CERTIFICATION OF APPROVAL

Safety of Scaffolding in Construction Site

by

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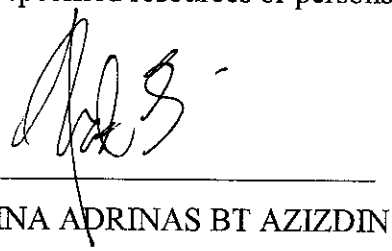
CERTIFICATION OF ORIGINALITY

This to certify that I am responsible for the work submitted in the project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified resources or persons



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ABSTRACT

This research project is undertaken to measure the degree of safety in the use of scaffolds in Malaysia and to correlate safe scaffold practice to construction management and labors. Fall from height is the leading cause of death for construction workers. Accident that relates to scaffold due to collapse or fall from scaffolding is the second leading cause of fall averaging 32% in five years 1999-2003-[NIOSH, 2000].This study focus on accident that relate to five types of scaffolding that are commonly employed in construction site. The methodologies used in this research are interviews with the people involved in the construction site and questionnaires which are distributed to the construction management and workers. Literature review discovers that adequate training, competency of erecting and dismantling scaffold and sufficient inspection and maintenance of scaffold can prevent accident.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

Scaffolding is a temporary framework used to support people and material in the construction or repair of buildings and other large structures. It is usually a modular system of metal pipes. The basic materials are tubes, couplers and boards. Tubes are either black or galvanized steel in a variety of lengths with a standard diameter of 48.3 mm. Tubes are generally bought in 6.3 m lengths to be cut down to certain typical sizes. Boards provide a working surface for users of the scaffold. They are made of seasoned wood by thicknesses of 38 mm, 50 mm and 63 mm with a standard width of 225 mm. The board ends are protected by metal plates called hoop irons or sometimes nail plates. Wood, steel or aluminum decking is used or laminate boards. Couplers are the fittings which hold the tubes together. The most common scaffold couplers are right-angle couplers, putlog couplers and swivel couplers. [1]

In employing scaffolding as a temporary supporting structure, the strength and stability has to suit the task to be carried out and height of the building. Additionally construction firms have to concern about the worker's safety while erecting, altering and dismantling scaffolding. They have to concern about the safety in the vicinity of the scaffold to avoid the accident from happening.

1.1 Background of study

The inspiration to conduct this study is mainly because of the great numbers of accident produced by the statistic shown below.

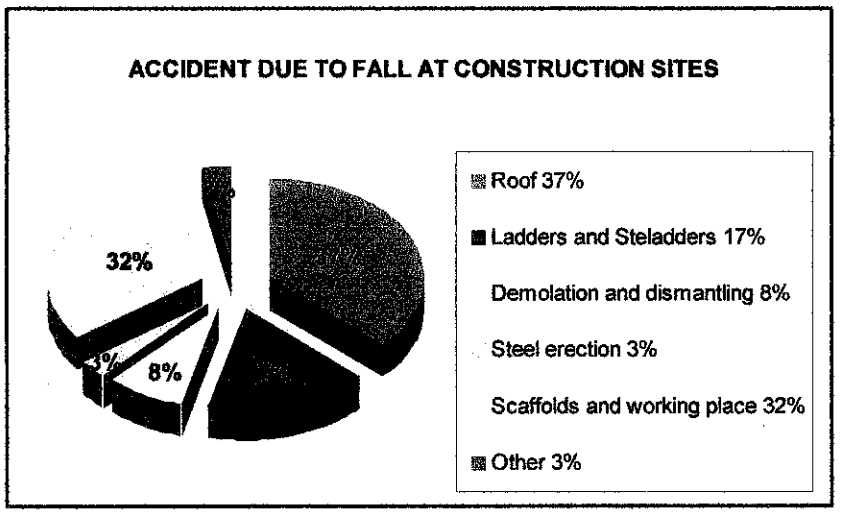

Figure 1.1: Accident of construction workers in 5 years (1999 – 2003).

The above chart illustrates the statistic produced by National Organization Institute of Safety and Health (NIOSH) shows that 383 workers involved in accident in five years time (1999 – 2003). Thirty seven percent of accident happened on roof, followed by thirty two percent happened involving scaffolds at working place. Seventeen percent of workers involved in accident while using ladders and stepladders. Another eight percent involved in accident while dismantling and erecting steel. Thirty two percent of workers involved in accident on scaffolding. The common causes of accidents reported are:

(i) Inadequate scaffold's structure

(ii) Scaffold's damage

(iii) Overloading

(iv) Improper anchoring

1.2 Problem Statement

Fall from height are the principal cause of fatality for construction workers. Fall relates with scaffold that is by collapse or fall from scaffolding is the second leading cause of fall averaging 32% in five years 1999-2003-[National Instituted for Occupational Safety and Health (NIOSH), 2000] [15].

Based on literature review, Malaysia scaffolding's management control is still in low level because accidents affecting the labours and scaffold's workers are mainly fatal injuries or death is cause by the lack of management control.

Safety is the most important factor to be concentrate by construction firms. Thus, management have to take precautionary steps to ensure that fatal accidents do not happen in the future.

The significant of the research project is to identify unsafe scaffold practices in creating safety scaffolding environment in construction sites and provide maximum safety to workers.

1.3 Objectives and Scope of Study

The objectives of this research are;

I. To highlight the scaffolding safety aspect related to the construction workers and management.
II. To determine the level of safety awareness of workers and management at construction site.
III. To identify the methods in enhancing safety of scaffolding application.

The scope of the study includes:

I. Scaffolding which are commonly used to build building in construction sites.
II. Cases happening in Perak.
III. Scaffolding maintenance process on site.

CHAPTER 2

LITERATURE REVIEW

2.1 Definition of Scaffolding

According to Wikipedia [1], Scaffolding is a temporary framework used to support people and material in the construction or repair of buildings and other large structures.

2.2 Key Element of Scaffolding

The key elements of a scaffold are standards, ledgers and transoms (refer figure 2.1). The standards, also called uprights, are the vertical tubes that transfer the entire mass of the structure to the ground where they rest on a square base plate to spread the load. The base plate has a shank in its centre to hold the tube and is sometimes pinned to a sole board. Ledgers are horizontal tubes which connect between the standards. Transoms rest upon the ledgers at right angles. Main transoms are placed next to the standards, they hold the standards in place and provide support for boards; intermediate transoms are those placed between the main transoms to provide extra support for boards [1].

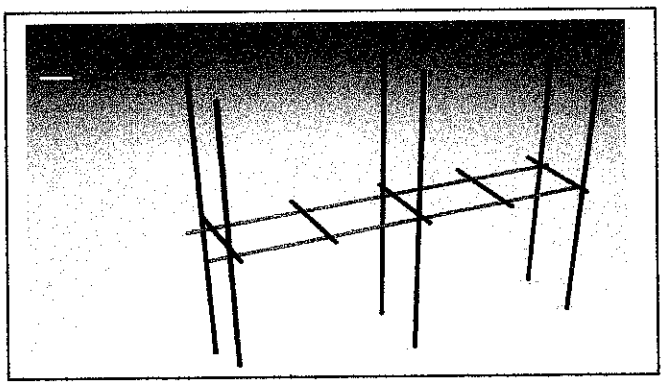

Figure 2.1: Basic elements of a scaffold

There are cross braces to increase rigidity, these are placed diagonally from ledger to ledger, next to the standards to which they are fitted. If the braces are fitted to the ledgers they are called ledger braces. To limit sway a facade brace is fitted to the face of the scaffold every 30 meters or so at an angle of 35°-55° running right from the base to the top of the scaffold and fixed at every level [1].

2.3 Scaffold Dimensioning

The spacing of the basic elements in the scaffold is fairly standard (refer figure 2.2). For a general purpose scaffold the maximum bay length is 2.1 m, for heavier work the bay size is reduced to 2 or even 1.8 m while for inspection a bay width of up to 2.7 m is allowed. The scaffolding width is determined by the width of the boards, the minimum width allowed is 600 mm but a more typical four-board scaffold would be 870 mm wide from standard to standard. More heavy duty scaffolding can require 5, 6 or even up to 8 boards width. Often an inside board is added to reduce the gap between the inner standard and the structure [1].

Transom spacing is determined by the thickness of the boards supported, 38 mm boards require a transom spacing of no more than 1.5 m while a 50 mm board can stand a transom spacing of 2.6 m and 63 mm boards can have a maximum span of 3.25 m. The minimum overhang for all boards is 50 mm [1].

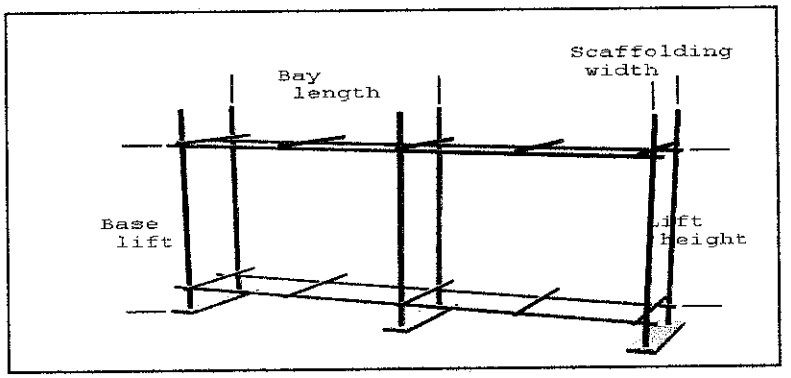

Figure 2.2: Basic scaffold dimensioning terms.

2.4 Scaffolding Safety Element

2.4.1 Ties

Scaffolds are independent structures. To ensure a constant and correct space between the structure and the scaffold ties are used to link it. General practice is to attach a tie every 6 m on alternate lifts. The ties are coupled to the scaffold as close to the junction of standard and ledger or node point as possible

Through ties are put through structure openings such as windows. A vertical inside tube crossing the opening is attached to the scaffold by a transom and a crossing horizontal tube on the outside called a bridle tube. The gaps between the tubes and the structure surfaces are packed or wedged with timber sections to ensure a solid fit [1].

Box ties are used to attach the scaffold to suitable pillars or comparable features. Two additional transoms are put across from the lift on each side of the feature and are joined on both sides with shorter tubes called tie tubes. When a complete box tie is impossible an l-shaped *lip tie* can be used to hook the scaffold to the structure, to limit inward movement an additional transom, a *butt transom*, is place hard against the outside face of the structure [1].

Anchor ties which also called *bolt ties*, these are ties fitted into holes drilled in the structure. A common type is a ring bolt with an expanding wedge which is then tied to a node point [1].

The least 'invasive' tie is a *reveal tie*. These use an opening in the structure but use a tube wedged horizontally in the opening. The reveal tube is usually held in place by a reveal screw pin or an adjustable threaded bar and protective packing at either end. A transom ties tube links the reveal tube to the scaffold. Reveal ties are not well regarded; they rely solely on friction and need regular checking so it is not recommended that more than half of all ties be reveal ties [1].

If it is not possible to use a safe number of ties *rakers* can be used. These are single tubes attached to a ledger extending out from the scaffold at an angle of less than 75° and securely founded. A transom at the base then completes a triangle back to the base of the main scaffold [1].

2.4.2 Foundations

Good foundations are essential. Often scaffold frameworks will require more than simple base plates to safely carry and spread the load. Scaffolding can be used without base plates on concrete or similar hard surfaces, although base plates are always recommended. For surfaces like pavements or tarmac base plates are necessary. For softer or more doubtful surfaces sole boards must be used, beneath a single standard a sole board should be at least 1,000 cm^2 with no dimension less than 220 mm, the thickness must be at least 35mm. For heavier duty scaffold much more substantial baulks set in concrete can be required. On uneven ground steps must be cut for the base plates, a minimum step size of around 450 mm is recommended [12].

2.4.3 Working platform

A working platform requires certain other elements to be safe. (Refer figure 2.3). They must be close-boarded, have double guard rails and toe and stop boards. Safe and secure access must also be provided [1].

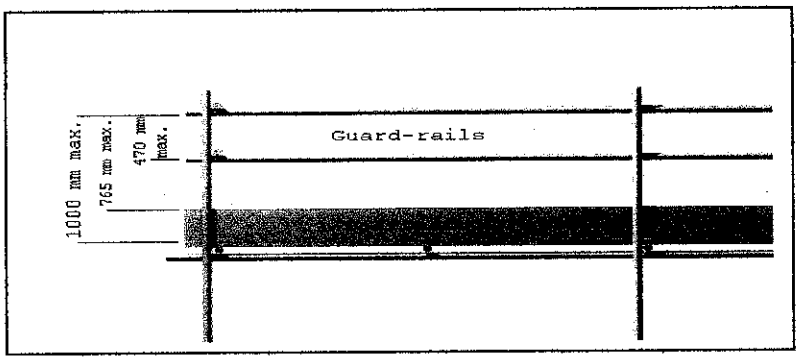

Figure 2.3: Scaffolding showing required protection of a working platform with maximum dimensions.

2.4 Types of Scaffold

According to Raftery John [2], the usual types of scaffold being used in construction site are putlog scaffold, independent tied scaffold, birdcage scaffold, truss out scaffold and tower scaffold.

2.4.1 Putlog Scaffold

Putlog Scaffold is a scaffold in which the building gives direct support to one complete elevation of the scaffold unit (refer figure 2.4). A single row of standards supports horizontal ledgers, which in turn support, with the assistance of the building structure, the horizontal putlogs. These putlogs bear the loading of scaffold boards to create the platform. The use of this scaffold is restricted to places that allow the insertion of putlogs into the fabric of the building, e.g. brickwork and certain masonry buildings. Non-load-bearing or decorative building facades are not suitable for putlog scaffolds. Putlog scaffolds, sometimes called bricklayers' scaffolds, depend for their support on the walls of the buildings on their inner side, and rows of standards on their outer side [2].

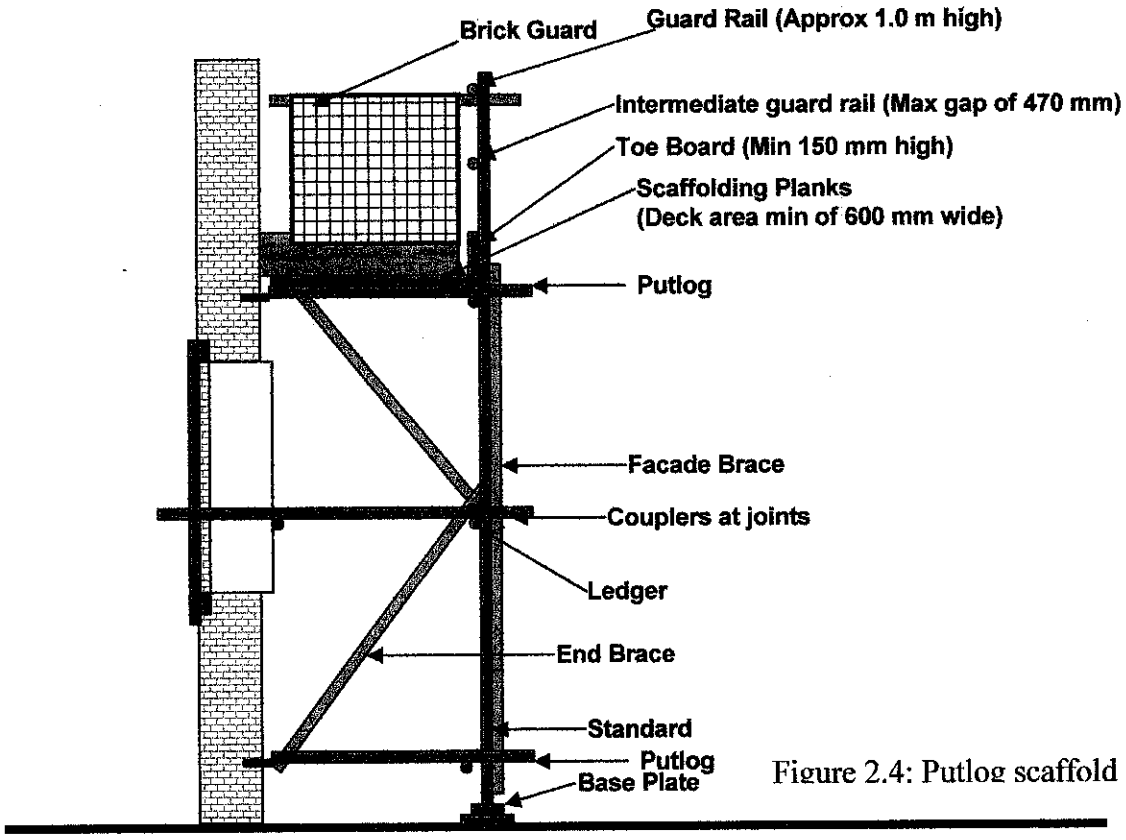

Figure 2.4: Putlog scaffold

2.4.2 Independent Tied Scaffold

Independent tied scaffold (figure 2.5) consists of two rows of standards, each row parallel to the building. The inner row of standards is set as close to the building as practical, or not further away than just enough to allow for inside board between the inside standards and the building or structure. The distance between the inside standards and the outside standards will be governed by the number of boards which will be required. Ledgers are fixed to the standards with right-angle couplers and the ledgers, like the standards, are fixed parallel to the building. Transoms are fixed to the ledgers with putlog couplers and the transoms are fixed at right angles to the ledgers. Bracers are fixed diagonally to the ledgers or standards. Sway bracing or longitudinal bracing is fixed to the standards or transoms and is fixed across the face of the scaffold (refer figure 2.6).

The self-weight of the scaffold together with any loads on it are transferred to the ground via the standards. The type of load, whether it is distributed load or a point load of any other loading, may be specifically designed. If no load-rating is quoted by the specification then one should be selected from the Code of Practice table of loads. The spacing of the standards or the bay length depends on the height and loading of the scaffold. The spacing of the ledgers or the lift height is normally 2 meter but in certain circumstances lifts may be greater, provided the standards are capable of supporting the load [2].

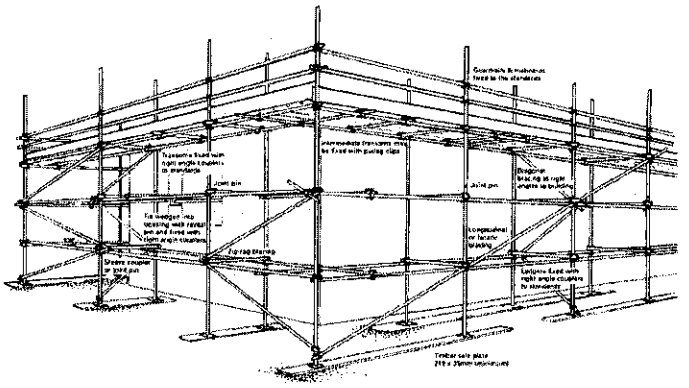

Figure 2.5: Independent tied scaffold install to a building

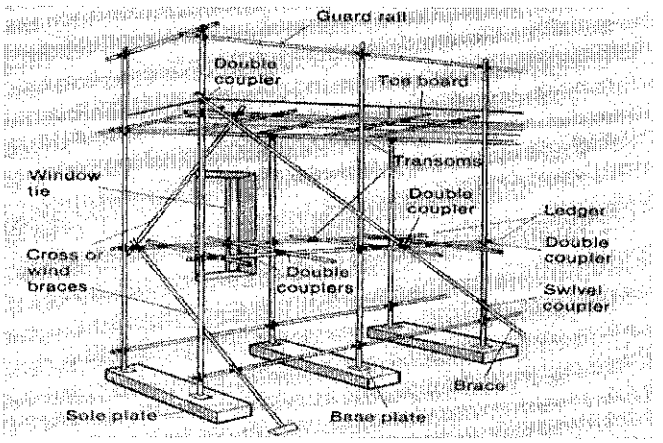

Figure 2.6: The position of the various member of independent tied scaffold

2.4.3 Birdcage Scaffold

Birdcage scaffold is normally an internal scaffold and is mainly used for ceiling work in large halls or open spaces. It consists of an arrangement of standards with ledgers and transoms supporting a closely boarded platform at the required level. The side and end bays may also be required scaffolding to the walls supporting the soffit. Birdcage scaffold is the general term used, but it can be divided into two types that are Birdcages with more than one lift and Single-lift birdcages (refer figure 2.7).

Birdcage with more than one lift is a light-duty scaffold, therefore light loads only should be placed on the scaffold; a maximum of 75 kg/m2 should be used as a guide, with a maximum standard spacing of 2.5 m in either direction. The foundations for a birdcage scaffold must be pitched on steel base plates, but many require special consideration for different conditions. Provision must be made for scaffold that is placed on highly polished wood, mosaic, marble or similar floors. Protective material should be laid under the sole boards [2].

Birdcage scaffolds must be securely tied to columns or the side walls throughout their length and height to prevent movement of the scaffold. Guardrails and toe-boards are necessary when the working platform finishes more than 155 mm form the walls or is higher than 2 m from the ground [2].

At first glance a single-lift birdcage may look stable; in fact it may be considerably less stable than a multi-lift birdcage. Because it is one lift, some think bracing may be omitted. The following are required to ensure stability:

(a) Bracing must be fixed to each corner at least, and every alternate pair of standards in both directions.
(b) There must be foot-ties all the way round and internal standards should be foot-tied in pairs in one direction at least.
(c) Foot-ties must be fixed to the bottom of the standards to which the bracing is connected.

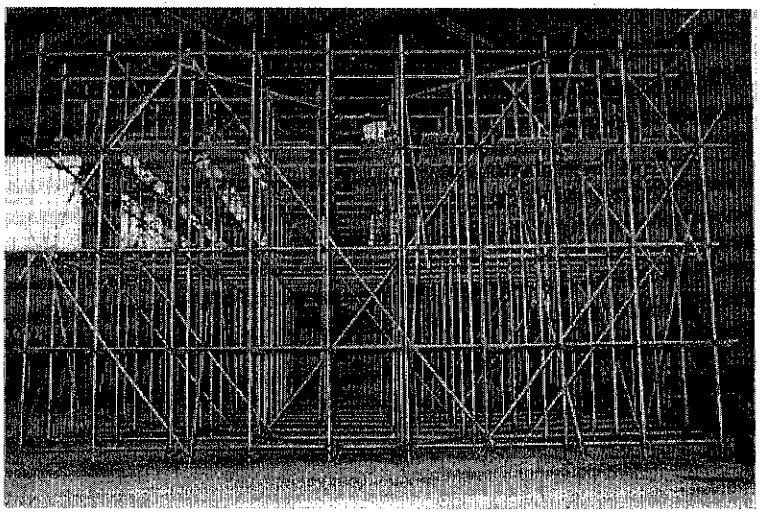

Figure 2.7: Birdcage scaffold

2.4.4 Truss Out Scaffold

Truss-out scaffold is an independent tied scaffold not erected from the ground but supported by a truss-out scaffolding structure projecting from the face of a building or structure. It is essential that assurances are obtained concerning the ability of the building to support the scaffolding safely (refer figure 2.8).

Timber soleplates and head plates must be used to distribute the load. Tubes projecting from the built-up inside scaffold (the horse) are known as needle transoms and must be secured with right-angle couplers and when possible rest on sills and be right up against reveals. The tie tubes must always be fixed at the back of a window or opening with right-angle couplers. The inner and outer ledgers should be fixed to and on top of the needle transoms, with right-angle couplers. Rakers should be set at an angle of not more than 35 degree from the vertical and be fixed with right-angle couplers with a check coupler fixed immediately underneath and in contact with the ledgers coupler. The raker should be fixed to the outside ledger with a right-angle coupler and the lower end of the raker secured to prevent displacement. The upper end of the raker should be fixed as close to the needle transom as possible.

The scaffold should be erected in accordance with the same recommendations as access scaffolds. The maximum height for a truss-out should be tied back to the building. The ties at higher levels should be distributed at the same frequency as for ground-based independent tied scaffold [2].

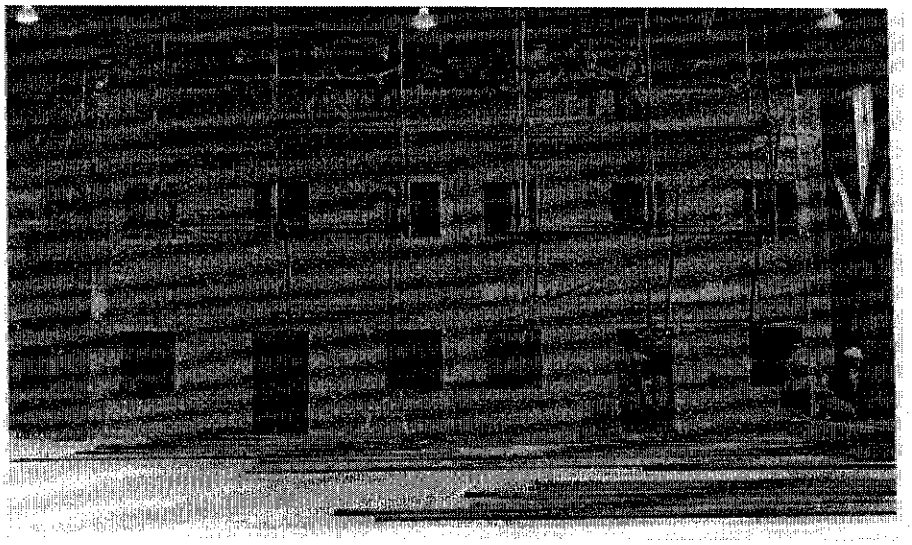

Figure 2.8: Truss-out scaffold install at building

2.4.5 Tower Scaffold

Tower scaffold is a scaffold mounted on wheels or castors. It usually consists of four standards, and is square in construction. It should not have more than one working platform and guardrails and toe-boards must be provided. Access may be gained to the working platform via a ladder or stairway positioned from either the inside or the outside of the structure. A tower scaffold tower must only be used for lightweight work, e.g. painters, plumber and wiring (refer figure 2.9).

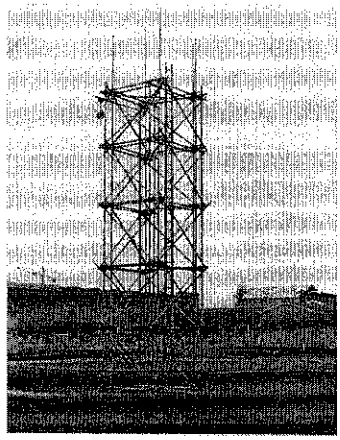

Figure 2.9: Tower scaffold

2.5 Safety Procedures on Construction Sites

In order to create safety of scaffolding environment in construction sites, the company operating the construction will need to define responsibilities for workers safety, to ensure that action was taken on unsafe working practises issues, train staff and workers to become aware of their safety responsibilities, monitor workers safety performance and audit and review the safety system of achieving safety working environment improvement so that it can provide maximum safety to workers [13].

The basis of all of these activities is an organizational commitment to continual safety improvement based on the safety policy. The advantages of improved safety management mainly it will reduce the great numbers of accident produced by National Organization Institute of Safety and Health (NIOSH) stated that 383 workers involved in accident in five years time (1999 – 2003) by 32% of accident happened involving scaffolds at working place. It manage to save company's costs to pay compensation to Department of Safety and Health (DOSH) due to their unaware of workers safety, improved public image and increased market opportunities, and viewed more favorably by the regulator and the construction sector [14].

According to Richard Doughty [3], the precaution procedures for erecting the scaffold's are:

a. The footing of scaffolding must be sound and rigid, capable of supporting the weight.
b. Only competent/trained persons shall erect and dismantle a scaffold according to the manufacturer's directions.
c. Scaffolds and components shall be able to support at least four times the intended load.
d. Two guardrails (handrail and mid rail), respectively above the scaffold deck, shall be attached to upright supports. The upright supports shall not exceed 2.5 meter apart. Toe boards shall be 0.1 meter high and are required for all open sides of the scaffold.
e. Screens shall be required between the toe board and mid rail where persons are required to pass underneath.
f. Any components of a scaffold damaged or weakened shall be repaired or replaced immediately. Don't paint the tops or bottoms of work platforms with anything that will hide defects (only the sides can be painted for identification).
g. The maximum span for 0.05 meter x 0.3 meter planks shall be 2.5 meter while minimum plank dimension shall not be less than 0.05 meter x 0.25 meter. Make the working-level scaffold platforms as wide as possible if there is not enough space to build the minimum platform size.
h. All planking or platforms shall be overlapped a minimum of 0.3 meter and secured from movement; or nail or somehow secure the ends together. Build longer platforms with the abutting ends of the plank/deck resting on separate supports or somehow secure them.
i. An access ladder or other safe access shall be provided.
j. Scaffold planks shall extend over their end support at least 0.15 meter but not more than 0.3 meter. Deck as much as necessary to protect yourself

when using the platform as a walkway, or for employees installing or dismantling the scaffold.

k. The legs or uprights of scaffolds shall be plumb and rigidly braced to prevent swaying.
l. Wire or wire rope used for scaffold suspensions shall be capable of supporting six times the intended load.
m. Shore or lean-to scaffolds shall not be used
n. Except for loats and needle beam scaffolds, work platforms and scaffolds more than six feet above the ground or floor level shall be provided with standard guardrails, mid rails, and toe boards on the open sides and ends.

2.6 Safety Procedures at Height.

According to J C Laney [4], it is important for workers to follow these safety procedures to ensure life still goes on while performing works at height:

a. Any open edges from which a person is liable to fall a vertical distance or more than 2.0 meters shall be protected by suitable fencing or barriers of a height between 0.9 meter and 1.15 meter.

b. Platforms, gangways or runs from any of which a person is liable to fall a vertical distance of more than 2.0 meters shall be closely boarded planked of plated.

c. Any working platform from which a person is liable to fall a distance of more than 2.0 meters shall be at least 0.400 meter wide.

d. Any gangways or run from any part of which a person is liable to fall a distance of more than 2.0 meters shall be at least 0.4 meter wide if it is used for the passage of person only. Its width shall be increased to at least 6.5 meter wide if it is used for the passage of materials.

e. Workers working at height where the erection of fencing or barriers is impracticable shall be provided with suitable safety belts or harnesses and sufficient suitable safe anchorage points or life line systems to ensure the safety of the workers. Safety netting shall also be used as appropriate. Workers working at height of above three meters should use safety belt or harness to be used properly.

CHAPTER 3

METHODOLOGY

3.0 Methodology

This section will explain the procedures that will be taken to achieve the project's objectives. Detailed methodology is summarized as shown in figure 3.1.

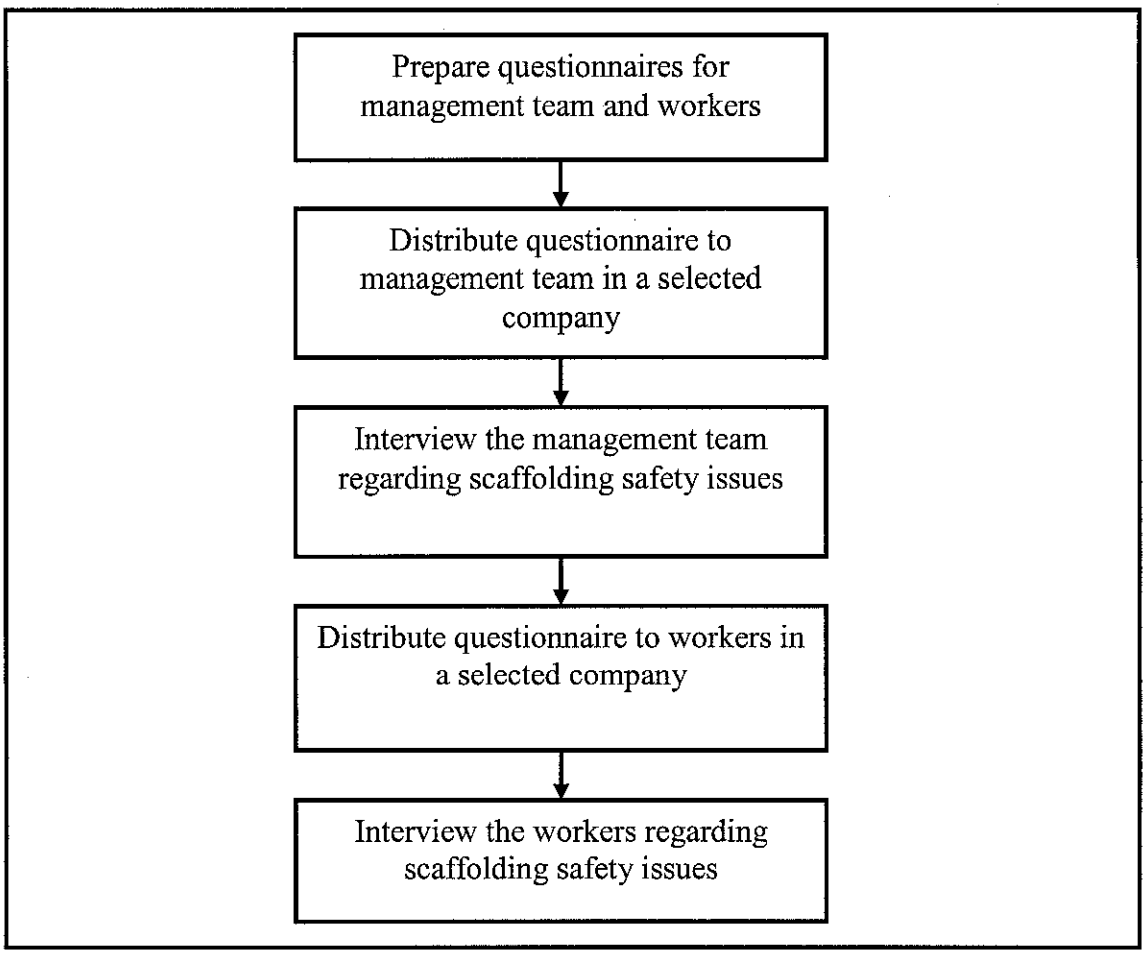

Figure 3.1: Summarize flow chart of methodology

3.1 Questionnaires

Study was conducted through two phases:

- Phase (1) is the field investigation & questionnaires distributed to the management team and construction workers.

- Phase (2) is interviews with some site safety officer and some scaffolding competent person in the construction companies.

Field questionnaire were distributed to management team and scaffolding workers on construction site and it is structured into four sections:

- The first section contains general information about the project undertaken
- The second section contains the scaffolding safety aspect
- The third section contains scaffolding safety awareness
- The fourth section contain free comments

These four sections were structured to assess the questionnaire answers with respect to scaffolding safety and the objectives for this study.

3.1.1 Sample of Management Questionnaire

This survey questionnaire is conduct to gather information on safety of scaffolding in construction site. All the information will be strictly treated as confidential.

GENERAL INFORMATION

Instruction: Please fill in the blank and thick (/) where appropriate.

Name : _____

Position : _____

Name of company : _____

SECTION A: PROJECT INTRODUCTION

1. Building type

☐ Residential ☐ Hospital

☐ Office ☐ Shopping Complex

☐ Other, please;_____

2. Building height

☐ 5 – 10 storey

☐ 10 – 15 storey

15 above

3. Construction methods

☐ Pre-cast concrete

☐ In situ concrete

☐ Steel construction

☐ Industrialized Building Systems

☐ Other, please state_____

SECTION B: SCAFFOLDING SAFETY ASPECT

1. Is there any safety department at the site?

☐ Yes ☐ No

2. Is there any safety policy for workers at the site?

☐ Yes ☐ No

3. Is any Personal Protective Equipment (PPE) for scaffolding works provided by the company at the site?

☐ Yes ☐ No

4. Do workers use Personal Protective Equipment (PPE) provided?

☐ Yes ☐ No

5. Is any initiative carried out to ensure the safety usage of scaffolding?

☐ Yes ☐ No

(i) If yes, which type of initiative that were carried out ;

☐ Inspection
☐ Restoration
☐ Repair
☐ Replacement
☐ Others_____

(ii) How frequent is the initiative carried out ;

☐ Once in 1 or 2 month
☐ Once in 3 or 4 month
☐ Once in 5 or 6 month
☐ Once in 6 month and above

(iii) Who is responsible for the maintenance ;

☐ Qualified person (Register scaffolders)
☐ Unqualified person (Any person on site)
☐ Others, please state; _____

6. Is there any safety supervision being carried out on the workers in performing the jobs related to scaffolding?

☐ Yes ☐ No

(i) Who is responsible for the supervision?

☐ Site safety officer
☐ Site supervisor
☐ Others, please state;_____

7. Do you receive any incentive if no accident occurs on the site?

☐ Yes ☐ No ☐ Not sure

(i) Type of incentive

☐ Money
☐ Holiday
☐ Days off
☐ Unrecorded leave
☐ Others, please state; _____

SECTION C: SCAFFOLDING SAFETY AWARENESS

1. Type of scaffold used;

☐ Putlog ☐ Birdcage
☐ Independent ☐ Truss-out
☐ Other, please state;_____

2. What is type of job operation on the scaffolding?

☐ Painting ☐ Formwork installation / removal
☐ Plastering ☐ Brickwork laying
☐ Concreting
☐ Others;_____

3. Normally, how many workers are allowed on the scaffold at any particular time?

- [ ] 1 – 5 people
- [ ] 6 – 10 people
- [ ] 11 – 15 people
- [ ] More than 15 people

4. On average, how much time is taken up by the workers when working on the scaffolding?

- [ ] 1 hour - 2 hours
- [ ] 2 hours – 4 hours
- [ ] More than 4 hours

5. Is there any accident that is related to scaffolding occur at the site?

[ ] Yes [ ] No

(i) If yes, how serious is the injury to workers

- [ ] Minor injury [ ] Death
- [ ] Major injury
- [ ] Other, please state;_____

(ii) Type of accident;

- [ ] Fall of workers
- [ ] Collapse of scaffolding
- [ ] Other, please state;_____

(iii) Reason of accident;

- [ ] Careless
- [ ] Fatigue
- [ ] Afraid of height [ ] Other, please state;_____

(iv) Sources of the above accidents due to ;

- [ ] No guardrail
- [ ] No harness
- [ ] Negligee
- [ ] Others, please state; _____

(v) If yes what is the frequency of accident per month;

- ☐ 1 – 5 times
- ☐ 6 – 10 times
- ☐ 11 – 15 times
- ☐ More than 15 times

7. Any safety training for new workers required before working on scaffolding?

☐ Yes ☐ No

(i) If yes, method of training;

- ☐ Oral Presentation
- ☐ Handout
- ☐ Practical
- ☐ Posters
- ☐ Others; _____
- ☐ Oral Presentation + handout
- ☐ Oral Presentation + handout + practical
- ☐ Oral Presentation + handout + practical + posters

8. Is medical checkup made compulsory for new workers before working with scaffolding?

☐ Yes ☐ No

9. From your observation, are the workers concerns about their safety?

- ☐ Occasionally
- ☐ Often
- ☐ Very often
- ☐ Not sure

SECTION D: COMMENT

Please make any appropriate comment of scaffolding safety on the construction site.

_____

_____

_____

_____

_____

_____

THANK YOU
YOUR COORPERATION IN ANSWERING THIS QUESTIONNAIRE IS HIGHLY APPRECIATED

3.1.2 Sample of Workers Questionnaire

Pengukuran ini adalah untuk mengumpul maklumat dalam keselamatan peranca dalam pembinaan bangunan tinggi. Semua maklumat adalah iuntuk tujuan pembelajaran dan adalah sulit.

MAKLUMAT AM

Intraksi: Sila isikan dalam kotak dan tick (/) yang bersesuaian.

1. Jenis kerja :

☐ Melepa ☐ masang kotak acuan

☐ Mengecat ☐ mengikat bata

☐ Lain-lain, nyatakan_____

2. Tahap kerja :

☐ Mahir

☐ Separuh mahir

☐ Kurang mahir

3. Pengalaman kerja :

☐ 1 tahun ke bawah

☐ 1 tahun – 5 tahun

☐ 5 tahun ke atas

SEKSYEN A: OPERASI KERJA

1. Adakah anda kerap melakukan kerja di atas perancah

☐ Kerap

☐ Jarang-jarang

☐ Kadang-kadang

2. Dalam satu masa, berapa lama anda bekerja di atas perancah

☐ 2 jam ke bawah

☐ 2 jam – 4 jam

☐ 4 jam – 8 jam

3. Pernah anda mengalami / melihat kemalangan yang berpunca daripada perancah di tapak binaan.

☐ Ya ☐ Tidak

(i) Jika ya, berapa kali berlaku setakat ini

☐ 1 kali

☐ Lebih dari 2 kali

(ii) Jenis kecedaraan yang di alami

☐ Cedera ringan
☐ Cedera parah
☐ Lain-lain; sila nyatakan_____

(iii) Punca berlaku kemalangan

☐ Kurang penyelenggaraan peranca
☐ Kecuaian pekerja
☐ Lain-lain,nyatakan;_____

SEKSYEN B: ORGANISASI

1. Pernahkah anda mendapat penerangan/latihan mengenai keselamatan bekerja di atas perancah

☐ Ya ☐ Tidak

(i) Jika ya, cara penerangan di beri;

☐ Secara lisan / bertulis
☐ Secara praktikal
☐ Secara lisan / bertulis dan praktikal

(ii) Adakah anda di beri penerangan mengenai menggunakan alat-alat keselamatan ketika bekerja di atas perancah

☐ Ya ☐ Tidak

2. Adakah anda diberi peralatan keselamatan ketika bekerja di atas perancah

☐ Ya ☐ Tidak

(i) Jika ya, keperihatinan anda menggunakannya

☐ Kerap
☐ Kadang-kadang
☐ Tidak pernah

SEKSYEN C: PENYELENGGARAAN

1. Adakah pihak pengurusan memantau kerja-kerja yang di lakukan di atas perancah

☐ Kadang-kadang
☐ Kerap
☐ Sangat kerap

(i) Jika ya, kekerapan pemantauan

☐ 1- 2 kali sehari

	3 - 5 kali sehari
	Lebih 5 kali sehari

2. Adakah pihak pengurusan menyelenggarakan perancah yang digunakan oleh anda.

	Ya		Tidak

(i) Jika ya, kekerapan

	Mingguan
	2 kali Seminggu
	Bulanan

SEKSYEN D: KOMEN/PENDAPAT

Pada pendapat anda, adakah anda rasa pihak pengurusan mengambil berat tentang keselamatan perancah dan pekerja yang bekerja di atas perancah

_____

_____

_____

_____

THANK YOU
YOUR COORPERATION IN ANSWERING THIS QUESTIONNAIRE IS HIGHLY APPRECIATED

3.2 Interviews

The objectives of the interviews carried out are to gain clearer information to support the literature review and to determine the actual practice within companies in handling works regarding scaffoldings.

3.2.1 Check List for Interviews

1. What types of scaffolding normally being used in construction site?
2. What are the general precautions of scaffold erection process?
3. What are the procedures involves in dismantling of scaffolds?
4. What is the correct method to store scaffold components?
5. What are the Safety Act and Regulation used for works regarding scaffolding?
6. What are the safety elements of scaffolds?
7. What are the general safety principles in using scaffolding?

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Study Case

This study concentrated in evaluating common safety practice in construction, to identify the safety aspect and safety level of scaffolding practices in Perak. The study case focused on five construction companies P1, P2, P3, P4 and P5 (refer appendix).

4.2 Questionnaires

The field questionnaire was distributed to the management team working in the building construction company and to the workers at the construction site. Management team and workers are the targeted sample population in this study (refer Table 4.1).

Management Team	Workers
Project Manager	Plasterer
Project Safety Officer	Painter
Safety supervisor	Formwork installer
Site Engineer	Scaffold competent person
Site supervisor	Electrical worker

Table 4.1: Management and Workers involved

Number of respondent in both targeted sample are stated in table 4.2. The questionnaire prepared to achieve the first and second objective of this study that is to highlight the scaffolding safety aspect to the construction workers and management and to determine the level of safety awareness of workers and management at construction site. Answers of questionnaire are not systematic especially the workers questionnaires and that is due to non-understanding of workers to the questions and scaffolding safety. The reason of that may be due to lack of employees to safety training programs.

Targeted Sample	Number of Respondent
Management Team	17
Workers	43

Table 4.2: Number of respondent in both targeted sample

4.2.1 Management Questionnaires Results

Section A: Project introduction

In the first section, the question is to find out the type of building, building height and the methods construction.

I. Building type

Result shows that only residential, hotel and university are involved in this project.

Building Type	**%**
Residential	60
Office	-
Hospital	-
Shopping complex	-
Others (hotel and university)	40
Total	100

Table 4.3 Type of building

II. Building height

According to the result, there is no 15 and above storey involved in this project.

Building Height	**%**
1 – 4 storey	40
5 – 10 storey	40
10 – 15 storey	20
15 above storey	-
Total	100

Table 4.4: Building height

III. Construction Method

According to the result, there is no pre-cast concrete involved in this project. This shows that most of the construction site in Perak still used in-situ concrete as their construction method.

Construction Method	**%**
Pre cast concrete	-
In-situ concrete	60
Steel construction	20
Industrialized Building Systems	20
Total	100

Table 4.5: Construction Method

Section B: Scaffolding Safety Aspect

In the second section, the question is to find out the scaffolding safety aspect implemented in the construction company .First most important safety aspect is the occurrence of safety department and safety policy in the company, in order to ensure safety rules and regulation among workers are followed, to take precautions step towards unsafe scaffold practice and to monitor workers are in the safe working environment.

I. Occurrence of Safety Department

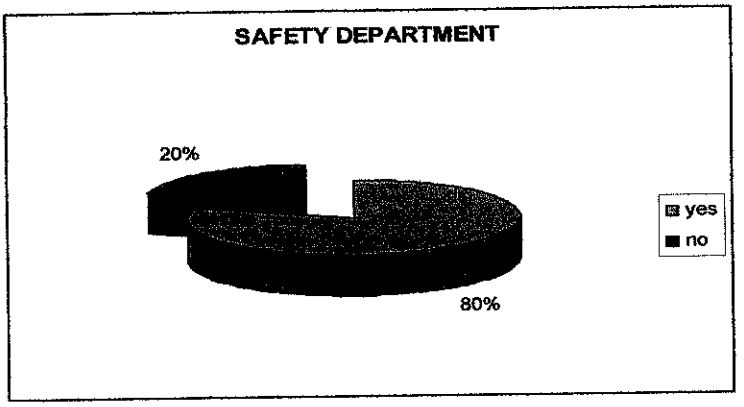

Figure 4.1: Occurrence of safety department in construction site.

II. Occurrence of Safety Policy for Workers

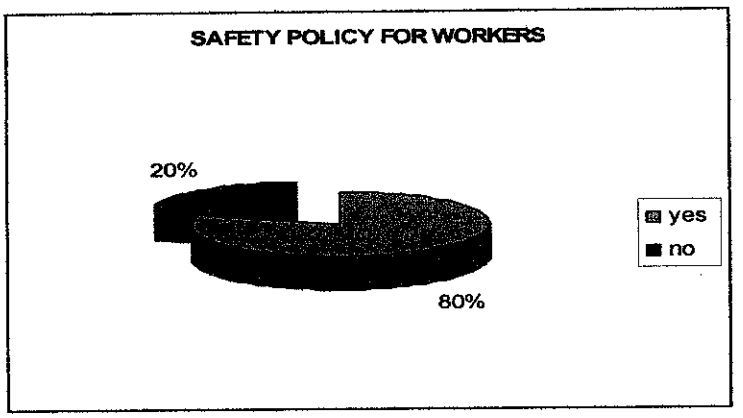

Figure 4.2: Occurrence of safety policy for workers in construction site.

Both of the graph above shows that there is still 20% of construction company fail to set up their safety department and safety policy. This may be due to lack of understanding on the important of the function or might be the thinking of loosing money to employ of the department and the policy.

III. Personal Protective Equipment Provided for Workers

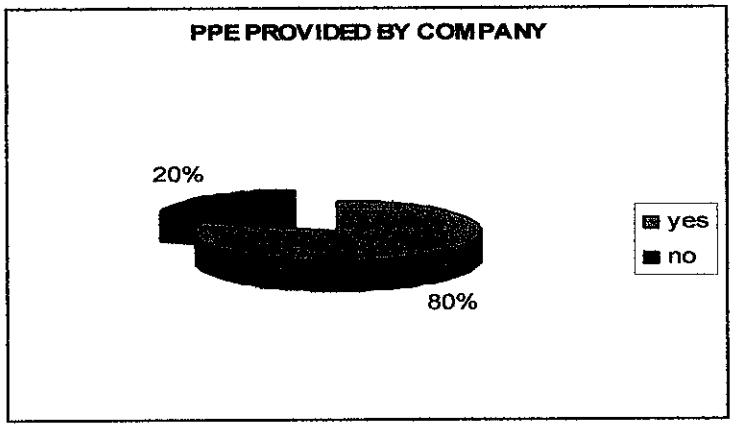

Figure 4.3: PPE provided for workers in construction site.

IV. Personal Protective Equipment Usage by Workers

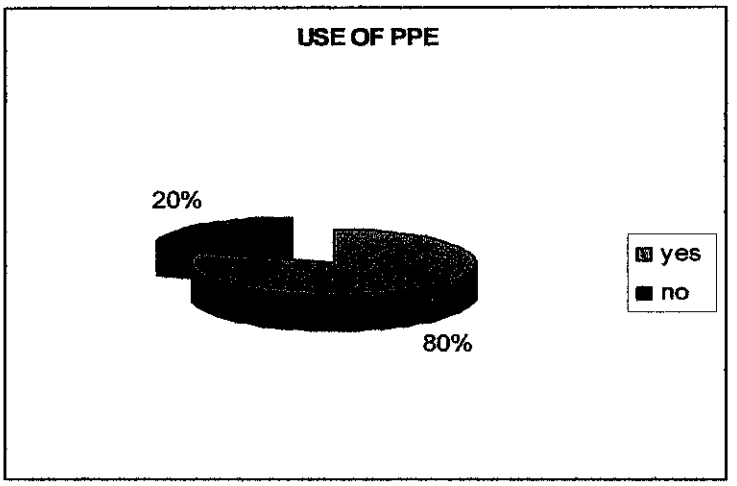

Figure 4.4: Usage of PPE by workers in construction site.

Both graph shows that there is still company did not comply to provide PPE in their construction site. This might because companies afraid of loosing money and maybe because of the project size are small. Small project at least required safety helmets and an applicable safety boots.

According to Factories and machinery act 1967 [5], it is a legal need for every employer to provide PPE and trained their workers to wear and use it in a proper manner. Every workers performing job or task on scaffold have to consider and concern about their safety. Workers have to follow the right guideline in avoiding accident. Wearing a safety helmet and safety boots is important because the condition of work is liable to injury. Safety belts are compulsory for every worker who works on a high level or over 3 meter high from the ground. Self- safety suit such as self-protector, ear protector, eye protector, hand and foot protector, body protector, rope detains, safety belt and rope drop detain are required depends on types and height of job performing. Absence of PPE may lead to serious injuries to workers.

V. Initiative Carried Out to Ensure Safety Usage of Scaffolding

Initiative carried out	**%**
Yes	100
No	-

Table 4.6: Initiative carried out to ensure safety usage of scaffolding

The third safety aspect is the initiative carried out to ensure the safety usage of scaffolding such as inspection and repair of scaffolding. These initiatives are carried out regularly by a qualified person or registered scaffolders .This initiative could detect any damage that might affect the safety of workers.

According to the Factories and Machineries Act 1967 [5], every site has to conduct initiative work on scaffolding to ensure the workers are safe. If any problem occurs on scaffold they will know about it immediately and the solution for the problems will be determined.

VI. Type of Initiative Carried Out

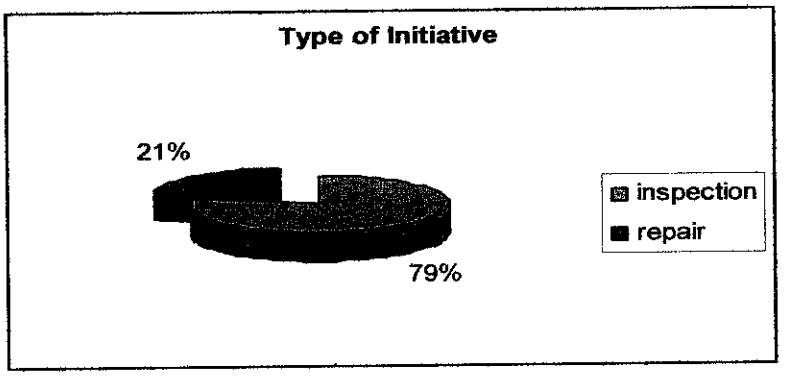

Figure 4.5: Type of initiative carried out.

Figure 4.5 shows that all five construction site comply to carry out the initiative and the main initiative being carried out was inspection 79% followed by scaffolding repair 21%.This is a good sign of safety concern in the constructions company depending on how frequent did they carried out the inspection and scaffolding repair. Inspection works being carried out at these sites are:

(i) Base-check for firm footing, adequate spread of load, no 'packed up' standard.

(ii) Check geometry- standard vertical, ledger and transoms horizontal spacing standard.

(iii) Staggering of joints in ledgers and standards.

(iv) Spacing of transoms

(v) Guard rail and toe-board provided.

(vi) Means of access- ladder meting all requirements.

(vii) Overloading- dangers of shock loading when loading out scaffold with crane or fork lift.

VII. Frequency of Initiative Carried Out

Frequency of Initiative	%
Once in 1 or 2 month	100
Once in 3 or 4 month	-
Once in 5 or 6 month	-
Once in 6 and above	-
Total	100

Table 4.7: Frequency of initiative carried out

VIII. Responsible Person for Initiative

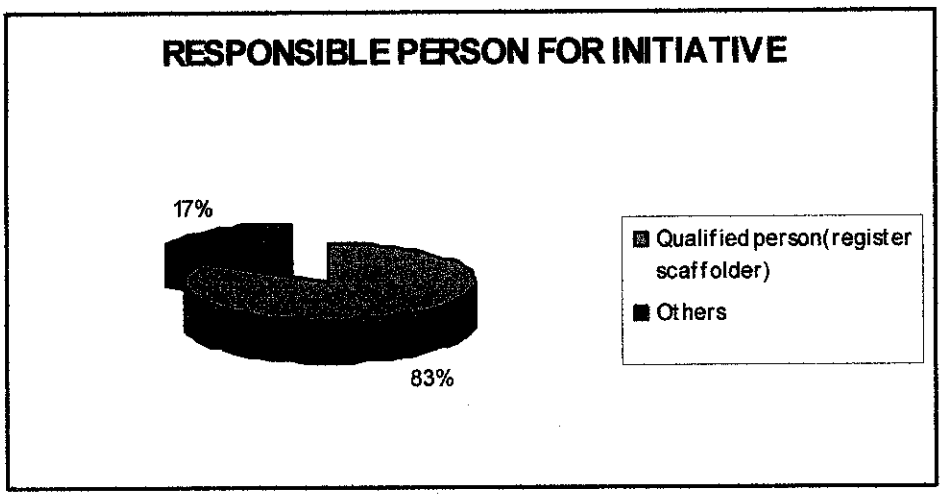

Figure 4.6: Responsible person to carried out initiative

The more frequent of inspection carried out is better in ensuring the condition of safe scaffold (refer figure 4.6). The pie chart above shows the main responsible person to carried out the initiative is the qualified person with percentage of 83% , registered with DOSH who check and supervise it regularly to make sure it is safe by following the guideline made by DOSH about the scaffold's erection, maintenance and safety.

Others refer to the site supervisor where it is illegal for a non registers person to carry out any maintenance to the scaffolding. A non registered person has no license and never receives any safety training by CIDB. Maintenance by non registered person may lead to scaffolding failure and with effect the safety of workers.

IX. Safety Supervision Carried Out to Ensure Safety Usage of Scaffolding

Safety Supervision	%
Yes	100
No	-

Table 4.8: Safety supervision carried out for workers

Table 4.8 shows that every surveyed construction site had perform site supervision. It shows that the management concern about the workers safety.

X. Responsible Person to Carried Out Workers Safety Supervision

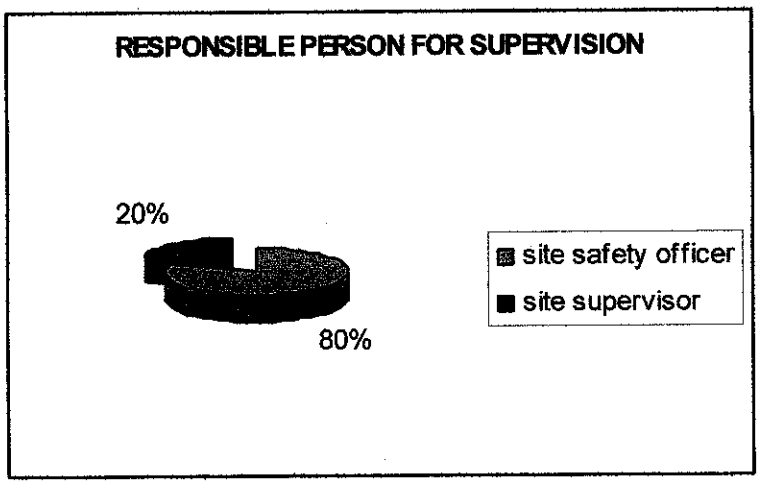

Figure 4.7: Responsible person to carried out workers safety supervision

Supervision's main purposes is to ensure that every worker carry out their job and follow the safety guideline to avoid accident. Figure 4.7 indicate that there is only one site supervise the workers by the site supervisor. It is actually not preferable since site supervisors never received any training regarding to site safety supervision. Safety supervision should be done by site safety officer since he has received safety training on workers supervising. Site safety officer are the responsible person to ensure safety on construction site.

Section C: Scaffolding Safety Awareness

In the third section, the question is to find out the scaffolding safety awareness among management team and workers.

I. Type of Scaffold Used in 5 Construction Sites

Types of scaffold used in site	Putlog	Independent	Birdcage	Truss out	Others
P1 (Residential)			1		-
P2 (Residential)	1				
P3 (Residential)		1			
P4 (Hotel)		1			
P5 (University)		1			
Total	1	3	1	-	-

Table 4.9: Type of scaffold used in 5 construction sites

Based on questionnaires conducted at five construction sites, there are three types of scaffold being used. They are independent tied scaffold, putlog scaffold and birdcage scaffold. Three construction sites used independent scaffold because this scaffold's type is easy to erect and its structure give a better safety assurance to the construction workers.

Furthermore, it can save cost for erecting and maintenance. One construction site used putlog scaffold. Putlog scaffold is cheaper and easy to erect then the other scaffolding types. However, the disadvantage of using putlog scaffold is it has low safety level. Another construction site used birdcage scaffold. It provides high level of safety features to workers.

II. Workers Performing Job on Scaffolding at Any Particular Time

Workers performing job	**%**
1 or 5 person	100
6 or 10 person	-
11 or 15 person	-
More than 15 person	-

Table 4.10: Workers Performing Job on Scaffolding at Any Particular Time

All construction sites allow only one to five workers to perform job only scaffold in certain time. It shows that they care about their workers safety. More than five people to be on scaffold it a certain time are dangerous because it can contribute accident to the workers.

III. Types of Jobs Operation on the Scaffolding

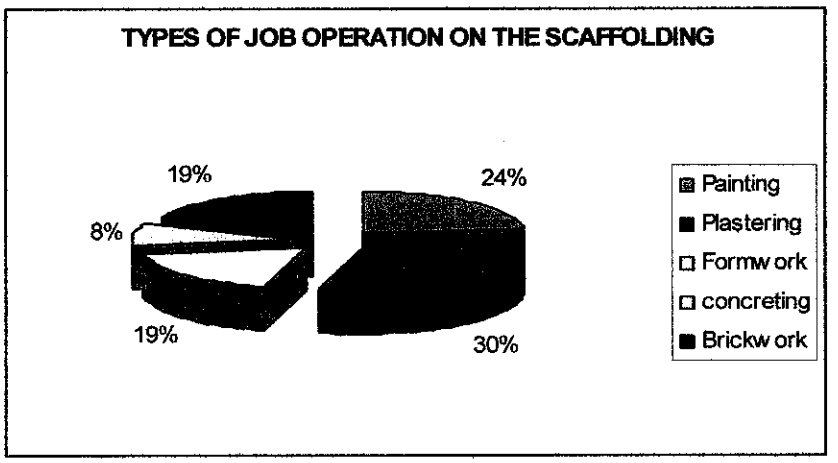

Figure 4.8: Types of jobs operation on the scaffolding

According to the questionnaire distributed at five construction sites, major work conducted on scaffold are painting and plastering while the minor works are formwork, concreting and brickwork.

IV. Duration for Workers to Work on Scaffolding

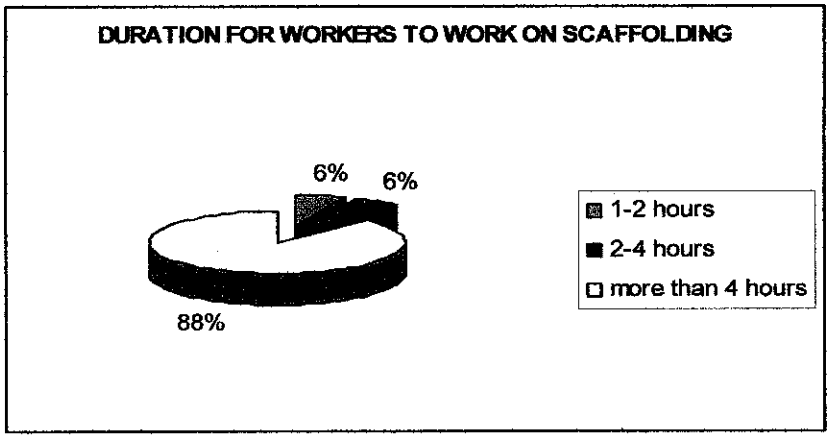

Figure 4.9: Duration for workers to work on scaffolding

According to the Factories and Machineries act 1967 [5], working on scaffolding are only allowed for eight hours per day. Long duration for workers to be on the scaffolding may lead to accident due tired and less concentration in performing works.

V. Accident Related to Scaffolding

The most important information obtain from this question is the occurrence of accident at construction sites, level of injury reason and sources of accident and frequency of accident per month. This information enables us to identify the level of safety awareness of workers and to examine whether management has provided sufficient safety needs to the workers.

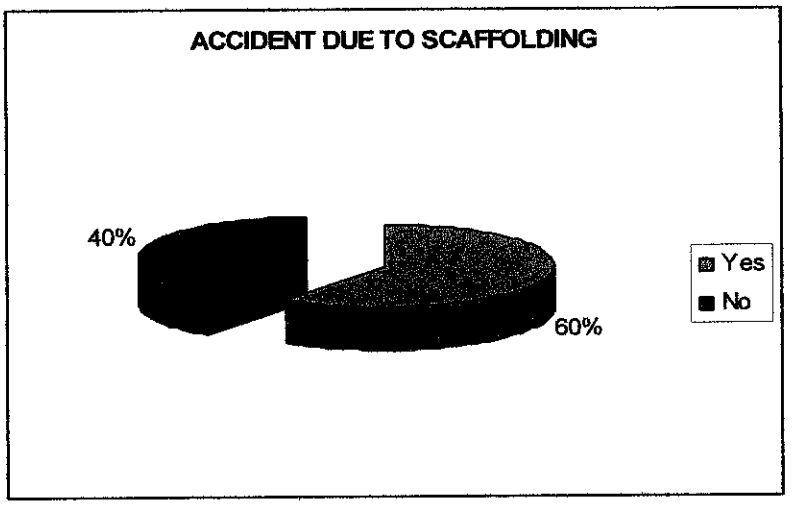

Figure 4.10: Accident related to scaffolding

VI. Level of Injury

Level of injury	%
Minor injury	40
Major injury	-
Death	20
others	-

Table 4.11: Level of injury

Sixty percent of construction sites have experienced accident. Forty percent of construction sites experience minor accident such as minor cuts and wound, and broken arms and legs. Twenty percent of the construction site experience death accident due to careless and mishandling of scaffolding.

VII. Types of Accident

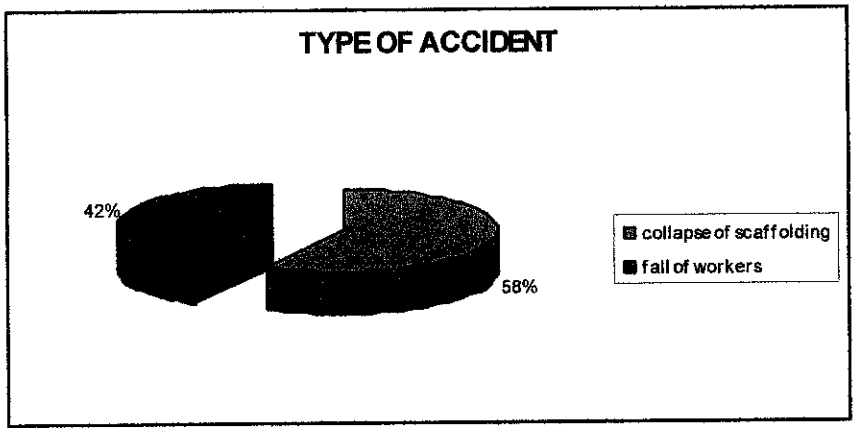

Figure 4.11: Types of accident

Fall of workers might contribute from misstep or slippery step-due to unclean scaffold and the ignorance of workers to wear safety belt and harness when performing work in high elevation, whereas collapse of scaffold might be to the improper inspection works, improper erecting works, erecting and inspection done by the non competent person erection of scaffolding without proper soleplate on soft watery ground.

VIII. Reason of Accident

Reason of accident	%
Careless	60
Fatigue	-
Afraid of high	-
others	-

Table 4.12: Reason of accident

Both minor and death accidents are due to careless of workers and the sources of accident is negligee that is ignorance of the rules and safety requirement and not obeying to used the PPE provided.

IX. Sources of Accident

Sources of accident	%
No guardrail	-
No harness	-
Negligee	60

Table 4.13: Sources of accident

For all the 60% cases of accident occur, the sources are neglected to follow safety rules and regulation.

X. Frequency of Accident

Workers performing job	%
1 or 5 times	60
6 or 10 times	-
11 or 15 times	-
More than 15 times	-

Table 4.14: Frequency of accident

Frequency of accident per month for the entire 60% of construction site is 1-5 times a month. To reduce or to eliminate number of accident, all of the management team agreed that continuous supervision and adequate training provided to workers made by management level can prevent accident from happen.

XI. Safety Training for New Workers

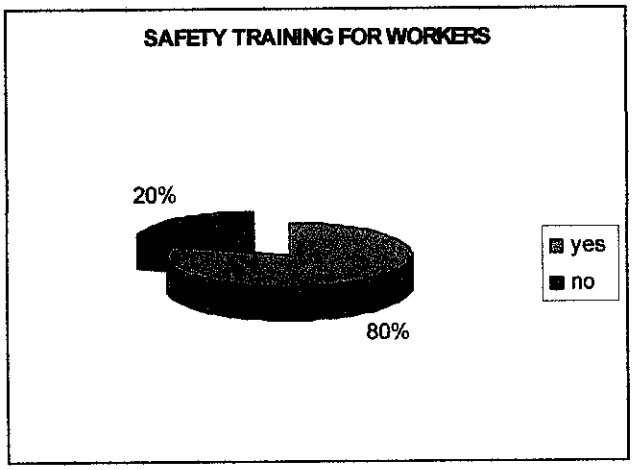

Figure 4.12: Safety training for new workers

The above figure shows the safety training receive by new workers before they perform their work on the scaffold. Training is a planned effort to assist workers in learning job-related behaviors that will improve their performance. Additional training provides them the opportunity to acquire new knowledge and skills and improve it effectiveness.

XII. Training Method

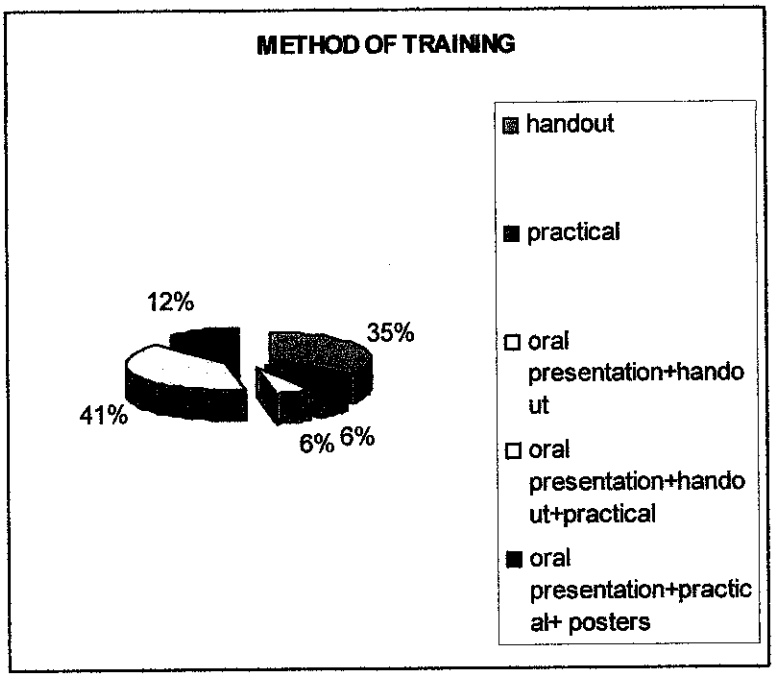

Figure 4.13: Training method

Construction firms had designed their own method of training and vary from one construction firms to the other. Main purpose of training is to familiarizing workers with their tasks and safety aspects of scaffolding. 41% used combination methods of oral presentation and hand-out, 35% used only oral presentation, 12% handout and 6% practical and also combination of oral presentation, handout and practical to their workers. They were given explanation and instruction about safety and how to use the safety equipments. The training method is important to ensure the understanding of workers in enhancing their safety awareness on construction site.

XIII. Medical Checkup Given to Workers

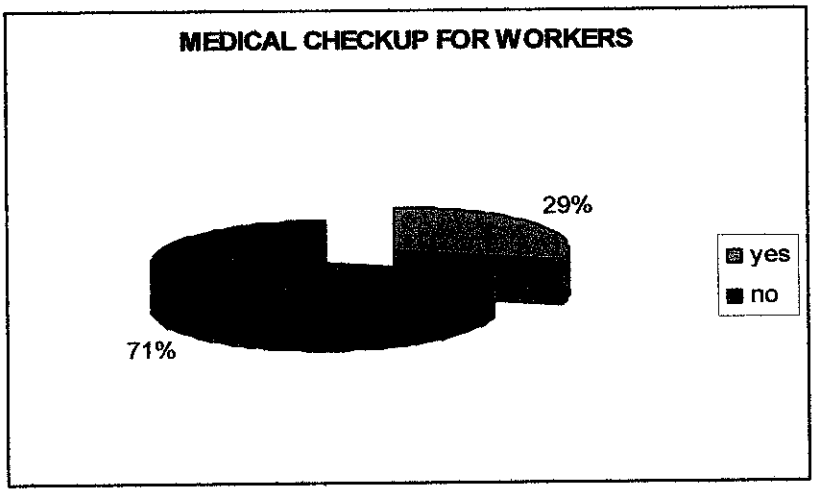

Figure 4.14: Medical checkup given to workers

Medical check up is important to determine the health level of a worker before the workers being given task on the scaffolding in a high elevation of a building. Medical checkup will ensure whether the workers have any illness that will affect his performance in doing the job.

XIV. Safety Concern of Workers

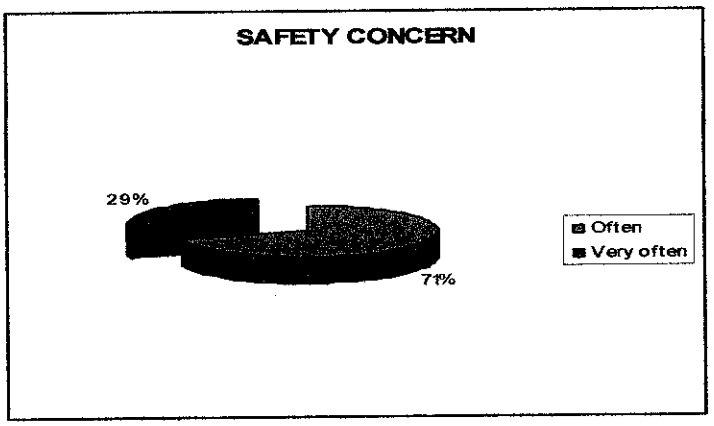

Figure 4.15: Workers concern on their safety

Figure 4.26 shows that 71% workers occasionally concern about their safety and 29 % often concern about their safety. The rarely use the PPE provided because they feel uncomfortable using it without thinking about the effect on their safety.

4.2.2 Workers Questionnaires Results

Section A: General Information

In the first section, the questions is to find out the type of works, level of workers such as skilled, semi-skilled and unskilled and working experience.

I. Type of Works on Scaffolding

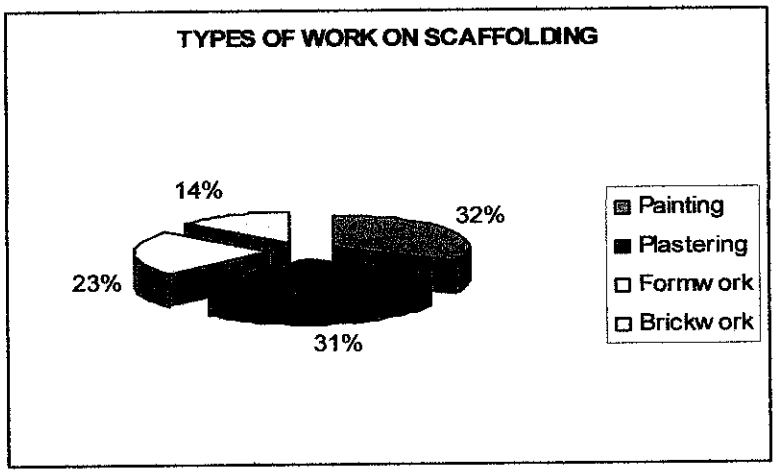

Figure 4.16: Type of works on scaffolding

Major works conducted on scaffold are plastering, painting, formwork and brickwork.

II. Level of Worker's

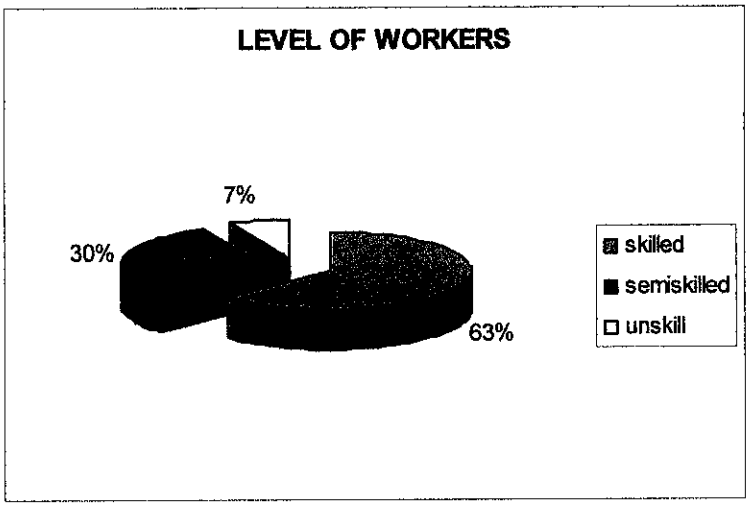

Figure 4.17: Level of worker's skill

There are three types of workers, based on their skill performing task or job on scaffolding that is skilled workers, semi-skilled workers and unskilled workers. One of the reasons why construction firms chose skilled workers is they have more experience and also can perform their task better then semi-skilled and unskilled workers.

III. Worker's Working Experience

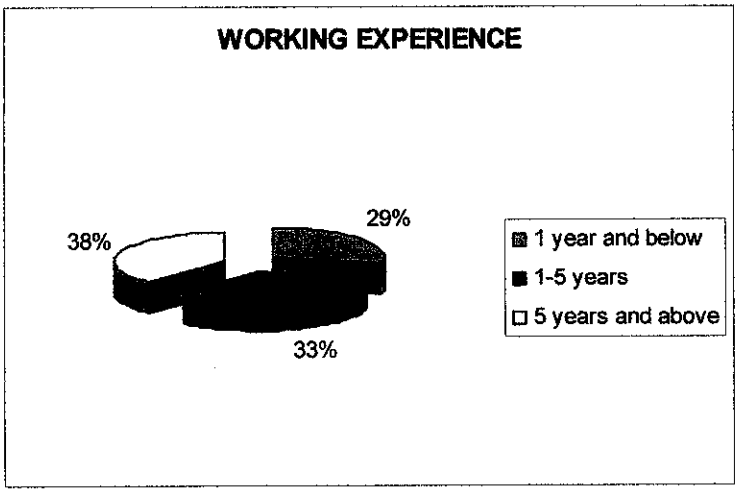

Figure 4.18: Working experience

Workers with more experience are more alert with safety issues and safety precaution when handling works related to scaffolding. Experience matter indirectly contributes in reducing the number of accident.

Section B: Scaffolding Safety Aspect

In the second, the question is to find out the scaffolding safety aspect implemented by the construction company for the sake of workers safety.

I. Supervision Made by Management

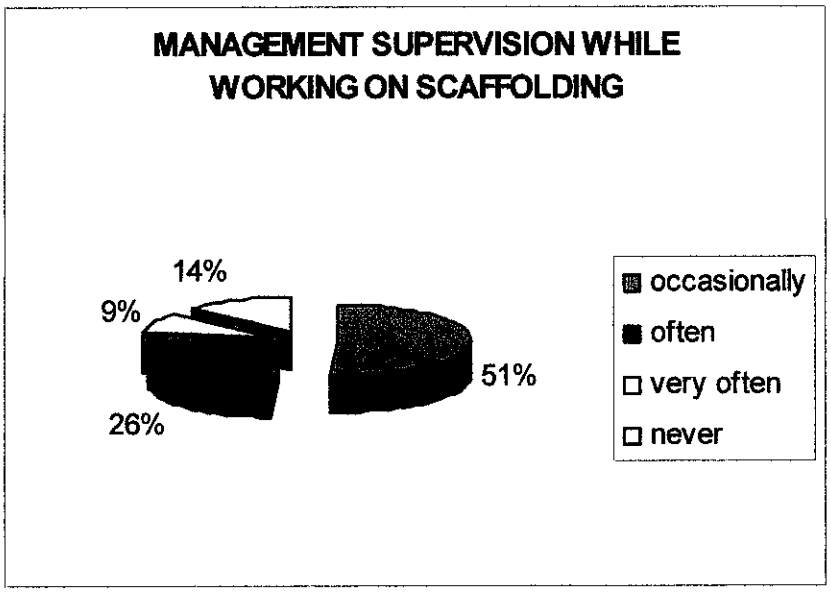

Figure 4.19: Supervision made by management

Construction firms had given an authority to site engineer, site supervisor or foreman to supervise workers at sites. Supervision is important to make sure that worker carry out their task and followed the safety guideline.

II. Frequency of Supervision

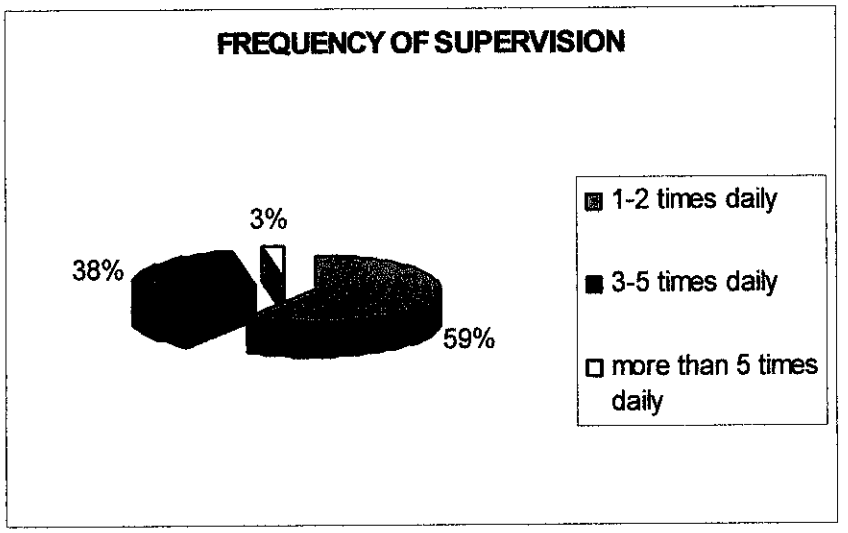

Figure 4.20: Frequency of supervision

Supervision is important to detect and identify the pace of worker's performance. Frequency of supervision varies from one construction firm with the other. These are one of the reasons of the accident happen to all the five sites that have been visited.

III. Maintenance Work by Management.

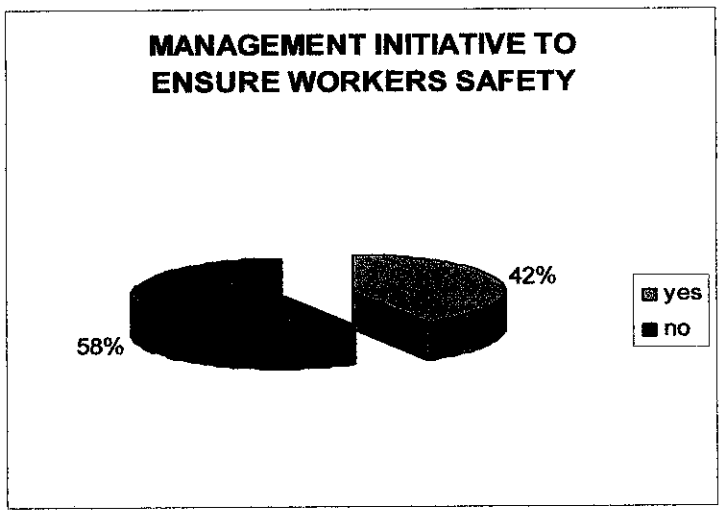

Figure 4.21: Maintenance work by management.

Besides supervision, in order to ensure that the scaffolding is safe for workers, construction firm have to conduct maintenance works. According to 43 workers at five construction sites, 42% said that their construction firm conducted scaffold's maintenance work such as base, guard rail, toe board and fittings inspection.

IV. Frequency of The Initiative Carried Out by Management.

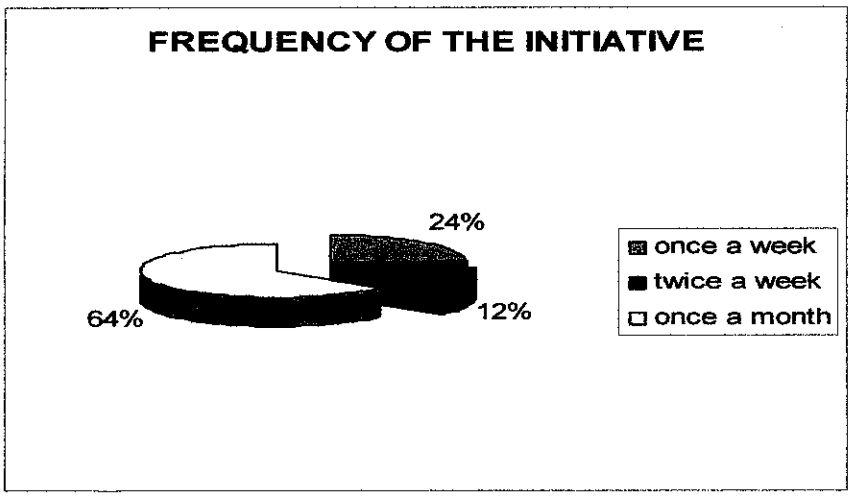

Figure 4.22: Frequency of the initiative carried out by management

The management initiatives are to ensure workers safety being carried out in certain time duration. The more frequent the maintenance is the more precise it can detect any damage and it can slowly eliminate risk of scaffoldings collapse that may lead to serious accident.

Section C: Scaffolding Safety Awareness

In the third section, the most important information obtain from this part is the occurrence of accident at construction sites, level of injury reason, the number of workers and type of works performs of scaffolding. This information enables us to identify the level of safety awareness of workers and to examine whether management has provided sufficient safety needs to the worker.

I. Workers Frequency on the Scaffolding

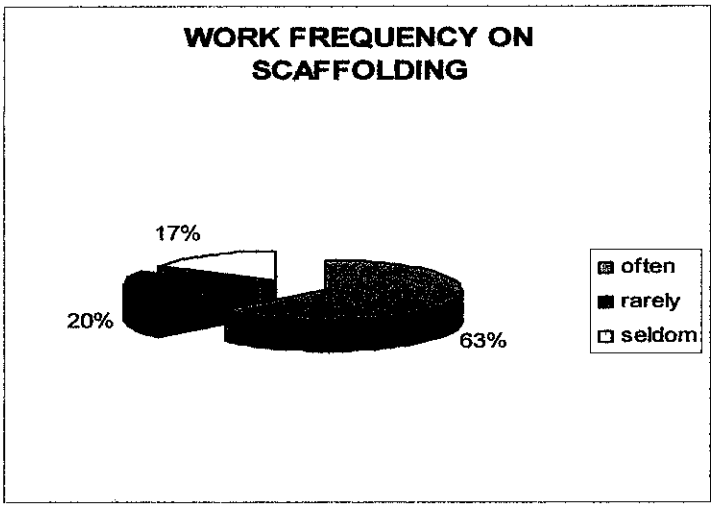

Figure 4.23: Workers frequency on the scaffolding

Workers used scaffolding to do plastering, painting, formwork, and brickwork. Based on questionnaires distributed 43 respondents at five construction sites, 63% of workers informed that they often completed their job on scaffolding followed by 20% of workers rarely use scaffold. Meanwhile 17% of them seldom use scaffolding.

II. Duration of Work Perform on Scaffolding

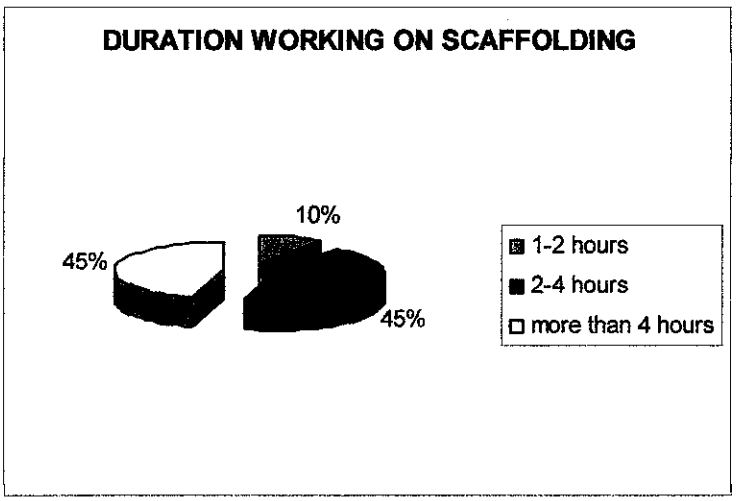

Figure 4.24: Duration of work perform on scaffolding

Construction firms should allow their workers to work on scaffolding only for eight hours per day-as stated in BOWEC-factory and machinery act. Working more than the limited time will create major safety problems since the workers are not in a good physical and mental state.

III. Workers Accident Experience

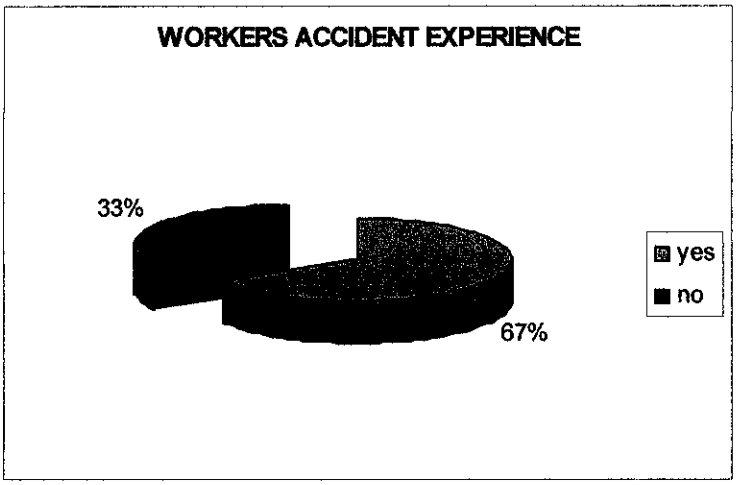

Figure 4.25: Workers Accident Experience

Based on figure 4.25, 67 % of workers had experienced accident. 68% of workers said that they had an experience of accidents on scaffold once and another 32% said that they had experience of accidents on scaffold more then once.

IV. Frequency of Accident

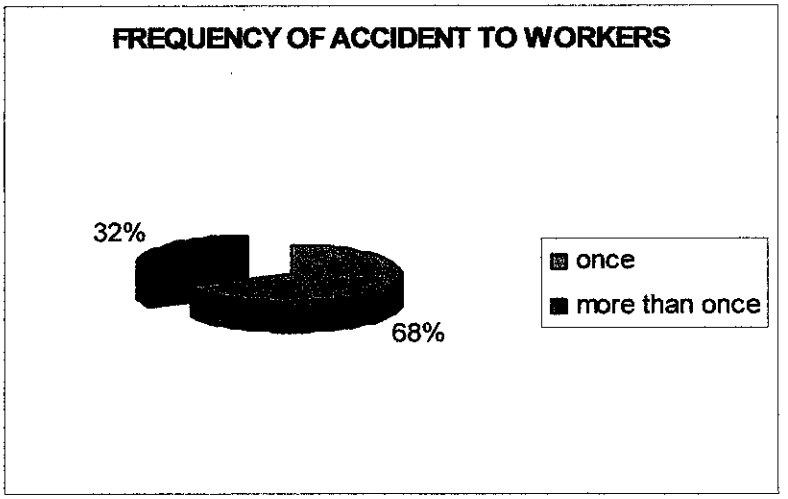

Figure 4.26: Frequency of accident

Based on questionnaires distributed at five construction sites, poor maintenance and negligence are defined as a cause of the accidents. 61% of workers said accidents occur because of negligence such as slipping while climbing the scaffolding. While the other 39% said accident happened because of scaffold's poor maintenance.

V. Level of Injury

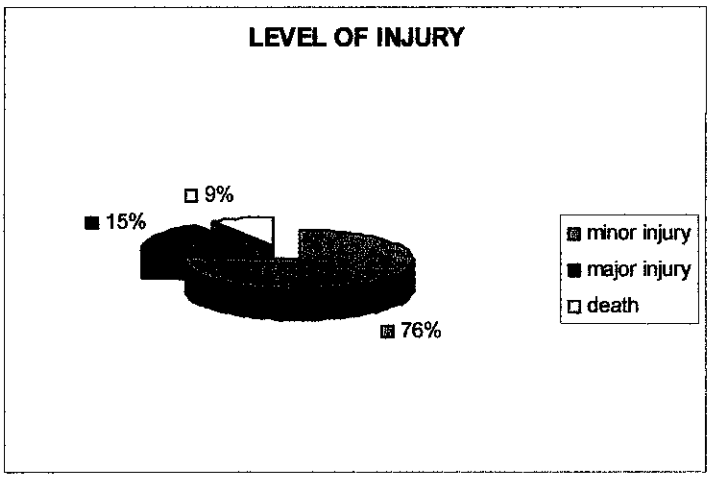

Figure 4.27: Level of injury

Based on questionnaires answer by 43 respondents from five construction sites, 76% of workers involved in accidents said that they only faced minor injury such as slight wound. The other 15% said that they faced major injury such as broken arms or legs. Only 9% of workers observed fatal accident due to careless and mishandling of scaffolding.

VI. Sources of Accidents

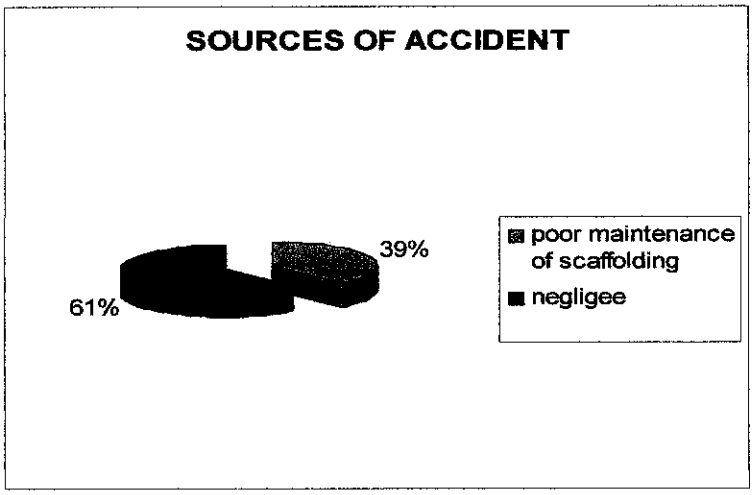

Figure 4.28: Sources of Accident

To reduce or to eliminate number of accident, all of the management team agreed that continuous supervision and adequate training provided to workers made by management level can prevent accident from happen. Thus management need to cooperate to enhance their safety training in order to met the above objective.

VII. Safety Training

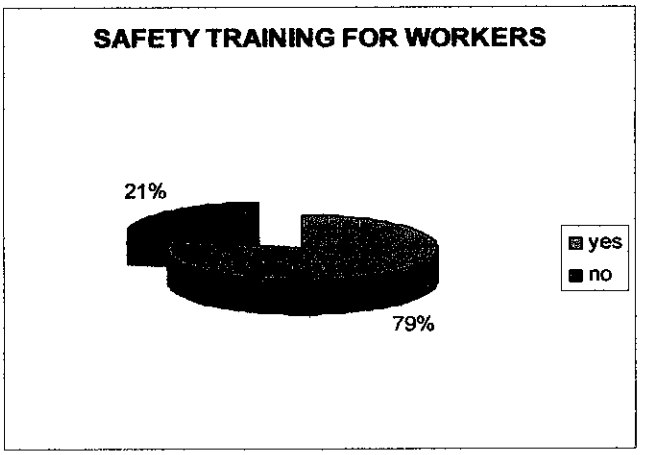

Figure 4.29: Safety training

Training main purpose is to familiarizing workers with their tasks and safety aspects [9]. 43 construction workers from five construction sites had answered the questionnaires and 79% of them said that they had received safety training provided by their firms. Meanwhile, another 21% of workers said that they did not receive any safety training.

VIII. Training Method

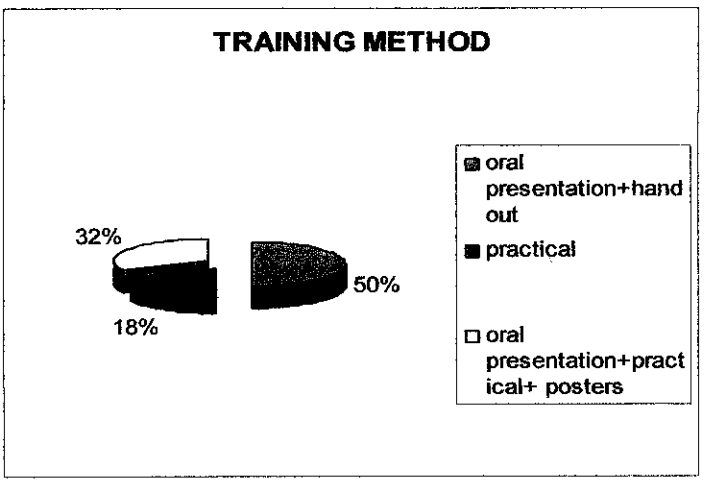

Figure 4.30: Training method

Every construction firms should have their own training method such as oral, hand out and practical training [8]. Based from questionnaires distributed to 43 workers from five construction sites, 50% of workers were given oral and hand out training. It highlight about particular hazards and current safety trends. The benefit of safety training is that it enable workers to improve their safety knowledge and self protection standard.

IX. PPE Briefing

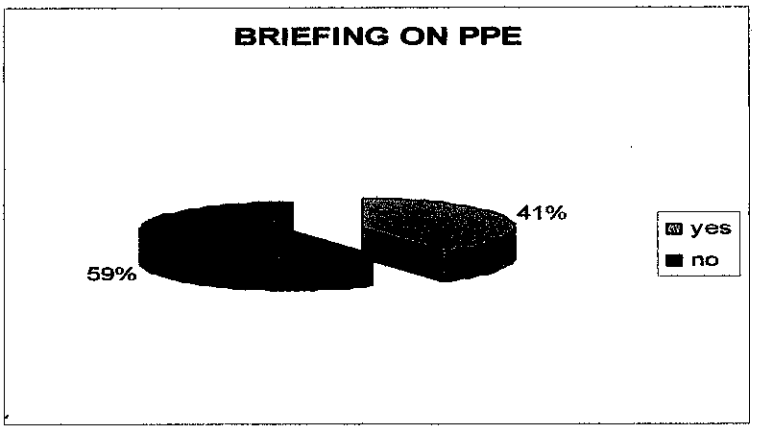

Figure 4.31: PPE Briefing

In order to enhance their understanding of self protection method, a brief on PPE usage shall be carried out. According to the Health and Safety at Work Act 1974 [5], employers have legal obligation to provide information, instruction, training and supervision. Construction firms shall also provide safety description to their workers.

X. PPE Provided by the Company

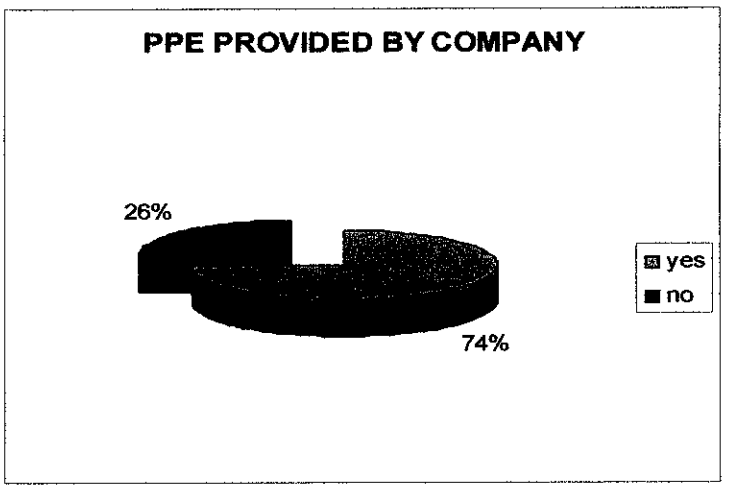

Figure 4.32: PPE provided by the company

Construction firms have the responsibility to provided safety equipment such as gloves, safety boots and helmets for the workers [11]. According to questionnaires 74% of them confirmed that their firms provided safety equipment at sites. Meanwhile another 26% said that their firm did not provided safety equipment for workers due to budget matter, and this will mainly contribute to the accident.

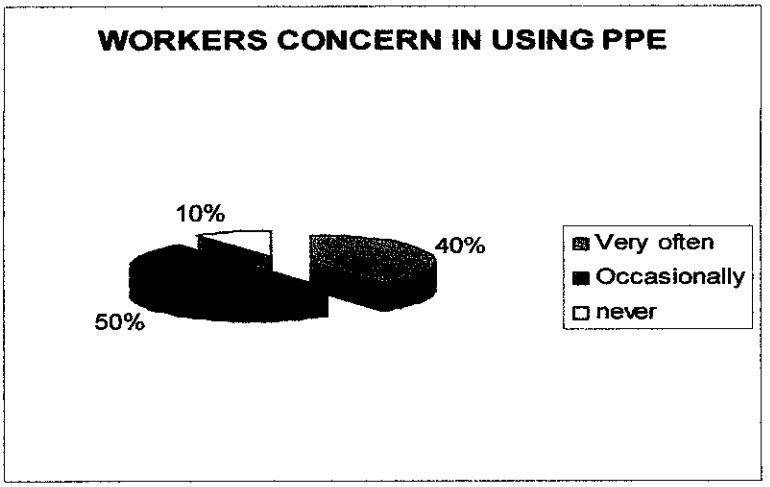

Figure 4.33: Workers concern in using PPE

Safety equipment such as gloves, safety boots and helmets for workers are important to protect workers from injury [10]. The result above shows that the safety awareness among workers are still at low level, thus management need to create program to give great understanding on the important of the proper usage of PPE.

4.3 Interviews

The objectives of the interviews carried out are to gain clearer information to support the literature review and to determine the actual practice within companies in handling works regarding scaffoldings.

a. What types of scaffolding normally being used in construction site?

According to the interviewee of P3 actually there are many types of scaffolding and it is actually depends on the task to be carried out and height of the building. One of the criteria in selecting suitable type of scaffold is the building height. Suitable scaffold is important for the construction of high rise building. The selection are made based on the safety factors, building construction types, types of task to be carried out also the erecting and dismantling process. The must commonly scaffolding used in construction site especially high rise building are:

i. Putlog scaffold,
ii. Independent tied scaffold,
iii. Birdcage scaffold,
iv. Truss-out scaffold,
v. Tower scaffold.

b. What are the procedures involves in erecting of scaffolds?

According to interviewee of P5 since he develops this step for erecting typical scaffold a for his firm procedures for erecting the scaffolds are:

a. Prepare a firm base by laying soles plates, large-section timbers not less than 0.225 meters x 0.04 meters. They are leveled and supported on firm ground.

b. Standards should be erected plumb with a maximum spacing of 2 meter. Each must be held on the sole plate by a base plate nailed or screwed down to the timber.

c. Ledgers must be provided at comfortable working heights for the planned job. Joints should be staggered but remain clear of a mid-span position and, preferably, be achieved with sleeve couplings.

d. Transoms used for independent type must be on top of parallel ledgers and spaced according to he boards to be used. There must be a double-up where board's ends will meet.

e. Putlogs for the putlog scaffold must be secured on top of the ledger and secured well into the fabric of the structure. The spade end, to provide improved load-bearing strength, is secured flat into mortar joints.

f. Ties must be secured, ideally to alternate lifts of the scaffold, but a minimum of 3.9 meter vertically. For independent types, the openings to the structure influences and spacing, and putlog type depend upon firm brickwork and suitable openings for stability.

g. Bracing must be adequate and secure to both planes of the scaffold. The tubes should be joined with sleeve couplings and fixed with swivel couplings.

h. Platforms are prepared from boards which, in accordance with BS 2482 must be of sound structure, free of defects and bended to each end.
i. Protection must be provided to eliminate the danger of employees, materials or equipment falling, wherever the scaffold height exceeds 1.98 meter.

c. What are the procedures involves in dismantling of scaffolds?

He says that dismantling of scaffold is actually a reverse method from erecting it. He also stress hard that it is a good practice to complete maintenance of scaffolding during dismantling. Any damaged pieces are repaired immediately; there should be no risk when they will be re-using. The following rules apply during dismantling:

a. An organized and systematic approach is required prevent from collapse by irresponsible dismantling. It must be incorporated to the place where temporary bracing or support is needed by using warning notices and barriers at the end of each working shift or day.
b. Every scaffold must be inspected and the detail must be recorded:
c. After erection
d. Every seven days (once of week)
e. After bad weather
f. Where wind might create a hazardous situation, a suitable means of holding down all loose boards must be provided and implemented.
g. It is good practice to turn back the boards adjacent to the structure to avoid dirty splash-marks. Turn over all scaffold boards immediately after raining to reduce the risk of slipping on dangerous boards.

h. Keep an even distribution of loading and avoid point loading at any particular place.
i. Retain a clean scaffold whilst in used and make special checks for slippery boards after bad weather.
j. Clean, check and maintain all scaffold parts as they are dismantled. Any damaged or otherwise unusable items must be repaired or discarded.

d. What is the correct method to store scaffold components?

According to him again, scaffold components and parts are costly. The correct way of storage can ensure that the components are safe and can be re-used. Scaffolds tube members must be stacked flat, preferably off the ground and in a suitable rack. A further advancement is to color-code the tubes in order of length, e.g. 3 meter length – red, 3.5 meter length – blue. A simple band at the end 0.155 meter wide would be sufficient to advise the user, and simplify selection.

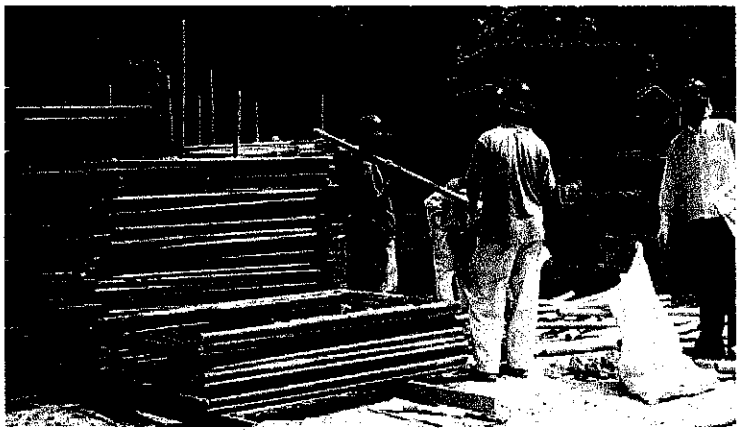

Figure 4.34: Efficient way of scaffold storage

A proper way to store scaffold boards are by racking arrangement - satisfactory for small amounts; a large quantity, however, need to be stacked off the ground. It is good practice to color-code the boards also, and to store boards in 'sets' of five. If boards are to be

stored for a long time, or have been soaked prior to storage, it allow the boards through the stack a clear passage of air, which improves drying out and reduces fungal attack. Scaffold's elements have to be stored based on their types, e.g. ledger, coupler and base-plate must be stored according to their types. Store them in dry place to avoid corrosion. Kept together similar fittings and separated it based on their types. Check-up must be made and all moving parts must be oiled before re-used.

Safety is defined as freedom from accidents or the condition of being safe from pain, injury or loss. According to New Oxford Dictionary, safety is free from danger, not able to be hurt or not likely to cause danger or herm or risk.J.C Laney [4] author of Site Safety book defined safety at construction site as "a construction site is safe when person can carry on their normal daily work without endue risk"

e. What are the Safety Act and Regulation used for works regarding scaffolding?

According to the interviewee from DOSH, Laws of Malaysia -Factories and Machinery Act 139 [5] is the main act used in Malaysia and this act applies to all works in construction site that deal with scaffolding. Scaffold safety rules are mainly describe in Factories and Machinery Act 139 under sub content-Factories and machinery (Building operations and Works of Engineering Construction)(Safety) regulations known as BOWEC-part X. which contain the following:

- Scaffold construction
- Scaffold Maintenance
- Supervision of work and inspection of material
- Design and drawing of scaffold to be approved
- Standards, uprights, ledgers and putlogs
- Support and stability of scaffold
- Gears for suspension of scaffold

- Cantilever, jib, figure and bracket etc..
- Scaffold supported by buildings
- Suspended scaffolds raised or lowered by means of winches
- Other suspended scaffold
- Inspection of scaffold
- Working platform
- Boards and planks in working platform and more.

f. What are the safety elements of scaffolds?

The interviewee from DOSH responds to my question on safety element of scaffold as soleplates, ledger, transoms and bracing. These elements contribute to scaffolding's safety.

Soleplates made from timber or other suitable material, to distribute loads from base plate to the ground or other load bearing surface. According to John Ridley [6], all soleplates must be bended throughout their full length. They must be sound and preferably because each piece takes the load from two or more standards. Any junction or joint in a soleplate must be set within the middle third or between two standards. Soleplates must be place at:

(i) Slate roofs, tiled roofs, asphalt roofs, bitumen felt roofs;
(ii) Ordinary ground, grass, asphalt paths, sloping ground made-up ground;
(iii) Mosaic, parquet and other finished floors.

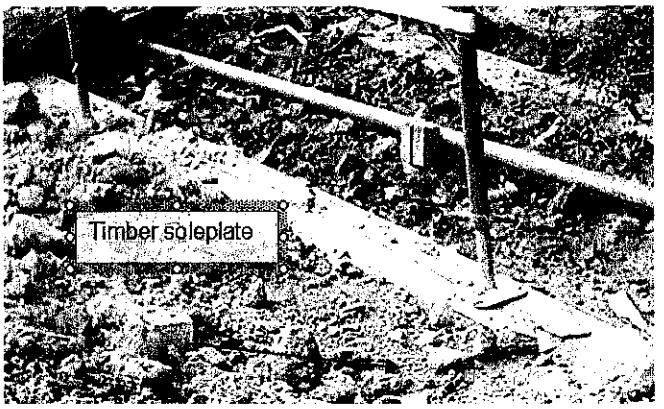

Figure 4.35: Timber soleplate

Ledgers are longitudinal tubes usually fixed parallel to the face of the building in the direction of scaffold's length. They also give support to other parts of the scaffold, such as transoms, putlogs, puncheons and hanging tubes. They should be fixed with right-angle couplers. Joints in ledgers adjacent to each other should be staggered. It should be secured with sleeve couplers, within a quarter to one-third of the distance between two-standards – the ledgers should never be joined in the middle of the bay. The distances between lifts are specified in BS 5973.

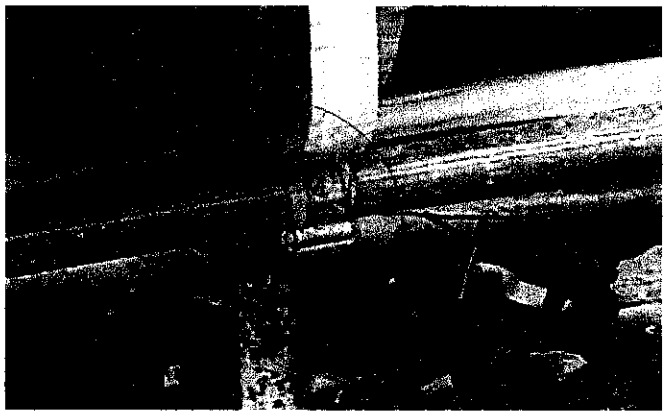

Figure 4.36: Ledgers fixed with right angle couplers

Transoms are tubes fixed horizontally across the ledgers or between the outside and the inside ledgers. Support boards to secure the standards and act as support boards. The spacing depends on the load and the thickness of the boards. Transoms fixed at standards with right-angle couplers or at ledgers with putlog couplers. At putlog couplers, they should be fixed as close as possible to the standards or less 0.3 meter. The main transoms cannot be removed temporarily. It only can be removed when the scaffold is being dismantled. Construction firms have to make sure that transoms do not project beyond the ledgers, especially in the first lift because they could constitute hazard. Sometimes it is necessary to connect longitudinal or sway bracing to transoms by using right angle couplers.

Statutory regulations for transom spacing when supporting boards are:

Board thickness	*Maximum transom spacing*
38 millimeter	1.5 meters
50 millimeter	2.6 meters
63 millimeter	3.25 meters

g. What are the general safety principles in using scaffolding?

The interviewee from DOSH respond during my interview session regarding the PPE required for every construction company in Malaysia. This is also based on the (Building operations and Works of Engineering Construction) (Safety) regulations known as BOWEC-part X [5]. Every workers performing job or task on scaffold have to consider and concern about their safety. Workers have to follow the right guideline in avoiding accident.

There are no standards rules to impose clothes for this kind of work but it consider between on condition and types of work. Wearing a safety helmet is most important because the condition of work is liable to injury. Safety belts are compulsory for every

worker who works on a high level or over 3 meter high from the ground. Scaffolding worker must wear an applicable safety boots.

A legal need every employer gives a safety suit and trained their worker
Below there are safety suits that worker must wear:

(i) Self-protector
(ii) Ear protector
(iii) Eye protector
(iv) Hand and foot protector.
(v) Body protector
(vi) Rope detain, safety belt and rope drop detain.

The function of edge protection covers the procedure, which clarifies that every corner or open area, ladder, landing and open space must be provided with guardrails. Guardrail or mesh screen is needed at the height of two meters or above from the platform in avoiding the risk of human or object falling.

Guardrail must be made from steel, tube and wood that has the minimum size of 0.75 meter x 0.55 meter. Steel wire rope is not allowed and the uses of chains are only needed at the entrance and access path only

Regulations:

(i) If the provided toe board at the working platform is at the height of above 0.2 meter and mid-rail must be installed at the height of not less than 0.69 meter.
(ii) Top guardrail must be installed at the height or not more than one meter above working platform to avoid any objects falling.
(iii) Guardrail provided at the working platform must be installed in the inner part of standard (upright).

The interviewee from DOSH said that toe board must be built from suitable material and has high quality such as wood or steel. If the wood plank used as the toe board, working platform must not exceed 4 times the thickness of working platform at the end of support following safety factors. Working platform must be tied or stable

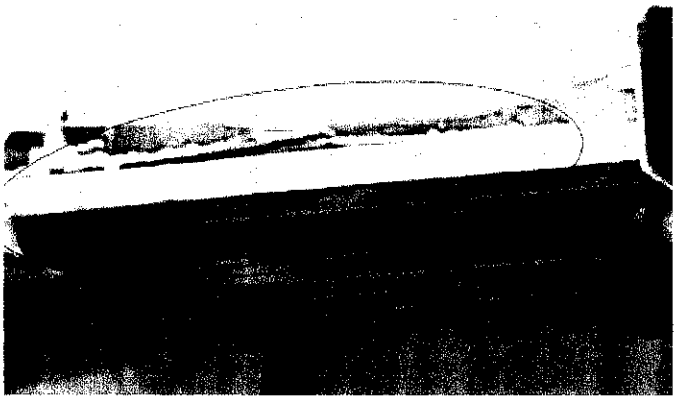

Figure 4.37: Toe board fixed to the standard

For plank wood must be from the 'keruing' type (grade A) or a type that is similar with it. It must be straight, not sawn, and dry without any defects that may lower the strength and life period of the wood. It must not be painted to cover the defect that it has. The wood size must not be below than 0.2 meter x 0.032meter. Knots must not exceed 1/6 of the whole plank size. The must not be more than one End split.[5].

Protection fans are sometimes fixed to access scaffolding to intercept anything may fall from the structure. Typical fan structures will only arrest small objects. Special consideration is required if heavy objects with a long free fall are to be catered for. These fans may be supported from the building or scaffold using wires or tubes [10].

4.4 Discussions and Recommendation

4.4.1 Scaffolding Safety Aspect

There are several elements in Scaffolding Safety Aspect that need to be highlighted:

1. Every construction site should have a safety department together with its safety policy to restrict workers safety.

2. Personal Protective Equipment should be provided by company and the used of PPE has to be compulsory suitable with the task undertaken by workers

3. Several important initiatives such as inspection, restoration, repair and replacement of scaffolding should be establish by the company to ensure scaffolding condition. The initiative should be monitored once a week to detect any possibilities to the scaffolding.

4. Responsible person to perform the initiative are the qualified person or the person that has undergone training and has registered with the Department of Safety and Health.

5. Frequent safety supervision by the site safety officer assist with site safety supervisor should be compulsory.

6. Number of workers allowed to perform job on the scaffolding should be monitor to avoid overloading and collapse of scaffolding.

7. Workers should use suitable types of scaffolding depending on the task performed.

8. Effecting training such the oral presentation together with handout and practical should be compulsory to all workers.

4.4.2 Scaffolding Safety Awareness

Results show that, there are injury happening in three sites with fatal injury in one of the construction site. This proves that the degree of safety awareness from management team and workers are in low level. Special attention has to be given by the authorized organization to overcome these problems to create a safer working place for workers.

4.4.3 Method of Enhancing the Scaffolding Safety

Some recommendations have to be considered by construction management team to create safe working environment in order achieve high quality jobs and products. It also necessary for DOSH [14] to monitor construction sites based on the recommendation below to ensure accidents are reduced and eliminated from occurring in construction sites. The recommendations are:

1. Every construction company has to design and create with innovative and proper training method or process about the safety of scaffolding for workers. It is because the workers always disregard their safety while performing work on it.

2. Every construction company has to make sure that the platform is safe to be use by workers. To make sure every worker perform their task well, supervision has to be carrying out frequently to ensure that the workers are following the safety guideline while working on scaffold. Companies have to give their workers a clear description about the safety working on scaffold.

3. Specializing firm or person who have an experience and skill should be appointed to supervise the scaffold erection. Every types of scaffold should have an

appropriate design to ensure that it is suitable with the height and types of building.

4. Every construction firms should give priority on scaffolding's maintenance works. Lack of maintenance can lead to accident. This maintenance works should be carried out by appropriate person-competent person who had experience courses and training from CIDB.

5. Job supervision on scaffolding is one of the important elements in construction site. Frequent supervision also can prevent overloading. Overloaded is the main contributed to collapse of scaffolding.

6. A safety officer representing the company has to be appointed on every construction site; usually he is one of the supervisors.

7. When the number of workers exceeds ten persons, the workers have to select a safety delegate. In big construction companies there may be a safety officer and a workers' safety delegate also in the central administration.

8. An internal safety inspection has to be carried out weekly at every construction site. An inspection report has to be written, describing the shortcomings and responsible persons for corrective actions. Both the representative of the company and of the workers has to sign the inspection report.

CHAPTER 5

CONCLUSION

5.1 Conclusion

From the research, the degree of safety awareness among workers and management team are relatively low. Thus, management team and workers should observe the highlighted scaffolding safety aspect as mentioned in chapter 4 in accomplishing a project. Indirectly this project contributes method in enhancing the safety of scaffolding and reducing accident related to scaffolding. Consequently scaffolds may become a safe equipment to work on if only the aspect of safety is considered as priority than money in order to provide the safety needs in the construction site such as training program, personal protective equipment by the construction firms. If we manage to prevent unsafe act the quality of our local construction will be increased. Thus, this project may help to create safety scaffolding environment in construction sites so that it will decrease the number of accidents on sites and provide maximum safety to workers.

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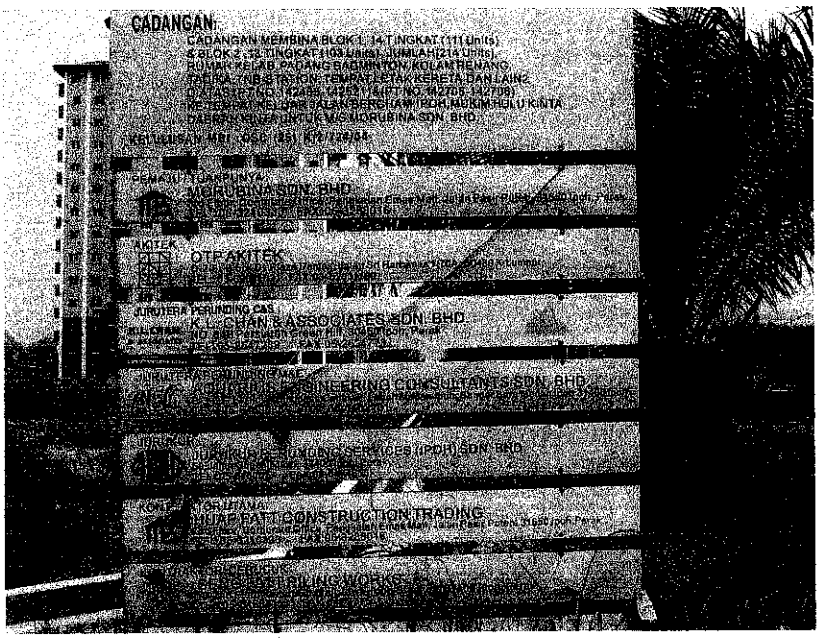
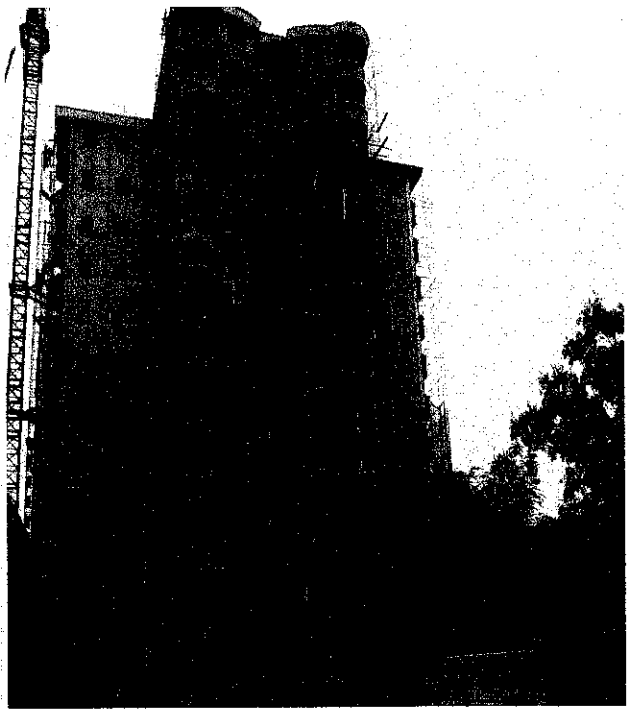
APPENDIX

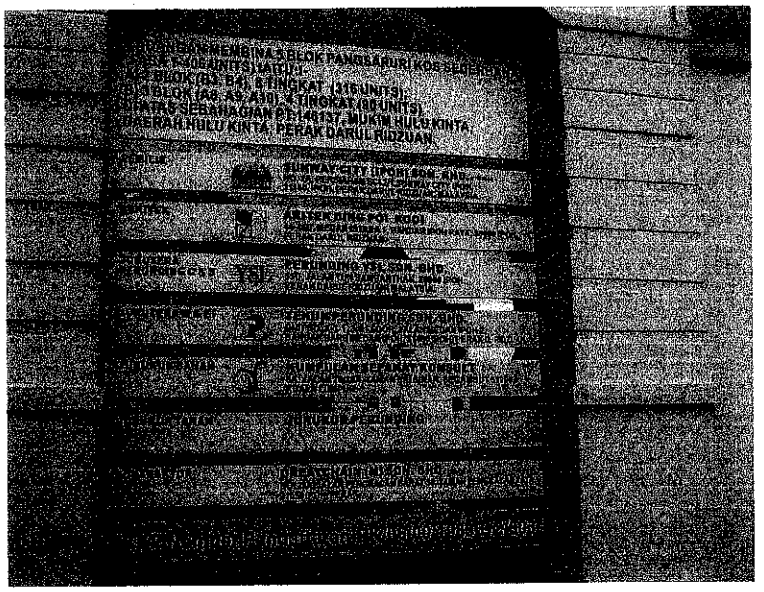
PROJECT PICTURES P1-P5



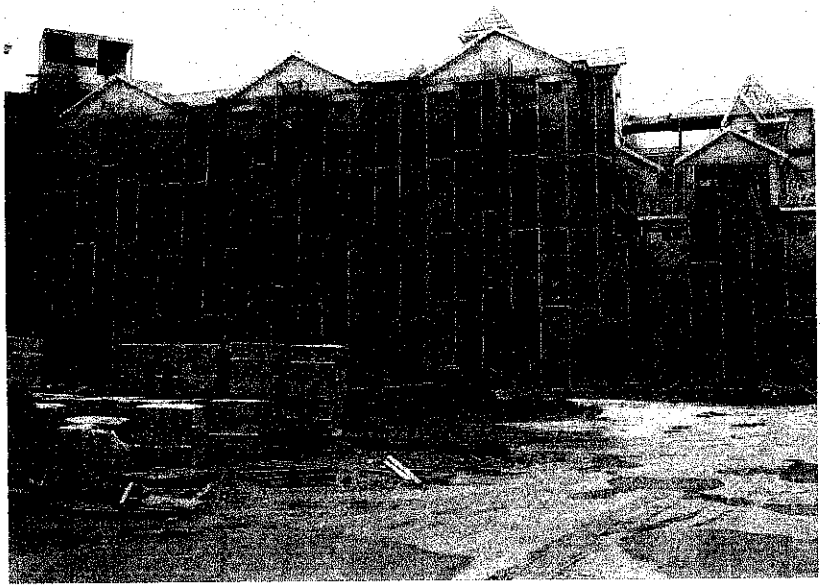
Project Description Board for P1



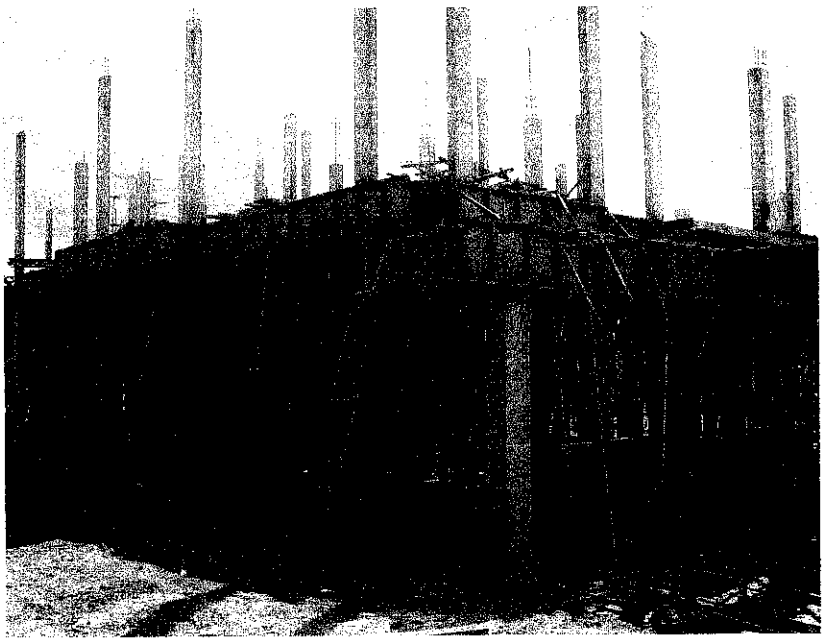
Front Elevation of P1



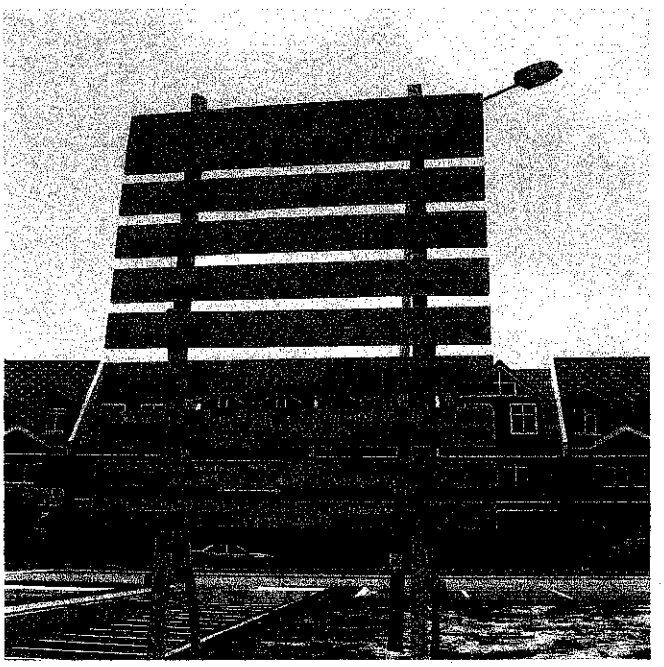
Project Description Board for P2



Front Elevation of P2

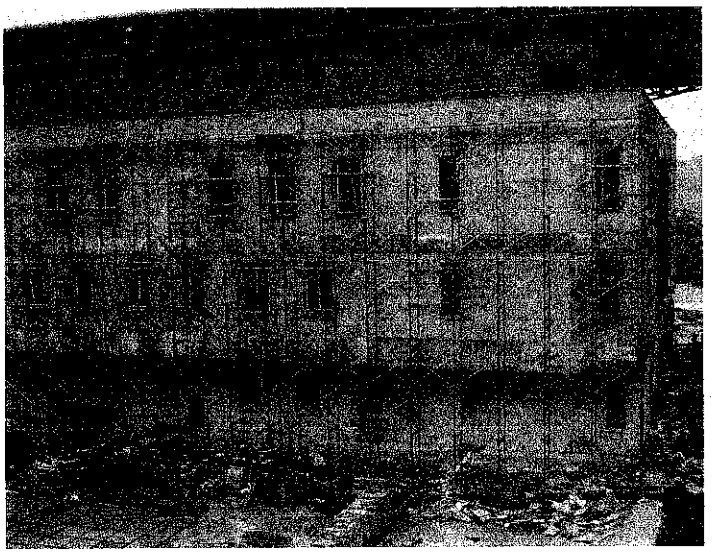


Front Elevation of P3



Project Description Board for P4

Front Elevation of P4



Front Elevation of P5