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SAFETY ASPECT IN INSTALLATION INDUSTRIALIZED BUILDING SYSTEM (IBS) COMPONENT

NOOR YUHANA BT MAAMOR

A report submitted in fulfillment of the requirements for the award of the degree of Bachelor Degree of Civil Engineering

Faculty of Civil Engineering and Earth Resources
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NOVEMBER 2009

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“Almighty Allah, please blessing to them….
My father, my mother, my brother, my young brother,
My lecturer, especially my supervisor Mr. Zahrizan B. Zakaria
My friends and to all muslim…..this is for us
Thanks you for your support”

ACKNOWLEDGEMENT

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ABSTRACT

Safety aspect in construction is very importance and it has to apply to any construction project. It can be lead to accidence that could cause injured to workers as well the public and some causes can lead to death. Pre-cast construction also not exclude from having hazard in its construction process during the installation component. However, the most construction accidents occur because lack of proper planning, unsafe equipment, not follow the method statement, unsafe site conditions, not using the safety equipment that was provided, and poor attitude towards safety during installation process. The aim of this project is to study the process of installation component pre-cast concrete and to identify the safety aspect and the requirement during the process installation at site, included to identify the level of safety during installation process at site. The data was collected through documents study, interview, and industrial visit, constructed and distributed questionnaire in order to identify the safety requirements in pre-cast construction. All of the interview and research questionnaire survey are conducted among contractor that registered as class 7 with Construction Industrial Development Board (CIDB) and class A with Pusat Khidmat Kontraktor (PKK) in Klang Valley. Returned questionnaire were analyses with used average index and frequency analysis method to identify safety aspect using pre-cast construction. The results indicate that the safety aspect implemented by company involved in precast construction process is at a good level at safety aspect during bracing, propping, welding and grouting process and very good level at safety in general aspect and safety aspect during lifting process. This are a few safety aspect and requirement during installation process such as construction site workers equipped with personal protective equipment (PPE) and etc. In conclusion with existence of this study, it can boost up knowledge and give detailed information about safety aspect in Industrialized Building System using pre-cast concrete and must improve step of awareness until 0% of accident.

ABSTRAK

Aspek keselamatan dalam pembinaan adalah sangat penting dan perlu dititikberatkan dalam mana-mana projek pembinaan. Ia akan membawa kepada kemalangan yang menyebabkan kecederaan yang serius kepada para pekerja atau orang awam malah kadang-kadang dapat membawa kepada kematian. Pembinaan pratuaang juga tidak terlepas daripada bahaya dalam kerja pembinaan semasa proses pemasangan. Bagaimanapun, kemalangan berlaku kerana kurang perancangan, peralatan yang tidak selamat, tidak mengikuti method statement, keadaan tapak yang tidak selamat, tidak menggunakan peralatan keselamatan yang disediakan, dan sikap yang lemah terhadap keselamatan semasa proses pembinaan. Matlamat projek ini ialah untuk mengkaji proses pemasangan komponen konkrit pratuang dan mengenalpasti aspek keselamatan dan keperluan semasa proses pemasangan di tapak bina termasuk mengenalpasti tahap keselamatan semasa process pemasangan di tapak bina. Data telah dikumpulkan melalui dokumen kajian, temuramah, dan melawat tapak, membuat dan mengedar borang kaji selidik untuk mengenalpasti keperluan keselamatan dalam pembinaan pratuang. Semua temuramah dan borang kaji selidik juga dijalankan kepada para kontaktor yang telah berdaftar sebagai gred 7 dengan Lembaga Pembangunan Industri Pembinaan (CIDB) dan kelas A dengan Pusat Khidmat Kontraktor (PKK) dalam kawasan lembah kelang. Pemulangan Boring kaji selidik akan dianalisis dengan kaedah indek purata dan kaedah kekerapan untuk mengenalpasti aspek keselamatan dalam pembinaan pratuang. Keputusan menunjukkan aspek keselamatan yang diamalkan oleh syarikat yang terlibat dalam proses pembinaan pratuang adalah di tahap bagus pada aspek keselamatan semasa merembat, propping, kimpalan dan grouting dan tahap sangat bagus pada aspek keselamatan secara umum dan aspek keselamatan semasa proses mengangkat. ini adalah sebahagian aspek keselamatan dan keperluan semasa proses pemasangan seperti pekerja ditapak bina dibekalkan dengan peralatan perlindungan peribadi (PPE) and lain-lain lagi. Kesimpulannya dengan adanya kajian ini, dapat menambahkan pengetahuan tentang aspek keselamatan dalam “Industrialized Building System”menggunakan konkrit pratuang dan langkah keselamatan perlu dipertingkatkan sehingga 0% kemalangan yang berlaku.

LIST OF ABBREVIATIONS

IBS – Industrialized Building System

CIDB - Construction Development Board Malaysia

SOCSO - Social Security Organization

DOSH - Department of Occupational Safety andHealth

AHP – Analysis Hierarchy Process

LRT - Light Rail Transport

PKK - Pusat Khidmat Kontraktor

PKNS – Perbadanan Kemajuan Negeri Selangor

A.I – Average Index

CMU - Concrete Masonry Unit

HIRARC - Hazard Identification Risk Assessment Risk Control

PPE - Personal Protection Equipment

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CHAPTER 1

INTRODUCTION

1.1 Introduction

A Pre-cast construction is classified as a one of the Industrialized Building System (IBS). However, Industrialized Building System (IBS) is not a new concept construction in Malaysia. Pre-cast construction is one of the construction method where the component is being produced factory or site lift off and attach be a building structure. Pre-cast concrete elements are concrete products that are manufactured and cured in a plant environment and then transported to a job site for installation. This method has its own significance and deficiency. Other that, safety aspect in construction is very importance and it has to apply to any construction project. Safety is an issue that has no end and every year will have accidents occurred at site construction. However, it can be lead to accidence that could cause injured to workers as well the public and some causes can lead to death.

Pre-cast construction also not exclude from having hazard in its construction process during the installation component. This method is less popular compare with conventional because of this phenomena, most contractor still not fully understand safety aspect when used the pre-cast in construction. Pre-cast method construction is different from ordinary method.

Pre-cast who do their own installations knows there are procedures required to achieve a high level of quality, customer satisfaction and most importance safety. Since the installation process are unique, the procedure may vary and become complex. To make installation run smoothly it is best to have experienced workers. Plan should take the initiative and train employees, developing them into highly skilled installer. This goes for foremen, welders, crane operators and whole crew. If procedures are kept simple and consistent, installation workers can achieve safe and cost effective installation.

Pre-cast concrete buildings were introduced in Malaysia in 1966 when the government launched two pilot projects for pre-cast houses. The construction of Tuanku Abdul Rahman Flats in Kuala Lumpur and the Rifle Range Road Flats in Penang were the first time that pre-cast concrete elements were used to construct mass houses (CIDB Digest, 2005). The Social Security Organization (SOCSO) record shows that a total of 4654 out of 73858 industrial accidents recorded in 2003 were come from the construction industry. (Mohammed Taher Alashwal, 2008) but it different if used precast concrete, the statistic from CIDB shows the accidents are 50% from heavy lifting, 20% installation, 10% other factor, and more 10% from during transportation component to storage accidents.

1.2 Background Study

Industrialized building system is not new concept in Malaysia. One of the common divisions in construction industry is the Industrial Building System (IBS) which has been introduced in Malaysia since 1966 for the projects which involve pre-cast construction. According to Construction Industry Development Board Malaysia there are five types of the IBS used in Malaysia:

1. Pre-Cast Concrete Framing, Panel and Box Systems.

2. Steel Formwork Systems.
3. Steel Framing System.
4. Prefabricated Timber Framing Systems.
5. Block Work Systems.

(Ahmad Baharuddin, 2006).

Pre-cast component come in a variety of shape for different of usage, both architecture and structure. It included the traditional pre-cast beam, column, slab, wall and usage of pre-cast element eliminates or greatly reduces conventional formwork and props. Pre-cast construction also lessens the problem of site wastages and the related environmental problem. The prefabricated also provide a safe working platform for workers to work on. Workers and material are also greatly reduced at the construction site. The most importance aspect of an installation is the safety of your workers and anyone on or near the jobsite. Installer must have a detailed safety procedure in their method of installation that meets all Department of Occupational Safety and Health (DOSH). Other than, crane operator also must be certified to meet DOSH requirements (Rofizlan Ahmad, 2001).

The construction industry knows as one of the most hazardous activities (C.R Che Hassan, O.J Basha,W.H Wan Hanafi, 2007). There are many hazards and risks associated with these five types of IBS at every stage of the construction process starting from the manufacturing stage to the erection stage. In every stage there are regulations and requirements to provide safety environment at the work place that has to be met.

1.3 Problem Statement

Industrialized Building System (IBS) is believed to be relatively not a new approach in Malaysia. However, the most precast construction accidents occur

because lack of proper planning, unsafe equipment, not follow the method statement, unsafe site conditions, not using the safety equipment that was provided, and poor attitude towards safety during installation process. Therefore, it indicated that there is lack of consideration of safety and risk evaluation in IBS construction. Besides that, the safety performance in the Malaysian construction industry has lagged behind most other industries as evidenced by its disproportional high rate of accidents as mentioned earlier in this study.

Furthermore, accident statistics can play an important role as a prime indicator for measuring safety performance as well as a framework for evaluating accident prevention program. However, the statistics of accidents occurred in the Malaysian construction sector have not been well organized and maintained. In addition, the assessment of the cost to provide safety in IBS construction is also unknown. Carelessness can lead to accidence that could cause injured to workers as well the public and some causes can lead to death. Among accident happen, to identify when workers fall current process installation component at high place and death causes crushed from component pre-cast current working. The hazards associated with pre-cast installation procedure can be very different from other type of works at site. (Rofizlan Ahmad, 2001).

1.4 Objective

The aim of this study is to provide a general perspective of safety in pre-cast concrete construction. The specific objectives of this study are as follows:

1. To study the process of installation component pre-cast concrete and manufacturing pre-cast element and
2. To identify the safety aspect and the requirement during the process installation at site.

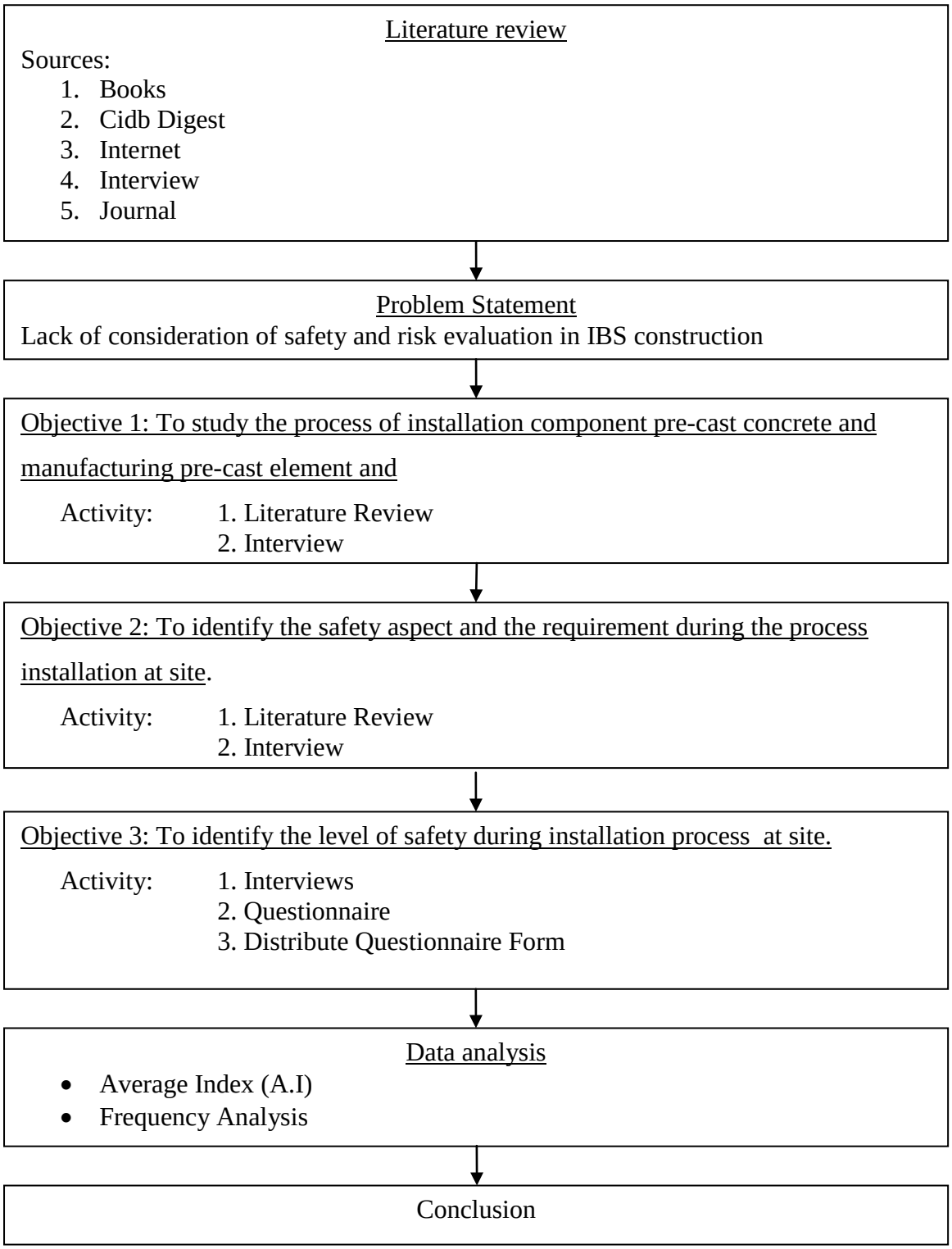
3. To identify the level of safety during installation process at site.

1.5 Scope of Study

The scope of this study is focused on element of Industrialized Building System (IBS) method and safety in IBS constructions specific in pre-cast concrete construction. The study is about the site safety in pre-cast concrete construction (installation stage) where the most of construction accidents happened and it the study area is Klang Valley. The data collected in this study are mainly from the companies' safety manuals documents study, case studies, questionnaire and interviews. The aspects being consider are:

1. This study is focus about pre-cast concrete as part of IBS element.
2. This study is focus about process installation pre-cast at the site (site safety).
3. This study is focus in manufacturing process for pre-cast concrete.
4. The respondents are the register as class A contactors with Pusat Khidmat Kontraktor (PKK).
5. The respondents are the register as grade 7 contactors with Construction Industry Development Board (CIDB).
6. The area of this study is in Klang Valley.

1.6 Methodology



1.7 Significant Of Study

The construction industry now is facing challenges in four aspects; time, cost, quality and safety. Actually, safety is one of the most important factors in construction industry where it will affect the time, cost and quality of any construction project.

Thus, this study will help to measure the safety in Industrialized Building System (IBS). Moreover, the compliance of the safety regulations coupled with the knowledge of safety provides advantages to the construction companies. It decreases of accidents and the project can be completed with high quality within the given time.

1.8 Expected Outcome

At the end of this course, the contactor should have at least a basic knowledge on the safety aspect and know their responsibility. Contractor can know safety aspect and requirement at site its ok or not.

CHAPTER 2

LITERARURE REVIEW

2.1 Introduction

This chapter explains about the process of installation component precast concrete and manufacturing pre-cast element and to identify the safety aspect and the requirement during the process installation at site and to identify the level of safety during installation process at site.

For this chapter, definition and description of Industrialized Building System (IBS) will be given. Beside that this chapter also included history about IBS in Malaysia, process installation, safety procedure when do the installation and etc.

2.1.1 Industrialized Building System (IBS)

IBS is stand for Industrialized Building System. In general, the construction methods can be classified into four categories:-

1. Conventional method
2. Cast in situ
3. Composite method
4. Fully fabricated

(Badir And Razali, 1998).

There are a few definitions of IBS according to few researchers. Those definitions are as stated in table 2.1:

Table 2.1: Definitions of IBS

References	Definition
Lessing et al, 2005	IBS as an integrated manufacturing and construction process with well planned organization for efficient management, preparation and control over resources used, activities and results supported by the used of highly developed components.
CIDB , 2003	IBS is define as a construction system which components are manufactured in a factory or off site, positioned and assembled into structure with minimal additional site work.
Warszawski, 1999	IBS also defined as a set of interrelated element that act together to enable the designated performance of the building.
Trikha, 1999	IBS as a system in which concrete component prefabricated at site or in factory assembled to form the structure with minimum in situ construction.
Esa And Nurudin, 1998	IBS is a continuum beginning from utilizing craftsmen for every aspect of construction to a system that make use of

	manufacturing production in order to minimize resource wastage and enhance value end users.
Parid Wardi , 1997	IBS as a system which use industrialized production technique either in the production of component or assembly of the building or both.
Junid, 1986	IBS as process by which components of building are conceived, planned and fabricated, transported and erected at site. The system includes balanced combination between software and hardware components. The software element includes system design, which is complex process of studying the requirement of the end user, market analysis and the development of standardized components.
Dietz, 1971	IBS as total integration of all subsystem and components into overall process fully utilizing industrialized productions, transportation and assembly techniques.

Hence, from my reading it can say that Industrialized Building System (IBS) is a process whereby the pre-cast concrete elements are concrete products that are manufactured or at site and cured in a plant environment and then transported to a job site for installation to be assemble together to form a building.

Other that, it is interesting to note that the term “Industrialized Building System” (IBS) is often misinterpreted as systems limited only for construction of building. In fact, IBS covers all types of structures as the word “building” actually relates to “construction”(Shaari and Elias, 2003).

2.1.2 History of Industrialized Building System (IBS) in Malaysia

The development of the building industry in Malaysia towards industrialized and prefabrication has just picked up speed with the government drive for Industrialized Building System, (IBS) through Construction Industry Development Board (CIDB) and others channels seen with the experiences in industrialized world developers. Consultant and contractor in Malaysia no choice but they must look forward and prepare their project for IBS, to follow what CIDB want. One of the challenges facing to our construction industry is to acute shortage of construction workers. The industrialized building system (IBS) is introduced to dependency on foreign workers. Nevertheless, early effort by government Malaysia to promote usage IBS as an alternative to conventional and labor intensive construction method has yet to make headway (Zuhairi Abd Hamid et al, 2007).

Although members of the industry are open to idea, a major portion of the shareholders are different, perhaps due to resistance towards change, insufficient information and lack of technology transfer method to support feasibility of change to IBS. It this case, clearly can see that it difficult to change and used new technology and methods in construction sector when compare to other sector. According to Harvas, 2007 construction sector is knows as traditional sector that can be characterized as reluctant and even to change (Zuhairi Abd Hamid et al, 2007). The usage of pre-cast element is not new in Malaysia. Industrialized building systems (IBS) began in early 1960's when ministry of housing and local government of Malaysia visited several European countries and evaluate their housing development program (Thanoon et al, 2003).

However, its usage in the Malaysian construction industry is relatively new. Pre-cast concrete were introduced in Malaysia in 1966 when the government launched two pilot projects for pre-cast houses. The construction of Tunku Abdul Rahman Flats in Kuala Lumpur and the Rifle Range Road Flats in Penang were the first time that precast elements were used to construct mass houses. Later Perbadaran Kemajuan Negeri Selangor (PKNS) brought technology from Germany for the construction of

numerous housing projects, ranging from low cost houses to high cost bungalows (CIDB, 2005).

In our construction industry today, the use of IBS as a method of construction is evolving. More local manufacturers have established themselves in the market. As a result, pre-cast concrete, steel and other IBS were used as hybrid construction system to build national landmarks such as Bukit Jalil Sport Complex, LRT and Pertonas Twin Towers. It was reported that at least 21 of various manufacturers and suppliers of IBS are actively promotion their system in Malaysia (Thanoon et al, 2003). IBS moved to next step of the development thought the establishment of IBS center; initiated by CIDB at Jalan Chan Sow Lin, Cheras, and Kuala Lumpur. The obligation to implement IBS strategies and activities from this centre serves both to improve performance and quality in construction, and also to minimize the dependency of unskilled foreign labors flooding the construction market (Zuhairi Abd Hamid et al, 2007).

Since then, numerous construction projects in Malaysia have utilized pre-cast component, especially when the requirement is to build quickly and with high accuracy and quality. Pre-cast component are used in a number of rapid construction of, among many others, schools, colleges, quarters, apartment, hospitals as well as road, rail, port and drain infrastructures (CIDB, 2005).

From the survey conducted by CIDB of Malaysia in 2003, the usage level of IBS in local construction industry stands at only 15% (IBS survey, 2003). On the hand, the total register contractor in Malaysia stands for 895 companies in year 2007. Registered IBS manufactured in which are available in the market. Almost all locally developed products are based on traditional material such as reinforced concrete and almost all innovative material are based on imported technology (IBS roadmap review, 2007).

2.2 Classification of Industrialized Building System (IBS)

In Malaysia, according to Construction Industry Development Board (CIDB) roadmap Industrializes Building System (IBS) 2003-2010, from classification, they have five main group were used in this country is :-

1. Pre-cast concrete framing, panel and box system
   - Pre-cast column, beam, slabs, 3-D component (balcony, staircase, toilet), permanent concrete formwork.

Figure 2.1: Pre-cast concrete framing system

2. Steel formwork systems
   - Tunnel form, beams and column moulding forms, permanent steel formwork (metal decks).

Figure 2.2: Steel Formwork Systems

3. Steel framing systems
   - Steel beams an column, portal frames, roof trusses.

Figure 2.3: Steel framing system

4. Prefabricated timber framing systems

- Prefab timber frames, roof trusses.

Figure 2.4: Prebriacated timber frame system.

5. Block work systems

- Interlocking concrete masonry units (CMU), lightweight concrete blocks

Figure 2.5: Block work system

(CIDB, 2003).

2.3 Activity in Pre-Cast Concrete Construction

There are many activity involve in pre-cast concrete construction. This activity is follow stage by stage. The activity are firstly design pre-cast component, secondly manufactured pre-cast component in factory, then transportation pre-cast component to site, and lastly installation component-component at site. This activity can conclude at this figure:-

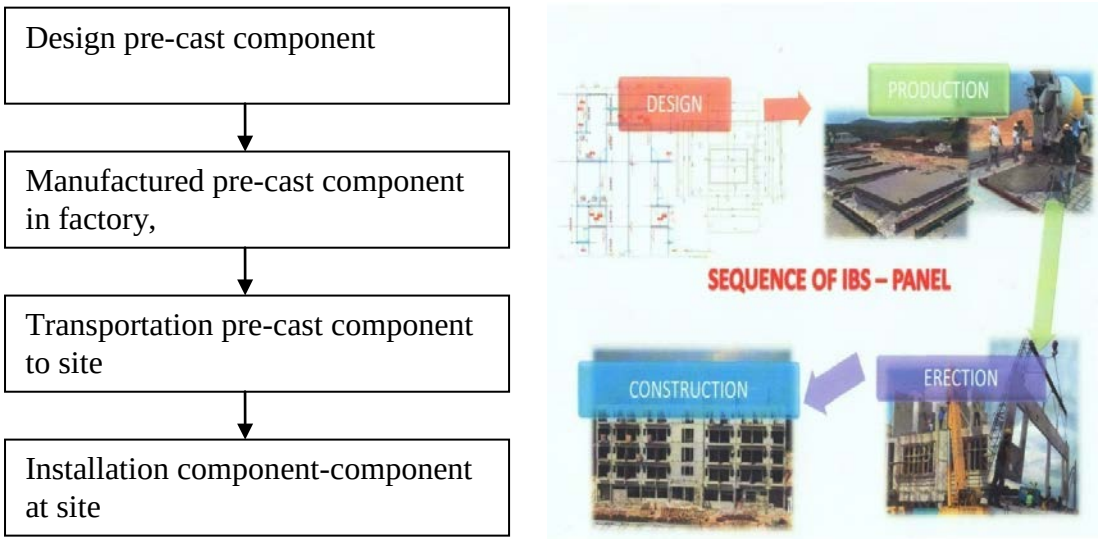


Figure 2.6: Activity in pre-cast construction

2.3.1 Manufacturing Producer in Pre-Cast Concrete Factory

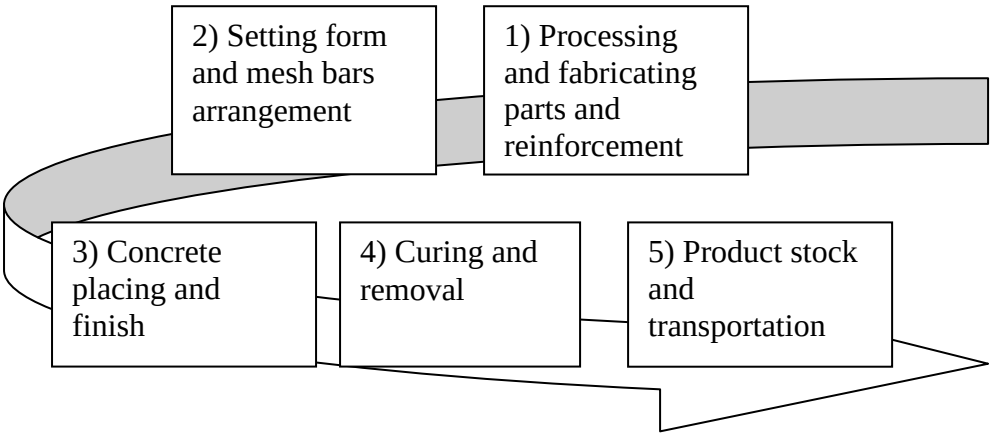


Figure 2.7: Manufactured in pre-cast factory

Figure 2.8: Do the formwork for pre-cast component

Figure 2.9: Metal form and mesh arrangement

Figure 2.10: Concrete placing

Figure 2.11: Transportation to site.

2.3.2 Procedure in Site Erection

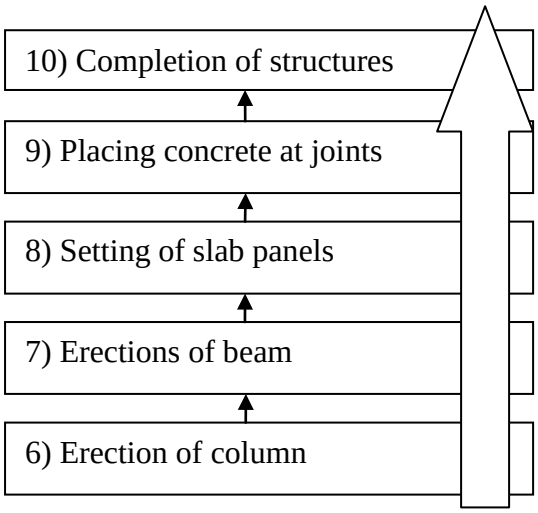


Figure 2.12: Procedure in site.

2.4 Pre-Cast Installation Procedure

Before the installation using pre-cast concrete, should know about the procedures required to achieve a high level of quantity, customer satisfaction and the most important is safety. Since every installation is unique, procedures may vary and can be complex (CIDB, 2005).

Every company develops its own special way of installing pre-cast. To make installation run smoothly, it is best to have experienced workers plants should take the initiative and train employees, developing them into highly skilled installers. This goes for foremen, welders, crane operators, and the whole crew. If procedures are kept simple and consistent, installation workers can achieve efficient, safe, and cost effective installations while improving their track records each time (CIDB, 2005).

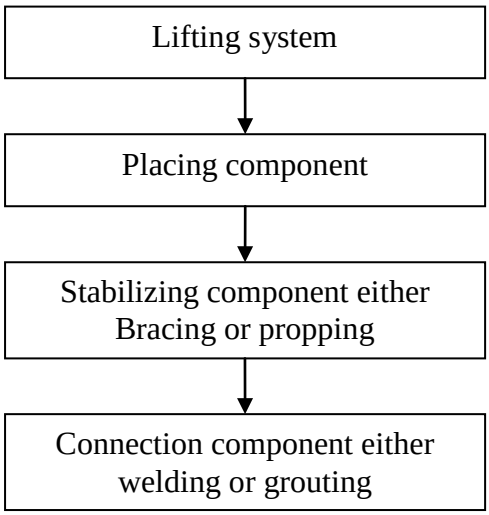


Figure 2.13: Process component Installation using pre-cast concrete

2.4.1 Lifting Systems

Most pre-cast units can be installed using standard two- and four- point picks. If products do not need to be flipped or turned vertically, they can be lifted straight off of truck beds and into their final location. Very large and heavy or odd-shaped units may require more complex lifting systems. If units must be flipped vertically and rotated, more specialized lifting apparatus will need to be hooked up to the crane (CIDB, 2005).

Most lifting apparatuses consist of wire ropes or chains employing spreader bars, hooks, shackles, rolling blocks, closed links, and lifting plates to complete the assembly. All hardware should have annual certification to verify capacity and safe working loads generally is required. DOSH have strict regulations on lifting systems. Connections or threaded anchor holes should be free of debris. Make sure inserts are also clean and greased if necessary. Check for burrs on threaded inserts. Do not over tighten bolts, especially ones close to product edges, and protect the pre-cast product from chipping when aligning. Wood, rubber, wedges, and plastic shims work well for

this. Sometimes, location elevations, pins, holes, or attachments may be incorrect (CIDB, 2005).

To attach products using bolts or plates, expansion bolts may be inserted into the pre-cast in alignment with structural connections. In this case, make sure holes are drilled at structurally sound locations. It is sometimes inevitable that steel will be encountered upon drilling. Or, new plates may be welded either to the pre-cast or on the fixed structure. Chemical anchors (resin capsule or epoxy anchors) can be used in place of expansion anchors for use with heavy loads. However, excessively high heat can degrade these chemical anchors. Be aware of manufacturers load ratings and recommendations. If structural connections require field modification, an engineer should be consulted (CIDB, 2005).

If foundation elevations or existing product dimensions are wrong, either they will have to be fixed or the pre-cast may need to be cut to fit. Incorrect base elevations that prohibit pipe or other utility connections will also likely require modification or new holes will have to be cut in the pre-cast (CIDB, 2005).

Installing products such as lintels and windowsills can be a complex process because of the nature of their final locations. Often, the surrounding pieces are already in place. Cases where product must fit vertically in between existing structures can also be complex. Since the product is usually lifted from points either on top or on the back of the product, the lifting devices will likely have to be disconnected prior to the complete installation of the product. Remember, do not want to damage the product or jeopardize its structural integrity (CIDB, 2005).

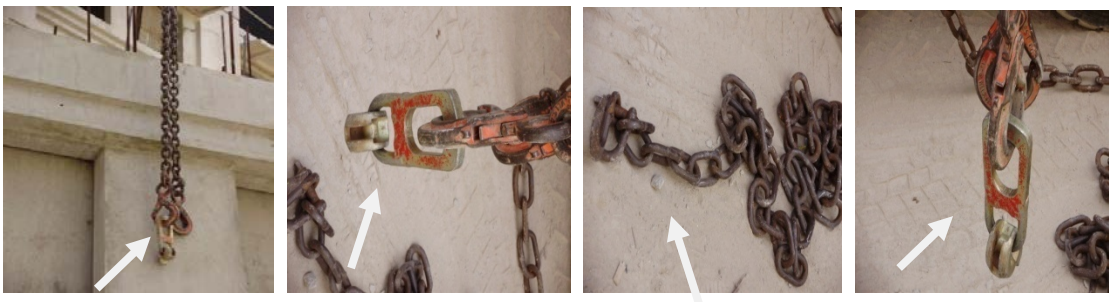


Figure 2.14: Example of equipment for lifting process (hook and sling)

Figure 2.15: Example of lifting process

2.4.2 Bracing and Stabilizing

Certain architectural and building application pre-cast may require temporary bracing to stabilize them against load like wind, seismic movement, eccentric dead loads, incomplete connections, and possible impact from construction equipment or other pre-cast members. Bracing should already be stored at the job site and readily available when needed. Once a piece of pre-cast is erected and while the crane or boom still carries the load, the bracing can be attached. At the ground, bracing must be positioned to ensure that the unit remains in the proper location. Most bracing can be adjusted by turnbuckles, by changing its position, or by other adjusting methods. Bracing should not be removed until the pre-cast units are within the acceptable placement tolerances and the permanent connections have been made (CIDB, 2005).

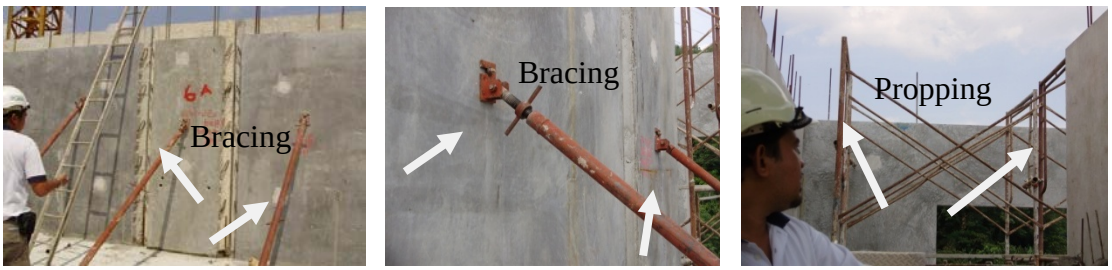


Figure 2.16: Example of bracing and propping

2.4.3 Welding

Some pre-cast component requires welding at their joints. Only certified welders should perform welding. All welders should be competent personnel. Often it is necessary to have connections welded immediately after product placement. It then becomes crucial that adequate workspace is available for both parties to work together without getting in each other's way or getting weld cables wound around other gear. Welds should be visually checked for quality when complete. If the connections will be exposed to weather, they and the weld should be coated with a protective coating. Remember that welding certain materials, such as galvanized metal, can be toxic and should be avoided (CIDB, 2005).

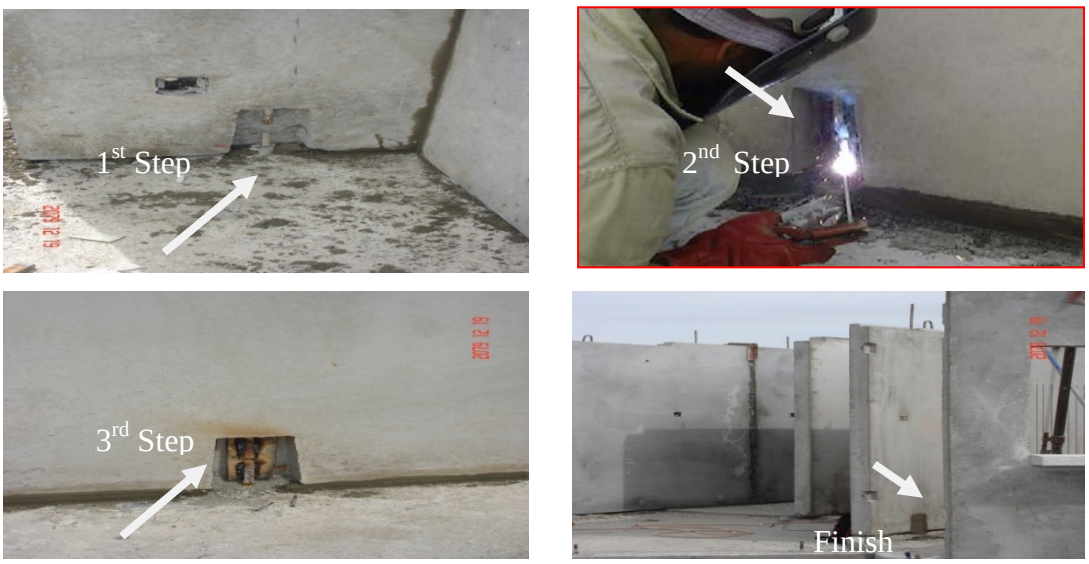


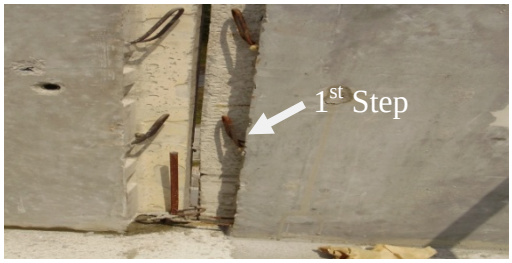
Figure 2.17: Step of welding process

2.4.4 Grouting

Grouting is done either prior to pre-cast placement or after. Grouting prior to placement is usually for products that incorporate cast-in dowels that slide into

predrilled holes or sleeves. Grout mixtures should be placed just before the units are installed into clean, rewetted holes. Pre-wetting prevents the dry concrete from absorbing grout mixture water. Once pre-cast units are in their proper location, further grouting may be required. A number of methods are used for this. If dowels project up into the pre-cast, grout may be pumped in through ports surrounding the dowels. The grout is pumped into the bottom port until it flows out of the top. This ensures the removal of air voids. These ports then need to be sealed with non absorptive stoppers. Dry packing is a grout placement method used to fill gaps or joints. At the end of the day, workers should tidy up work areas, clean up any messes, put away tools, and organize material and supplies for the next day if the job is not complete. A brief production meeting should be held to determine the next day's schedule, what supplies and materials will be needed and which ones have to be ordered (CIDB, 2005). There are a few types of material for grout such as sika, hilti, dong ji, e-mix, and etc.

Having these meetings will help workers work more efficiently and feel more confident that they know what's required to achieve a quality finished job. Whether your pre-cast products will be underground or above ground, a quality installation will be evident. On time, quality installations with a great safety record will impress the parties involved in the construction and the owner, as well as build the esteem of your installation crew. By achieving these, your company will get the reputation it deserves and also increase your chances of getting the next job (MC Magazine, 2001), (CIDB, 2005).



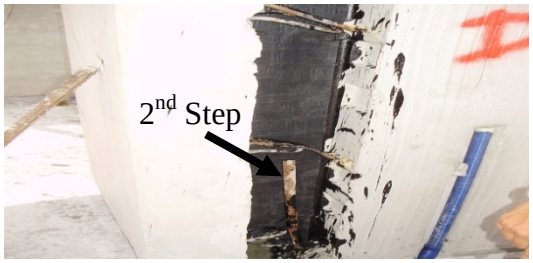


Figure 2.18: Step of grouting process used placement method

Figure 2.19: Step of grouting process used pumped method

Figure 2.20: Example of grout material either used placement or pumped method

2.5 Safety in General

Same as conventional method, pre-cast concrete not exclude from having hazard in its construction process during the installation. In this chapter, safety aspect

current the process installation component will identify. Furthermore, accident statistics can play an important role as a prime indicator for measuring safety performance as well as a framework for evaluating accident prevention program However, the statistics of accidents occurred in the Malaysian construction sector have not been well organized and maintained.

Furthermore, the worker should follow the safety aspect to ensure that accidents not happen at site. Hazard and safety aspect for control hazard must identify and record. For example, Job Safety Analysis must have at each of project for identified that what risk will happen and safety aspect to reduce or avoid risk from happen. The document was used in this objective such as Risk Assessment Report, Job Hazard Analysis Report and Hazard Identification Risk Assessment Risk Control (HIRARC). To make sure this aspect hazard control successful done, gives explanation to workers about safety of company procedure. Arrange “safety talk” or “tool box meeting” by right personnel like safety officer.

2.5.1 Personal Protective Equipment

The workers will provide with personal protective equipment (PPE) as part as effort to protect worker when do the construction. PPE like helmet, goggles, safety belt, safety boot and gloves should provide and responsible to company to ensure the equipments were being used with correctly. Most severe worksite optical injure are cause by worker does not wear eye protection or used not suitable equipment with work. So there are many eye equipment common used is safety spectacles, goggles, welding shields and face shields (Dave Heberle, 1998), (V.J. Davies and K. Tomasin, 1990).

Furthermore, injury in head will make worker handicapped or can death. So the worker will use safety helmet to protect head from dangerous. All workers

including those in office should wear sensible or safety boot to prevent abrasions and cuts form sharp object on the ground, contractions sites especially hazardous. Binding wire, nails and other sharp object on rough, uneven and untidy ground result in thousands of foot accidents some of with become serious. Safety boot can protect feet from dangerous or accidents and can protect from electricity and can be insulator electricity. In addition to offering protection from falling and crushing item, construction worksite footwear should also help prevent the wearers from slipping. Other than, the worker can be exposes to accident must be provided suitable hand equipment with the right work. Among injury will happen is injured, scalded and blue-black. There were many types of gloves in market to purpose (Dave Heberle, 1998), (V.J. Davies and K. Tomasin, 1990). Responsible employer is to ensure that worker wear suitable personal protective equipment (PPE) during the construction.

2.6 Safety in Component Installation

Safety aspect during installation process of component pre-cast, it can see from activity-activity when do the installation. That activity is lifting system, stabilizing bracing or propping, and the last connection component welding or grouting. Other that, also practice general safety aspect current in site construction. Don’t forget about crane, it also important machine in site construction.

2.6.1 Safety aspect in Lifting Systems

This process is critical activity in process installation component using pre-cast concrete in construction. This is because hazard when do this process were high risks.

That worker can lead to danger from component falling or move from crane. It can make critical injured and can lead to death if that workers crushes from falling component current process installation. There were other stages of safety must implementation current do the process installation. Worker or people who sit on or near the process of lifting component must not sit bottom the component during lifting process. The installation process were stopped immediately when windy day, rain condition or at night. Must checked the crane, lifting sling belt, shackle, used suitable Personal Protective Equipment (PPE), site condition and used communication equipment such as walkie talkie and understand hand signal, also good communicate between rigger and operator crane. Maintain lifting equipment in serviceable condition (CIDB, 2006). The weight of the component is identified before lifting process. When working at heights, make sure all safety equipment is used properly at all times, no matter how long the task may take and used safety harness (CIDB, 2005). Ensure hook / safety latch / sling fully secured and ensure to follow Standard Operation Procedure (SOP) (CIDB, 2006).

2.6.2 Safety Aspect in Placing Component

It’s like what CIDB suggestion in IBS digest (magazine). Component alignment work or prevent component from encroach other object also used with equipment like bars or shims. Don’t used hand for this work (CIDB, 2005). If work at high place make sure worker used suitable safety equipment like ‘safety harnesses. Ensure used suitable Personal Protective Equipment (PPE). After all checking process, component to be lift and place to the area need to be installed make sure no other workers to be at that particular area until installation work completed. Placing slowly to avoid from clipped. When aligning products, use objects like 2x4s, bars, shims, wedges, or other tools to stop the pre-cast from hitting other objects (CIDB, 2005). Ensure safety clearance while lifting and placing and accuracy of location (CIDB, 2006). Make sure component precast are secure in good position.

2.6.3 Stabilizing of Component

The third phase for installation process used precast concrete method is stabilizing component either bracing process or propping process.

2.6.3.1 Safety Aspect in Bracing Process

Objective for installation of bracing equipment is to make sure the component is at a stable condition before do the last connection. From research they have two method bracing installation were identify. Bracing can install using bolt at component or install at component using G-clamps. For this method, bracing equipment can modify for no length necessary. Safe process component installations are defends to that equipment and method installation. If these process installations do with incorrect method, that component can fall and it can lead to danger to worker or who near at site. However, after the installation of component bracing to be placed, all bracing component to be checked by safety officer before lifting belt to be release. Bracing should not be removed until the pre-cast units are within the acceptable placement tolerances and the permanent connections have been made (CIDB, 2005). Make sure bracing component in good condition. Safety personnel must do the inspection after bracing. Ensure used suitable Personal Protective Equipment (PPE).

2.6.3.2 Safety Aspect in Propping Process

Propping used to patching component was product force compaction like beam or slab. Installation propping equipment does in correct method to ensure it safe to patching that component pre-cast. Ensure used suitable Personal Protective Equipment (PPE). All propping component to be placed accordingly follow the method statement which approved by PE. Safety personnel do the inspection after installation of propping.

2.6.4 Safety Aspect for Last Connection of Component

Method that used for this process are welding or grouting. There have safety procedure must follow when process connection component. This work is importance to complete process installation using pre-cast component.

2.6.4.1 Safety Aspect during Welding Process

Before welding works, make sure area or place for welding work clear from any material whereby easy to burn like rubbish. Fire equipment such as fire extinguishers should prepare every time before welding works. Checked Personal Protective Equipment in a good condition before used. . According CIDB, 2006 ensure the worker determine joint location for welding works before welding. That worker must do the inspection by itself. Prepared with suitable protection equipment to worker, want to do the welding to make sure in safe condition. Personal protection

equipment usually used is eye, face protection, and hand protection. Ensure the worker used suitable protection equipment (PPE). To make sure welding work done in correct method, only professional worker allow. Ensure welding is carried out by certified welders. Make sure used qualified worker. That professional worker must register to Department of Occupational Safety and Health (DOSH). Ensure welding work according to welding sequences. Comply with local authority's requirement (CIDB, 2006). Other then, this professional worker must have training for fire control.

2.6.4.2 Safety Aspect during Grouting Process

Perform grouting are clean all joints to received grout. Then fill and compact all joints. Trims and tidy excess mortar and lastly interpret safety procedure. (CIDB, 2006) Mixture specification for detail connection grouting and method carried on refers to work method Statement Company. Material for grouting can send to site in ready mix design or own mixture in site. Safety for grouting are ensure ladder is secured, joints are cleaned, and joints are fully filled and compacted, and used suitable Personal Protective equipment (PPE) (CIDB, 2006). Component pre-cast cannot impose any load after grouting process. Time to conserve for this work depends on mixture design by provider.

2.7 Summary

In this chapter, the definitions of Industrialized Building System (IBS) were discussed. It can be conclude that IBS is define as a process whereby the pre-cast concrete elements are concrete products that are manufactured or at site and cured in a plant environment and then transported to a job site for installation to be assemble together to form a building. There are four main stages for installation process used precast concrete method. starting with lifting system, placing of component, then stabilizing of component either bracing process or welding and the last is connection of component either welding or grouting process.

The most important aspect of an installation is the safety of the workers and anyone on or near the jobsite. Installer must have a detailed safety procedure in their method of statement for installation that meets all Department of Occupational Safety and Health (DOSH). Other than that, Crane operators also must be certified to meet DOSH requirements. The hazards associated with a pre-cast installation procedure can be very different from other type of works at site. The main thing for workers to keep in mind is to be constantly aware of their surroundings. Workers should practice clear and concise communication, know the rules and regulations, and watch out for others. Workers should at no time be underneath a suspended product. Then when aligning products, use objects like 2x4s, bars, shims, wedges, or other tools to stop the pre-cast from hitting other objects. Do not use your hands or feet! When working at heights, make sure all safety equipment is used properly at all times, no matter how long the task may take. Use ladders according to manufacturers' recommendations and secure when appropriate. If work is to be done in excavations, make sure that the shoring is adequate.

This thesis is more to study the safety aspect using precast concrete method. This chapter attempt to highlight a survey on IBS construction using pre-cast concrete construction. Each and every factor is connected with each other.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the method used in caring out of the study. A carefully and thoroughly planning and scheduling has been organized on the methodology. This is to ensure proper sequence for a smooth running of the study started from literature review, interview, site visit to manufacturing and site construction, and questionnaire survey, data collection, data analysis and lastly the discussion of the result, suggestion and conclusion. The methodology procedure is to ensure that the information obtained for this study is relevant and acceptable for evaluation.

From the literature review, the primary data collection in several ways. Classifying an approach as quantity or quantitative, survey, and action does not mean that an approach selected, the research may not move from the method. Each approach have it strength and weakness and each is particular suitable. The approach adopted and the methods of data collection selected will depend on the nature of the inquiry and the type of information required (Judith, 1999).

3.2 Literature Review

Literature review is most important aspect in any research work. It is used to understand the background of the research. It has to provide a basis idea and fundamental for the research. The literature review obtained from several sources such as journal, book, article, and information from internet, brochure from CIBD like book from CIDB, IBS digest, seminar paper, and previous thesis. For this study, the purpose of literature review is to focus in definition and types of system in industrialized building system (IBS) and application in Malaysia. Redzuan (2006), highlighted than the mass of literature physicals imposed to read, let alone assimilate. Furthermore, it's too much information can cause over saturation. This may lead reduce possibility of developing new perspective.

Therefore, the objective of this work achieved through undertaking a comprehensive literature search to define:

1. Industrialized building system.
2. History of Industrialized Building System (IBS) in Malaysia.
3. Classification of IBS.
4. Safety in general.
5. Safety using pre-cast construction.

The information obtained is systematically transferred into notes, table and diagram and some of the information is printed as hard copy for future references. Therefore, in pre-cast concrete will take the special importance especially to see activity in installation component pre-cast and the safety aspect. So from this literature review will used as a reference to do the questionnaire.

3.3 Factory Visit (Manufactured Pre-Cast Component)

Process manufacturing pre-cast component were one of the activity in pre-cast construction. So, one visit to manufacturing already done to see process manufactured component-component in factory. Therefore, it have two factory were chosen to be visit is SP Setia Berhad at Puchong, Selangor and Eastern Pretech (Malaysia) Sdn Bhd at Sungai Besi, Kuala Lumpur. We also getting all information and more detailed about the process and activity in manufactured element pre-cast when we do the factory visit.

3.4 Industrial Visit (Site Visit)

Site visit purpose to know safety aspect when do the installation using pre-cast concrete. To see how the process installation using pre-cast component, so that site visit was doing. For industrial visit, it is done with two visits. First visit are doing to develop questionnaire and get information about safety aspect using pre-cast concrete at site construction. Then, for seconds visit are to distribute that questionnaire to use for data analysis. All information was get from this visit were used to develop and distributes questionnaire. Therefore, site visit, were doing at Klang Valley.

3.5 Interview

Interview is one of the most popular and simple method to achieve the objective of this study. Interviews were being to person who involve in pre-cast

construction. It include person who in-charge in work when do the manufactured at factory, and person in-charge in work when do the process installation.

The objective for this is to determine method how to manufactured component in factory and process installation at site using pre-cast construction. Safety aspect for installation at site construction will get from interviews.

3.6 Questionnaire Survey

Questionnaire survey is one of the most popular and simplest methods in order to achieve the objectives of this study. Questionnaire is defines as a formal set of question or statement designed together the information from respondents that will accomplish the goals of the research project (Redzuan, 2006). The questionnaire designed need to meet the objective and aim of the study. The design decisions depend on the purposes of the study, the nature of the problem, and the alternatives appropriate for its investigation (Stephen Issac, 1971). A design is a strategy for constructing the research structure using concise notation that summarize a complex design structure efficiently, to show all of the major parts of the research project the background problems theoretical frameworks, hypothesis, research questions, methodology-work together to try to address the center research objective (King et al, 1994). Three fundamental considered before design the question:

- What is the purpose of the survey?
- What kind of question the survey developed to answer?
- What sorts of results consider from the questionnaires?

Two type of question that used in the questionnaire survey, open-ended and close-ended. Open-ended question do not provide respond choice and sensitive to the respondents desire for expression. The close-ended sub divided to dichotomous and

multiple choices question. The close-ended questions supply response choices and reduce in interpreter bias and easy to analysis. Dichotomous question are close-ended question that offer to response choices and suitable to understand the respondents demographic compassion (Redzuan, 2006).

In this research, all of the questionnaires are designed as close-ended question. Space is provided as an option for respondents to give more details information. These questionnaires were doing to identify affecting the safety aspect when the process installation component using pre-cast concrete in construction. Questionnaires were sending to person who is involved in pre-cast concrete construction. Questionnaires also send to person who has experiences and knowledge in pre-cast construction. The person means person who works at company or organization were used pre-cast concrete as their construction. This questionnaire will send by hand.

Preparation question for questionnaire depends on literature review and industrial visit either factory visit or site visit. The questions already divide in three parts. For part A connected with background despondences like name, position, name of company and experiences using pre-cast concrete construction. Furthermore, part B for safety aspect when do the installation component pre-cast concrete. For part C is about the safety crane when used pre-cast construction. The following explained the reasons:

- To avoid the possibility of getting low response rate from the survey.
- To make sure the target groups answer the question.

Safety aspect in pre-cast concrete was based on a rating scale of 1 to 5 as below. This rating scale was developed based on rating scale implemented by Department of Occupational Safety and Health (DOSH) in evaluating the OSH-MS of Malaysian conventional civil construction sites.

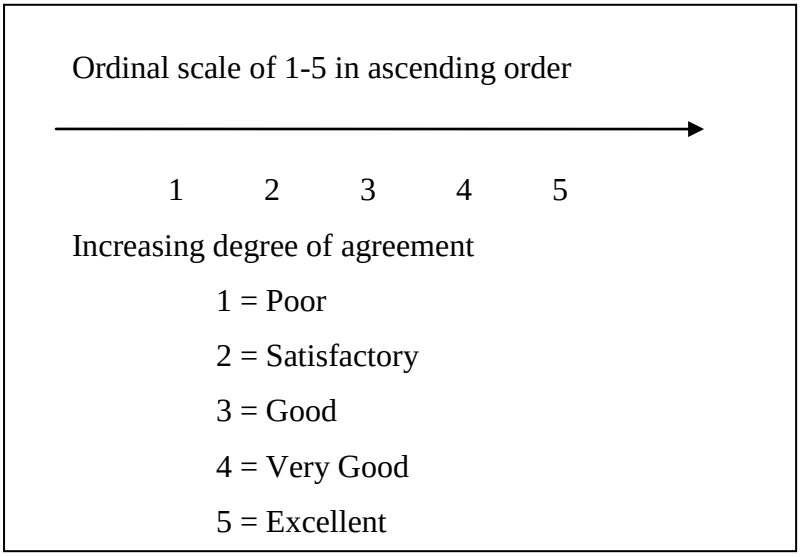


Figure 3.1: Five ordinal measures of agreement of method likert's scale

3.7 Data Analysis

After collect questionnaire, do the data analysis. Data analysis carried out the quantative data obtained from the questionnaire survey. Quantitive data collection trough the questionnaire first separate for easier analysis. The data categories under different variables to represent the result of the research objectives. A different statistic method such as frequency analysis and average index is the technique being used to get the data analysis. The discussions were mainly to evaluate the results obtained from the survey and rank the factors. The summary of the study then presented with the conclusion of the study, recommendation from the conclusion along with the recommendation for further studies in this area.

3.7.1 Frequency Analysis

The frequency analysis used to represent results of data analysis of the number of response that the respondent gives to different variables in the questionnaire. The result tabulated in the form of frequency number and percentage according to the total respondents. For graphic result presentation, pie chart and column graph is used as summary.

3.7.2 Average Index

In average index analysis, the results further summarized to obtain the level of importance in evaluating the factors, which involve in the survey on safety level in IBS method whereby using pre cast concrete construction. The questionnaires are based on five-point scale starting with 5 for excellent to 1 for poor. The average index analysis for each variable can calculate by using formula by Al Hammed et .al, 1996 as below:

$$\text{Average index (A.I)} = \frac{\sum aixi}{\sum xi}$$

Where,

ai = constant expressing the weight given i

xi = variable expressing the frequency of response for i = 1,2,3,4,4…….n

x1	=	number of respondent for poor	for a_1=1
x2	=	number of respondent for satisfactory	for a_2=2
x3	=	number of respondent for good	for a_3=3
x4	=	number of respondent for very good	for a_4=4

x5 = number of respondent for excellent for a_5=5

The overall level of agreement by the respondents to the safety which influences the safety aspect in installation IBS component are summarized based on the classification of the rating scale which has been modified (Abd Majid & R. McCaffer, 1997). The classifications of the rating scale are as shown in table 3.1:

Table 3.1: Modification of the level of agreement and evaluation for average index analysis, (Abd Majid & R. McCaffer, 1997)

Average index	Level of agreement of evaluation
1.0≤ average index<1.5	Poor
1.5≤ average index<2.5	Satisfactory
2.5≤average index<3.5	Good
3.5≤average index<4.0	Very good
4.5≤average index≤ 5.0	Excellent

3.8 Limitation of Study

This study is finding out on element of Industrialized Building System (IBS) method and safety in IBS constructions specific in pre-cast concrete construction. The aspects being consider are:

1. This study is focus about pre-cast concrete as part of IBS element.
2. This study is focus about process installation pre-cast at the site (site safety).
3. This study is focus in manufacturing process for pre-cast concrete.
4. The respondents are the register as class A contactors with Pusat Khidmat Kontraktor (PKK).
5. The respondents are the register as grade 7 contactors with construction industry development board (CIDB).
6. The area of this study is in Klang Valley.

CHAPTER 4

DATA ANALYSIS

4.1 Introduction

This chapter was discussed about the analysis of the results from the return questionnaire form and structure interview which were distributed to the contractor, developer, consultant and government. The techniques used for the analysis of questionnaire survey were average index analysis and frequency analysis.

4.2 Questionnaire Analysis

In the previous chapter, the questionnaire forms are divided into three sections. Section A is about demographic details of respondents. In section B, the questionnaire is about finding the safety aspect during the installation process and in section C, the questionnaire is about finding the safety in crane.

Ninety sets of questionnaire form were distributed to contractor, developer, consultant and government bodies which are registered grade 7 under Construction Industry Development Board (CIDB) and registered class A under Pusat Khidmat Kontractor (PKK) area Klang Valley. Out of the total 90 questionnaire form sent out, only 76 responses were received. The responses rate is summarized in the table 4.1. It shows that the percentage of respondent rate is excellent.

Table 4.1: Respondent's rate

No. of questionnaire form send out	No. of returned questionnaire form	Responses rate
90	76	84%

4.3 Structure Interview

In structure interview were asked about safety aspect in precast concrete such as safety awareness during installation, statistic for accidents occur because used precast concrete, types of accidents always happen, types of personal protection equipment (PPE) that always used for pre-cast and etc.

4.4 Respondents' Backgrounds

First section for the research questionnaires form which is section A. It is about respondents profile, background, experiences, company experience and how many accidents happen in pre-cast construction.

4.4.1 Respondents' Backgrounds

Analysis of respondents profile is shows in figure 4.1.

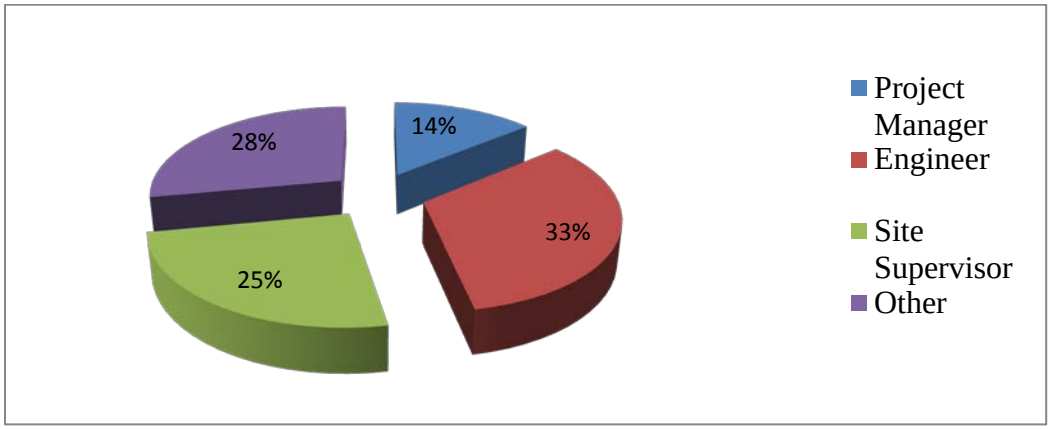


Figure 4.1: Composition of respondents by profession

Figure 4.1 shows the composition of respondents by profession. From the total 76 responses received, 17 responses (14%) received from project manager, 25 responses (33%) received from engineer, 19 responses (25%) received from site supervisor and 21 responses (28%) received from others such as safety officer.

This shows that all the returned questionnaires form are answered by a group of professional personnel that involved directly in the construction industry especially used method pre-cast concrete.

4.4.2 Respondents Experiences

The respondents have different level of working experience in precast concrete. Figure 4.2 shows the respondents total working experiences in precast concrete.

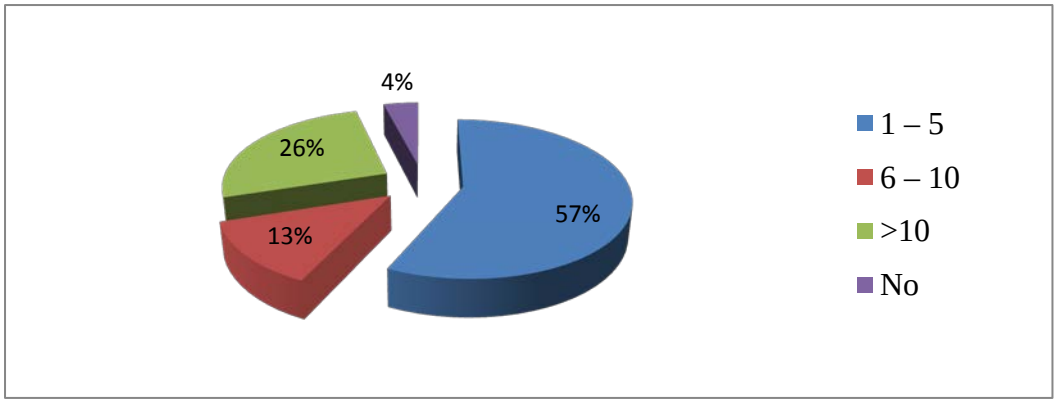


Figure 4.2: Respondent experiences in precast construction

From figure 4.2 shows the respondent experience in precast construction. Under one to five years, only 57% of the respondents (43 responses) have working experiences in precast construction. For six to ten years there are 13% of the respondents (10 responses) have working experiences used method precast concrete, and 20% of respondents (26 responses) which is answered the questionnaire form have working experiences in precast construction.

Majority of the respondent are involved in the construction industry using precast concrete compared to the respondent that never involved in method precast concrete. Finally, it can say, only 4% of respondent are not involve in construction industry using precast concrete.

4.4.3 Respondents' Experiences in Accidents

Every respondent have differences experiences involved in accidents during used precast concrete. It's depends to experiences in precast concrete, method and implementation they used to solve the problem or to manage the project.

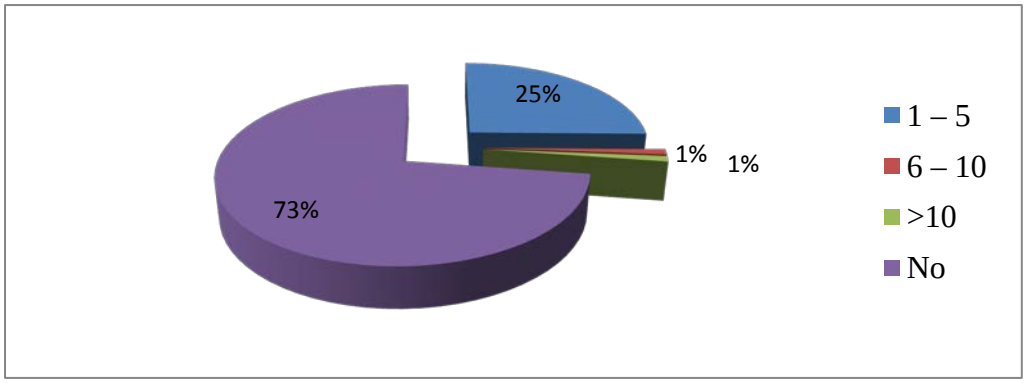


Figure 4.3: Respondents experiences involved in accident

Figure 4.3 shows the respondent experiences involved in accident used precast concrete. 73% of respondents not involved in accidents when used precast concrete. Only 25% of the respondents have one to five years experiences involved in accidents and 1% has six to ten years of experiences involved in accidents. Finally, 1% of the respondents have more than ten years of accidents experiences. Majority of respondents have not involved in accidents compare to the respondents have involved in accidents using precast concrete. It shows, precast concrete can decrease accidents in site construction.

4.5 Safety Aspect and the Requirement during the Process of Installation at Site

There are many activities involved in precast concrete method. Starting design precast component, follow by manufactured at factory and then transportation to site. From the interview and literature review there're four phase for installation process used precast concrete. There are:-

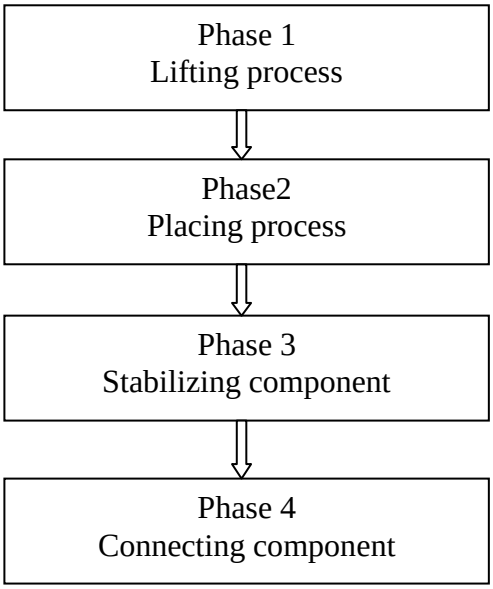
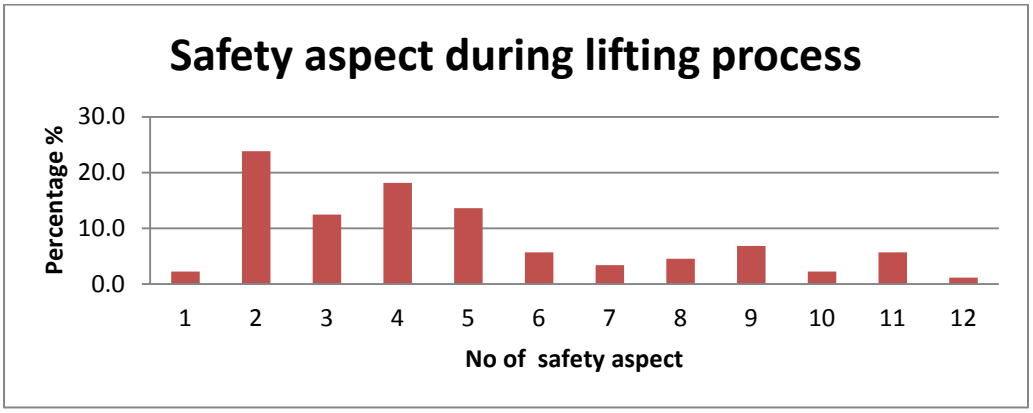


Figure 4.4: Four phase for installation process used precast concrete.

4.5.1 Safety Aspect during Lifting Process

Lifting process is one of critical activity in installation process using method precast concrete. Analysis of the structure interview is shows in figure 4.5.



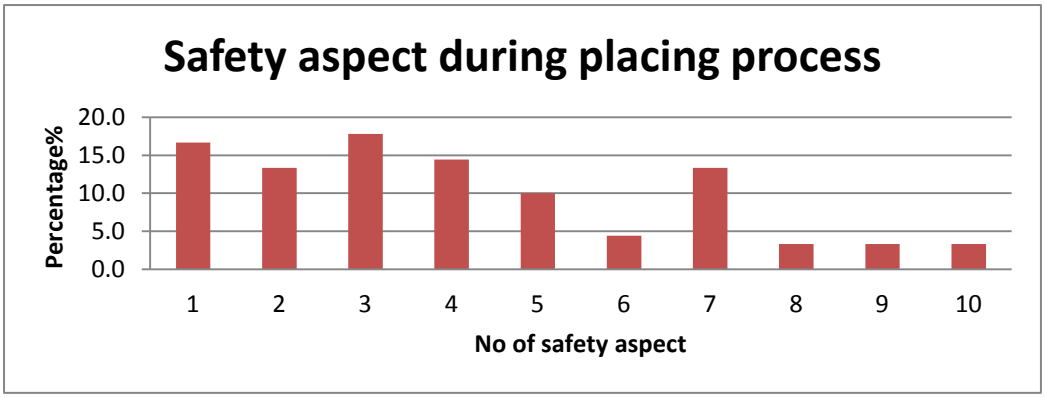
No	Safety aspect during lifting process
1	Skilled
2	Make sure worker not near during lifting process
3	The installation process were stopped immediately when windy day, rain condition or at night
4	Check hook condition before used
5	Install component with correct hook
6	Check equipment for lifting process
7	Must understand hand signal
8	Used suitable PPE
9	Check the walkie talkie before used
10	Must have certificate / register with DOSH
11	Follow the method statement
12	Crane in good condition

Figure 4.5: Safety aspects during lifting process

Figure 4.5 shows the percentage for safety aspect and requirement during lifting process. 23.9% of respondents agree, make sure the worker not near during lifting process are the most important of safety aspect and requirement during lifting process. 5.7% of respondent agree, the worker should understand hand signal and checked the walkie talkie before used are one of safety awareness during lifting process. Finally 1.1% of respondents agree, ensure crane in good condition before used also one of safety aspect and requirement during lifting process.

4.5.2 Safety Aspect during Placing Process

The second phase of installation process is placing process. Analysis of returned structure interview for safety aspect and requirement during placing process is shows in figure 4.6.



No	Safety aspect during placing process
1	Checked the walkie talkie before used
2	Good Communications between rigger and operator crane
3	Placing slowly to avoid from clipped
4	Precast component secure in position
5	Used wire from hitting other component
6	Rigger give the right instruction
7	Used safety harness at high place
8	Used shims from hitting other object
9	Understand hand signal
10	Don't removed crane before secure right position

Figure 4.6: Safety aspects during placing process

Figure 4.6 shows the safety aspect during placing process for installation process used precast concrete method. 17.8% of respondent agree the worker should placing slowly to avoid from clipped are one of the most important safety aspect and requirement during placing process. 13.3% of respondents agree good communication between rigger and operator crane and used safety harness when work at high place

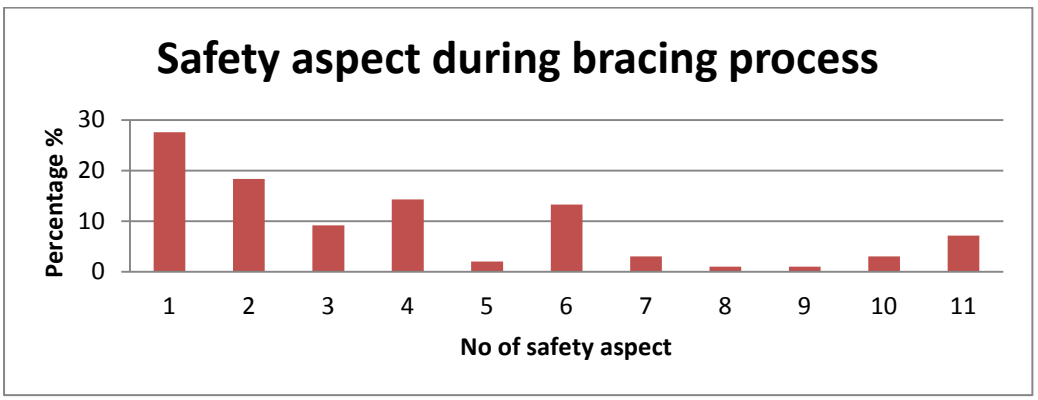
also one of safety awareness. The last part should be consider during placing process is used shims from hitting other object, understand hand signal and don't removed crane before secure in right position.

4.5.3 Safety Aspect for Stabilizing of Component

The third phase for installation process used precast concrete method is stabilizing component either bracing process or propping process. Actually used bracing or propping, it depends on position of component such as wall, it were used bracing but to install second floor slab it were used propping.

4.5.3.1 Safety Aspect during Bracing Process

Analysis of returned structure interview for safety aspect and requirement during bracing process is shows in figure 4.7.



No	Safety aspect during bracing process

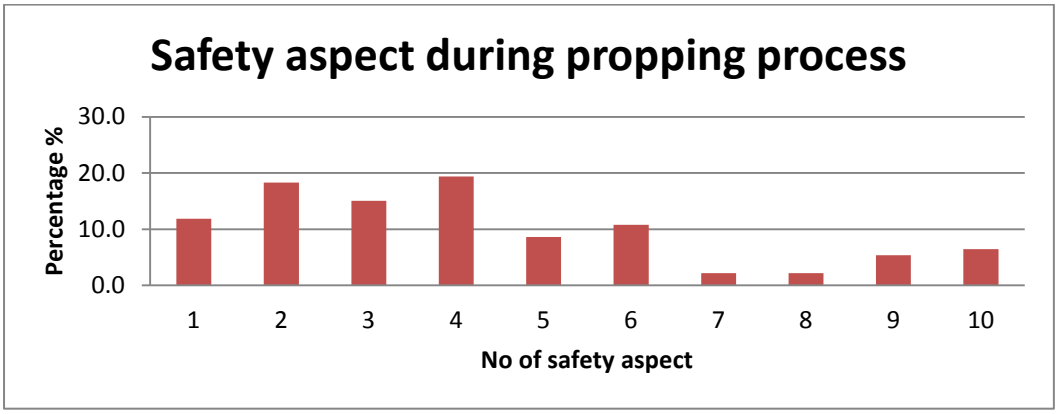
1	Checking bracing equipment before used
2	Install with the right bracing equipment
3	Follow the method statement
4	Release when getting instruction from erection design engineer
5	Area are cleaned to bracing
6	Install at flat surface and strong to support load of component
7	Angle / elevation 45-60
8	Bracing equipment in good condition
9	Make sure worker have skilled and healthy
10	Shoe / feet must be strong to support load of component
11	Used Suitable Personal Protective Equipment (PPE)

Figure 4.7: Safety aspects during bracing process

Figure 4.7 shows the safety aspects and requirement for bracing process. The main part might be consider during bracing process is checked bracing equipment before used with percentage 28%. 7% of respondents agree, the worker used suitable Personal Protective Equipment (PPE) is one of part of safety awareness. Finally 1% of respondents agree bracing equipment in good condition and ensure the worker have skilled and healthy also one of the important safety aspect and requirement during bracing process.

4.5.3.2 Safety Aspect and Requirement during Propping Process

Analysis of returned structure interview for safety aspect and requirement during propping process is shows in figure 4.8.



No	Safety aspect during propping process
1	Bracing equipment cannot be used for propping
2	Checking equipment before used
3	Release when getting instruction from erection design engineer
4	Install at flat surface / strong
5	Follow method statement and relevant drawing
6	Do the right
7	Used suitable propping equipment
8	Area are cleaned to propping
9	Component pre-cast cannot impose any load
10	Suitable PPE

Figure 4.8: Safety aspects during propping process

Figure 4.8, analysis from structure interview it founds safety aspect during propping process. 19.4% respondent agree propping should install at flat surface or strong as the most important of the safety aspect and requirement during propping process. 10.8% respondents agree the worker must do the propping rightly are one of part of safety awareness. Finally, 2.2% respondents agree the worker used suitable propping equipment and area is cleaned to propping also a few part of safety aspect and requirement for propping process.

4.5.4 Safety Aspect for the Last Connection of Component

The last processes for the installation process used precast concrete method are connection component either welding or grouting process. For connection actually it depends on condition component, and where component were manufactured.

4.5.4.1 Safety Aspect and Requirement during Welding Process

Analysis of returned structure interview for safety aspect and requirement during welding process is shows in figure 4.9.

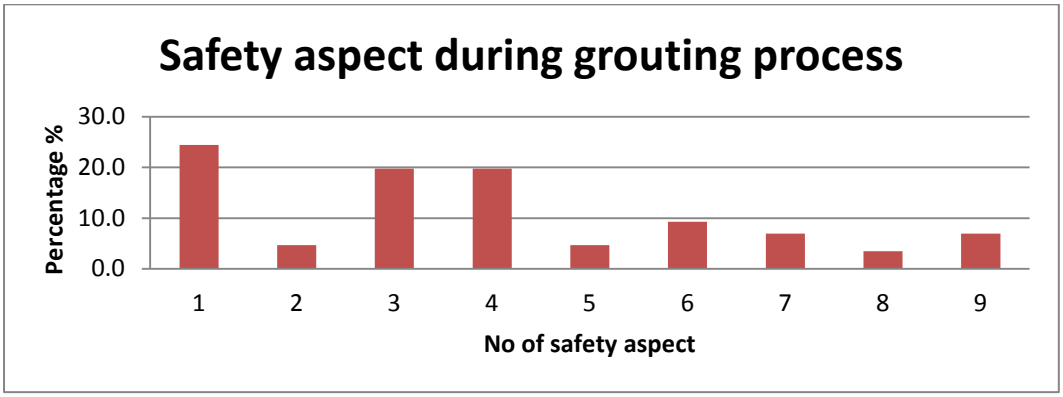
No	Safety aspect during welding process
1	Skilled and getting certificate from DOSH
2	Training fire control
3	Provided Fire extinguishes
4	Suitable PPE
5	Worker should wearing suitable suit or cloth not easy to burn
6	Check equipment for welding before used
7	Joints are cleared to welding
8	Ensure welding works are carried out by certified welders
9	Ensure place to welding are cleared from any material like rubbish
10	Make sure only competence worker

Figure 4.9: Safety aspects during welding process

Figure 4.9 shows the safety aspect for welding process. 22.8% respondents agree contractor should provided fire extinguishers at site are one of the most important parts in safety aspect and requirement during welding process. 11.4% respondents agree before welding, ensure place to welding are cleared from any material where easy to burn like rubbish one of important safety aspect and requirement during welding process. Finally, 0.8% respondents agree ensure welding works are carried out by certified welders is a few parts in safety aspect and requirement for welding process

4.5.4.2 Safety Aspect during Grouting Process

Analysis of returned structure interview for safety aspect and requirement during grouting process is shows in figure 4.10.



No	Safety aspect during grouting process
1	Joints are cleaned
2	Don’t have bubbles in grouting
3	Component pre-cast cannot impose any load after grouting
4	Area for grouting are cleaned
5	Make formwork with correct method
6	Joints are fully filled and compacted

7	Refer to method statement
8	Used safety harness at high places
9	Used suitable Personal Protection Equipment (PPE)

Figure 4.10: Safety aspects during grouting process

Figure 4.10 shows the main part might be consider in safety aspect and requirement during grouting process is the worker clean joint for grouting from any material which is 24.4%. 7.0% respondents agree worker refer method statement and used suitable Personal Protection Equipment (PPE) is a few of safety aspect and requirement for grouting process. Finally 3.5% respondents agree, used safety harness when work at high place also one of the important in safety aspect and requirement during grouting process.

4.6 Analysis of Safety Level at Site

Analyses of the return questionnaire are analyses and as follow:-

Table 4.2: Classification of agreement of evaluation

Average index	Level of agreement of evaluation
1.0≤ average index<1.5	Poor
1.5≤ average index<2.5	Satisfactory
2.5≤average index<3.5	Good
3.5≤average index<4.0	Very good
4.5≤average index≤ 5.0	Excellent

4.6.1 Safety in General Aspect

Analysis of returned questionnaires for safety in general aspect is show in table 4.3.

Table 4.3: Safety in general aspect

(1) Poor (2) Satisfactory (3) Good (4) Very Good (5) Excellent

Safety	Frequency Analysis					Ave Index (A I)	Rank
	1	2	3	4	5		
Construction site workers equipped with personal protection equipment (PPE)?	0%	5%	21%	29%	45%	4.13	1
Construction site workers, used personal protection equipment (PPE)?	5%	20%	20%	14%	41%	3.66	5
“Tool box meeting” or “safety talk” always done at site?	0%	12%	25%	26%	37%	3.88	3
Job hazard analysis constantly prepared before the installation?	1%	16%	26%	24%	33%	3.71	4
Safety talk and tool box meeting arrange by the person who qualifies such as safety officer	4%	7%	16%	37%	37%	3.96	2

From analysis it shows the majority respondent highly agreed on the level of agreement of evaluation for safety in general aspect, in rank very good. So from the

table 4.3 shows the majority respondents agreed on safety aspect of the construction site workers equipped with personal protective equipment (PPE) with average index (AI) is 4.13. AI for tool box meeting or safety talk always done at site is 3.88. The last is the construction site workers, used personal protection equipment (PPE) is 3.66. According to CIDB, 2006 the workers should use suitable PPE. This is because the workers still not practices and still not consider use personal protective equipment during installation process.

4.6.2 Safety Aspect during Lifting Process

From table 4.4 presented the analysis of returned questionnaire for safety aspect during lifting process.

Table 4.4: Safety aspect during lifting process

(1) Poor (2) Satisfactory (3) Good (4) Very Good (5) Excellent

Safety Aspect	Frequency Analysis					Ave Index (A.I)	Rank
	1	2	3	4	5		
Safety measure has been conducted during installation process such as do the barrier to avoid anyone to near during lifting process	0%	5%	24%	33%	38%	4.0	4
The installation process were stopped when windy day, rain condition or at night?	0%	0%	20%	32%	49%	4.3	1

The worker used personal protection equipment during lifting process	0%	17%	12%	32%	39%	3.9	5
Has been equipped “safety harness” while working at high place?	0%	8%	14%	30%	47%	4.2	2
Communication equipment being used during lifting process?	0%	5%	21%	30%	43%	4.1	3

From table 4.4 shows the level of safety during lifting process in level very good. It’s because majority respondents agree safety aspect in ranking very good and all safety aspect are important during lifting process. The highest ranging for safety aspect are the installation process were stopped when windy day, rain condition or at night with average index is 4.3. A.I for communication equipment being used during lifting process is 4.1. Surprisingly, the worker used personal protective equipment during lifting process is ranked last with A.I 3.9. According to CIDB, 2005 the worker should used suitable PPE. This is because the workers still not practice personal protective equipment as one of safety aspect should be obeyed and followed during process installation.

4.6.3 Safety Aspect during Placing Process

From table 4.5 presented the analysis of returned questionnaire for safety aspect during lifting process.

Table 4.5: Safety aspect during lifting process

(1) Poor (2) Satisfactory (3) Good (4) Very Good (5) Excellent

Safety Aspect	Frequency Analysis					Ave Index (A.I)	Rank
	1	2	3	4	5		
The worker used personal protection equipment during placing process	0%	5%	24%	33%	38%	4.0	4
Used wire from hitting other component	0%	0%	20%	32%	49%	4.3	1
Precast component secure in position	0%	17%	12%	32%	39%	3.9	3
Has been equipped “safety harness” while working at high place?	0%	8%	14%	30%	47%	4.2	2
Communication equipment being used during placing process?	0%	5%	21%	30%	43%	4.1	5

From table 4.5 shows the level of safety during placing process in level very good. It’s because majority respondents agree safety aspect in ranking very good and all safety aspect are important during placing process. The highest ranging for safety aspect are the workers used wire, shims or bars from hitting other component with average index is 4.3. A.I for precast component secure in position is 4.1. Surprisingly, Communication equipment being used during placing process is ranked last with A.I 3.9. According to CIDB, 2005 the workers should used communication equipment during placing process. This is because the workers still do not use communication tool nicely. The workers should ensure well off communication tool better and understand hand signal during placing process.

4.6.4 Safety Aspect during Bracing Process

Analysis of returned questionnaires for safety aspect during bracing process is show in table 4.6.

Table 4.6: Safety aspect during bracing process

(1) Poor (2) Satisfactory (3) Good (4) Very Good (5) Excellent

Safety Aspect	Frequency Analysis					Ave Index (A.I)	Rank
	1	2	3	4	5		
During Bracing process, the components were checked before it is used?	0%	4%	17%	45%	34%	4.1	1
Bracing were release after getting instruction from “erection design engineer”?	3%	4%	28%	36%	30%	3.9	4
Construction site workers equipped with personal protection equipment (PPE)?	0%	4%	16%	45%	36%	4.1	2
The bracing need to be installed correctly?	0%	3%	22%	42%	33%	4.1	3
Communicate with other construction site teams for bracing works.	11%	21%	29%	14%	25%	3.2	5

From table 4.6, it found that majority respondents agreed for the safety aspect during bracing process at level very good and good. Through table 4.6 average index (AI) of the component was checked before it is used is 4.1. A.I for the bracing need to be installed correctly is 4.1. According to CIDB, 2005 bracing must be positioned to

ensure that the unit remains in the proper location. This is because the workers should ensure bracing equipment installed properly and in right positioned so that the component do not fall which will cause current accident during bracing process. Communicate with other construction site teams for bracing works is the last ranking in safety aspect during bracing process with A.I is 3.2. This is because the workers still no practice good communication between other construction site team, so it can lead to accidents. Rigger and operator crane are required to have good communication.

4.6.5 Safety Aspect during Propping Process

Table 4.7 shows the returned of questionnaire form for safety aspect during propping process.

Table 4.7: Safety aspect during propping process

(1) Poor (2) Satisfactory (3) Good (4) Very Good (5) Excellent

Safety Aspect	Frequency Analysis					Ave Index (A.I)	Rank
	1	2	3	4	5		
Using the proper personal Protection equipment (PPE)	8%	17%	26%	26%	22%	3.4	4
Propping equipment will be release after getting instruction from “erection design engineer”?	1%	8%	18%	39%	33%	3.9	3
The propping need to be installed in a good	0%	3%	21%	36%	41%	4.1	1

condition							
The installation of propping equipment method refers to Company's "method statement"	4%	3%	16%	39%	38%	4.1	2
Communicate with other of construction site teams for propping works.	9%	32%	20%	16%	24%	3.1	5

From table 4.7 shows the level of safety during propping process in level very good and good. It's because majority respondents agree safety aspect in ranking very good and all safety aspect are important during propping process. The highest ranking for safety aspect is the propping need to be installed in a good condition with average index is 4.1. According to CIDB, 2005 shows ensure propping secured. It shows the propping should do in good condition and secure. A.I for propping equipment will be release after getting instruction from "erection design engineer" is 3.9. Surprisingly, Communicate with other of construction site teams for propping works is ranked last with A.I is 3.1. This is because during propping process the workers are required to have good communication to be sure propping can installed properly so that component not fall.

4.6.6 Safety Aspect during Welding Process

Analysis of returned questionnaire form for safety aspect during welding process is show in table 4.8

Table 4.8: Safety aspect during welding process

(1) Poor (2) Satisfactory (3) Good (4) Very Good (5) Excellent

Safety Aspect	Frequency Analysis					Ave Index (A.I)	Rank
	1	2	3	4	5		
Communicate with other of constructions site teams for welding works.	7%	26%	29%	18%	20%	3.2	4
Construction site workers equipped with personal protection equipment (PPE) for welding works?	0%	5%	16%	37%	42%	4.2	1
Equipment for welding work was checked before use?	0%	7%	24%	28%	42%	4.1	2
Fire extinguisher equipment was provided during welding works?	9%	16%	13%	18%	43%	3.7	3
Welding component in a good condition?	7%	26%	29%	14%	24%	3.2	5

From table 4.8, shows the majority respondents of respondents for the safety aspect during welding process at level very good. Through table 4.8 average index (AI) of the Construction site workers equipped with personal protection equipment (PPE) for welding works is 4.2, making it the highest ranked safety aspect for welding process. As for the Fire extinguisher equipment provided during welding works with A.I is 3.7. Welding component in a good condition is the last ranking in safety aspect during bracing process with A.I is 3.2. According to CIDB, 2006 if the connections after welding exposed to weather the welds should be coated with a protective coating.

4.6.7 Safety Aspect during Grouting Process

Analysis of returned questionnaire form for safety aspect during grouting process shows in table 4.9.

Table 4.9: Safety aspect during grouting process

(1) Poor (2) Satisfactory (3) Good (4) Very Good (5) Excellent

Safety Aspect	Frequency Analysis					Ave Index (A.I)	Rank
	1	2	3	4	5		
Equipment for grouting work needs to be checked before used?	0%	5%	24%	33%	38%	4.0	3
Construction site workers equipped with personal protection equipment (PPE)?	0%	12%	16%	30%	42%	4.0	4
The grout curing in a good condition before it release?	0%	5%	21%	30%	43%	4.1	1
The implementation method of grouting works refers to “work method statement”?	0%	4%	21%	38%	37%	4.1	2
Communicate with other constructions site teams for grouting works.	16%	26%	21%	16%	21%	3.0	5

From table 4.9 shows the level of safety during grouting process in level very good and good. It’s because majority respondents agree safety aspect in ranking very good and all safety aspect are important during lifting process. The highest ranking for

safety aspect is the grout curing in a good condition before it release with average index is 4.1. Time to curing depends on mixture design by provider. A.I for Equipment for grouting work needs to be checked before used is 4.0. Surprisingly, communicate with other constructions site teams for grouting works is ranked last with A.I 3.0. This is because the workers still no practice good communication between other construction site team. The workers should have a good communication with other site team.

4.7 Summary

In the questionnaire on the safety aspect and the requirement during the process of installation at site and to identify the level of safety at site, majority of the respondents agree on the level of safety at site in the questionnaire form. Level of agreement of evaluation for all questions in section B in questionnaire such as safety in general, safety aspect during lifting process, bracing process, propping process and etc are in rank good and very good. From analysis, it shows communicate with other constructions site teams for all installation process still in last ranked, this is because the workers still not practice good communication with other construction site team. Is there no relationship or communication not important to ensure the safety of the workers. The workers are required to have good communication to be sure all installation process can install properly so that component not fall. Actually communication is one of safety aspect importantly in installation process, so the worker must improve communicate with other site team to decrease of accident. One more thing the workers should consider to use suitable Personal Protective Equipment (PPE) during installation process because it also can decrease of accidents. This is because the workers still not practices and still not consider use personal protective equipment during installation process. To reduce the worker from not wear PPE is the worker who does not wear PPE imposed a fine and tightens rules.

Therefore the ranking of the safety aspect and requirement during process of installation and for identify the level of safety during installation process at site is determine.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATION

5.1 Introduction

This chapter concludes the study by summarizing the result of the data analysis. The chapter begins with limitation of the study. Based on the literature review, structure interview, questionnaire form, questionnaire distributes and data analysis, the objectives of this project has been achieved. Recommendations to overcome safety aspect and requirement during process of installation at site and identify the level of safety aspect during installation process at site are included. Recommendation for further study on this topic also presented here.

5.2 Conclusion

This section presents the research finding of this study. Basically all the objectives of this study have been successfully achieved.

First objective for this study are to study the installation process for pre-cast concrete component and manufactured pre-cast element. The second objectives are to identify the safety aspect and the requirement during the process of installation at site. There are many activity involved in method precast concrete. Starting design precast component, follow by manufactured at factory and then transportation to site and lastly installation precast component at site. During interview and literature review they are three phases during installation precast component. Starting lifting process, follow by placing process, stabilizing component either bracing process or propping process, and the lastly process are connection component either welding process or grouting process. Majority agree, this are a few safety aspect and requirement during lifting process, such as make sure worker not near during lifting process, checked the walkie talkie before used, understand hand signal, ensure crane in good condition and etc.

Third objectives for this study are to identify the level of safety aspect during installation process at site. From questionnaire form, the level at site is identified and classified stage by stage. Those are as follow:-

Safety in general aspect	**Rank**
Construction site workers equipped with personal protective equipment (PPE).	1
Safety talk and tool box meeting arrange by the person who qualifies such as safety officer.	2
“Tool box meeting” or “safety talk” always done at site.	3
Job hazard analysis constantly prepared before the installation.	4
Construction site workers used personal protection equipment (PPE).	5

Safety aspect during lifting process	**Rank**
The installation process were stopped when windy day, rain condition or at night.	1
The worker equipped with “safety harness” while working at high place.	2
Communication equipment being used during lifting process.	3
Safety measure has been conducted during installation process such as do the barrier to avoid anyone to near during lifting process.	4
The worker used personal protection equipment during lifting process.	5

Safety aspect during placing process	**Rank**
Used wire from hitting other component.	1
Has been equipped “safety harness” while working at high place.	2
Precast component secure in position	3
The worker used personal protection equipment during placing process.	4
Communication equipment being used during placing process.	5

Safety aspect during bracing process	**Rank**
During Bracing process, the component was checked before it is used.	1
Construction site workers equipped with personal protection equipment	2
The bracing need to be installed correctly.	3
Bracing were release after getting instruction from “erection design engineer”.	4
Communicate with other construction site teams for bracing works.	5

Safety aspect during propping process	**Rank**
The propping need to be installed in a good condition.	1
The installation of propping equipment method refers to Company’s “method statement”.	2
Propping equipment was release after getting instruction from “erection design engineer”.	3
Using the proper Personal Protection Equipment (PPE).	4
Communicate with other of construction site teams for propping works.	5

Safety aspect during welding process	Rank
Construction site workers equipped with personal protection equipment (PPE) for welding works.	1
Equipment for welding work was checked before use.	2
Fire extinguisher equipment was provided during welding works.	3
Communicate with other of constructions site teams for welding works.	4
Welding component in a good condition.	5

Safety aspect during grouting process	**Rank**
The grout curing in a good condition before it release.	1
The implementation method of grouting works refers to “work method statement”.	2
Equipment for grouting work needs to be checked before used.	3
Construction site workers equipped with personal protection equipment (PPE).	4
Communicate with other constructions site teams for grouting works.	5

5.3 Recommendation

Below are some recommendations to increase the safety aspect in precast construction.

1. Safety for other activity for precast construction such as safety aspect during transportation process to site, safety aspect during manufactured component at factory, and safety aspect have been considered during component design.
2. Person who in charge or involved in precast construction must know about safety aspect in precast concrete.

3. The worker or company should follow the step to avoid accident such as do the safety talk and tool box meeting every day or every week, follow the method statement, used suitable PPE, proper planning transportation and etc.
4. The installation process must stopped immediately such as when windy day, rain condition or at night, over loading crane, not enough machine or damage of component and etc.
5. Safety officer must play an active role to control the safety at site.
6. During installation used precast concrete, the worker must follow by order such as lifting process, placing process, stabilizing process either bracing or propping and lastly connecting component either welding or grouting.
7. Improve safety awareness until no accident will happen.
8. The site participant must have at least a basic knowledge on the safety aspect and know their responsibility.

5.4 Recommendations for Further Study

There is some suggested by the author for further study. Firstly the company must gives cooperation with students to do their study or Thesis. It is because in my experiences less many companies give cooperation with students. Second, people who are responsible to must do a research about statistic for accident occur because precast concrete method it is because no statistics were recorded. Thirdly this study conducted in area Klang Valley only. Therefore, further study should cover all target area in Malaysia. For further study should use a different methodology. The method should use are analysis hierarchy process (AHP) for good safety approach.

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APPENDIX A

Questionnaires

Section A

(Bahagian A)

Instruction (Arahan)

Please Circle and Fill In the Blanks (*Sila Bulatkan Dan Isi Tempat Kosong)*

RESPONDENT'S INFORMATION

(Latar Belakang Responden)

1. Position (*Jawatan*)
   a) Project Manager (*Pengurus Projek*)
   b) Engineer (*Jurutera*)
   c) Site Supervisor (*Penyelia Tapak*)
   d) Others (*Lain – Lain*) _____

2. Type Of Company (*Jenis Syarikat*)
   a) Consultant (*Perunding*)
   b) Contractor (*Kontraktor*)
   c) Developer (*Pemaju*)
   d) Government (*Pihak Kerajaan*)
   e) Others (*Lain – Lain*) _____

3. Number Of Year The Company Have Involved In The Construction Using Pre-Cast Concrete. (*Tempoh Penglibatan Syarikat Dalam Pembinaan Menggunakan Konkrit Pre-Cast*)
   a) 1-5
   b) 6-10
   c) 11-20
   d) >20

4. Number of Construction Projects Using Pre-Cast You Have Involved. (*Bilangan Project Menggunakan Precast Yang Pernah Anda Terlibat*)
   a) 1-5
   b) 6-10

c) >10
d) Tiada (No)

5. During you involvement in construction using Pre-cast, how many accidents ever happen? (*Selama Anda Terlibat Dalam Pembinaan Menggunakan Pre-Cast, Berapakah Bilangan Kemalangan Yang Pernah Berlaku*.)
   a) 1-5
   b) 6-10
   c) >10
   d) Tiada (No)

Section B

(Bahagian B)

Please choose the suitable value from likert scale below

(Sila pilih mana-mana dibawah dan isikan ditempat yang anda rasa sesuai.)

(5) = Excellent (Cemerlang) (4) = Very Good (Sangat baik) (3) = Good (Baik)

(2) = Satisfactory (Memuaskan) (1) = Poor (Lemah)

	Categories 1: Safety In General Aspect **(*Kategori 1 : Keselamatan Dalam Aspek Umum***					
No	**Safety**	**1**	**2**	**3**	**4**	**5**
1.	Construction site workers equipped with personal protection equipment (PPE)? (P*ekerja di tapak pembinaan diberi peralatan perlindungan peribadi (ppe)?)*					
2.	Construction site workers, used personal protection equipment (PPE)? (P*ekerja di tapak pembinaan menggunakan peralatan pelindungan peribadi yang diberikan?)*					
3.	"Tool box meeting" or "safety talk" always done at site? (*"Tool box meeting" atau "safety talk" selalu diadakan di tapak pembinaan?)*					
4.	Job hazard analysis constantly prepared before the installation? (J*ob hazard analysis selalu dilakukan sebelum kerja pemasangan*?)					
5.	Safety talk and tool box meeting arrange by the person who qualifies such as safety officer (*Safety talk and tool box meeting dikendalikan oleh orang yang layak seperti pegawai keselamatan*)					

(5) = Excellent (Cemerlang) (4) = Very Good (Sangat baik) (3) = Good (Baik)
(2) = Satisfactory (Memuaskan) (1) = Poor (Lemah)

	Categories 2: Safety Aspect During Lifting Process **(*Kategori 2 : Aspek Keselamatan Semasa Kerja Mengangkat***					
No	**Safety Aspect**	**1**	**2**	**3**	**4**	**5**
1.	Safety measure has been conducted during installation process such as do the barrier to avoid anyone to near during lifting process *(Langkah keselamatan dijalankan semasa process pemasangan seperti membuat halangan untuk mengelak sesiapa berdekatan semasa kerja mengangkat.)*					
2.	The installation process were stopped when windy day, rain condition or at night? (K*erja pemasangan akan diberhentkan apabila keadaan angin kencang, hujan lebat atau malam.*					
3.	The worker used personal protection equipment during lifting process (P*ekerja menggunakan peralatan perlindungan peribadi semasa kerja mengangkat)*					
4.	The worker equipped with “safety harness” while working at high place? (P*ekerja diberi “safety harness” sekiranya bekerja ditempat yang tinggi)*					
5.	Communication equipment being used during lifting process? (A*lat komunikasi digunakan semasa kerja mengangkat komponen dilakukan*)					

(5) = Excellent (Cemerlang) (4) = Very Good (Sangat baik) (3) = Good (Baik)
(2) = Satisfactory (Memuaskan) (1) = Poor (Lemah)

	Categories 3: Safety Aspect During Bracing Process **(*Kategori 3 : Aspek Keselamatan Semasa Kerja Merembat***					
No	**Safety Aspect**	**1**	**2**	**3**	**4**	**5**
1.	During Bracing process, the component will be checked before it is used? (S*emasa kerja merembat, komponen akan diperiksa sebelum penggunaanya.)*					
2.	Bracing will be release after getting instruction from “erection design engineer”? (P*erembat akan dibuka setelah mendapat arahan daripada “erection design engineer”)*					
3.	Construction site workers equipped with personal protection equipment (PPE)? (*Pekerja di tapak pembinaan diberi peralatan perlindungan peribadi (ppe)?)*					
4.	The bracing need to be installed correctly? (P*emasangan perembat dipasang dengan betul)*					
5.	Communicate with other construction site teams for bracing works. (B*erkomunikasi dengan ahli pasukan di tapak pembinaan untuk kerja merembat)*					

(5) = Excellent (Cemerlang) (4) = Very Good (Sangat baik) (3) = Good (Baik)
(2) = Satisfactory (Memuaskan) (1) = Poor (Lemah)

	Categories 4: Safety Aspect During Propping Process **(*Kategori 4 : Aspek Keselamatan Semasa Kerja Propping***					
No	**Safety Aspect**	**1**	**2**	**3**	**4**	**5**
1.	Using the proper Personal Protection Equipment PPE *(Menggunakan ppe yang sesuai)*					
2.	Propping equipment was release after getting instruction from "erection design engineer"? (A*lat propping dibuka setelah mendapat arahan daripada "erection design engineer")*					
3.	The propping need to be installed in a good condition (P*ropping dipasang dalam keadaan yang baik*					
4.	The installation of propping equipment method refers to Company's "method statement" (K*aedah pemasangann alat propping perlu dirujuk kepada Company "method statement")*					
5.	Communicate with other of construction site teams for propping works. (B*erkomunikasi dengan ahli pasukann di tapak pembinaan untuk kerja propping)*					

(5) = Excellent (Cemerlang) (4) = Very Good (Sangat baik) (3) = Good (Baik)
(2) = Satisfactory (Memuaskan) (1) = Poor (Lemah)

	Categories 5: Safety Aspect During Welding Process **(*Kategori 5 : Aspek Keselamatan Semasa Kerja Kimpalan***					
No	**Safety Aspect**	**1**	**2**	**3**	**4**	**5**
1.	Communicate with other of constructions site teams for welding works. (B*erkomunikasi dengan ahli pasukan di tapak pembinaan untuk kerja mengimpal)*					
2.	Construction site workers equipped with personal protection equipment (PPE) for welding works? (P*ekerja di tapak pembinaan diberi peralatan perlindungan peribadi untuk kerja mengimpal (ppe)?)*					
3.	Equipment for welding work was checked before use? *(Peralatan untuk mengimpal diperiksa sebelum menggunakannya?)*					
4.	Fire extinguisher equipment was provided during welding works? (A*lat pemadam api disediakan semasa kerja mengimpal?)*					
5.	Welding component in a good condition? (*Mengimpal komponen dalam keadaan yang baik)*					

(5) = Excellent (Cemerlang) (4) = Very Good (Sangat baik) (3) = Good (Baik)
(2) = Satisfactory (Memuaskan) (1) = Poor (Lemah)

	Categories 6: Safety Aspect During Grouting Process **(*Kategori 6 : Aspek Keselamatan Semasa Kerja Turapan***					
No	**Safety Aspect**	**1**	**2**	**3**	**4**	**5**
1.	Equipment for grouting work needs to be checked before used? (P*eralatan untuk groutingl perlu diperiksa sebelum menggunakannya?)*					
2.	Construction site workers equipped with personal protection equipment (PPE)? *(Pekerja di tapak pembinaan diberi peralatan perlindungan peribadi (ppe)?)*					
3.	The grout curing in a good condition before it release? (Grout diawet dalam keadaan yang baik sebelum dibuka?)					
4.	The implementation method of grouting works refers to “work method statement”? (K*aedah perlaksanaan kerja grouting dirujuk kepada”work method statement”)*					
5.	Communicate with other constructions site teams for grouting works. (*Berkomunikasi dengan ahli pasukan di tapak pembinaan untuk kerja menurap)*					

Section C

Bahagian C

Please choose the suitable value from likert scale below

Sila pilih mana-mana dibawah dan isikan ditempat yang anda rasa sesuai.

(5) = Excellent (Cemerlang) (4) = Very Good (Sangat baik) (3) = Good (Baik)

(2) = Satisfactory (Memuaskan) (1) = Poor (Lemah)

	Categories 1: Safety Aspect In Crane **(*Kategori 1 : Aspek Keselamatan Dalam Kren***					
Category (kategori)	**Crane safety**	**1**	**2**	**3**	**4**	**5**
`	Skilled (*Berkemahiran)*					
	Have information of site condition and site spacing *(Mempunyai maklumat tentang keadaan tapak dan ruang tapak)*					
	Not use a proper ppe (*Tidak menggunakan ppe yang sesuai)*					
Operator	Understand the hand signals during crane operation (*Memahami isyarat tangan semasa kren beroperasi)*					
	Experienced in the transportation of the pre-cast element (Mempunyai p*engalaman untuk menghantar elemen pre-cast)*					

(5) = Excellent (Cemerlang) (4) = Very Good (Sangat baik) (3) = Good (Baik)
(2) = Satisfactory (Memuaskan) (1) = Poor (Lemah)

Crane hazard(hazard kren)	Danger zone exist before crane operation *(Zon bahaya diwujudkan sebelum kren beroperasi)*					
	Crane operator has competence certificates *(Pemandu kren mempunyai sijil kecekapan*					
	Defects of rubber tires and low air pressure (*Kerosakan tayar getah dan tekanan udara yang rendah)*					
	Truck in a good condition (*Trak dalam keadaan baik)*					
	Overloading (*Lebihan beban*)					
Transportanion and driver hazard	No license or driving certificate to drive such as vehicle license (*Tiada lesen atau sijil memandu seperti kenderaan)*					
	Have an information about weight and types of component (*Maklumat berkaitan berat dan jenis komponen)*					
	Driver noticed about transportation transport law including load restrain (*Pemandu mengetahui undang-undang kenderaan termasuk penahan beban)*					
	Lack of training (*Kurang latihan)*					
	Defect on wheels or low air pressure *(Kerosakkan pada roda atau tekanan udara yang rendah)*					