A STUDY OF THE ADEQUACY OF CONSTRUCTION INDUSTRY STANDARD FOR MANUAL CALCULATION IN INDUSTRIALISED BUILDING SYSTEM (IBS) CONTENT

MOHAMAD RAZI BIN AHMAD SUHAIMI

SULTAN IDRIS EDUCATION UNIVERSITY

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MOHAMAD RAZI BIN AHMAD SUHAIMI

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

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“Syukran Jazilan” to all. May Allah Shower us with His Blessings and Love and living in the path of Islam. Ameen.

ABSTRACT

This study aimed to determine the adequacy of Construction Industry Standard (CIS 18:2010) for manual calculation in Industrialised Building System (IBS) content. In addition, this study examined the weaknesses and improvements that needed to ensure that the manual calculation of the IBS system content used by the industry is according to the current needs. Literature research, focus groups and interviews were used to collect the data. The focus group involved 43 respondents with two series of workshop and 32 experts for validation workshop. The findings show that, there are several requirements for the new IBS methods and these manuals need to be reviewed after 5 years of use. As a result of the focus group discussion, they have proposed the addition of several elements such as Building Modelling Information (BIM), Prefabricated Prefinished Volumetric Construction (PPVC), Prefab Bathroom Unit (PBU) and Prefab-Staircase in the new IBS system. In addition, there is a suggestion to reduce the factor 0.1 of IBS score for the reusable formwork system as it involves more work compared to other IBS systems. In conclusion, new elements for the new IBS content manual are needed to meet the construction industry standard based and the new construction technology. In implication, the findings could be beneficial for the industry in term of the contribution of the manual calculation for IBS content.

KAJIAN KECUKUPAN MANUAL STANDARD INDUSTRI PEMBINAAN BAGI KANDUNGAN SKOR SISTEM BANGUNAN BERINDUSTRI (IBS)

ABSTRAK

Kajian ini bertujuan untuk menentukan kecukupan Standard Industri Pembinaan (CIS 18: 2010) untuk pengiraan manual dalam Sistem Bangunan Industri (IBS). Di samping itu, kajian ini melihat kelemahan dan penambahbaikan yang diperlukan untuk memastikan pengiraan manual kandungan sistem IBS digunakan oleh industri mengikut keperluan semasa. Kajian literatur, kumpulan fokus dan temuduga digunakan untuk mengumpulkan data. Kumpulan fokus melibatkan 43 orang responden dengan dua siri bengkel dan 32 orang pakar untuk bengkel pengesahan kajian. Penemuan kajian menunjukkan bahawa terdapat beberapa keperluan untuk penambahan kaedah IBS baharu dan manual ini perlu dikaji semula selepas 5 tahun penggunaan. Hasil daripada perbincangan kumpulan fokus, mereka telah mencadangkan penambahbaikan beberapa elemen baharu seperti *Building Information Modeling* (BIM), *Prefabated Prefinished Volumetric Construction* (PPVC), *Prefab Bathroom Unit* (PBU) dan *Prefab Staircase*. Di samping itu, terdapat cadangan untuk mengurangkan faktor 0.1 skor IBS untuk sistem acuan berulangan yang boleh diguna semula kerana ia melibatkan langkah kerja yang banyak berbanding dengan sistem IBS yang lain. Sebagai kesimpulan, elemen baharu untuk manual kandungan IBS yang baharu diperlukan untuk memenuhi standard industri pembinaan berdasarkan dan teknologi pembinaan terkini. Implikasi bagi penemuan ini boleh memberi manfaat kepada industri dari segi sumbangan pengiraan manual untuk kandungan IBS.

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LIST OF ABBREVIATION

BIM	-	Building Information Modelling
CIDB	-	Construction Industry Development Board
CIMP	-	Construction Industry Master Plan
CIS	-	Construction Industry Standard
CITP	-	Construction Industry Transformation Programme
COBie	-	Construction Operations Building Information Exchange
GDP	-	Gross Domestic Product
IBS	-	Industrialised Building System
ICT	-	Information Communication Technology
IFC	-	Industry Foundation Class
MBAM	-	Master Builders Association Malaysia
MC	-	Modular Coordination
MPC	-	Malaysian Productivity Cooperation
PBU	-	Prefab Bathroom Unit
PPVC	-	Prefabricated Prefinished Volumetric Construction
PWD	-	Public Works Department
UBBL	-	Universal Building by Law

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

IBS score system is a systematic and well-structured assessment that can be used to measure the usage of IBS in a consistent way. The highest IBS score is the indicator for higher quality and productivity in construction. The calculation of IBS score is shown in the Construction Industry Standard (CIS): 2010 Manual for Industrialised Building System (IBS) Content Scoring System. The base of calculation is using the IBS factor in three sections which are structural system, wall system and other simplified solutions.

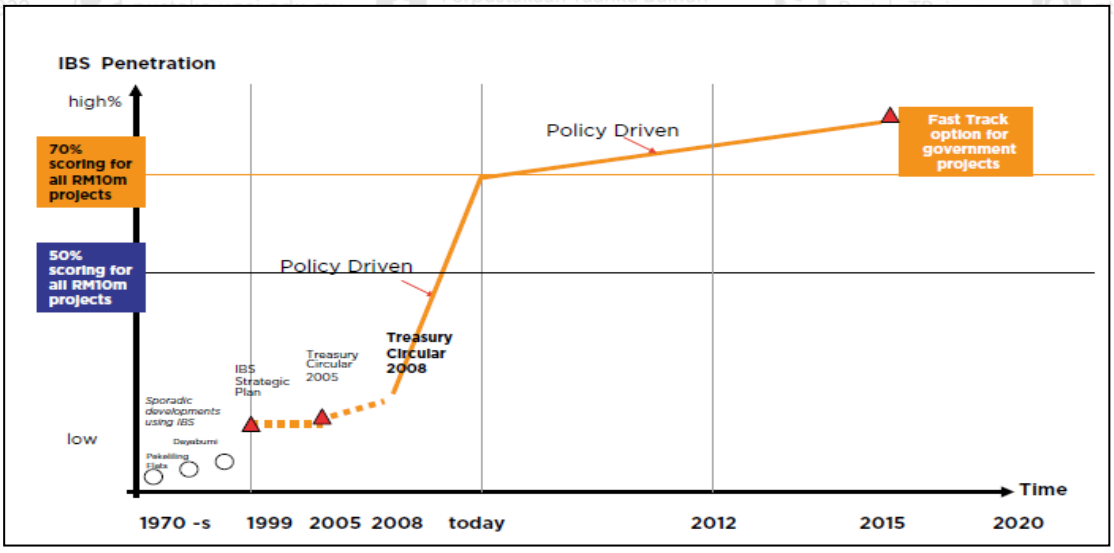
The Construction Industry Development Board (CIDB) was established with the existence of the Amended Construction Industry Development Board (Act 520) Act 2011. According to the Amendment of Section 4 of the mother act, one of the functions of the Board has been improved is to regulate the implementation of the Industrialised Buildings System in the industry construction refers to Section 4. (1) (m) (Government of Malaysia, 2015).

The construction industry in Malaysia is experiencing a migration from conventional methods to a more systematic and mechanised method known as the Industrialised Building System (IBS) (Abdul Kadir, Lee, Jaafar, Sapuan, & Ali, 2005). The word 'system' is a set of interacting or interdependent components forming an integrated whole or a set of elements and relationships which are different from relationships of the set or its elements to other elements or sets. Systems have a structure defined by components/elements and their composition (Yildirim, 2012).

In ensuring that the vision of the industry is successful, the government recommends all construction industry players involved with government projects to have at least 50% of IBS content in their construction elements that have been calculated using the IBS Score Manual developed by CIDB. In order to achieve this, the Ministry of Finance has issued a Treasury Circular Letter No. 7 the year 2008 (1PP PK 1/2013) aimed at informing all agencies about the decision to implement IBS method in government building projects worth RM 10 Million and above (Ministry of Finance (MOF), 2008).

Continued efforts have been made by CIDB to ensure that the use of IBS will continue in the construction industry in Malaysia. Therefore, the Cabinet on 9 July 2010 has approved the IBS Roadmap 2011-2015. Among the efforts undertaken was to maintain 70 IBS scores for government building construction projects. It further supports and encourages the private sector to achieve an average of 50 IBS scores in 2012 (CIDB, 2010a).

The private sector get an exemption to the Malaysian construction levy (CIDB levy 0.125% of the total cost of project according to Article 520) on contractors that have use IBS in 50% of the building components in residential buildings (Kamar, Hamid, Zain, & Ahmad Hazim Abd. Rahim, 2008).



Source : Roadmap IBS 2011-2015(CIDB, 2010a)

Figure 1.1. The use of IBS for the Government Sector up to 2020.

Starting with IBS Strategic Plan in 1999 and in 2008 the Treasury Circular was issued to mandate the use of IBS in stages. Table 1.1 shows the IBS content for the private sector by type of building and increased structure by year. The IBS content involves Residential (landed), Residential (non-landed), Commercial (shopping centres and office buildings Industrial (factory land) and Institutional (schools).

Table 1.1

IBS content for the private sector by type of building and increased structured by year

Year	Residential (landed)	Residential (non-landed)	Commercial (shopping centres and office buildings)	Industrial (factory and warehouse)	Institutional (schools)
2012	-	50	50	50	50
2013	45	50	50	50	50
2014	45	55	55	55	55
2015	45	55	55	55	55

Source: Roadmap IBS 2011-2015 (CIDB, 2010a)

The Construction Industry Transformation Program (CITP) 2016-2020 was launched on 15th September 2015 which comprises four (4) thrusts which are:

Thrust 1: Quality, Safety and Professionalism

Thrust 2: Environmental Sustainability

Thrust 3: Productivity

Thrust 4: Internationalisation

In this document, IBS industry has fall into Thrust 3 which is Productivity with consideration of the use of IBS for both major sectors namely Government and Private. The objective of this thrust is to double the productivity of the construction industry matched by higher wages. It has been mentioned that the use of IBS can reduce unskilled workers, reduce waste at construction sites, cleaner construction sites and better construction quality control (CIDB, 2015b). IBS features a potential construction system for the future with an emphasis on quality, higher productivity and less labour intensive (Baharuddin, Rahman, & Omar, 2006).

In addition, it can increase productivity, reduce risk issues related to occupational safety and health, thereby reducing dependence on foreign workers. Under the P3b initiative Increase the Use of IBS in Private Projects through Development Order (DO) by the local authority (PBT). Only three states, Selangor, Johor and Penang are identified for projects worth RM 50 million and above with 50 IBS scores by 2020.

The 1PP PK 1/2013 circular has been issued by the Ministry of Finance Malaysia on 31 October 2008 and addressed to All Secretary General of the Ministry, All Head of Department of Justice, All State Secretary, All Head of Federal Statutory Bodies and All Local Authorities. To achieve the objective of implementing the IBS method.

The Government has decided on the use of component content for each government project worth 10 million and above at not less than 70 IBS scores. The content of this score is based on the Construction Industry Standard (CIS 18: 2010) - Manual for Industrialised Building System (IBS) Content Scoring System. The

achievement of IBS's use of Government projects has increased from 24% in 2012 to 69.4% in 2015 (CIDB, 2015a).

Table 1.2

The use of IBS in Government projects in Project Monitoring System 2 (SPP2) until May 2016

BIL	KEMENTERIAN	BIL PROJEK FIZIKAL PEMBINAAN	BIL PROJEK YANG MEMENUHI KRITERIA	BIL PROJEK YANG DILAKSANAKAN SECARA IBSKos Projek ≥ RM10 Juta
			Bangunan baru kos bangunan ≥ RM10 Juta	Kos Projek ≥ RM10 Juta
1	JABATAN PERDANA MENTERI (JPM)		68	2
2	KEMENTERIAN BELIA DAN SUKAN (KBS)		7	6
3	MINISTRY OF TRANSPORT (MOT)		8	5
4	MINISTRY OF FINANCE (MOF)		12	11
5	KEMENTERIAN KOMUNIKASI DAN MULTIMEDIA MALAYSIA (KKMM)		1	0
6	KEMENTERIAN KEMAJUAN LUAR BANDAR DAN WILAYAH (KKLW)		13	9
7	KEMENTERIAN KESEJAHTERAAN BANDAR, PERUMAHAN DAN KERAJAAN TEMPATAN (KPKT)		60	57
8	MINISTRY OF TOURISM AND CULTURE (MOTAC)		7	7
9	KEMENTERIAN PEMBANGUNAN WANITA, KELUARGA DAN MASYARAKAT (KPWKM)		12	10
10	MINISTRY OF DEFENCE (MOD)		21	13
11	MINISTRY OF AGRICULTURE (MOA)		4	2
12	KEMENTERIAN WILAYAH PERSEKETUAN (KWP)		4	3
13	KEMENTERIAN PENDIDIKAN TINGGI (KPT)		35	16
14	KEMENTERIAN DALAM NEGERI (KDN)		42	42
15	KEMENTERIAN KESIHATAN MALAYSIA (KKM)		158	123
16	KEMENTERIAN PENDIDIKAN MALAYSIA (KPM)		210	155
17	KEMENTERIAN PERDAGANGAN DALAM NEGERI, KOPERASI DAN KEPENGGUNAAN (KDNKK)		2	1
18	MINISTRY OF PLANTATION INDUSTRIES AND COMMODITIES (MPIC)		2	1
19	MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION (MOSTI)		2	2
20	KOPERASI SERBAGUNA MALAYSIA BERHAD (KSM)		1	0
21	MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY (MITI)		1	0
	JUMLAH		670	465
			Peratusan Penggunaan IBS Projek Kerajaan	69.4%

Source: Implementation Coordination Unit (ICU) (2016)

Implementation Coordination Unit (ICU) has set the Key Performance Indicator (KPI) to produce one report on the status of IBS adoption in government projects and submitted to the Ministry of Finance (MOF) in June 2016. It was reported that 69.4% (465 out of 670 projects) of public projects adopted IBS and achieved 70 IBS score (CIDB, 2017).

In 2017, ICU has produced one report on the status of IBS adoption in government projects and submitted to MOF on 31 August 2017. It was reported that

77.8% (1113 out of 1431 projects) of public projects adopted IBS and achieved 70 IBS score (CIDB, 2017).

IBS is a construction method that involves elements of building structures produced in a controlled environment whether at the plant or at the site of construction and installed into a building structure. IBS is divided into five main categories: Precast Concrete, Blocks, Steel Framing, Timber Framing, Reusable Formwork and other categories that have been identified. other categories that meet IBS criteria such as Dry Wall System and Expanded Polystyrene System (EPS) Wall (CIDB, 2014).

The building components that can be constructed using the IBS system consist of 5 types of components i.e. Column, beam, wall, slab and roof truss. Referring to the IBS Module 01 Introduction to the Industrial Buildings System (IBS) For Building has explained regarding component fragmentation by category.

Table 1.3

IBS Building Component by category with fraction to component

Category	Component
Precast Concrete	Column Beam Wall Slab
Block	Column Beam Wall
Steel Frame	Column Beam Roof Truss
Timber Frame	Column Beam

Reusable Formwork	Roof Truss Column Beam Wall Slab
Others	Column Beam Wall Slab

Source: IBS Module, M01 Introduction to Industrialised Building System (IBS) for Building (CIDB, 2014)

The history of categorisation of IBS components is explained in Table 1.4.

Table 1.4

Categorisation of IBS Components

Year of IBS Introduction	Categorisation of IBS	IBS Component
Early 60's	Badir, Kadir, & Hashim (2002)	i. Frame system ii. Panel system iii. Box system
Early 90's	Badir & Razali (1998)	i. Precast concrete framing, panel and box systems ii. Load bearing block iii. Sandwich panel iv. Steel frame
2003	CIDB (2002)	i. Precast concrete framing, panel and box system ii. Formwork system iii. Steel framing system iv. Prefabricated timber framing system v. Blockwork system
2010	CIDB (2010a)	i. Precast concrete system

	ii. Formwork system iii. Steel framing system iv. Prefabricated timber framing system v. Blockwork system vi. Innovative

The first IBS scoring standard has started in 2005, the "Manual for Industrialised Building System (IBS) Content Scoring System". After 5 years of industry use, several improvements have been made including making the IBS Score as a standard in the construction industry and is named as "Construction Industry Standard (CIS 18: 2010) Manual for IBS Content Scoring System". In 2016, improvements were made with the addition of components and reviewing the entire CIS content of 18: 2010 (CIDB, 2015a).

1.2 Problem Statement

Construction Industry Standard (CIS 18: 2010) Manual for IBS Content Scoring System is a reference and guide to construction industry players, especially for the IBS players. Apart from that, this manual has also become a reference source and the scientific materials used in the syllabus at universities involving the subject of construction. To ensure this Manual for IBS Content Scoring System has a positive impact on the industry, reviews and improvements are needed. The new technology in the construction sector, such as Prefabricated Prefinished Volumetric Construction (PPVC) and Building Information Modelling (BIM) needs to be considered. According to the

Stage Effectiveness Study Program Standards to Stakeholders that were conducted on 1 to 20 September 2013 by the Malaysian Qualifications Agency's Standard Division found that the duration and requirements of the program standard review were for five (5) years.

The Construction Industry Standard (CIS 18: 2010) published in 2010 and has now reached its seven-year use. It is therefore necessary to make improvements and revisions of the standards to meet current industry requirements.

1.3 Research Question

The main questions that would be answered in this research are as follows:

i. Is the current IBS content according to CIS 18: 2010 (Manual for IBS Content Scoring System (IBS Score)) effective?

ii. What are the new factors influencing current IBS content?

iii. What are the significant indicators of IBS content in terms of IBS usage?

iv. What are the recommendations to improve the IBS content?

1.4 Research Objective

The aim of this study is to identify the effectiveness of IBS content according to Manual for IBS Content Scoring System (IBS Score) CIS 18:2010. The aim is supported by the following objectives:

i. To identify the adequacy of Manual for IBS Content Scoring System (IBS Score) CIS 18:2010.

ii. To study the new factors of IBS Score implementation.

iii. To propose a recommendation to improve the IBS content.

To explain further, Table 1.5 shows a summary of the research objectives and research questions in this research. The table included research objectives, research gaps, research questions and the expected results.

Table 1.5

Summary of Research Objective, Research Gap and Research Question

No.	Research Objective	Relation to Literature Review (Research Gap)	Research Question
1	To identify the adequacy of Manual for IBS Content Scoring System (IBS Score) CIS 18:2010.	There are few reports that identify the factors influencing the IBS content	What are the factors influencing current IBS content?
2	To study the new factors of IBS Score implementation.	Based on the literature, there is currently no available data captured related to the significant factors of IBS content implementation	What are the significant factors contributed by IBS content implementation?
3	To propose a recommendation to improve the IBS content.	There are plenty of workshop discussion, interview and information on the recommendation to improve the IBS content	What is the recommendation to improve the IBS content?

1.5 Scope of the Study

The scope of the study focus on the following:

i. Adequacy of CIS 18: 2010 and changes of the IBS factor.

ii. Obtain inputs from IBS professionals through focus group discussion about the new system or product.

1.6 Significance of the Study

This study was conducted in order to assist and benefit the stakeholders such as CIDB Malaysia and construction industry players in general. Construction industry players, especially those directly involved in the IBS construction project, require the latest construction standards to assist them in full engagement. The results of this study are for the input and further knowledge to be standardised in CIS 18 being proposed to CIDB Malaysia. The CIS 18 is the official document and used by the construction industry as a reference document in the calculation of the IBS content in a building.

1.7 Operational Definition

In this research, there are some terms used to clarify the research. Hence, the definition of each term is explained as follows:

1.7.1 Industrialised Building System (IBS)

IBS is defined as a system or construction technique in which components are manufactured in a controlled environment (on site or off site), transported, positioned and assembled into a structure with minimal additional works (CIDB, 2010a).

Kamaruddin, Mohammad, Mahbub, & Ahmad (2013) described IBS as a construction technique where components are manufactured on or off-site, transported and then assembled into a structure with the minimum of work. IBS is also considered as a Modern Method Construction (MMC).

1.7.2 IBS Professional

A person who has attended a course organised by Accredited Training Centre by CIDB and meets a certain requirement.

1.7.3 IBS Score System

IBS score system is a systematic & well-structured assessment that can be used to measure the usage of IBS in a consistent way. The higher IBS score is the indicator for higher reduction of site labour, lower wastages, less site materials, a cleaner environment, better quality, neater and safer construction at the site, faster project completion as well as lower total construction costs (Mustafa, Ahmed, Amila, Zawawi, & Ghazali, 2015).

1.7.4 Structural System

The structural system for IBS score including precast concrete beams and columns, steel, prefabricated timber, etc.

1.7.5 Wall System

The wall system for IBS score involving precast concrete panel, glass, dry partition, blockwork, etc.

1.7.6 Other Simplified Construction Solutions

The context of other simplified construction solutions is based on standard components according to MS 1064 (Part 4, Part 5 and Part 10) and the repetition of structural layout. In the IBS Roadmap 2003-2010, the Modular Coordination (MC) was introduced. MC is a concept of coordination of dimensions and shape where buildings and components are dimensioned and positioned in a basic unit or module known as 1M which is

equivalent to 100mm, as stipulated in MS 1064 and developed in 2000. The concept allows standardisation in design and building components (CIDB, 2007). It encourages participants from manufacturers and assemblers to enter the market, thus reducing the price of IBS components. In essence, MC will facilitate open industrialisation which is the prime target of the roadmap. The proposed enforcement of using MC through Uniform Building By-Laws (UBBL) would encourage open system in IBS.

1.8 Summary

This study aims to identify the factors influencing IBS score, a significant indicator of IBS Score and to propose the recommendation to improve or change the IBS score. The foundation of this study is provided in this chapter to give a clear view before proceeding further to the following chapters. Chapter 1 consists of an overview of the research which stated research objectives, research questions, problem statement and significance of the study. Chapter 2 includes previous studies done by various researchers including journals, articles, books and theses to identify the research gap. Chapter 3 provides information on the research methods of the research. The focus group methods have been chosen to achieve objectives that have been stated.