DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

INSTALLATION OF PRECAST COLUMN AND BEAM

(INDUSTRIALISED BUILDING SYSTEM)

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DECEMBER 2018

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Entitled

INSTALLATION OF PRECAST COLUMN & BEAM (INDUSTRIALISED BUILDING SYSTEM)

Accepted in partial fulfilment of requirement has for obtaining Diploma In Building.

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STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references stated herein, prepared during a practical training session that I underwent at Pembinaan Marwan Sdn Bhd. for duration of 14 weeks starting from 3rd September 2018 and ended on 7th December 2018. It is submitted as one of the prerequisite requirements of DBG307 and accepted as a partial fulfilment of the requirements for obtaining the Diploma In Building.

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Thank you to my supervising lecturer, Dr. Siti Akhtar Binti Mahayuddin and all the UiTM lecturers, which have taught and give their best to nurture me in becoming a better student and person. A huge appreciation also meant for lecturers in Department of Building who have directly involved during my training period. I value the time and effort they have contributed towards the successful completion of my training and report.

Last but not least, thank you to my beloved parents for their sacrifices over the years of me growing up and become a better person.

Thank you so much.

ABSTRACT

Buildings are one of the main symbols for an advanced country. For a country that is actively developing, it is crucial to have large scale of technology against time especially in a construction sector. Therefore, this report will be introducing to everyone about how a building can be built in a short period of time. This report was conducted at construction site, *Bangunan Klinik Kesihatan (Jenis 3)* at Pauh, Perlis. The main objective of this report is to illustrate the growth of Industrial Building System in Malaysia. Next, to identify the method of installation for IBS and determined the equipment and machineries used through the process. Varieties type of columns and beam were used for clinic's building. A modern and efficient infrastructure is a key to prosperity of balance economy.

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CHAPTER 1.0

INTRODUCTION

1.1 Background and Scope of Study

This report contains development of Industrial Building System in Malaysia and the installation of precast column and beam at *Klinik Kesihatan (Jenis 3) Pauh, Perlis*. This report is focusing on the Industrial Building System based on CIDB's current Industrial Building System (IBS) classification which is well known in Malaysia. It will consist of explanation on how Industrial Building System components will be installed. This report will be explaining;

i. The installation of precast column and beam.

ii. The equipment and machineries use for the process.

1.2 Objectives

i. To understand the construction method of precast column and beam for Industrial Building System.

ii. To understand the equipment and machineries used for installation of Industrial Building System.

1.3 Methods of study

i. Observation

Through observation that I have done, I have observed the sequence of Industrial Building System installation starting from when the lorry arrived at the site until the columns and beams were unloaded from the lorry. I have also involved with the team in reading the details drawing of location precast column and beam at the site to know the actual position of columns and beams that supposed to be installed. I have been observing for two months where 80% of the installation has already done. I did take photos and videos for my reference and jotted down notes to make sure that I do understand the whole process. As I am doing my training here, I did analysis on the drawings and plans of Industrial Building System given by generosity of the team. There are two types of drawing which are structural drawing and architectural drawing. The team also contributed few articles and journals regarding my report that I have chosen.

ii. Interview

I did also do some interview sessions with the crane supervisor who explained more details about the installation and how to handle Industrial Building System. Besides, I also did interview sessions with engineers and workers at the site. I did record few sessions and jotted down notes.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction of Company

On 28th June1983, Pembinaan Marwan Sdn Bhd incorporated and becomes a building and civil engineering contractor based in Ipoh, Perak. Pembinaan Marwan Sdn Bhd is fully owned Bumiputera company registered with Construction Industry Development Board (CIDB) and Pusat Khidmat Kontraktor(PKK) with grade registration G7 (Bumiputera).

Since the incorporation in 1983, PMSB has mobilized constructions and civil engineering projects either for private or government sector. Over 50 small and large projects were successfully completed with the value of more than RM 440,000.00 million. For instance, from the construction of schools, office builders, hospital, court house, wholesale complex to the channelization of river in Kampung Gajah, Perak.

PMSB is a company that has vision, efficient in management and technical, in compliance with its practices and innovation. In 1994, PMSB was recognized as the Kontraktor Bumiputra Beribawa Malaysia by the Prime Minister's Department. In 2012, the company was selected to be in Teraju's TERAS Bumiputera Entrepreneurs Programme also by the Prime Minister's Department under Majlis Tindakan Agenda Bumiputera (MTAB).

Today, after decades of steady growth powered by a relentless dedication to excellence, PMSB will continues to earn its reputation by participating with goverment agencies and private projects throughout Malaysia in order to be known as a successful Bumiputera Contractor's Company.

2.2 COMPANY PROFILE

The logo and symbol for Pembinaan Marwan Sdn Bhd is shown in figure 2.1 below.

Figure 2.1 PMSB logo & symbol

2.2.1 Company Managing Director

Datuk Hj. Wan Azizi Bin Dato' Seri Haji Wan Mohamed DPSM, DSM, AMP, JP

2.2.2 Name of company

Pembinaan Marwan Sdn. Bhd.

2.2.3 Date of Incorporation

28TH June, 1983

2.2.4 Business and Registered Address

No. 6 Jalan Canning Estate Garden, 31400 Ipoh, Perak Darul Ridzuan.

2.2.5 Prime Bank

i. Maybank Malaysia Berhad

ii. RHB Islamic Bank Berhad

2.2.6 Authorised Capital & Paid Capital

i. RM 5,000,000

ii. RM 4,250,000

2.2.7 CIDB registration No

1960523-PK001422

Grade: G7(Bumiputera)

2.2.8 Business Registration No

8162/83 (Tempatan 103470-H)

2.2.9 Email

Pmsb_mw@yahoo.com

2.2.10 Company Mission and Vision

i. To be a leading construction company in Malaysia in tern of client services

ii. To provide services efficiently and effectively through its personnel and capital resources

iii. To deliver a quality finished products and services to client

2.3 Organization Chart

The company organization chart is shown below in Figure 2.2.

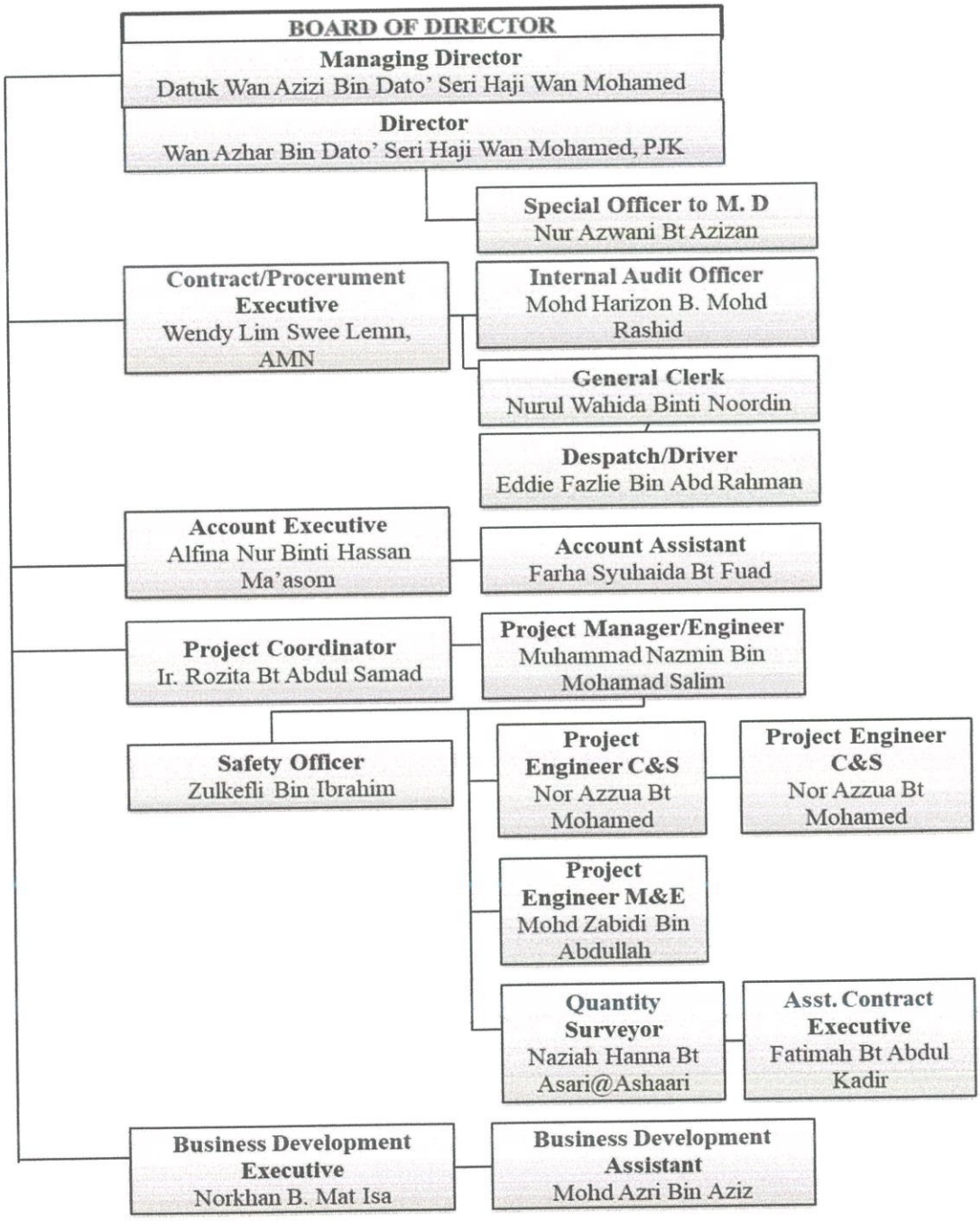


Figure 2.2 Organizational Chart of PMSB

2.4 LIST OF PROJECT

After 30 years of soaring towards a better construction company. Pembinaan Marwan Sdn Bhd has completed small and big projects. All the completed projects can be seen in Table 2.1.

2.4.1 Completed Projects

Table 2.1 Completed Projects

No	Project	Client	Value	Date of Completion
1	Integrated Development Program For Orang Asli in Sungai Perak	Malaysia Public Work Department	RM 26,270,252.00	30th June 2016
2	Complete of Abandon Works at Pulau Pangkor Police Station At Lot 5325 Pangkor, Perak Darul Ridzuan	Ministry of Home Affairs	RM 22,622,300.67	06th December 2013
3	Proposed Educational Project Development for Secondary School Education Mata Ayer, Mukim Ngulang, Perlis Indera Kayangan.	Ministry of education Malaysia	RM 21,417,585.50	29th February 2012
4	The Design and Built of Water Treatment System of Perkampungan Orang Asli, Perak for Package 1A	Ministry of Rural & Regional Development	RM 11,789,709.00	11th February 2010

2.4.2 Projects in Progress

While Pembinaan Marwan Sdn Bhd is handling on project in Pauh, Perlis, they also currently are handling another project as shown in Table 2.2.

Table 2.2 Projects In Progress

No	Project	Client	Value	Date of Completion
1	Health Clinics Kuala Kangsar	Malaysian Public Work Department	RM 21,997,480.29	12th May 2019
2	Health Clinics Pauh, Perlis	Malaysian Public Work Department	RM 22,114,300.67	20th Nov 2019

CHAPTER 3.0

INSTALLATION OF PRECAST COLUMN AND BEAM (INDUSTRIALISED BUILDING SYSTEM)

3.1 Introduction to Installation of Precast Column and Beam (IBS)

Project *Klinik Kesihatan (Jenis 3)* is currently carried out in Pauh, Perlis. It is a project that held to Jabatan Kerja Raya by Kementerian Kesihatan Malaysia while Pembinaan Marwan Sdn. Bhd is hired as the main contractor. The area of the site is 1.759 hector. The project duration started from 25th May 2017 and expected to end on 20th November 2019. However, due to slight problems and delay, the project will be end approximately few months late. Project also includes other building such as quarters block (type G), ancillary, pump house, TNB substation, guard post and garage ambulance. List of nominated sub-contractor can be seen in Table 3.1.

Table 3.1 List of Nominated Sub-contractor

NSC Electrical	Nadi Ara Mechanical and Electrical Engineering Sdn. Bhd.	No 6, Taman Indera, Jalan Sekolah Derma, 01000 Kangar, Perlis.
NSC Mechanical	Shamnita Maju Enterprise	No 4, Lorong Sri Purnama Kampong Jejawi Dalam, 26000, Arau Perlis.

This project used mostly cast in situ method however there were few components for concrete structure that used precast column and beam at the main building. Besides that, the main wall of the building used concrete block masonry unit (CMU).

For this report, the focus will be on the Industrial Building System that is getting known in Malaysia. This system is actually quite new to a small state such as Perlis so it is a wise choice to choose this method of construction.

The main team that involved in this project to ensure that it runs smoothly without any problem is Mr. Mohd Azwan Bin Zakaria as the project manager, Mr. Muhammad Taufiq Bin Abdullah as the site engineer, Mr Mohammad Nasri Bin Jamil as the environment officer, Mr. Syafiq Jasrul as site supervisor and Miss Nor Azreen as the site clerk. All of them have played their roles really well. The site chart can be observed in Figure 3.1 below.

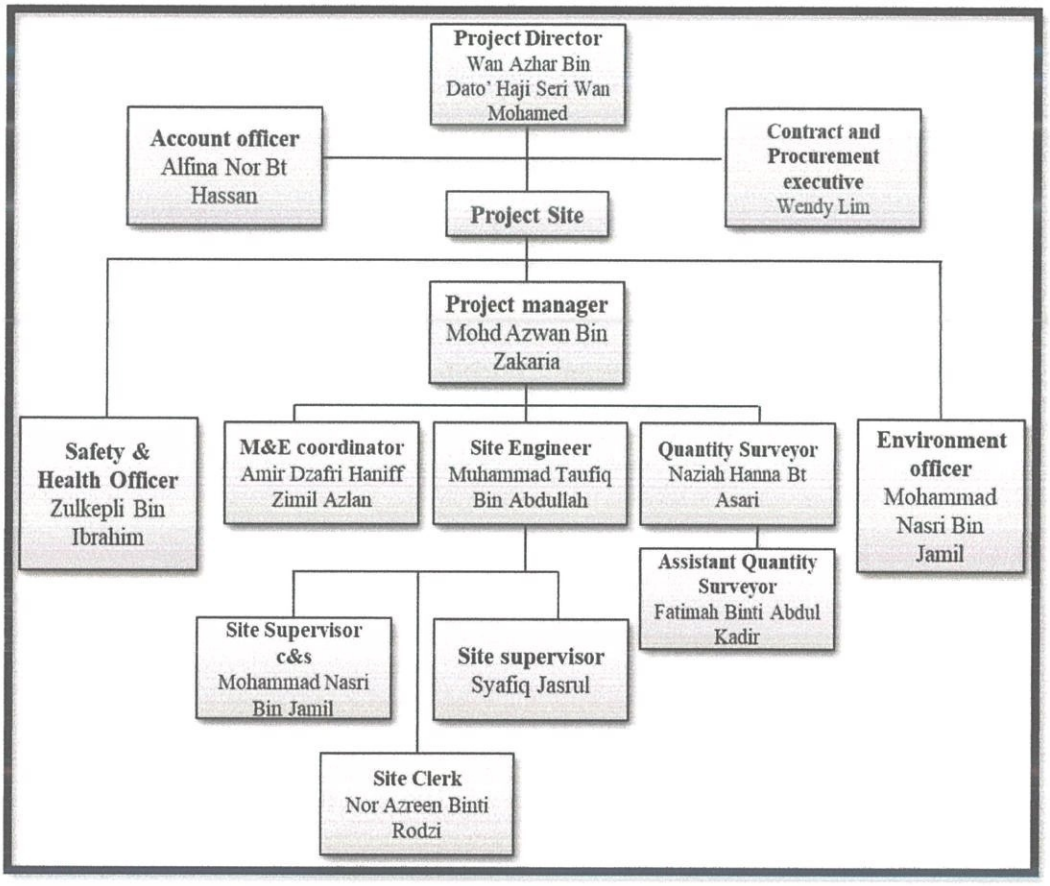


Figure 3.1 site chart project

Source: Pembinaan Marwan Sdn Bhd

Project *Klinik Kesihatan (Jenis 3)* is located at Jalan Desa Pauh 1, Taman Desa Pauh, 02600 Pauh, Perlis. The location of this construction site is not at the centre of Perlis hence it is far from busy road and human activities. However, this construction site still located next to a residential area which is Taman Desa Pauh. The project is located as shown in Figure 3.2 below.

Figure 3.2: Location Plan of the site

Image source: https://www.google.com/maps/place

The project is known as Klinik Kesihatan (Jenis 3) Pauh, Perlis. The authorities involved are *Jabatan Kerja Raya Perlis* with Civil Engineers Federation Perlis. The client for this project is *Kementerian Kesihatan Malaysia*. The main contractor for this project is Pembinaan Marwan Sdn Bhd. Project started 25th May 2018 but had some delayed for couple of months and still will be ended at 20th November 2019. The project signboard for as Klinik Kesihatan (Jenis 3) Pauh, Perlis is as shown in Figure 3.3 below.

Figure 3.3: Project signboard

3.2 Industrial Building System

Industrial building system (IBS) has been executed in few countries such as Japan, United Kingdom, Sweden and Hong Kong. It has been introduced at the early of 1960s but only started to deploy actively in Malaysia at year 1998 after Cabinet Ministers endorsed Industrial Building System strategic plan. Industrial Building System in Malaysia was first implemented in two pilot projects for Jalan Pekeliling, Kuala Lumpur and Rifle Range, Penang of 17-18 series flats. The construction industry has started to embrace it as a method of attaining better construction quality, reducing all hazards regarding safety and health, settle the labour problems and fasten the project period. Hence, Industrial Building System is one of the effective methods to apply.

The focus of this study is on the method installation of precast column and beam. Project *Klinik Kesihatan (Jenis 3)* only use component precast column and beam for the main building. The concept of precast construction also known as prefabricated majorly standardised and produced in location far from the building and transported to site. Industrial Building System components in Project *Klinik Kesihatan (Jenis 3) Pauh, Perlis* is shown in Photo 3.1.

Photo 3.1: Industrial Building System been installed in Project *Klinik Kesihatan (Jenis 3)* Pauh, Perlis.

3.2.1 Precast Column

Generally, columns come from numerous ranges of design, shape and finishes. It can be in any shape whether circular or square shape and designed to take in any additional fittings. Columns height starts from 2.5 metre to 4 metre high and taken much more time to build. Meanwhile, precast column can be made to the architect's design. Precast column can provides essential support and are ideal for multi-story and industrial buildings which is very convenient and time saving. Precast column on site can be seen in Photo 3.2 below.

Photo 3.2: Precast columns on site

Precast column can give an impressive finish and support quite loads from the building and beams. It too can be erected at night or in residential area as it does not associated with any noise from machines. Thus, it would not produce deafening sound. Precast comes with empty holes at the bottom following the main bars arrangement and size.

As the strength and stability exist, it increases the extensive span of building. For every installation of precast column, it is estimated to finish minimum 8 numbers of columns in a day. Precast components must go through grouting process using Grade 60 also known as non-shrink grout.

There are few types of precast column that have been used in this project.

i. CR 1

CR 1 is the type of column which has no corbel or steel fittings for jointing.

ii. CR 2

CR2 is the type of coloumn which Corbel is at the left side.

iii. CR 3

CR3 is the type of column which corbels are at the side upper and lower.

iv. CR 4

CR4 have corbels at the left and lower.

v. CR 5

CR5 has three corbels.

vi. CR 6

CR6 have corbels at the each side of column.

3.2.2 Precast Beam

From ancient time, system beams and columns has been use to support roof. A beam is structural member which has spans horizontally between supports and carries loads which act at right angles to the length of the beam. Example of precast beams on site can be seen in Photo 3.3.

Photo 3.3 Precast beams

Beams are used to support roof and other components in a building that need it support. Concrete beams and slabs during construction require complex process and take longer time to finish. Thus, precast beams are introduced to the construction field. The jointing of precast beams can be seen in figure 3.4.

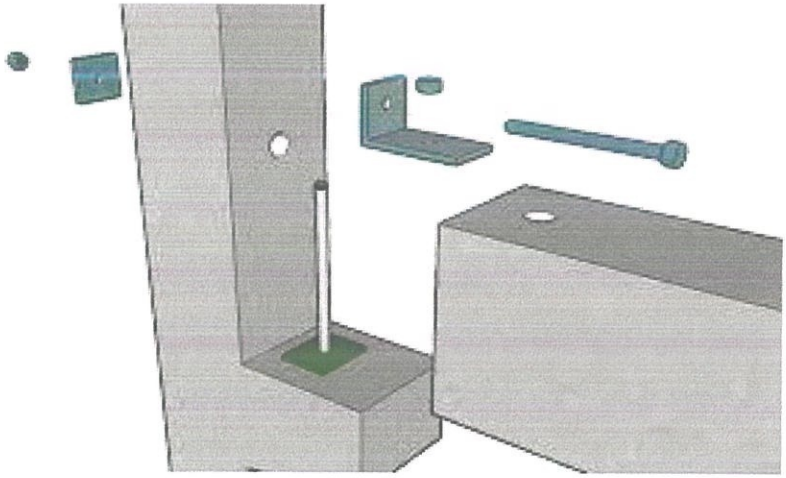


Figure 3.4 Example of precast Beam Jointing

Image source: http://www.bs-italia.it/prodotti/bsitalia_rs2540_schede5en.php

Precast beam is an alternative way for economical and high quality building. It is built to transfer load from wall or slab above and straight to the vertical element. They are compacted, set and cured in very controlled environment and after getting required strength then transported to the real location where the beams are to be used and placed as whole and joint are made. The simplest beam will be rectangular beam. Alternatively, the beams will be provided with recesses at the end that fit over corbels or steel sections projecting from the columns. Precast beams and columns jointing is shown in Photo 3.4.

Photo 3.4: Precast beams on site

There are two types of beam use in this construction which have different in length and weight. Both beams have same design and shape. Crane will be used to lift up and place the beams on the corbels as the weights are quite heavy. All the precast components will be handled with the necessary provided lifting equipment, consisting of adequately size lifting wire roped, specially provided clamp or shackles. At the end of the precast beam, there will be corrugated sleeve/ducts that need to be checked and cleared out from any dust and debris or loose concrete.

Furthermore, precast concrete components need to be grout. The grouting material is known as Non-shrink grout cement as poured at precast components must be achieved minimum of compressive strength of 50 MPa after 28 days. Non-shrink grout will be tested using 3 numbers of cubes of 1 cube 100x100x100 cubes for compressive test at 7 days and another 2 numbers of for 28 days stren

3.3 Equipment and Machineries

Offsite construction is a description of spectrum manufactured or assembled away remotely from the building site prior to installation in their final position. It is an interchangeable terms which refer to the part of construction process which carried out away from building area or sometimes made in temporary production facilities close to construction site.

Therefore, machineries involved while installing or transporting the Industrial Building System components are very crucial to be known. Installation of precast column and beam will be installed with using crane. The open radius of crane is for 60 tonnes. Crane will be used to move the components from lorry once it arrived. Example of 60 tonnes crane is as shown in Photo 3.5.

Photo 3.5 Crane on site for IBS

For installing column, levelling is the first thing to check. Levelling is also known as art of determining the relative elevations of different objects or points on the earth's surface. However, in installing Industrial Building System, auto level is use to check on the floor level.

Basic surveying tasks usually involved with measurement of angles procedure. Every method of measurement must be related to the system which is used to define the positions of points in order to use the result. A theodolite is an arrangement of optical and electronic components which must be assembled accurately. Any theodolite must give accurate results in any condition whether tropical or arctic weather. Theodolite size must be small and light enough to be carried comfortably. Figure 3.5 shows differential in levelling.

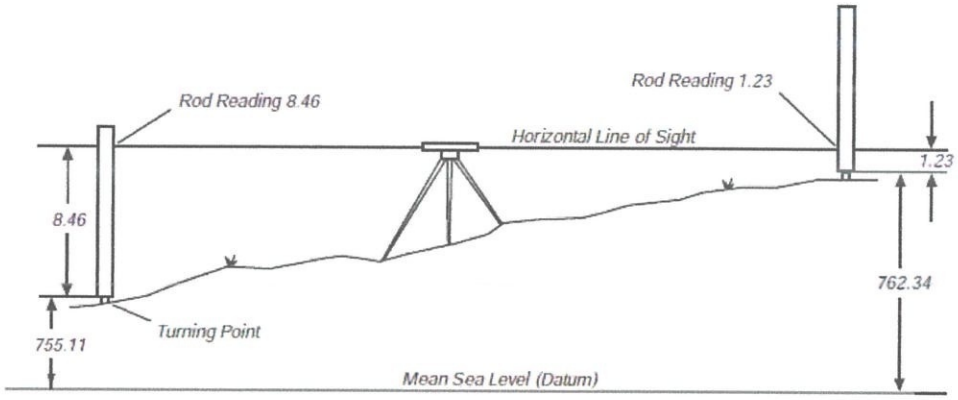


Figure 3.5 Differential in levelling

Image source: https://www.researchgate.net/figure/Spirit-levelling-procedure_fig1_312031900

Besides that, shim plate is also very important component when installing the precast column as the precast column will rest on shim plates at the bottom. The required bottom level of precast column will be controlled by shim plates. The crane will stop once the precast column rest on it. Shim plates function to fill small gaps or spaces between objects. It is usually use in order to adjust for better fit. Shim plates also being used as spacers to fill gaps between parts subject to wear.

For rigging, wire rope with diameter of 3mm to 15mm will be used to complete the crane accessories for lifting the precast column and beam. It will be used to lift precast column and cranes up to 10 tonnes. Shackles are also one of equipment for crane to lift the Industrial Building System components. It will be tied at the top of column or both end of beam.

Last in installing the components, grouting must be done. The grouting material use for non-shrink grout (NSG cement) as poured shall achieve a minimum of compressive strength of 50Mpa after 28 days. Three numbers of cubes consisting of 100mmx100mmx100mm cube use for compressive test at 7 days and another two numbers of cubes for 28 days strength.

3.4 Method statement

The installation of precast columns in the construction site was done according the sequence of method statement below.

3.3.1 Precast Column

6th September 2018 – 14th September 2018

NO	*OPERATION*	*SEQUENTIAL DIAGRAM*	*MACHINERIES AND PLANT*	*MANPOWER/ LABOUR*	*EQUIPMENTS*	*DURATION*
1.	Check the starter bars position, level of the floor and mark the setting out of column on the floor.			- 1 skilled worker - 1 unskilled labor	-Automatic level -Level staff	- 1 hour

2.	Crane park into the position where location precast column to be installed is within the working radius & hoisting capacity the crane.		- Crane	- 1 driver		- 40 minutes
3.	Crane slowly lifting up column until it is vertical and hoist to the location it will be installed.		- Crane	- 1 Driver - 1 Signal man		- 15 minutes

4	When the column reaches the install location, workers will hold the precast column into its correct orientation and instruct the crane slowly lower down the precast column to allow the starter bars to slot into the corrugated ducts in the precast column.		- Crane	- 1 driver - 2 unskilled workers - 1 signal man		- 15 minutes
5.	The precast column will rest on shim plate at bottom. The required bottom level of precast column will be controlled by shim plate		- crane	- 1 driver - 2 unskilled workers		- 10 minutes

7	The verticality of the precast column will be checked with theodolite. Once the check is done, crane will slowly lower down the precast column and checked again before remove the wire ropes and shackles on top of the precast column		- Crane	- 1 driver - 1 skilled worker	- Theodolite	- 20 minutes
8	Workers will seal the gap at the bottom of precast column with dry mixed of non-shrink grout (mortar form).			- 2 unskilled workers	- Trowel - Pail	- 1 1/2 hour

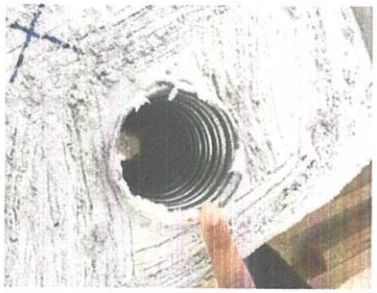
9	When the non-shrink grout at the bottom of precast column is set, the workers will start mixing the non-shrink grout & water at the great ratio by using mixing gun and pouring the non-shrink grout (liquid form) into the corrugated ducts from the opening at the middle of precast column. Only 2 out of 4 openings will be poured.			- 2 unskilled workers	- 2 number of pipes - pail	- 1 hour
10	Workers will clean up the non-shrink grout and seal the corrugated duct openings at middle of precast column			- 2 unskilled workers	- Trowel - Scoop - Pail	- 10 Minutes

11	Volume of the non-shrink grout used will be recorded. Then, compare the actual used volume of non-shrink grout with the calculated volume. The difference between the actual used volume and non-shrink grout must not exceed 10% of the calculated volume.			- 1 skilled worker		- 20 Minutes

3.3.2 Precast beam

The installation of precast beams in the construction site was done according the sequence of method statement below.

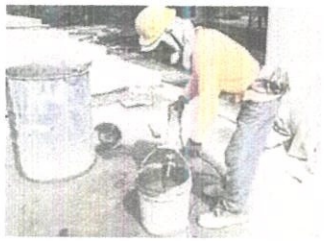
22nd November 2018 – 29th November 2018

NO	*OPERATION*	*SEQUENTIAL DIAGRAM*	*MACHINERIES AND PLANT*	*MANPOWER/ LABOUR*	*EQUIPMENTS*	*DURATION*
1.	Check the dowel bars & neoprene pad position on corbel and corrugated ducts in the precast beam are free from any blockage.			- 1 skilled worker	- Measuring tape - Marker	- 10 Minutes

2.	Ensure that the location installed is within the working radius & hoisting capacity of the crane.		- Crane	- 2 skilled workers - 1 installer - 1 driver - 1 signal man	- Measuring tape - Binocular - Wire rope	- 20 minutes
3.	A rope is tie to the precast beam to control the movement of the beam during the hoisting process. The precast beam is hoisted to install location by using a set of 2-legged wire rope.		- Crane	- 1 driver - 2 skilled workers - 1 installer	- Binocular - Wire rope	- 40 minutes

4	Crane will slow down the swing to let the workers guide the beam to the correct position & orientation by using two numbers rope tied at the precast beam.		- Crane	- 1 driver - 2 skilled workers - 1 installer	- Wire rope - Binocular - Steel stair	- 1 hour

5	The signal men will instruct the crane to slowly lower down the precast beam to allow the dowel bars to slot into the corrugated ducts. The crane stop immediately once the precast beam is touch on the neoprene pad and workers remove the lifting shackle.		- Crane	- 2 skilled workers - 1 driver - 1 installer - 1 signal man	- Wire rope - Binocular - Steel stair - Shackles	- 15 minutes
6	The workers will adjust the precast beam to match the setting out line before the precast beam is allowed to seat fully on the corbel.		- Crane	- 2 Skilled workers	- Wire rope - Shackles - Steel stair	- 5 minutes

9.	The grouting work of precast beam start shortly after the removal of wire ropes. When the dry mixed of non-shrink grout is set to the workers will mix with water at correct ratio by using mixing gun.			- 1 skilled worker	- Pail - Non-shrink grout - Mixing gun	- 15 minutes
10	The workers start pouring the non-shrink grout into the corrugated ducts and vertical gasps are full.			- 1 skilled worker	- Pail - Non-shrink grout - Gloves	- 5 minutes

11	Clean up the non-shrink grout on the precast beam or floor.			- 1 skilled worker	- Basin - Trowel	- 10 minutes

CHAPTER 4

CONCLUSION

4.1 CONCLUSION

As the development of Malaysia improved, the economic growth has created a higher demand in construction sector. This causes the demand of building construction increased rapidly which is very fit to upgrade to new construction method which enhance quality over project. In other words, Industrial Building System (IBS) is a suitable methodology to fulfil the quality concern. Industrial Building System (IBS) has grows enthusiastically as an alternative of attaining a better construction quality and productivity. The aim to expand Industrial Building System (IBS) in Malaysia is to promote better system in delivering construction end-products which offers efficiencies.

Industrial Building System (IBS) method construction is not as new as it seems because it has started to implement since 1960 in Malaysia by the use of precast concrete beam-column elements. However, Industrial Building System (IBS) is not a common practice for project located in rural areas and small state like Perlis. As much as there were studies regarding advantages and setback, these studies were focusing on huge projects located in urban area. Therefore, the advantages and setbacks are resistance to change through challenges and some even produce negative perceptions towards the design. Nevertheless, it is a positive step for a small state like Perlis to be exposed and try a new construction method apart from the conventional technologies to more systematic and mechanized system employing the latest method.

However, some advantages are not applicable and problems still arise. For instance, Malaysia has lacks of local Industrial Building System (IBS) manufacturer so not many manufacturers are available to supply at cheaper price and it takes time to get a new supply. For example in this site, the company has to pay the payment with cash first until the next step can be taken. Besides, Industrial Building System (IBS) also requires highly skilled workers to install as it is very risky if the workers are not properly trained. The installation work involved with crane and huge machineries so it is crucial for them to identify risks and hazards. Large components also might be a problem to transport from one place to another and this will leads to cost increasing and time especially in rural areas.

After all, there are a lot of solution and ways to handle the Industrial Building Components. The machineries and equipment involved exist to help ease the contractor's works. Both of machineries and equipment actually make the installation work easier and swift.

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