

# HAZARD EVALUATION OF WORK TYPES FOR BUILDING CONSTRUCTION

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**ABSTRACT:** As the scale of building construction is larger and more complex and the adaptation of new technology is increasing, the tendency of the risk serious accident cases is increasing now. Especially, the accident rate is below 10% at the building construction workers in Korea but among the total industrial accidents it exceeded by 35%. To prevent a construction accident, it is essential that not only to have a through grasp of the characteristic of safety problem but also to establish of efficient safety counter plan are required. According to the type and situation of building construction, the acquirement of necessary information is useful to prevent the hazard of work and establish the counter plan. Among the safety information it is a thing of especial importance that to estimate the hazard of work types for building construction to prepare the counter plan of safety. This study will analyze all of the 1600 accidents of the building construction works from the data of KOSHA(Korea Occupational Safety & Health Agency) which were collected during 11 years(1992~2002) data relating to serious accidents of the building construction works, and suggest the counter plan according to the each work type in building construction works.

*Key words : hazard, construction safety, safety management*

## 1. INTRODUCTION

Once look into current aspect of building construction safety, the project scale is much higher, larger and complex by applying new method and new technology. In this situation the hazard is increasing now because quantities of construction and restrict conditions are expanded. Therefore many studies on the safety management of building construction are executed on the side of hazard management method such as fuzzy theory, development of safety management model and computation of hazard cause and on the side of the hazard analysis method such as Sensitivity Analysis, Monte Carlo Simulation, Influence Diagram, Decision Tree, and Analysis Hierarchy Progress. But in spite of these study and effort, the accident ratio does not view the decline aspect. The reason is thought that the ground matching appliance of this hazard analysis and management method are insufficient. Therefore it is need urgently making the effective safety management method on the aspect of prevention and appliance on the ground. Among the safety information that is used for the prevention of construction hazard, the very strong and stimulus element is the information about previous accident cases.

Especially previous accident cases that having similarity with the scheduled work enable us to forecast the hazard and establish safety counter plan by offering the strong information about safety management. Namely it is need

evaluation of hazard that suitable for the possibility and forecast the shape of accident because accidents of building construction is occurred on account of complex cause which is chained many dangerous elements. So it is very useful for prevention of accident and establish counter plan that hazard evaluation of work types for building construction according to the hazard occurring ratio because it enable us to obtain the safety information.

This study aims to analyze the accident instances for 11 year (1992~2002) of Korea and present quantitative hazard evaluation according to work types of building construction for effective safety management. .

## 2. HAZARD EVALUATION OF BUILDING CONSTRUCTION

### 2.1 Hazard Probability

Hazard probability means that occurring probabilities caused in danger, and enable us to divide accident frequency into various categories and make the safety management counter plan by offering grasp the work type that accident is occurred strongly. Table 1 is the probability division of danger generation and defined to the 5-step. But the item used at this definition defines single element and system, and the inventory defines many kinds of item and system.

**Table 1.** A grade according to hazard occurrence probability

Diction	Grade	Occurrence Situation	
		Item	Inventory
Frequent	A	Occurred frequently	Experienced repeatedly
Probable	B	Occurred frequently on the work	Occurred frequently
Occasional	C	Occurred occasionally on the work	Occurred occasionally
Remote	D	It seems to be nonexistence but occurred on the work little	It seems to be nonexistence but the probability exist highly
Improbable	E	It is assumed that not experience accident but hazard is exist	It seems to be nonexistence but the probability is exist little

## 2.2 Hazard evaluation of building construction

This study analyzed the hazard probability for hazard evaluation about 22 types of building construction by using 1635 statistical instances of building construction accident which is collected from 1992 to 2002 at Korea Occupational Safety Health Agency. Namely averages cases of serious accident can be presented to 149 cases because of 1635 cases are collected for 11 years. This study assumed that the occurrence probability of remote (grade D) ratio is below 0.7% according to table 5 because probability of 1 accident instance is below 0.7% among 149 serious accident cases. And on the assumption that 148 accidents occurs every year, this study assumed that the occurrence probability of occasional (grade C) ratio is '0.7%~4%' because 1 accident instance is occurred for 2 months (4%). Also this study assumed that the occurrence probability of probable (grade B) ratio is '4%~8.1%' because the probability of monthly occurrence ratio is 8.1%, and the occurrence probability of frequent (grade A) ratio is upper 4%. Therefore it is divided on the side of grade according to occurrence type division table.

**Table 2.** Definition of the range about hazard occurrence probability

Grade	Normal Division	Quantitative Division
A	Frequent	upward 8.1%
B	Probable	4% ~ 8.1%
C	Occasional	0.7% ~ 4%
D	Remote	below 0.7%
E	Improbable	non-occur

The calculation of occurrence probability grade for the hazard is presented like form 1. Form 1 means the data of the occupied portion among the total accidents at the building construction. Also the hazard grade is presented

like table 2 according to this calculation.

## 2.3 Hazard occurrence Analysis of building construction

The quantities of accident for work types of building construction is researched according to quantity that temporary installation work (190), steel frame work (180) and form work (285). Table 3 is a fixed quantity presentation about accident ratio of 22 types for building construction as a frequency division in the basis of hazard analysis document for definition of the hazard occurrence probability range.

**Table 3.** Analysis of hazard occurrence probability according to big work types for building construction

	Work types division	Quantity	Probability (100%)	Grade
B U I L D I N G  C O N S T R U C T I O N	temporary installation work	190	11.6	A
	earth and foundation work	100	6.1	B
	steel frame work	180	11.0	A
	form work	285	17.4	A
	steel bar work	53	3.2	C
	concrete work	90	5.5	B
	waterproof work	27	1.7	C
	masonry work	34	2.0	C
	mortar and tile work	88	5.4	B
	stone and wall work	115	7.0	B
	glass and window work	38	2.3	C
	embellishment and metal work	16	1.0	C
	E/V work	42	2.6	C
	paint work	60	3.7	C
	facility work	103	6.3	B
	electric work	39	2.4	C
	curtain wall work	3	0.2	D
	insulation work	7	0.5	D
	break work	21	1.3	C
	lift work	75	4.6	B
	movement beyond work	33	2.0	C
	etc.	36	2.2	C
Total		1,635	100	

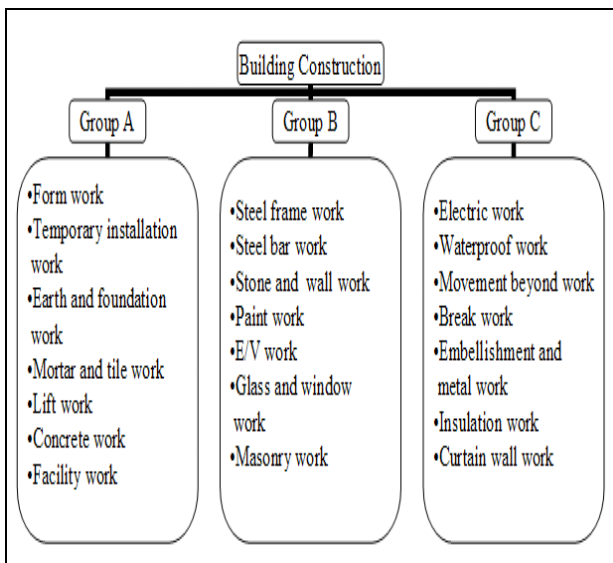
Once divide hazard occurrence probability according to accident cases of work types for building construction like this, temporary installation work, steel frame work and form work are researched that accident occurrence probability is high because they occupied 10% ratio among total construction accident.

Table 4 is a presentation that works types for building construction according to grade of hazard occurrence probability.

**Table 4.** hazard occurrence probability according to work types for building construction

Probability Construction	A (Frequent)	B (Probable)	C (Occasional)	D (Remote)	E (Improbable)
Building Construction	<ul style="list-style-type: none"> <li>• form work</li> <li>• temporary installation work</li> <li>• steel frame work</li> </ul>	<ul style="list-style-type: none"> <li>• stone and wall work</li> <li>• facility work</li> <li>• earth and foundation work</li> <li>• concrete work</li> <li>• mortar and tile work</li> <li>• lift work</li> </ul>	<ul style="list-style-type: none"> <li>• paint work</li> <li>• steel bar work</li> <li>• E/V work</li> <li>• electric work</li> <li>• glass and window work</li> <li>• etc. work</li> <li>• masonry work</li> <li>• movement beyond work</li> <li>• waterproof work</li> <li>• break work</li> <li>• embellishment and metal work</li> </ul>	<ul style="list-style-type: none"> <li>• insulation work</li> <li>• curtain wall work</li> </ul>	
Total	3	6	11	2	

**2.4 Survey and Analysis of determination of hazard according to work types for building construction**



**Figure1.** Classification according to work types for building construction

Figure 1 shows classification of 22 work types into 3 groups. This picture is made for understanding hazard according to work types for building construction. Follow the "Case Study of Important Accident for 11years", that was made by Korea Occupational Safety & Health Agency, 21 work types from 22 work types of building construction omitting the others work are divided into 3 groups. By an important accident cases 3 groups which are classified with

subject it executed a question investigation in construction sites and the construction safety specialists. Actual construction sites and the specialists regarding the construction each work type what kind of think, it did the hazard question which it investigates. It analyzed the question of 21 things which except on the question of 8 things where the consistency falls from in 29 question paper taking back.

Reclassification it did again in the group which is new to be classified with the ABC group at occurrence frequency order by the frequency occurs from actual experience or site knowledge or the safety management. Table 5 shows how many times they answer about disaster occurrence danger and to arrange an occurrence frequency. This table shows the risk work type that comes from the important disaster instant report of 11 years and the question investigation against the risk of each work type which is reflected the experience of the construction specialists. The result which analyzes a important disaster instance, it appears with the fact that the steel-frame work is most dangerous and then form construction, temporary installation construction, lift work, stone and wall construction, elevator construction, break construction, concrete construction, steel bar construction, curtain-wall construction, earth & foundation construction, mortar and tile construction, facility construction, glass & window work, movement beyond construction, electric construction, waterproof construction, embellishment and metal construction, paint construction, insulation construction, and masonry construction.

**Table 5.** Hazard ranking according to question

Work type	Danger ranking	Response	Response frequency (%)	Group
steel frame work	1	21	10.5	Group A
form work	2	20	10.0	
temporary installation work	2	20	10.0	
lift work	4	16	8.0	
stone and wall work	5	14	7.0	
E/V work	5	14	7.0	
break work	5	14	7.0	
concrete work	8	10	5.0	
steel bar work	8	10	5.0	
curtain wall work	10	8	4.0	
Earth and foundation work	11	7	3.5	Group B
mortar and tile work	11	7	3.5	
facility work	11	7	3.5	
glass and window work	14	6	3.0	
movement beyond work	15	5	2.5	Group C
electric work	16	4	2.0	
waterproof work	16	4	2.0	
embellishment and metal work	16	4	2.0	
paint work	19	3	1.5	
insulation work	19	3	1.5	
masonry work	19	3	1.5	
Total		200	100	

### 2.5 Hazard according to work types for building construction.

The ranking of Hazard according to work types for building construction which it follows with the important 1635 accident cases analysis is below Table 6. Also Table 6 presents the Hazard according to Question investigation of the construction specialist manager. With this by 2 methods together it follows each public classification hazard of the building construction which is analyzed in dangerous degree and it follows hold it does in each hazard ranking and many specific gravity. Hazard of analysis of accident cases and analysis of specialist question is similar generally at the each work type. Namely, the matrix construction which is the first dangerous ranking of accident cases analysis appeared with the second danger from question analysis of the specialists. Consequently, hazard according to work types for building construction is judged propriety by the question of work type analysis due to accident cases and the specialists.

**Table 6.** Analyzed hazard according to work types for building construction

Hazard ranking	hazard according to accident cases	Hazard according to analysis of question
1	form work	steel frame work
2	temporary installation work	form work
3	steel frame work	temporary installation work
4	stone and wall work	lift work
5	earth and foundation work	stone and wall work
6	facility work	E/V work
7	concrete work	break work
8	mortar and tile work	concrete work
9	lift work	steel bar work
10	paint work	curtain wall work
11	steel bar work	earth and foundation work
12	E/V work	mortar and tile work
13	electric work	facility work
14	glass and window work	glass and window work
15	etc.	movement beyond work
16	masonry work	electric work
17	movement beyond work	waterproof work
18	waterproof work	embellishment and metal work
19	break work	paint work
20	embellishment and metal work	insulation work
21	insulation work	masonry work
22	curtain wall work	

### 3. CONCLUSION

Considering that the risk degree of the important accident cases become increasing according that the scale of the building is larger and more complicated than before, this study analyzes the report of the important accident cases for the last eleven years, in order to show the base data for the construction safety management counter plan and supervision, and compute the risk of the building construction's each work type by the analysis of the accident cases and the survey of the construction manager.

Therefore the result of this study is as follows.

1) As of the risk probability of work types by the analysis of the accident cases and the survey of the construction manager, the work types classify and present.

2) As a result of analyzing Korea Occupational Safety and Health Agency the disaster of each work type, the occurrence probability shows that the form work is 17.4%, the temporary installation work is 11.6% and the steel-frame work is 11.0%. This probability is graded 'A' for that the

standard capacity probability yardstick of the danger is over 8.1%.

3) As a result of numerically expressed the occurrence probability, the accident incidence of preparatory work process is 29.0%

4) As a result of conducting a survey of the construction site and the construction security manager on the hazard according to work types for building construction, the steel-frame work is ranked as the 1st. Next orders are the form work, the temporary installation work, and the lifting work. It is different of analyzing the important accident cases.

5) As a result of considering and comparing the hazard according to work types for building construction, the analysis of the accident cases and the survey of the construction manager generally coincides with the hazard ranking. So it is adequate for the analysis of the hazard.

This study is based on the original analysis of the disaster cases and the survey of the construction manager. And as a result of this study it is thought that contribution is possible in the aspect of prevention for accident by applying to similar type of the building construction such as Green Building.

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