

CAUSES OF ACCIDENTS AT CONSTRUCTION SITES

**Abdul Rahim Abdul Hamid, Muhd Zaimi Abd Majid,
Bachan Singh**

*Faculty of Civil Engineering, Universiti Teknologi Malaysia, 81310 UTM
Skudai, Skudai, Johor, Malaysia.*

*Corresponding Author: *rahimhamid@utm.my*

Abstract: The statistic of accidents at construction sites give us a picture that Malaysian construction industry is one of the critical sectors that need a huge and fast overhaul from the current site safety practices. Accident don't just happen, they are caused by unsafe acts, unsafe conditions or both. Most accidents result from a combination of contributing causes and one or more unsafe acts and unsafe condition. In order to improve the overall safety performance we need to investigate the root causes of construction accidents. That knowledge could be utilised in formulating more conducive working conditions and environments at construction sites. Therefore, a study has been conducted to identify the causes of accident at construction sites. This study was started out by reviewing literature from journals, books and web pages. Then reported accidents cases kept by the Department of Occupational Safety and Health Malaysia (DOSH) were examined to investigate causes of accidents. Surveys using questionnaire forms were carried out to obtain data from respondents who are mainly contractors and the rest are developers and consultants firms all around countries that are well versed with the construction safety. The finding of this study reveals that accidents are the result of many contributing factors, causes, and sub causes. Some of the critical factors are unsafe method, human element, unsafe equipment, job site conditions, management, and unique nature of the industry. The causes of accidents in Malaysia were found to be similar to that mentioned in literature review. However, some of the causes are low in frequency of occurrence. The main cause of construction accidents found are the workers' negligence, failure of workers to obey work procedures, work at high elevation, operating equipment without safety devices, poor site management, harsh work operation, low knowledge and skill level of workers, failure to use personal protective equipments and poor workers attitude about safety.

Keywords: *Accident Prevention; Causes; Construction Accident; Safety*

1.0 Introduction

The number of industrial accidents reported to the Social Security Organisation (SOCSO) has declined by 35 percent from 1995 to 2003. SOCSO had received 114,134 reports on industrial accidents in 1995 and in 2003, the number had reduced to 73,858 cases. However, the number of fatalities arising from industrial accidents for the same period only marginally decreased by 0.7 per cent from 828 in 1995 to 822 in 2003 (SOCSO, 2001). In other words the industrial accidents for every 1,000 workers have declined from 15.4 in 1995 to 7.4 in 2003. However, if one compare this rate with that of the developed nation such as Sweden, Japan, South Korea and European countries, there is still big task ahead to get the right figure. Malaysian government aims to bring down the ratio of occupational mishaps to three (3) for every 1,000 workers before the country becomes fully developed (Abdullah, 2001).

The number of construction accidents for the same period on the other hand has increased by 5.6 per cent from 4,406 cases in 1995 to 4,654 cases in 2003. In addition, the fatality rate has increased by 58.3 per cent from 60 cases in 1995 to 95 cases in 2003. The fatality rate from construction accidents are among the highest compared to the overall industry (NSTP, 2000). International Labour Organisation (ILO) also highlighted the growing risks for workers worldwide especially in construction works where the rate of fatal accidents could be 10 or even 20 times higher than the average (ILO, 1996).

The accidents that went unreported could be higher bearing in mind that 80 per cent of Malaysian construction workers (NSTP, 2002) are foreigner where some of them might have worked without or with expired work permits. Research in United Kingdom (UK) by Health and Safety Executives(HSE) has shown that the accidents reporting level in construction industry is only at 55 per cent (HSE, 2001).

According to SOCSO the number of recipients for compensation has increased 36 percent from 182,763 person in 1995 to 247,790 person in 2003. In 2003 alone SOCSO has paid about RM 754 million, a staggering 161 percent increased from RM 289 million in 1995, as compensation for the industrial accidents. For the year 2004 it is estimated that the amount of compensation could reach over RM 800 million payable to over 260,000 recipients (Fong, 2004). Going by the Accident Iceberg Theory, the hidden or indirect costs of an accident is eight to 33 times more than that of its apparent or direct costs (Fong, 2003). Therefore, just imagine the amount of hidden costs that we spent yearly to finance these accidents and diseases. In UK the cost of industrial accidents was estimated to be between 14.5 billion pounds and 18.1 billion pounds (in 95/96 prices) (HSE, 1999). Whereas, in the United States(US) the total accident costs to the construction industry alone was estimated to be between US\$ 21 billion and US\$ 40 billion (in 1995 price) (Everett and Frank, 1996).

The construction industry is a high risk industry because there is a high risk of accident occurrence. Reasons are time, cost and quality that are always the main factors considered ahead of safety. Safety issues are always considered secondary and take a back seat in construction. Many employers have not established comprehensive accident

prevention policies but instead concentrate on maximizing profit. They do not emphasize on safety because they do not know how high the actual cost of an accident is until it occurs. The statistics of accidents occurred in the construction industry indicate that the accident rate in Malaysian construction industry is still high and it give us a picture that construction industry is one of the critical sectors that need a huge and fast overhaul from the current site safety practices. In order to prevent an accident, preventive measures must be taken. In order to prevent accidents, one must know the causes of accident, more specifically the root cause of accidents.

The aim of the study is to investigate the causes of accident at construction sites in Malaysia. The three objectives of this study are to review the causes of accident in construction; to identify the causes of accident from the reported accident cases and to study the perception of construction professionals regarding causes of accident at the construction sites in Malaysia.

2.0 Literature Review

An accident can be defined as an unplanned, undesirable, unexpected, and uncontrolled event. An accident does not necessarily result in an injury. It can be in term of damage to equipment and materials and especially those that result in injuries receive the greatest attention (Hinze, 1997). All accidents, regardless of the nature of the damage or loss, should be of concern. Accidents that do not cause damage to materials or equipment or injury to personnel may foretell future accidents with less desirable results.

2.1.1 Accident Causation Models

Accident causation model is not a new model to identify the root problem of safety in construction and other industry. The objective of this model is to provide tools for better industrial accident prevention program (Abdelhamid and Everett, 2000). As described by Heinrich (1980) accident prevention is an integral program, a series of coordinate activities, directed to the control of unsafe personal performance and unsafe mechanical conditions, and based on certain knowledge, attitudes, and abilities. The famous models that were developed that relate to accident causation are namely domino theory that was invented by Heinrich in 1930 and multiple causation theory that was developed by Petersen in 1971.

2.1.2 Domino Theory

Accident causation model was pioneered by Heinrich in 1930, which discussed accident causation theory, the interaction between man and machine, the acts, the management role in accident prevention, the costs of accident, and the effect of safety on efficiency.

Heinrich developed the domino theory (model) of causation that consist of five dominoes namely ancestry and social environment, fault of a person, unsafe acts and condition, accident, and injury. This five dominoes model suggested that through inherited or acquired undesirable traits, people may commit unsafe acts or cause the existence of mechanical or physical hazards that result in injury (Abdelhamid and Everett, 2000). This theory has pointed two main things; first, people are the fundamental reason of caused accident. Most of the accident occurs are caused by wrong doer of the worker. Secondly, the management should be responsible for the accident prevention. The management should provide workers with safety facilities to prevent the workers from hazardous environment.

Heinrich's domino sequence was a classic in safety and health thinking and teaching for over 30 years in many countries around the world. However, in the late 1960s the domino sequence was updated by Bird to reflect the direct management relationship involved with the causes and effects of all incidents and accidents, which could downgrade a business operation (Heinrich et al, 1980). Theory put forward by Bird has the same concept of illustrated dominoes as Heinrich's but the five elements were different. Bird's updated domino elements are lack of control – management, basic causes – origins, immediate causes – symptoms, incidents – contact, and people – property – loss. Bird's approach has emphasized more on the management role to prevent losses.

In addition to that, Adams (1976) and Weaver (1971) had also put forward the updated version of the domino theory. Adam had the same view as of Bird's but emphasized more on the organisational structure of the management. The objective of an organisation, how certain works were being planned and executed would certainly have an impact on accident prevention (Heinrich et al, 1980). Weaver had put forward the same concepts of elements or factors as of Heinrich's. However, he stressed on the important to recognized the root of unsafe acts or conditions which eventually emphasized on bigger management roles in preventing accidents (Heinrich et al. 1980).

2.1.3 Multiple Causation Model

This model was presented by Petersen in 1971 that has totally different concept with the domino theory that influenced many researchers during Heinrich time. This model was inspired by his believed that many contributing factors, causes, and sub-causes are the main culprits in an accident scenario. Under this concept, the factors combine together in random fashion, causing accidents. By using multiple causation model, the surrounding factors to the accident would be revealed (Abdelhamid and Everett, 2000). The set questions will be used to identify the root causes of the accident. For example for stepladder accident, the question would be “why the defective ladder was not found in normal inspection, why the supervisor allowed its use, whether the injured person knew that he should not use the ladder, and so on”. The questions asked is not pointed only to the injured person, but also to the management, supervisor, and other person or department that relate to the accident. The answer of these questions could be used to

identify the root cause of the accident, and also can be use as an improvement tools for inspections, supervisions, training, better definition of responsibilities, and pre-job planning by supervisors. Multiple causation model also pointed out that the root causes of accident normally relate to the management system such as management policy, procedure, supervision, effectiveness, training, etc (Abdelhamid and Everett, 2000).

2.2 Human Error Theories

The approach of this theory is pointed to the worker as the main factor of the accident. This approach as mentioned by Abdelhamid (2000) studies the tendency of humans to make error under various conditions and situations, with the blame mostly fall on human (unsafe) characteristics only. But this theory does not blame the workers as the main problem for accident, other factors such as design of workplace and tasks that do not consider worker (human) limitation also take part as the reason why accident happened (Abdelhamid and Everett, 2000). In general, the overall objective of human error theory is to create a better design workplace, tasks, and tools that suitable with human limitation. There are some theory that related to the human error theory such as behavior model, human factor model, and Ferrel theory. Most of these theories address the human (worker) as the main problem that makes an accident happen such as permanent characteristic of human, the combination of extreme environment and overload of human capability and conditions that make human tends to make mistake (Abdelhamid and Everett, 2000).

2.3 Causes of Accident

Accident don't just happen, they are caused. According to Ridley 99 per cent of the accident are caused by either unsafe acts or unsafe conditions or both (Ridley, 1986). As such, accidents could be prevented. The unsafe act is a violation of an accepted safe procedure which could permit the occurrence of an accident. The unsafe condition is a hazardous physical condition or circumstances which could directly permit the occurrence of an accident. Most accident results from a combination of contributing causes and one or more unsafe acts and unsafe condition. Accident theories and models discussed in the previous section have evolved from merely blaming workers, conditions, machineries into management roles and responsibilities. Nowadays, accident models are being used to better explain the causes of accident so that appropriate actions could be taken to make improvement. However, in order to effect permanent improvement, we must deal with the root causes of accident.

A review of the literature indicates that finding the factors and causes that influence construction accidents has been the passion of many researchers. Kartam and Bouz (1998) did a study in Kuwaiti construction and noted that the causes of accidents were due to worker turnover and false acts; inadequate safety performance; improper cleaning and unusable materials; destiny; low tool maintenance; supervisory fault; and

misplacing objects. Abdelhamid and Everett (2000) conducted a more comprehensive study in the USA and classified the causes into human and physical factors. Human factors were due failed to secure and warn; Failed to wear personal protective equipment (PPE); horseplay; operating equipment without authority; operating at unsafe speed; personal factor; remove safety device; serviced moving and energized equipment; took unsafe position or posture; used defective tool or equipment; and other unsafe action. While, physical factors were due to; unsafe act of another person(s); disregard known prescribed procedures; defects of accident source; dress or apparel hazard; environmental hazard; fire hazard; hazardous arrangement; hazardous method; housekeeping hazard; improper assignment of personnel; inadequately guarded; public hazard; and other unsafe conditions.

Lubega et al (2000) did a study in Uganda and concluded the causes of accidents were mainly due to lack of awareness of safety regulations; lack of enforcement of safety regulations; poor regard for safety by people involved in construction projects; engaging incompetent personnel; non-vibrant professionalism; mechanical failure of construction machinery/equipment; physical and emotional stress; and chemical impairment. Pipitsupaphol and Watanabe (2000) did a study in Thailand construction sites and classified the causes into the most influential factors i.e. unique nature of the industry; job site conditions; unsafe equipment; unsafe methods; human elements; and management factors. They further concluded that major immediate causes were due to failure to use personal protective equipment; improper loading or placement of equipment or supplies; failure to warn co-workers or to secure equipment; and improper use of equipment.

Toole (2002) also did a study in the USA and suggested that the causes of accidents were due to lack of proper training; deficient enforcement of safety; safety equipment not provided; unsafe methods or sequencing; unsafe site conditions; not using provided safety equipment; poor attitude toward safety; and isolated and sudden deviation from prescribed behavior. Tam et al (2004) did a study in China and noticed that the causes of accidents were due poor safety awareness from top leaders; lack of training; poor safety awareness of project managers; reluctance to input resources for safety; reckless operation; lack of certified skill labor; poor equipment; lack of first aid measures; lack of rigorous enforcement of safety regulation; lack of organizational commitment; low education level of workers; poor safety conscientiousness of workers; lack of personal protective equipment (PPE); ineffective operation of safety regulation; lack of technical guidance; lack of strict operational procedures; lack of experienced project managers; shortfall of safety regulations; lack of protection in material transportation; lack of protection in material storage; lack of teamwork spirits; excessive overtime work for labor; shortage of safety management manual; lack of innovative technology; and poor information flow.

3.0 Methodology of the Study

The study had been conducted through several phases namely literature review, data collection, data analysis, discussion and conclusion. First objective was achieved through literature review. A literature review was conducted encompassing all various means available to obtain the widest range of the relevant information from books, articles, and websites related to the cause of accident in construction. The results of the first objective was then been used in the assessment for the second and third objective. This study adopted an approach by Pipitsupaphol and Watanabe (2000) that classify the causes based on six most influential factors i.e. unique nature of the industry; job site conditions; unsafe equipment; unsafe methods; human elements; and management factors. Each of these causes will have their own sets of causes and sub-causes of accidents

The second objective was achieved through the analysis of the reported accident cases from year 2000 to 2004 obtained from DOSH documents. Accident cases documents were prepared by DOSH investigating officers and known causes were recorded. Those documents were examined thoroughly and the stated causes were classified into the respective categories. The numbers of counts for each case were calculated. Those counts were then averaged out in order to calculate the percentage frequency based on the six most influential factors.

The last objective was achieved through the analysis of the response to questionnaire received involving 116 respondents from the construction industry within peninsular Malaysia. A checklist was designed to assist in the investigation during the site surveys to 116 construction sites involved in various construction works mostly in the state of Selangor, Johor, and Wilayah Persekutuan Kuala Lumpur and Putrajaya. The rest of the construction sites are located in Negeri Sembilan, Kelantan, Terengganu, Pahang and Kedah. Hence, the data shall represent only the localised scenario until a more comprehensive study is conducted. The targeted respondents were persons who are very well verse about the construction work and in particular accidents at sites such project manager, site manager, assistant manager, director, resident engineer, project/site engineer, safety and health officer, project executive, site supervisor, clerk of work and foreman. Respondents were mostly from class A, B and C contractors while the rest were from consultant and client organizations.

Table 1: Distribution of Causes of Construction Accidents from DOSH Reports

Cause of Accidents	Frequency		
	Count	Average	%
1. Unsafe equipment			
▪ Without safety devices	4	7	9.7
▪ Equipment failure	9		
▪ Not ergonomics	8		
2. Job site conditions			
▪ Poor site management			
▪ Construction materials arrangement		8	11.1
▪ Equipment and waste material arrangement			
▪ Slippery and muddy work surface	15		
▪ Excessive noise	0		
▪ Poor illumination	2		
▪ Poor ventilation	6		
3. Unique nature of industry			
▪ Work operation	6		
▪ Rough Work			
▪ Mental and physical requirements		8	11.1
▪ High energy required			
▪ Variable hazard	16		
▪ Work at high elevation	15		
▪ Limitation of working area	3		
▪ Transient workforce	2		
4. Unsafe method		19	26.4
▪ Incorrect work procedure	43		
▪ Knowledge level	6		
▪ Failed to obey work procedure	8		
5. Human element			
▪ Negligence	15		
▪ Body effort	2		
▪ Tiredness			
▪ Pain			
▪ Drug addiction			
▪ Alcohol intake		9	12.5
▪ Experience	4		
▪ Total work hours			
▪ Training undertaken			
▪ Personal Protective Equipment (PPE)	21		
▪ Self emotion	0		
▪ Attitude	12		
▪ Stubborn			
▪ Assume safety is not important			
▪ Give up easily			

Table 1 (cont.)

6. Management			
▪ Education	30		
▪ Safety training			
▪ Orientation			
▪ Poor inspection program	60	21	29.2
▪ Insensitive	7		
▪ Motivation program	4		
▪ Inadequate warning system	15		
▪ Non-compliance with safety regulation	18		
▪ Poor safety policies	34		
▪ Safety is not an important element	0		
TOTAL			100

Respondents from each site were required to fill in only one questionnaires form. The questionnaires form was structured in three (3) sections:

1. Section A: Background data of the respondents and the projects (6 questions)
2. Section B: General information(2 questions)
 - i. View on seriousness of accident rate
 - ii. Type of accident frequently happen
3. Section C: Cause of accident at construction sites (6 parts)
 - i. Unsafe equipment (3 questions)
 - ii. Job site conditions (6 questions)
 - iii. Unique nature of industry (7 questions)
 - iv. Unsafe method (3 questions)
 - v. Human element (11 questions)
 - vi. Management (9 questions)

The answer selection for the questionnaires consists of predetermined answer in yes or no mode. A total of 116 questionnaires forms was collected and then analysed. The frequency of the answer was calculated in the percentage forms. The percentage is used to review the actual situation and the significant of the cause of accident at construction sites.

4.0 Results and Discussion

Summary of the results and discussions presented below are based on the analysis of the construction accident reports and questionnaire surveys primarily to answer objectives number 2 and 3 respectively.

4.1 Causes of Construction Accidents from DOSH Reports

The results were obtained by examining 128 accident cases from DOSH reports from year 2000 to 2004 as shown in Table 1 and Figure 1 which answer objective 2 of this study. The analysis shows that the causes of construction accidents on average are mainly attributed to the management (29.2%) such as poor inspection programs, poor safety policies and lack of safety education programs. Second major cause is due to the unsafe method (26.4%) mostly related to incorrect work procedure. Human element come in third position (12.5%) as lack personal protective equipment usage and workers' negligence contribute to the cause of accidents. Working in variable hazard and at high elevation has been part of the unique nature of the construction industry (11.1%) which associates this industry as more risky than others. Finally, factors such as unsafe equipments (9.7%) and job site conditions (11.1%) especially poor site management also have roles in contributing to the cause of accidents at construction sites. The overall results are not comprehensive as the reports are not geared toward revealing all possible root causes as stipulated in the multiple causation model. Furthermore, the documented reports were prepared by the enforcement officer who would naturally focus on the management when it comes to the aspect of accident prevention.

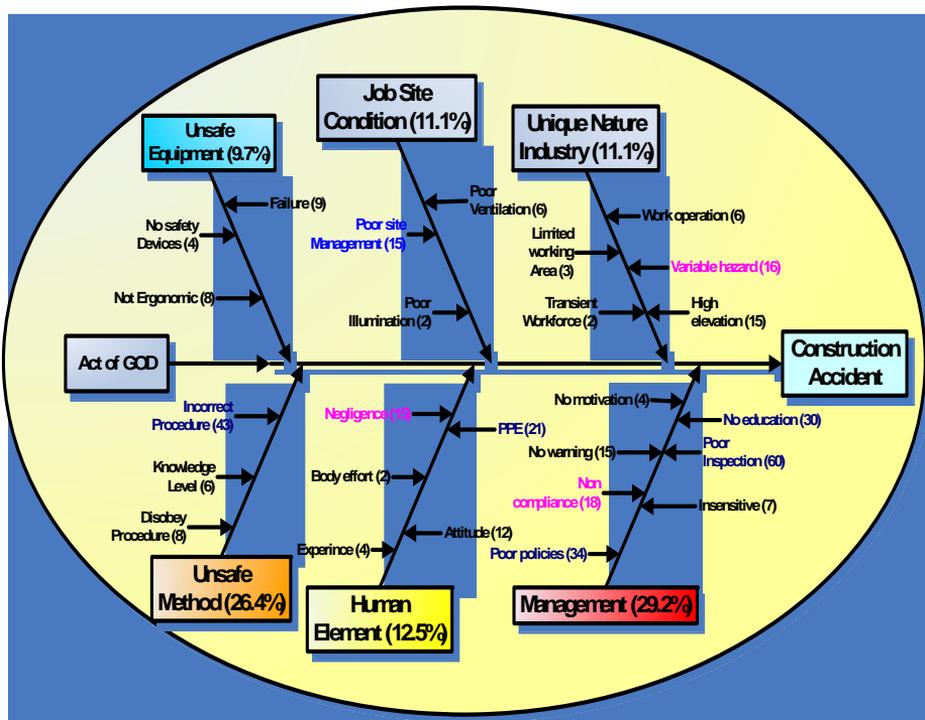


Figure 1: Causes of Construction Accidents from 128 DOSH reports in year 2000 to 2004

4.2 *Results of Survey*

The first section of questionnaire reported the information about the seriousness of accident rates and types of accident occurred at our construction sites. Figure 2 indicates that 57 % of 116 respondents say that construction accidents rate are moderate in Malaysia, 31 % say that it is serious and 12 % says it is not serious. It can be concluded that most of the respondents feel that construction accidents rate in Malaysia country is serious and moderate, indicating greater awareness among site personnel that accidents are not to be taken lightly and have its share in the performance of the construction projects.

Table 2 and Figure 3 indicate the respondents view on the types of accidents that are commonly occurred at construction sites. The results show that falls (22.2%), stepping on objects (18.2%) and struck by falling objects (17.1%) are the top three most commonly found types of accidents in construction. This could be attributed to poor fall protection, poor house keeping or poor work method for example failure to secure materials during hauling or lifting. This finding coincides with the latest accident data obtained from SOCSO which indicates that falls is the major type of accidents in Malaysia.

Similarly, Pipitsupaphol and Watanabe had found that the three most frequently occurring type of accidents in Thailand were workers being struck by falling objects, stepping on or striking against objects and person falling (Pipitsupaphol and Watanabe, 2000). Falls and struck by falling objects also have been the cause of the highest number of injuries and fatalities in the U.S. construction industry as reported by OSHA and Huang et al (2003). It also follows Schriver (1997) findings, which indicate fall from roof is the most common cause of fatality in construction sites. The reasons behind such incident are inadequate scaffolding, lack of edge protection, unprotected openings in buildings, lack of edge protection in roof work, dangerous demolition work and inappropriate use of ladders and hoists. Another common factor of construction accident is being struck by falling objects, materials or tools. Such incident may be due to lack of toe boards on scaffoldings, lack of tool belts for workers, bad storage and stacking and poor housekeeping. To prevent fall accidents, few preventive measures must be taken. Scaffolding must be properly put up and its stability ensured to prevent any untoward incident. Workers working at high places must be equipped with personal protective equipment (PPE) and all potential hazards must be identified, assessed and removed to reduce fall accidents.

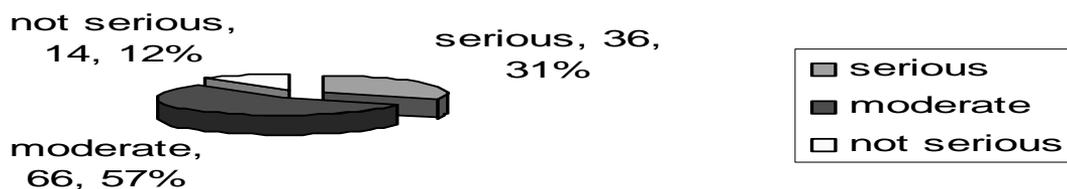


Figure 2: Proportion of Response about the Seriousness of Accident Rates

Another type of accidents which received 10.8% of the respondent agreement is exposure to /or contact with electric current. This type of accident is attributed to incorrect usage of electric sockets, damaged insulation of electric wires/cables or faulty electric tools. Overexertion or strenuous movement will cause fatigue to the human body and/or unbalance body movement comes in fifth place 63.6%. The last four types of accidents in the questionnaire, namely caught in between objects (6.8%), exposed to/contact with harmful materials (6.6%), exposed to/contact with extreme temperatures (5.5%), and other type (5.1%) are not to be taken lightly as they are potentially alarming.

Table 2: Distribution of Response about the Types of Accidents in Construction

Types of accident	Count	%	Ranking
Falls	101	22.2	1
Struck by falling objects	78	17.1	3
Stepping on objects	83	18.2	2
Caught in between objects	31	6.8	6
Over-exertion or strenuous movements	35	7.7	5
Exposed to/contact with extreme temperatures	25	5.5	8
Exposed to/contact with electric current	49	10.8	4
Exposed to/contact with harmful materials	30	6.6	7
Other type	23	5.1	9
TOTAL	455	100	

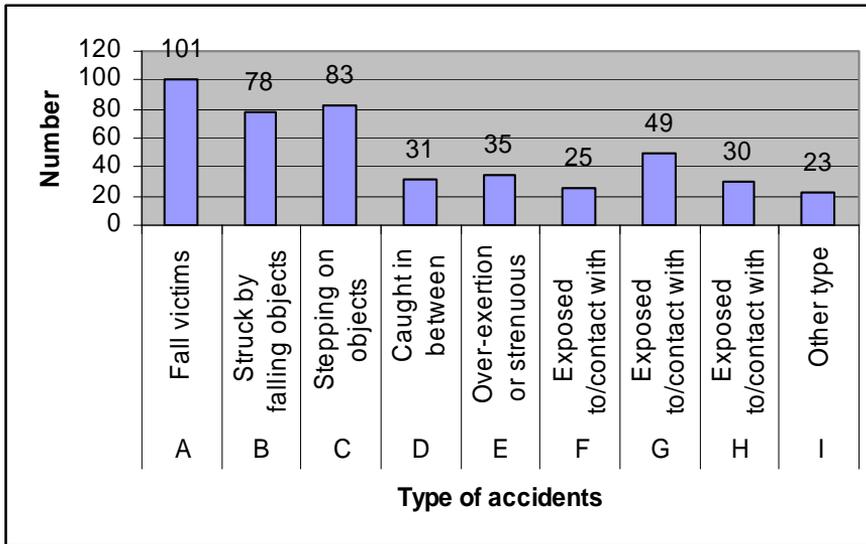


Figure 3: Frequency Type of Construction Accident

Table 3 and Figure 4 show the questionnaire survey analysis that indicates the respondent agreement towards causes of construction accidents in Malaysia. From the questionnaire survey, the causes that received the highest respondent agreement is workers’ negligence which received 110 count. The other top ten causes of construction accidents found are related to failure to obey work procedure (104), work at high elevation (101), equipment without safety devices (100), poor site management (99), harsh work operation (99), low level of workers’ knowledge and skills (97), incorrect work procedure (95), attitude of the workers (95), and failure to use personal protective equipment (95). Whereas, the causes that received the lowest respondent agreement were excessive noise (29), transient workforce (61) and poor illumination (65). The ranking of those causes indicates their level of significance.

The analysis shows that the causes of accidents are more related to the employees rather than the employers as indicated by the results to the factor of human elements (17.7%) and unsafe method (18.9%) as compared to the management (15.8%). The other factors are equally important as their average percentage of respondent agreement is quite close i.e. unsafe equipment (17.1%), unique nature of industry (17%), and job site conditions (13.5%).

Unsafe method can be defined as incorrect procedures and work styles that have been practiced by the workers. This may be due to the insufficient information from the management resulting in workers disobeying the works procedures. In addition, the level of knowledge and skills of the workers towards the procedures that have been taught to them will contribute to the proper execution of works.

The human element or factor such as the negligence of the workers in doing their works will also lead to the accident. The unsatisfactory body condition of the workers such as tiredness, illness, alcohol and drug consumption will also affect the efficiency of works. The experience of the workers such as the total number of man hours and training that they have undertaken may also be one of the factors that determine the occurrence of the accidents at sites.

The accidents may also occur if the workers do not use the personal protective equipment (PPE) that has been provided by the management such as safety boots, safety belts, safety helmets, goggles and so on. If they failed to use the PPE as required, the percentage of the risks being exposed to them is even larger. PPE should be used by all employees particularly in those conditions where safety hazards are envisaged and used, not as a substitute but as a supplement to administrative and engineering controls as a part of the safety program.

Table 3: Distribution of response about the Causes of Construction Accidents

Factor of Accident	Immediate cause of accidents	Response Count, Yes	Ranking	Average Count	%
1. Unsafe equipment	i) Equipment without safety devices	100	4	90	17.1
	ii) Equipment failure	94	11		
	iii) Equipment not ergonomic	75	25		
2. Job site conditions	i) Poor site management	99	5	71	13.5
	ii) Excessive noise	39	29		
	iii) Poor illumination	65	27		
	iv) Poor ventilation	82	21		
3. Unique nature of the industry	i) Work operation	99	5	89	17
	ii) Variable hazard	94	11		
	iii) Work at high elev.	101	3		
	iv) Limitation of working area	88	15		
	v) Transient workforce	61	28		
4. Unsafe Method	i) Incorrect procedure	95	8	99	18.9
	ii) Knowledge level	97	7		
	iii) Fail to obey work procedure	104	2		

Table 3 (cont.)

5. Human Element	i) Negligence	110	1	93	17.7
	ii) Body effort	87	17		
	iii) Experience	90	14		
	iv) Personal Protective Equipment (PPE)	95	8		
	v) Self esteem/ Motivation	82	21		
	vi) Attitude	95	8		
6. Management	i) No Education provided to the workers	94	11	83	15.8
	ii) Poor inspection Program	86	18		
	iii) Insensitive to the current situation at site	84	20		
	iv) No Motivation Program	73	26		
	v) No warning system	76	23		
	vi) Non compliance with safety regulation	88	15		
	vii) Poor company safety policies	85	19		
	viii) Consider Safety as unimportant element	81	24		
TOTAL				525	100

In addition, the workers attitudes also influence the occurrence of accidents. For example, the workers who are stubborn to use the safety equipment, to obey the work procedures, assume that the safety is not important, always give up and bored with certain type of works will loose attention and concentration in doing their works. As a result, they may not handle the equipments and fail to do the work in a safe manner. Failure of the management to do the inspection on conditions, workers, materials and equipments at sites will also lead to the occurrence of accidents. Thus, it is important to the management to do the inspection regularly, so that any weaknesses or problems that occur at sites can be solved on time and early action can be taken in order to prevent the accident from occurring. As we know, prevention is better than cure. Besides that, the poor, incomplete and non-enforceable company's safety policy, rules and regulations will also lead to the occurrence of the accidents. If the management themselves are not keen in putting the safety policy, rules and regulations they created into practice, the workers seem could not care less.

The overall analysis of the respondents view show that all causes of accidents in each category had occurred at the construction sites. Each causes listed in the checklist has not fail to capture the respondent agreement. Hence, it proves that accidents are the

result of many contributing factors, causes, and sub causes. The list of causes, however, is not exhausted and yet to be extended when a more comprehensive study is being taken.

This indicates that the employee somehow must shoulder a major portion of the blame for being involved in accidents due to their actions such as negligence and failure to obey work procedures. This is not to say that the employers are totally innocent. Some of their actions too such as failure in the provision of safe system when working at high elevation, provision of equipment without safety devices, provision of comprehensive safety education program and poor site management contribute significantly to the unsafe acts and conditions. As a responsible employer, one should provide safety training and motivation program to the workers in order to enhance the workers knowledge and discipline.

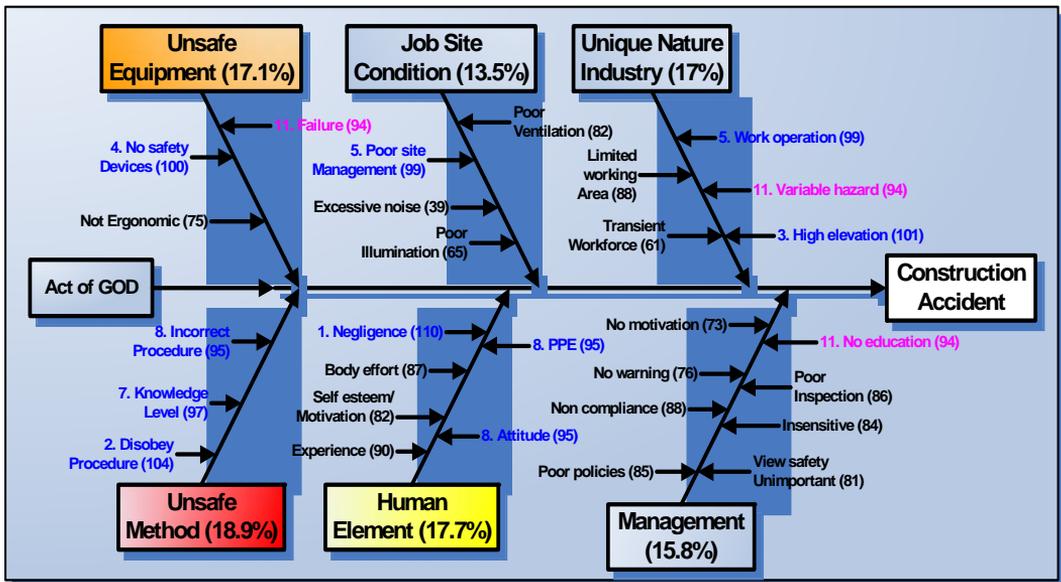


Figure 4: Causes of Construction Accidents from 116 surveys

5.0 Conclusions

Generally, the production of construction products is a risky, complex and lengthy process. The total development of a construction project normally consists of several phases requiring a diverse range of specialized services. Cost, time, quality and safety are important characteristic of every project. For the construction industry in Malaysia, there has been greater emphasis on the first three aspects at the expense of safety. Lack of

adherence to safety requirements has led to increased exposure of workmen and the general public to risky situation at construction sites resulting in a high chance of occurrence of accidents. Accidents could result in not only direct physical injury to persons or damage to property, but also short and long term effects to the company, society and eventually nation.

The literatures show that accident are caused by a wide range of factors, some of which are unsafe equipment, job site conditions, unique nature of the industry, unsafe method, human element and management. From the survey results, it is found that all the respondents are aware of the main causes of accidents. The cause of accidents in the construction industry is a multi faceted phenomenon mainly attributed to workers' negligence, failure of workers to obey work procedures, work at high elevation, operating equipment without safety devices, poor site management, harsh work operation, low knowledge and skill level of workers, failure to use PPE and poor workers attitude about safety.

The findings somehow testify the claim of multiple causation model which say accident is the result of many contributing factors, causes and sub causes. Thus, the employer, employees, suppliers, manufacturers, governing agencies must combine forces and try to prevent future construction accidents by addressing the root causes of accidents. By reducing the number of accidents, the construction industry doesn't have to be labeled as a 3D (Dirty, Dangerous, and Demeaning) anymore.

References

- Abdelhamid, T.S. and Everett, J.G. (2000) Identifying of Root Causes of Construction Accident. *Journal of Construction Engineering and Management*, ASCE, January/February 2000, pp.52 – 60.
- Abdullah Ahmad Badawi. (2001) Teks Ucapan Kempen Bulan Keselamatan dan Kesihatan Pekerjaan 2000.[online]Available <http://www.dosh.gov.my/maklumat/ucapan/10200019tpmukempen.html>
- Everett, J.G. and Frank, P.B. (1996) Costs of Accidents and Injuries to the Construction Industry. *Journal of Construction Engineering and Management*, ASCE, Vol 122, No. 2, Paper No. 10616.
- Fong Chan Onn - Minister Of Human Resources (2003) Speech in National Conference & Exhibition On Occupational Safety & Health (COSH 2003)Sunway Pyramid Convention Centre, [online] Available <http://www.mohr.gov.my>
- Fong Chan Onn - Minister Of Human Resources (2004) Speech in Majlis Penyampaian Faedah
- PERKESO Tampin, Negeri Sembilan, [online] Available <http://www.mohr.gov.my>
- Heinrich, H.W., Petersen, D. and Roos, N. (1980) Industrial Accident Prevention – A Safety

- Management Approach. Fifth Edition. USA: McGraw Hill.
- Hinze, J.W.(1997). Construction Safety. New Jersey: Prentice Hall, Inc.
- HSE (1999) Press Release E207:99 Work Accident and Ill Health Cost Society Billions – New HSE Report Estimates [online] Available <http://www.hse.gov.uk/press/e99207.htm>
- HSE. (2001) Levels and Trends in Workplace Injury: Reported Injuries and the Labour Force Survey 1997/1998 [online] Available <http://www.hse.gov.uk/laborsurvey>
- Huang, X. and Hinze, J. (2003) Analysis of Construction Worker Fall Accidents. *Journal of Construction Engineering And Management*, ASCE, pp. 262-271
- ILO. (1996) Press Release: ILO Highlights Growing Risks to Worker Health and Safety. [online] Available <http://www.ilo.org/public/english/bureau/inf/pr/96-13.htm>
- Kartam N., A., Flood I., and Koushki P., (2000) Construction Safety in Kuwait: procedures, problem, and recommendation. *Journal of Safety Science* 36, pp. 163 – 184.
- Lubega, H. A., Kiggundu, B. M. and Tindiwensi, D. (2000) An Investigation into the Causes of Accidents in the Construction Industry in Uganda – 2nd International Conference On Construction In Developing Countries: Challenges Facing The Construction Industry In Developing Countries, 15-17 Nov 2002, Botswana, pp1-12 [online] Available <http://buildnet.csir.co.za>
- NSTP (2000) No Induction Course Attendance, No Construction Workers, Developers, Contractors Have Until July 1 to Comply. 9 April 2001.[online] Available <http://www.aboutsafety.com/article.cfm?id=683>
- NSTP (2002) Appeal to Re-Hire the Indonesian Construction Workers. Malaysia.
- Pipitsupaphol, T. and Watanabe, T. (2000) Identification of Root Causes of Labor Accidents in the Thai Construction Industry. *Proceedings of the 4th Asia Pacific Structural Engineering and Construction Conference (APSEC 2000)* 13-15 September 2000 Kuala Lumpur, pp193-202.
- Ridley, J. (1986) Safety at Work, 2nd Edition. London: Butterworth Ltd.
- Schrifer, W. (1997) An Analysis of Fatal Events in the Construction Industry 1997 [online] Available <http://www.cdc.gov/elcosh/docs/d0600/d000645/d000645.html>
- SOCSO (2001) Statistik Kemalangan Industri [online] Available.
- Tam C.M., Zeng S.X. and Deng Z. M. (2004) Identifying elements of poor construction safety management in China. *Safety Science*, 42 (2004) 569–586
- Toole, T. M. (2002) Construction Site Safety Roles. *Journal of Construction Engineering and Management*, ASCE, 12(3) , pp.203-210.