

THE CAUSE AND EFFECT OF FALL FROM HEIGHT ACCIDENTS AND  
MITIGATION MEASURES IN PENINSULAR MALAYSIA

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## DEDICATION

*“...a special dedication to my family*

***best father***

*Allahyarham Mat Salleh bin Razali*

***lovely mom***

*Siti Zaleha binti Abdul Rashid*

***wonderful siblings***

*Dato’ Ts. Dr. Mohammad Ezanni bin Mat Salleh*

*Mohammad Ezham bin Mat Salleh*

*Allahyarhamah Norrehan binti Mat Salleh*

*Mohamad Ashraf bin Mat Salleh*

***best friend thick and thin***

*Nurmahamira Zairani binti Muhamad Zaini*

*Thank you for love, guidance, and encouragement...”*

*Alhamdulillah*

THANK YOU ALLAH☺



PTTA  
PERPUSTAKAAN TUNJUKKAN AMINAH

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## ABSTRACT

Falls from height (FFH) is a significant threat to the construction environment and are the leading cause of serious and fatal injuries for construction workers in Peninsular Malaysia and throughout the world. Working at a height increases the likelihood of being involved in a fall from a height accident. Many previous researches or most current incident investigation protocols concentrate on immediate accident circumstances rather than exploring how the problems originate, the effect of accidents and how to mitigate the accidents, often due to the need to prosecute offenders or limitations in time and resources for the investigation. This research is motivated to identify the cause and effect of fall from height accidents and its mitigation measures in Peninsular Malaysia. The quantitative approach was adopted in identifying the cause, effect and mitigation measures of fall from height accidents. A questionnaire survey has been used as the main method in the data collection and was distributed to 365 respondents around Peninsular Malaysia. But, only 115 set questionnaires were returned completely. Data were analysed using the Relative Important Index (RII). The findings of this research indicate that the main causes of fall from height accidents are individual attitudes, which are workers' negligence toward safety rules with an RII value of 0.901. Then, the adverse effects of falls from height accidents are in humanitarian categories, which are injuries, or permanent disabilities with an RII value of 0.899. After that, the utmost possible mitigation measures with the highest RII ranking are in the health protection categories, which are forbid working at height if alcohol or drugs have been detected on workers with an RII value of 0.930. Lastly, the identified causes, effects and mitigation measures of fall from height accidents were selected and integrated into a framework of fall from height accidents, which are a novelty for this research. The establishment of the framework is important to recognise the root cause of the problem and enhance safety performance at site.

## ABSTRAK

Jatuh dari tempat tinggi (FFH) merupakan ancaman terbesar kepada persekitaran pembinaan dan merupakan punca utama kecederaan serius dan maut bagi pekerja binaan di Semenanjung Malaysia dan seluruh dunia. Bekerja di tempat tinggi meningkatkan kemungkinan terlibat dalam kemalangan jatuh dari tempat tinggi. Banyak penyelidikan terdahulu atau protokol penyiasatan insiden terkini hanya tertumpu pada keadaan kemalangan serta-merta daripada meneroka bagaimana masalah itu timbul, kesan kemalangan dan cara mengurangkan kemalangan, selalunya disebabkan oleh keperluan untuk mendakwa pesalah atau had masa dan sumber untuk penyiasatan. Penyelidikan ini bermotivasi untuk mengenal pasti punca dan kesan jatuh dari tempat tinggi dan langkah-langkah mitigasinya di Semenanjung Malaysia. Pendekatan kuantitatif telah digunakan dalam mengenal pasti punca, kesan dan langkah-langkah pengurangan kemalangan jatuh dari tempat tinggi. Tinjauan soal selidik telah digunakan sebagai kaedah utama dalam pengumpulan data dan telah diedarkan kepada 365 responden di seluruh Semenanjung Malaysia. Tetapi, hanya 115 set soal selidik dikembalikan sepenuhnya.. Data dianalisis menggunakan Indeks Penting Relatif (RII). Dapatan kajian ini menunjukkan bahawa punca utama kemalangan jatuh dari tempat tinggi adalah sikap individu iaitu kecuaiannya pekerja terhadap peraturan keselamatan dengan nilai RII 0.901. Kemudian, kesan buruk kemalangan jatuh dari tempat tinggi adalah dalam kategori kemanusiaan iaitu kecederaan atau hilang upaya kekal dengan nilai RII 0.899. Selepas itu, langkah mitigasi yang paling terbaik dengan kedudukan RII tertinggi adalah dalam kategori perlindungan kesihatan, yang melarang bekerja di tempat tinggi jika alkohol atau dadah telah dikesan pada pekerja dengan nilai RII 0.930. Akhir sekali, punca, kesan dan langkah mitigasi yang dikenal pasti kemalangan jatuh dari tempat tinggi telah dipilih dan disepadukan ke dalam rangka kerja kemalangan jatuh dari tempat tinggi, yang merupakan sesuatu yang baru untuk penyelidikan ini. Penubuhan rangka kerja adalah penting untuk mengenali punca masalah dan dalam meningkatkan strategi pencegahan kemalangan FFH dalam projek pembinaan.

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## LIST OF SYMBOLS AND ABBREVIATIONS

( $\alpha$ )	Cronbach's Alpha
n	the sample size
N	the population size
e	the acceptable sampling error
$\bar{c}$	average covariance between item-pairs.
$\bar{v}$	average variance
BOWEC	Building Operations and Works of Engineering
CIDB	Construction Industry Development Board
CITP	Construction Industry Transformation Plan
DOSH	Department of Safety and Health Malaysia
FMA	Factory and Machinery Act 1967
FFH	Fall from height
IBS	Industrialized Building System
OSH	Occupational Safety & Health
OSCHIM	Occupational Safety & Health Construction Industry Management
PPE	Personal protective equipment
RII	Relative Important Index
SHASSIC	Safety and Health Assessment System in Construction
SHO	Safety and Health Officer
SOSCO	Social Security Organization
SSS	Site Safety Supervisor

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background of Research

The construction industry is a dynamic and innovative industry that delivers buildings and infrastructure for all aspects of commercial and domestic activity. It is a global industry that facilitates the development and maintenance of buildings, transport links, and energy supplies. It is an industry that continues to deliver many incredible things, from ever taller skyscrapers to expansive bridges, impressive stadia, and structures that rise out of land reclaimed from the sea.

The construction industry has grown over the last decades and resulted in improvements in company profits, financial accessibility, and increased commodity demand in Malaysia and other countries. Despite its importance, Mohammadi *et al.* (2018) describe construction as one of the most dangerous industries due to its unique, dynamic, and temporary nature. This dynamic and innovative industry is faced with safety challenges on a project-by-project and day-by-day basis. Accidents are a major problem in various industries as well as in everyday life. Hu *et al.* (2019) mentioned that compared to other industries, the construction industry has lousy working environments, a complicated situation, a high labour turnover rate, a lack of safety management, low educational standards, and poorly trained workers. According to Mat Ali *et al.* (2019), the average incident rate in 2018/19 for fatalities was 11.28 accidents per 100 000 workers in the construction industry, turning this industry into

one of Malaysia's most dangerous industries. Compared with Malaysia, the average number of fatal accidents in the construction industry is much lower in other countries. The average incidence rate for fatalities in Singapore, the United States of America, Australia, and the United Kingdom in 2018/19 was 2.9 per 100,000 workers, 9.5 per 100,000 workers, 1.74 per 100,000 workers, and 3.3 per 100,000 workers, respectively (Mat Ali *et al.*, 2019). These developed countries demonstrate their commitment to applying good safety culture in order to reduce the rate of fatalities.

Occupational accidents in the construction industry are prevalent and can result in permanent disabilities and a high fatality rate. Fatal accidents, in general, result in a large number of casualties as well as significant personal, social, and financial costs (Forteza *et al.*, 2017). Moreover, multistory or high-rise buildings remain predominant in building construction projects, and there exist numerous risks related to working at height, vertical transportation, and heavy machinery equipment (Shao *et al.*, 2019). The Occupational Safety and Health Administration (OSHA) of the United States reported the four leading causes of fatalities in construction, which are falls, being struck by equipment or machinery, electrocution, and being caught in between equipment (OSHA, 2007). Falls from heights are one of the leading causes of serious work-related accidents and deaths in the construction industry (Dong *et al.*, 2017).

Furthermore, working four feet or higher off the ground puts workers at a greater risk of falling, but anything capable of causing you to lose balance and fall is a hazard. Most falls occur from a working platform, framework, ladders, or scaffolding. According to Ali *et al.* (2010), the causes of accidents were low safety awareness from top leaders, lack of training, lack of organizational commitment, lack of technical guidance, uncontrolled operation, unwillingness to input resources for safety, lack of certified skilled labour, unsafe equipment, lack of first aid measures, lack of enforcement of safety regulation, and lack of personal protective equipment (PPE). A lot of researchers have studied this industry and most of the researchers' studies share the same conclusions that construction-related accidents are more likely to occur when there are inadequate company policies, unsafe practices, and poor attitudes of construction personnel, low management commitment, and insufficient safety knowledge and training of workers (Hanapi *et al.*, 2013). Therefore, falling from height can be classified as a significant problem in construction accidents in the Malaysian construction industry (Williams *et al.*, 2019).



## 1.2 Problem Statement

Sensitisation of workplace safety in Malaysia began in 1967 with the introduction of the Factory and Machinery Act (FMA). Then, the Occupational Safety and Health Act (OSHA) was also promulgated in 1994; after a few years of the FMA's establishment, to enhance occupational safety and health control. In 2001, DOSH started implementing a Building Construction Safety Audit every four months on the construction site to facilitate that the OSH components are in procedure, appropriate and efficient in securing workers' safety and health, subsequently preventing accidents (Awang, 2007).

Unfortunately, statistics from the Department of Safety and Health (DOSH) Malaysia have shown that the number of fatalities in the construction industry is five times greater than in other sectors (Chong *et al.*, 2016). Over the years, the construction industry has reported the highest rates of work-related injuries and deaths. The Master Builders Association Malaysia (MBAM) identified the rate of fatalities in the construction industry per 100,000 workers has increased at an alarming rate. In 2014, the fatality rate was 7.26 per 100,000 workers. In 2015, it went up to 10.74, in 2016 it went further up to 12.78, and in 2017, it shot up to 14.94 per 100,000 workers.

Consequently, as shown in Figure 1.1, the occupational accident statistics by sector until November 2020, as reported to DOSH, the highest number of fatalities is from the construction and manufacturing sectors. The construction sector, which contributed to 222 out of 6793 total accidents for non-permanent disability, permanent disability, and death was also. This sector has the 6th highest ranking among 10 occupational sectors in Malaysia. From the statistics revealed, the board of authorities must give more attention to the problem in order to reduce the number of accidents in the future. Additionally, according to the statistics on FFH accidents reported to SOCSO and DOSH in Table 1.2, the number of accidents reported to SOCSO has increased significantly every year. In 2015, there were 10775 FFH accident cases, and the number of accidents increased by 24% to 13112 accidents in 2019. The statistics indicate that this is quite worrying, and proactive action should be taken to evaluate and re-examine the exact cause of this FFH accident has led to these statistics increasing drastically every year.

**OCCUPATIONAL ACCIDENT STATISTICS BY SECTOR UNTIL NOVEMBER 2020 (REPORTED TO DOSH ONLY)**

SECTOR	NPD	PD	DEATH	TOTAL
Hotel and Restaurant	144	2	1	147
Utilities (Electricity, Gas, Water and Sanitary Service)	228	3	4	235
Finance, Insurance, Real Estate and Business Services	303	6	14	323
Construction	160	4	58	222
Transport, Storage and Communication	343	6	10	359
Manufacturing	4027	209	58	4294
Wholesale and Retail Trade	123	3	1	127
Public Services and Statutory Authorities	77	2	3	82
Mining and Quarrying	32	1	2	35
Agriculture, Forestry and Fishery	907	20	42	969
<b>TOTAL</b>	<b>6344</b>	<b>256</b>	<b>193</b>	<b>6793</b>

LEGEND:  
 PD - PERMANENT DISABILITY  
 NPD- NON PERMANENT DISABILITY

Source: International Policy and Research Development Division

**Figure 1.1:** Occupational accident statistic by sector (DOSH, 2020)

**Table 1.1:** FFH Accidents Reported to SOCSO and DOSH (SOCSO Annual Report, 2019)

Year	Total FFH Accidents Reported to DOSH	Total FFH Accidents Reported to SOCSO
2019	7	13112
2018	20	12069
2017	15	11540
2016	14	10775
2015	14	9290

According to FFH accident statistics, the companies are mandatory to report the accident to DOSH, however only some of the companies that are concerned and responsible report the incident to DOSH. Meanwhile, the statistics released by SOCSO differ significantly compared to DOSH because the companies are required to report the accidents to SOCSO in order to receive compensation and make claims for the accidents. Furthermore, discrepancies in data gathered from SOCSO and DOSH were

due to companies involved in accidents tend to avoid reporting the accident to DOSH in order to achieve a zero-rating of Loss Time Injury (LTI) and avoid accident investigation (Manu *et al.*, 2018). Hence, in this case, data from SOCSO might represent the real number of accidents at a construction site in Malaysia.

According to previous research, accidents due to falling from height arise from inadequate company policies, unsafe practices, poor attitudes of construction personnel, poor management commitment, and insufficient safety knowledge and training of workers (Jamaludin, 2010). The Malaysian government has worked hard to reduce the number of accidents through legislation, regulation, and enforcement in the construction sector. One of the efforts is to engage a responsible person to carry out safety inspections and safety audits on construction sites under the DOSH requirements to evaluate the performance towards occupational safety and health compliances. Zhang *et al.* (2019) concluded that such substantial threats to construction workers' safety and associated socio-economic losses have made accident prevention a prime target for improved construction management practices.

In safety research, the ultimate objective is to prevent accidents from occurring. The challenge for safety experts is to improve the safety systems by reducing accidents. (Grant *et al.*, 2018). Significantly, it is imperative to find any loopholes that contributed to the fall from height accident. It is important to have a systematic framework that can assist industry players in discovering how fall from height accidents arises at construction sites. There is a need to determine a way to cope with this problem. This problem will always increase if all parties do not work together to reduce the number of cases. Lack of adequate safety measures goes beyond health concerns since the cost of construction injuries can substantially impact the financial success of construction organisations and increase the overall cost of construction by up to 15% (Aminbakhsh *et al.*, 2013). Hence, this research will shed a light on these issues with its ultimate aim to uncover the cause and effect of FFH accidents and its possible mitigation measures.

### **1.3 Research Questions**

The following research questions were formulated from the problem statement above.

The research questions of this research are:

1. What are the causes and effects of fall from height accidents in the Malaysian construction industry?
2. What are the mitigation measures for fall from height accidents?
3. How to develop a framework for
4. fall from height accidents for working at height practitioner to enhance the safety performance in construction projects?

#### **1.4 Objective of Research**

This research aims to identify the cause and effect of fall from height accidents and mitigation measures in Peninsular Malaysia. In order to achieve these aims, the objectives of this research are:

1. To determine the significant cause and effect of fall from height accidents in the Malaysian construction industry.
2. To evaluate possible mitigation measures for accident prevention due to fall from height.
3. To propose a framework of fall from height accidents in a construction project to enhance safety performance at site.

#### **1.5 Scope of Research**

The research scope will focus on the cause and effect of falls from height accidents and mitigation measures in the Malaysian construction industry. This research focuses on a construction site where activities are being carried out by private and government departments. Hence, the observation is made by randomly selected construction projects around Peninsular Malaysia. A questionnaire is distributed to the relevant construction personnel and will include expertise from a construction site highly experienced in the construction industry. The method of data collection is based on quantitative approaches. Then, the data is analysed using the Relative Important Index to determine the cause and effect of fall from height accidents and mitigation measures in the Malaysian construction industry.

## 1.6 Significance of Research

A successful construction project can be determined by four aspects-time, cost, quality, and safety. Without money, the project cannot complete on the due date. Safety can make the same impact with money. If an accident happens, it may disturb the time of the project, it may delay some a few days or a month. It may increase the cost, besides; the quality of management is decreased. This research focuses on identifying the cause and effect of fall from height accidents in the Malaysian construction industry.

As a consequence of this problem, this research will help to propose possible mitigation measures to prevent accidents in a construction project. Besides, this research also proposed a framework of causes, effects and mitigation measures due to fall from height accidents. Therefore, the framework shall contribute to the management which is can provide a systematic precaution step and improve their preventive strategies for carrying out the work to minimise risks of falling from height. This research also intended to management in implementing the mitigation measure to achieve effective construction projects. As a result, accident statistics can be decreasing, and the construction project is completed on time.



## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

An accident that happens on a construction site can cause severe physical injury. In this chapter, several parts are discussed: the type of accident at a construction site, the type of fall accident, the causes and effects of fall accidents, and accident mitigation measures in the construction industry.

#### 2.2 Construction Industry

The construction industry is defined in terms of the activities and products that are either included in or excluded from it. The construction industry encompasses a wide variety of products, from individual houses to high-rise buildings and significant infrastructure, including highways, power plants, and oil rigs. The construction industry is unique among other industries as its activities often take place outdoors, in uncondusive conditions for safety and health. Workers on construction sites are exposed to constant changes in the nature of the work, the location of the work, and the composition of the workers. Most people associate the construction industry with a dangerous working environment and high risk compared to other fields (Misnan and Mohammed, 2014).

### 2.2.1 Worldwide Construction Industry

The construction industry is a booming sector, particularly in developing nations, with a continuous growth process. As part of the development process, the migration of people is taking place from rural to urban areas. This phenomenon is most significantly observed in the "Asian Tiger" countries, China and India (Shao *et al.*, 2019). Moreover, this sector is primarily an urban-based sector that deals with preparing and constructing real estate properties. The construction industry also involves repairing any current structure or making certain modifications to the same. Therefore, some developed cities must maintain an increasing number of building construction projects due to the ageing of their buildings (Shao *et al.*, 2019). This construction industry also involves heavy and mega civil engineering activities. The construction of mega projects such as bridges, roads, and high-rise buildings, comes under this category. Megaprojects are large-scale development agreements that typically cost \$1 billion or more, take several years to develop and build, involve a variety of domestic and foreign stakeholders, and have a significant impact on millions of people (Flyvbjerg, 2014).

Generally, management of mega construction projects is extremely challengeable, but not only because of their large scale, long-term effects, high socioeconomic and environmental impacts, they are also vulnerable to a high number of people, contractual and technological complexity, and sensitivity to changes in the macro-environment (Erol *et al.*, 2018).

### 2.2.2 Malaysian Construction Industry

The construction industry in Malaysia is essential to the national economy and has always played a primary role in domestic infrastructure growth. The increasing competitiveness of the market and the extensive implementation by local contractors of the Industrialized Building System (IBS) improve current procedures to achieve more excellent quality and product levels (Waris *et al.*, 2014). In the 11th Malaysia Plan (Economic Planning Unit, 2015), it is stated that, in order to achieve superb construction quality and productivity, the Malaysian construction industry was encouraged to transition from conventional construction into the Industrialized

Building System (IBS). This transformation from traditional building techniques gives momentum to onsite mechanised equipment deployment. The use of mechanised equipment improves the productivity of buildings and decreases dependence on foreign labour as well. The population of Malaysia has risen to 32.3 million in 2018 from 27.5 million in 2010 (Statistics, 2018), generating enhanced demand for construction and infrastructure growth. Since the 1980s, Malaysia has been pushed towards industrialisation and is anticipated to become a high-income developed country by 2020 (Bohari *et al.*, 2015).

In view of this need, the Construction Industry Transformation Plan (CITP) was launched in September 2015 by Prime Minister Datuk Seri Najib Razak. CITP is on the national agenda of Malaysia to transform the building industry between 2016 and 2020. It aims at transforming the construction industry into four strategic areas: quality, safety and professionalism, environmental sustainability, productivity and internationalisation (CIDB, 2019). In the area of safety in CITP, four visions are proposed to emphasise a safety culture. Therefore, the first strategic thrust of the CITP is quality, safety, and professionalism. These elements are the key prerequisites for the transformation of construction into a highly developed industry. Some of the main problems in the sector impacting the public, businesses, workers and consumers are high fatalities and accident statistics, the insufficient integration of health and safety elements into the working environment, low-quality buildings and collapsing infrastructure, and the delay in construction permit approvals (Hamid, 2019). Moreover, the CITP also suggests that the Safety and Health Assessment System in Construction (SHASSIC), which reviews a contractor's success in safety and health within a project, should be implemented more effectively. Then, initiatives to train certified safety officers (SHO and SSS) and third-party OSH inspectors have been introduced to ensure that at least one SHO or SSS is provided at each construction site (Hamid, 2019).

Next, in CITP, two key performance indexes have been set in order to emphasise a safety culture. The two KPIs are the fatalities must be reduced by 10% annually starting from 2021 onwards and Occupational Safety and Health Construction Industry management (OSCHIM) to be enacted in 2020. In addition, new regulations are implemented for high-risk activities such as falsework or temporary structures, lifting operations, and working at height (CIDB, 2019). Undoubtedly, these are just some examples of



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