

CONSTRUCTION FATAL ACCIDENTS IN VIETNAM: AN EXPLORATORY STUDY

Soo-Yong Kim¹, Luu Truong Van² and Yurl Hur³

¹ Division of Construction Engineering, Pukyong National University, San 100 Yongdang-Dong Nam-Gu Busan, 608 – 739, Korea

² Interdisciplinary Program of Construction Engineering and Management, Pukyong National University, San 100 Yongdang-Dong Nam-Gu Busan, 608 – 739, Korea

³ Taegeon General Construction Company, 1369-9 Yeonsan-dong, Yeonjie-gu, Busan, 607-836, Korea

Abstract

Construction activities are characterized as hazardous work. Therefore, it is very imperative to explore comprehensively fatal accidents and safety performance in both developed and developing countries. The goal of this study was to look at the reasons behind fatal accidents in HCMC, Vietnam's largest city. The survey sample consists of 91 fatal accident cases in total that occurred in construction sites during the years 1996-2005 and were reported to the Department of Labor-Invalids-Social Affairs in HCMC. The study was conducted by means of field surveys with relevant individuals working in construction sites and statistical analyses. The research resulted in failing to wear/use PPE as unsafe acts and in poor safety management procedures/methods in sites as insecurely working conditions behind serious accidents in the construction. The paper stresses that accidents tended to occur more in state-owned companies than in others and involved more with masonry/welding people and workers without labor contracts than with other workers.

Keywords: Accident analysis; Construction Industry; Construction Safety; Fatal accidents

Symbols

ARCTM	Accident Root Cause Tracing Model
DLISA	Department of Labor-Invalids-Social Affairs
HCMC	Ho Chi Minh City
PPE	Personal Protective Equipment

1. Introduction

During the past 3 decades, the volume of fatal accidents in construction industry was relatively high compared to that in other industries. For example, there were 1,107 fatal accidents in Japanese construction industry during 1989, which was 2.4 times greater than those in manufacturing industry [14]. Similarly, in the United States, the rate was twice

higher than that in other industries for non-fatal accidents and three times for fatal accidents [6]. It was reported that five construction workers were killed every 2 weeks and one member of the public was killed every month by construction activities in United Kingdom [17]. Notably, in developing countries, fatal accidents in the construction industry has become even worse due to inappropriate safety codes and standards, lack of personal protective equipment, inadequate safety training, poorly designed facilities and substandard material quality [11]. In this situation, effective actions should be properly taken to ensure the safety in construction projects and one of the best solutions is carrying out an exploratory study to identify main causations behind fatal accidents. The objectives of this study were to identify and analyze the major reasons which caused fatal accidents in the Vietnamese Construction Industry. These goals can be accomplish through analyzing fatal accident data that were reported to the Government department and a survey on safety issues in construction sites. The research findings provide essential basis to determine major reasons causing fatal accidents in construction. As a result, they help improving the labor safety in construction area in Vietnam.

2. Literature Review

Based on the fatalistic views of accident, many people believe that accident is the fatality and it just happens [3]. As a matter of fact, most of accidents occur as a result of human failure, and they may be prevented. In general, the major causes of accidents are related to the unique nature of the industry, human behavior, difficult work-site conditions, and poor safety management, which result in unsafe work methods, equipment, and procedures [10]. The identifying various types of fatal accidents in construction industry have been widely recognized by concerned professionals and researchers.

Research results from accidents in the U.S. construction industry indicated, “accidents due to persons falling are not only the largest single category but also give to almost half the total fatalities” [15]. According to an analysis report on fatal accidents in U.S construction industry during 1985-1989, Hinze et al., [9] revealed that over 99% of “fall” accidents were falls from elevation and struck by accidents which were caused by falling of equipment or materials, especially heavy equipment. In another research that had been conducted in the United Kingdom, it was reported that 52% of fatal accidents that occurred during 1981-1985 was fall of people [2]. In a study of fatal accidents in India in the period 1974-1979, Malhotra [13] also found that 54% of total fatal accidents have been caused by falls of persons. According to a research report on fatal accidents in the construction industry in HCMC during 1992-1996, 45% of fatal accidents are fall of persons, followed by electric shocks (28.3%) and caught in/between objects (16%) [18]. Thus, fall of persons has been generally reported as a common type of fatal accidents in the construction industry.

Many studies on the causes of construction injuries have been conducted by different researchers in the world and have received much publicity and attention such as Hinze [4] [5] [7] [9], Jaselskis and Suazo [11], Koehn et al. [12], Sawacha et al. [16]. There was a few studies specifically addressed the major causes of fatal accidents in developing countries. Unlike in developed countries where data relevant to safety issues is usually available, in Vietnam it is difficult to successfully conduct a study on construction safety since past accidents have not been completely reported [18]. In effect, among reports on

fatal accidents in construction projects stored at the Department of Labor-Invalids-Social Affairs (DLISA) of provinces or cities in Vietnam, accidents in all sectors must be reported by law authority, and thus very few information about the major causes is found. Obviously, a better understanding of the major causes becomes a distinct need in order to prevent fatal accidents in the Vietnamese construction industry.

3. Research Methodology

A questionnaire was developed to facilitate data collection of the researchers and to ensure consistency in the elements to be examined. There are two major categories of questions. The first category refers to information about accident description such as workplace, when, where, and how the accident occurs, and type of fatal accidents. The second one represents the victim's personal information such as name, age, sex, salary, trade, and work experience. The same set of questions was also directed to construction sites, where fatal accidents were occurred. Each question is accompanied by a set of common safety factors that must be examined in the answers, which can assist the researchers in refining the replies as well as comparing the obtained information from different interviewees.

The survey sample consists of 91 fatal accident cases in total that occurred in construction projects during the years 1996-2005. To prepare an interview with involved personnel, the researchers reviewed all relevant information available in accident reports obtained from DLISA in HCMC. Questions for the interviewee were structured so that he or she would answer freely. All answers were cross-checked with other participants to ensure the data consistency.

Data collected from each construction company were directly recorded on the questionnaire. The Pearson chi-square test was exclusively chosen to test whether there is a difference among factors that reflect fatal accident occurrence as well as differences between fatal accident characteristics and other relevant factors. A 10% level of significance is considered to be statistically significant. Construction personnel who have fully responsible for fatal accidents such as foremen, site engineers, and project managers were interviewed to cross-check for the consistency in collected information as well as to obtain more pertinent and reliable information supporting the analysis.

4. Discussions of Research Finding

The results from the data analysis have revealed major factors that primarily caused fatal accidents in construction sites. These major safety factors are presented and discussed in the following subsections.

4.1. Findings from the analysis of victims' personal information

Firstly, the survey indicates that the majority of dead workers were unskilled workers (60.4%), followed by electricians (12.1%), masons (7.7%), welders and mechanics (5.5%), carpenters (3.3%), concrete workers (3.3%), piling workers (1.1%) and other workers (6.6%). The length of service of dead workers was less than 6 months (68.1%), followed by

6-12 months (19.8%), 1-5 years (7.7%) and over 5 years (4.4%). Most of them were male (98.9%) and had the mean age of approximately 28. Among victims, the high proportion of dead workers was in the group of unskilled workers and short experience workers that many of them were enforced to work on a seasonal basis while being not much aware of accident prevention. In Vietnam, very few construction workers were trained in their work. With the booming of construction market at present, laborers even with no specific skills and low education still get hired by construction companies. Due to their less work experience, they do not perceive unsafe conditions and often get injured. Therefore, it is necessary to provide construction workers with sufficient safety training before they are assigned to specific tasks.

Moreover, most of the victims of construction fatal accidents were young workers (65.93% of victims are less than 30 years old). It is easy to understand this proportion because young workers had no good professional qualification and experience as their aged co-workers. Besides, they were often assigned to carry out heavier tasks that may be prone-to-danger.

On the other hand, the most common unsafe conditions at sites, where fatal accidents occurred, include hazardous methods/procedures (34.1%), inadequate supports and guards (26.4%), and poor housekeeping (11.0%). “Management don’t care about unsafe conditions” and “management fail to identify unsafe conditions” are also identified as main causes for unsafe conditions as expressed by respondents.

In addition, it is revealed that victims tend to commit mistakes such as failing to use/wear Personal Protective Equipment (PPE) (18.7%), using unsafe procedures/methods (18.7%), disregard of known/prescribed safety regulations, rules, codes, etc. (16.5%), psychological factors (13.2%), using defective equipment (12.1%), and unsafe acts of coworkers/others (11%). It is common that workers did not wear a PPE (except for hard hats) while working at construction sites. This is in part because of they hadn’t habits to wear it or they didn’t feel comfortable doing so. In addition, because PPE was not strictly required by laws, most contractors did not want to provide PPE to their workers. They think that PPE is unnecessary and costly.

Due to poor safety management at sites, workers often select, by mistake, inappropriate (i.e. unsafe) methods to carry out their work. Moreover, neglecting or disregarding prescribed/known construction procedures was very common at sites where management staff and workers were neither fully aware of nor seriously interested in the safety issues during the construction.

For working time and season aspect, the survey results showed that most of fatal accidents occurred during the morning, between 9:30 AM and 11:30 AM (37.4%). According to Hinze’s explanation [8], in this particular length of time, workers are most concentrated on accomplishing their tasks, hence accidents are more likely to occur. Unlike other safety-related studies, which revealed that accidents tend to occur on Mondays, this survey showed that a higher rate of fatal accidents fell on Tuesdays and Thursdays.

Furthermore, it is interesting to point out that fatal accidents also occurred more often with highest frequency in April (19.8%) and during the period between March and April (28.6%) than on other months. This was explained that contractors usually accelerated the

work schedule during those months in order to complete the work before the rainy season in the following months (Figure 1). The number of accidents was lowest during February because the Vietnamese Lunar New Year takes place in this month, and during this period, many people take vacation or are likely not to concentrate on the work.

*Volume of construction projects (\$,
Budgeted Cost of Work Performed of
projects with small and medium scale)*

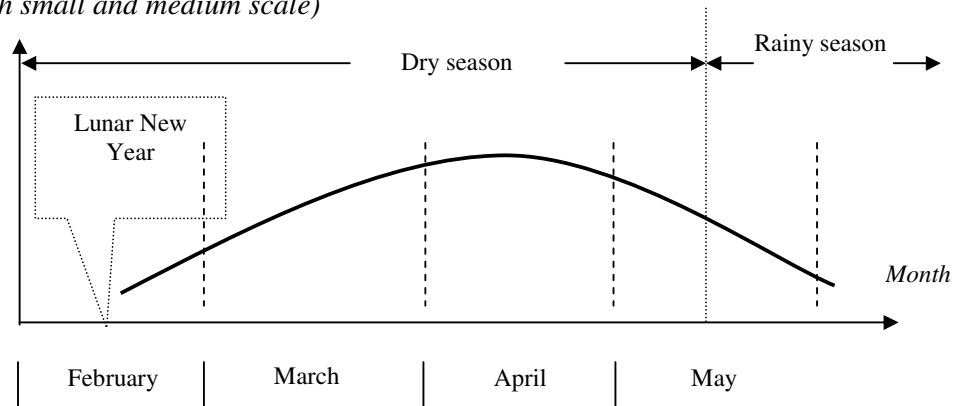


Figure 1. Typical Yearly Schedule for Construction Projects in Vietnam

4.2. Discussion from other findings

The survey data were also analyzed under different views in order to identify types, root causes, and likelihood of fatal accidents at construction sites. About types of fatal accidents, unlike previous studies ([15], [2], [9]) on construction safety around the world, this survey showed that the highest number of fatal accidents (60.4%) was “falling of persons” (refer to Table 1). There was a tendency of “Falling of persons” to occur in works on roofs, floors, and scaffolding. The main causes were inadequate Personal Protective Equipment (PPE) such as safety belts, safety nets; the worker’s carelessness and slipping; ladder collapsing, fall of people from scaffolds. It was found that even falling from a height of 1.7 meters, many workers often were dead due to brain injury. In such accidents, hard hats were found very helpful in protecting the worker’s life.

Table 1. Fatal Accident Rate versus Types of Accidents

Variable	Description	Frequency	Percent (%)
Types of fatal accidents	Falling of persons	55	60.4
	Electric shock	35	38.5
	Caught in/between objects, excavations, structures, etc.	1	1.1
	Fire and explosion	0	0
	Struck by objects	0	0
	Others	0	0

About 50% of the falling accidents took place because workers “failed to wear PPE”. In effect, most of Vietnamese workers do not want to wear safety belts (while knowing its use for protecting their life) as they do not feel comfortable working with safety belts. Besides, safety nets are considered as expensive items and usually not provided in construction sites, as contractors do not want to pay for them.

According to the survey results, approximately half of fatal accidents (46.15%) related to workers’ carelessness such as slipping on floors, stepping on unsecured roofs, and throwing (instead of handing in) materials, followed by violation of construction safety procedures (18.6%), insufficient PPE (18.68%), and inappropriate operation actions (16.48%). It is necessary that construction managers understand and strictly comply with safety standards/regulations. Construction managers should apply/exercise appropriate construction procedures, periodically inspect hand tools for safety, and sufficiently equip workers with PPE.

The second large volume of fatal accidents fall on deaths of “electric shock” (38.5%). Like previous relevant works described in [7], this survey indicated that electric shock accidents were resulted from four common causes: (1) direct contact with un-insulated electric wire; (2) contact of operated cranes with overhead lines; (3) materials contact with electric wire; and (4) caught of ladders in overhead lines. In addition, electric discharge from high-voltage cables and electric leaks from defective hand tools also caused fatal accidents. Many construction workers (especially unskilled workers) often disregarded the restricted areas of high-voltage cables when working nearby and this resulted in high rate of deaths due to electric discharge. Besides, around the restricted areas, there are neither warning signs, barriers, nor fences. These electric shocks could be avoided if electric restricted areas are completely isolated and hand tools are properly maintained.

The third prevailing cause of fatal accidents is “caught in/between objects, excavations, structures, etc” (1.1%). It was found that the major causes were unsafe construction procedures and violation of safety regulations (excavation without talus, lack of shoring system to support the sides of the trench, improper formwork removals, etc.). It is interesting to point out that most of this type of fatal accidents occurred in mobile construction groups. Due to lack of safety training, some construction workers may not act professionally when being exposed to hazards.

Major causes of fatal accidents are identified based on the Accident Root Cause Tracing Model (ARCTM) [1] that was developed by Abdelhamid and Everett. According to this model, a labor accident is caused by one or more of following three root causes: (1) Failing to identify unsafe conditions that existed before an activity was started or that developed after an activity was started; (2) Deciding to proceed with a work activity after worker identifies an existing unsafe condition; (3) Deciding to act unsafe regardless of initial conditions of the work environment.

The survey results (refer to Table 2) revealed that a mixture of the 1st and 2nd root causes was found as the most dominant root cause (60.4%) of fatal accidents, followed by the 1st root cause (38.5%) and the 2nd root cause (1.1%). The main reason for the occurrence of the 1st and 2nd root causes could be that a large number of construction workers had a low-level education and had never been in a formal safety training, thus neither completely understanding nor being able to predict the possible causes of fatal accidents.

In effect, the results indicated that the lack of training was a critical factor behind fatal accidents (53.8%), followed by poor management procedure (35.2%) and negative attitudes of workers towards safety performance (11%). As a result, in order to minimize the rate of fatal accidents, training workers in fundamental safety under an appropriate accident prevention program should be compulsory in construction companies. Also, the management procedure should be periodically updated and properly improved in accordance with current construction methods.

Table 2. Fatal Accident Rate versus Root Causes and Others

Variable	Description	Frequency	Percent (%)
Root causes	The mixing between 1 st root cause and 2 nd root cause	55	60.4
	Failing to identify unsafe conditions (1 st root cause)	35	38.5
	Deciding to proceed with a work activity after worker identifies an existing unsafe condition (2 nd root cause)	1	1.1
	Deciding to act unsafe regardless of initial conditions of the work environment (3 rd root cause)	0	0
Others	Lack of training for workers	49	53.8
	Inadequate management procedures	32	35.2
	Inappropriate attitudes of workers on safety (e.g. disregard safety codes)	10	11.0

In order to avoid fatal accidents, there is a need to analyze conditions that may leads to the likelihood of the fatal accidents. For working conditions, the survey analyzed other work-related factors such as trades, labor contracts, and company ownerships to identify the rate of fatal accidents versus these factors.

- (i) **Trades:** A majority of masons (85.7%) and welders (80%) were dead due to falling from heights. Meanwhile, most of electricians were dead due to both of falling from heights (45.5%) and electric shock (45.5%). It is likely that unsafe platform and scaffolding, unsafe postures, hazardous methods, lack of PPE, and deficiency of safety nets as well as safety belts are the main causes for falling of persons from elevations.
- (ii) **Labor Contracts and Unskilled Workers:** The findings indicate that, 46.5% of dead workers had no labor contracts and they were between 21 and 30 years old. Without a formal labor contract, construction workers might not be properly supervised and protected when performing heavy or dangerous works. It was also found that 74.6% of dead workers were unskilled workers and had no labor contracts. In effect, many unskilled workers were employed in construction companies because the employers wanted to dodge payments for social security of workers, thus saving the overall costs. Moreover, it was found that 80% of dead workers having contracts did not have length of service more than 6

months. This implies that work training and experience should be one of the most important factors to ensure safety in construction projects.

- (iii) **State-Owned Companies:** The survey also shows that more fatal accidents (54.9%) occurred in state-owned companies than in other organizations (Table 3). This can be explained that state-owned companies usually won more large construction contracts than others did, and they often subcontracted the job to smaller companies which tend to hire many unskilled workers for low pay. High concentration of unskilled workers is a major reason for potential fatal accidents

Table 3. Fatal Accident Rate versus Types of Construction Firms and Labor Contracts

Variable	Description	Frequency	Percent (%)
Types of construction firms	State-owned companies	50	54.9
	Private companies	27	29.7
	Mobile construction groups	13	14.3
	Joint venture companies	1	1.1
Types of the labor contracts	No labor contracts	71	78.0
	Long-term labor contracts	11	12.1
	One-year labor contracts	8	8.8
	Six-month labor contracts	1	1.1

5. Limitations

The current study has been conducted with a certain limitations, and its scope should be extended so that the research outcomes will be achieved with a high reliability. The first limitation concerns the size of the survey sample, in which only 91 cases of fatal incidents were collected. The limited number of cases may not reflect the actual construction safety issues as a large scope revealing more significant cases would yield a more comprehensive result. Second, the fatal accident data used for this study were collected from a record for a short length of time (1996-2005). The period of data collection should be extended as the survey is a work in progress and it should be steadily updated to incorporate new possibilities of accident occurrences. Finally, data used for this survey were collected from construction companies mainly located in HCMC, therefore it may not represent a common situation on construction safety for the entire country.

6. Conclusion

In conclusion, the rate of fatal accidents has highly increased in the construction sites in Vietnam. As a consequence, it is needed to identify and understand the major causes of these accidents before establishing an effective prevention program. This is also the major objectives of the study that has been recently conducted with the selected construction sites in HCMC, Vietnam.

The data was collected through structured questionnaire and interviews with foremen, field engineers, and on-site construction managers. The research results revealed different major

causes that led to fatal accidents in the construction industry in Vietnam. The major factors include non-experience/training, young ages, unsafe working conditions, unsafe actions, and working times/seasons. The research resulted in most common types of fatal accidents in construction sites: “fall of persons”, “electric shock” and “caught in/between objects”. Hazardous construction procedures, insufficient supports and guards, and poor housekeeping are the three most commonly unsafe conditions. The results of this research also reveal four typical unsafe actions which are failure to use/wear PPE, using unsafe construction procedures, disregard prescribed construction procedures, and psychology factors such as distraction, quarrelling, teasing, and abusing. In summary, “failing to identify unsafe conditions that existed before an activity was started or that developed after an activity was started” and “deciding to proceed with a work activity after worker identifies an existing unsafe condition” are main root causes of fatal accidents. The survey also examined the frequency of fatal accidents versus other work-related factors such as trades, labor contracts, and company’s ownerships. It was shown that accidents tended to occur in state-owned companies and involved with masonry/welding people and workers without labor contracts. The results also indicate that lack of worker training and poor safety management procedures are the main problems behind fatal accidents.

Finally, the major factors identified from the survey should be used to establish a checklist to prevent accidents in construction projects. The checklist should be developed as a part of a safety-management program that needs to be implemented at all levels of staff in construction firms. More future studies on safety for the Vietnam construction industry need to be accomplished before achieving effective preventive program. These studies probably include a nationwide survey on construction injuries, an evaluation of the impacts of fatal accidents on the overall construction cost, and a revision/update of the Vietnam Labor Codes/Regulations.

References

- [1] **Abdelhamid, T.S., Everett, J.G. (2000)**. “Identifying root causes of construction accidents”. *J., Constr. Eng. and Manage., ASCE*, 126, 67 – 71.
- [2] **Davies, V.J., Tomasin, K. (1996)**. “Construction Safety Handbook”. Thomas Telford Publishing, London.
- [3] **Desai, K.G. (1988)**. “Construction Safety Management” (Vaid, K.N., editor). National Institute of Construction Management and Research Press, Bombay, p.126.
- [4] **Hinze, J. (1978)**. “Turnover, new workers and safety”. *J. of Constr. Div., ASCE*, 104, 409-417.
- [5] **Hinze, J. (1981)**. “Human aspects of construction safety”. *J. of Constr. Div., ASCE*, 107, 61 – 72.
- [6] **Hinze, J., Appelgate, L.L. (1991)**. “Costs of construction injuries”. *Journal of Constr. Eng. and Manage., ASCE*, 117, 537 – 550.

- [7] **Hinze, J., Russell, D.B. (1995).** “Analysis of fatalities recorded by OSHA”. J., Constr. Eng. and Manage., ASCE, 121, 209 – 213.
- [8] **Hinze^b, J. W. (1997).** “Construction Safety”. Prentice Hall Inc, NewJersey.
- [9] **Hinze, J., Pedersen, C., Fredley, J. (1998).** “Identifying root causes of construction injuries”. J., Constr. Eng. and Manage., ASCE, 124, 67 – 71.
- [10] **Janadi, O.A., Bu-Khamsin, M.S. (2002).** “Safety factors considered by industrial contractors in Arabia”. J. of Building and Environment, 37, 539 – 547.
- [11] **Jaselskis, E., Suazo, G.A.R. (1994).** “A survey of construction site safety in Honduras”. Journal of Constr. Manage. and Econom., 12, 245-255.
- [12] **Koehn, E., Kothari, R.K., Pan, C. (1995).** “Safety in developing countries: Professional and bureaucratic problems”. J., Constr. Eng. and Manage., ASCE, 121, 261 – 272.
- [13] **Malhotra, M.K. (1988).** “Safety Legislation in the Construction Industry”. In: Construction Safety Management (Vaid, K.N. editor). National Institute of Construction Management and Research Press, Bombay.
- [14] **Nishigaki, S., Vavrin, J., Kano, N., Haga, T., Kunz, J.C., and Law, K. (1994).** “Humanware, human error, and Hiyari-Hat: A template of unsafe symptoms”. J., Constr. Eng. and Manage., ASCE, 120, 421 – 442.
- [15] **Plumbe, W.J.C. (1969).** “Accident Prevention on the Construction Industry”. In: Conference of Safety on Construction Sites. The Institution of Civil Engineers, London.
- [16] **Sawacha, E., Naoum, S., Fong, D. (1999).** “Factor effecting safety performance of construction sites”. Int. J. of Project Manage., 17, 309-315.
- [17] **Suraji, A., Duff, A. R. (2001).** “Development of causal model of construction accident causation”. J., Constr. Eng. and Manage., ASCE, 127, 337 – 344.
- [18] **Trinh, T.V. (1999).** “Research Solutions to Secure Labor Safety for Construction Workers, Compiled Introductions about Labor Safety”. In: Research Report of the Vietnamese Research Institute of Labor Safety and Ergonomics in Ho Chi Minh City (in Vietnamese).