on this the development of the methodology around the research objectives was discussed. The complete procedure of the development of the questionnaire with a new structure of writing has been discussed. All the details needed are included. Appropriate justifications for the research methods used, questionnaire, sampling, sample size, and statistical analysis was given in the chapter.	59-75 60-61 61-70
5	The results and discussion chapter must provide an in-depth analysis and comparison with previous to explain any irregularities in the results. Their must be validation/justification for the results and the discussions must be based on the results and not the candidates opinion.	The analysis were backed by the literature review and the work performed on the research area. Justification and validity measures for the results were included in the analysis and dissections with the comparison and mention of the previous work on the subject which are listed here: On general characteristics Validation precautions taken	 82-83 84

		Constructability Application results Comparison of Constructability Application between the Phases Section three: Comparison of Constructability Application Between IBS and Conventional Methods of Construction. Section Four: Comparison of Actual and Potential Ease of Application of Constructability Concepts in IBS Construction	92, 93 97, 102,104, 106, 112 124 131, 134
6	The conclusion must tie up with the objective and scope of the work and highlight the candidate's contribution.	The conclusions were organized in three major sections in line with the objectives of the research and focusing on the contributions.	141- 153
7	Further detailed corrections are as indicated in the examiner's reports and copies of the thesis and typo errors should be corrected.	Other modifications and adjustments were completed accordingly.	