

A Case Study on Safety Assessment of Construction Project

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Abstract. Construction industry plays a vital role in the economic development of any country. As construction industry is less mechanized and more labor intensive, construction workers are backbone of this industry. So the major consideration is ensuring workers safety during construction. This paper is aimed to examine the current safety status and identify the main causes of not practicing safety rules in the construction sites in Bangladesh. The study was conducted in three stages. Firstly the existing rules and regulations of construction safety were studied. Secondly physical survey was conducted among the ongoing construction sites. Thirdly factors that influence the safety performance in construction sites were identified by conducting questionnaire survey and ranked based on Factor Index (FI). This study found 20 major causes those affect the construction safety performance at job site. According to the physical survey data, it was obvious that workers were working without PPE and fall protective system. From the data analysis, the main cause of not practicing safety rules are lack of enforcement of safety rules and regulations, lack of safety awareness among the construction stakeholder and lack of safety training. The survey results may help the authorities to increase the awareness of safety and enforce the construction safety rules in the next project approach.

Keywords: Construction industry, BNBC, BLA, safety performance, PPE, factor index

1. Introduction

Construction industry is considered as one of the most dominating sources of economic growth and development of any country (Berardi, 2017). It also have a great contribute to the Bangladesh national economy (Ahmed, Hoque, Islam, & Hossain, 2018). Construction involves a little percentage of the overall

workforce. But it is regarded as the most hazardous industry due to its unique nature and the safety record of building construction industry has always been poor (Friend & Kohn, 2018; Hollnagel, 2018; Kibert, 2016). Within many business developments sector construction industry is one of the largest and rapidly growing industrial sectors. This industry is considered as the most dangerous industry in recent year (Guo, Yu, & Skitmore, 2017). The incidence rate for both fatal and non-fatal accidents causing death, injuries and illnesses exceeds that of numerous different enterprises. At least 108 thousand workers are killed on site every year, which represents about 30% of all occupational deaths (Bourmpoula, Kapsos, & Pasteels, 2015). The risks are 3 to 6 times more likely than any other occupation (ILO, 2015). More than 26,000 U.S. construction workers in the past two decades have died at work. That equates that every working day five construction worker deaths approximately (Kabir, Watson, & Somaratna, 2018). Of these fatalities, 40% involved incidents related to falls from height (Ahmed, Islam, Hoque, & Hossain, 2018; Zhang, Teizer, Lee, Eastman, & Venugopal, 2013). Being a developing country construction industry is growing rapidly in Bangladesh. It represents 7.6 percent of Bangladesh's gross domestic product (GDP) and employs more than 3.3 million people (BBS, 2018). There are more than a thousand companies in Bangladesh who are involved in the construction business (Dewri, Amin, Sen, & Faridi, 2012). But in Bangladesh safety management issues are characterized as a very poor rate. From the literature review of this study it is clear that more than 800 death is occurred in construction sites during the phase of 2008 to 2013 (JAMAL, 2015). In Bangladesh more than 40% workers die due the falling from height. In the case of accident construction industry could have been in highest position, but the accidents occurred in Rana Plaza during 2013 had resulted in 1331 deaths (JAMAL, 2015). As a result the fatalities rate of workers in garments sector is the highest position. If we skip the fatalities rate in garments sector, construction industry is placed in highest rank. So the author wants to find out what are the

actual onsite scenario and what are the reasons behind the labor death or injury in construction sites in Bangladesh.

The prime objectives of this study are as follows:

To investigate the current safety status in building construction in Bangladesh.

To analyze the safety factors those influence the safety performance in construction sites.

2. Methodology

In order to find out the actual scenario of the workers safety, a broad literature review was conducted from published and unpublished documents, newspapers, internet, journals, articles, reports, newsletters, and OSHE (Bangladesh Occupational Safety, Health and Environment Foundation) statistics. At the same time existing rules and regulations about construction safety in Bangladesh were studied. Then the questionnaire was designed from the gathered information and survey was conducted among different construction sites. After that the major causes were ranked based on factor index.

2.1. Questionnaire Design

There are 20 factors were selected from literature review and experts opinion which may cause the fatalities in construction sites. A well-structured close-ended questionnaire was designed in order to gather information from building construction sites in Bangladesh. The questionnaire was designed in such a way that there was no biasness. In most cases, the respondents (the contractor, engineers, project managers and the workers) were used to answer with respect to four points of scaling. So the conventional four points scaling were selected to design the questionnaire:

- Very important or very serious effect (4 points)
- Important or serious effect (3 points)
- Moderate important or moderate effect (2 points)

- Least important or least effect (1 point)
- No effect (0 point)

2.2. Data Collection and Analysis

The engineers, contractors, project managers and labors were included in this survey. The opinion of university teacher related to construction field was also included here. The questions were thrown in separately within the worker as well as engineer, project manager and contractor. Among 100 copy of questionnaire, the total 67 respondent's data were observed. At the time of the whole survey various complications and impediments were faced. Although the worker and engineer were shown their willingness to give the answer of the question, the contractor, project manager and related person of contractors were shown unwillingness to take part in the survey. Some on-going construction sites were visited physically so that the given data from construction stakeholder could be checked in accordance with the actual evidence present in the sites.

This section includes the preferences of respondents on main factors influencing safety management on construction sites. The data was analysed by using the following formula:

$$TWV = \sum_{i=1}^4 P_i V_i$$

(1)

Where, TWV = the total weight value; P_i = the number of respondents rating the safety factors; V_i = the weight assigned to each factor i .

The factor index (FI) for each factor was derived by dividing TWV by the number of respondents (n) and the mean of FI was also determined by the following equation:

$$FI = \sum_{i=1}^4 \frac{P_i V_i}{n}$$

(2)

Then the mean of factor index (μ) was calculated and deviation was found by using the following equation:

$$\text{Deviation} = (FI - \mu)^2 \quad (3)$$

In the case of ranking the factor index was used and the maximum value of factor index was considered as 1st and gradually decreasing the rank respectively.

3. Results and Discussions

3.1 Physical Survey Results

To assess the real scenario on the question of construction safety, the physical survey was conducted in different construction sites in Bangladesh.



Fig. 1: Labor working without any fall protective guardrail system.

From figure 1 it is shown that the labors are working without any fall protective tools. According to the BNBC (Bangladesh National Building Code)-2006, the slab must be guarded against falling. Not only the slab but also any opening in walls, slabs as well as edge of the slab and staircases must be guarded against falling. But the actual scenario during construction does not satisfy the labour safety regulations. As a result the proximity of fatalities is increasing day by day.



Fig. 2: Worker working without safety boots, hand gloves, head protection.

From the figure 2, it is clear that the labors are working without hand gloves, safety boots. According to the BNBC-2006, the area where personal protective equipment are necessary must be used. In this figure the necessity of boots, hand gloves are essential, but no uses was found during construction. The labors were asked why they were not using boots, hand gloves. The answer was that they were not provided by contractor. The working environment does not satisfy the BNBC. As a result the workers are facing skin diseases.



Fig. 3: Labour working without hand gloves, eye protective tools during painting & cutting.



Fig. 4: Labor working without protective measures during bending rod & cutting wood

When we conducted the physical survey, it was observed that the workers were painting and cutting tiles without eye protective equipment, gloves and respiratory protection which is shown in figure 3, figure 4. In spite of having the regulation for eye protection for labor, the contractor violates the rules which are against the BNBC. Impact hazards include flying objects such as chips, fragments, particles, sand and dirt. These hazards typically result from tasks like chipping, grinding, machining, masonry work, wood-working, sawing, drilling, chiseling, powered fastening, riveting and sanding. These objects or sparks are usually very small but can cause serious eye damage such as punctures, abrasions and contusions.

In the case of stair and lift, it is essential that the protection against falling must be needed according the BNBC-2006. But the observation resulted that there was no fall protective measurement during construction which is shown in figure 5. It was observed that the safety belt was provided by contractor but workers were not using during lift installation. As a result workers and other related person of construction may experience in hazard. How safety rules are avoided in the construction project in shown in figure 5 and figure 6 in the stair and lift core section.



Fig. 5: Unprotected lift core and staircase



Fig. 6: Working environment without fall protective system and safety belt was provided which was not used.

According to the figure 7 it is clear that the workers are working without helmets, hand gloves which were not observed during physical survey. Eye protection system is very poor. But the BNBC says that the proper safety measurement is needed during lift installation. Physical survey showed that the contractor violates the building construction regulation. Having no skin protection, eye protection, the sparking resulting from welding may harm the skin which may lead to skin cancer. As the intensity of light was very high, the eye may be damaged due to the lack of safety. Figure 8 shows the uncovered and unprotected hazardous materials with no safety measure that is the most crucial potential factor of influencing accident and fatalities in results.



Fig 7. Workers working without hand gloves, helmets and poor eye protection during welding in lift installation.



Fig. 8: Electrical wires and equipment are kept in hazardous condition.

The figure 8 shows that the electrical wires are kept randomly which may cause the electrocution. In our country more than 40% worker die due to electrocution. On the other hand the coil spreads spark which was uncovered. As a result the proximity of happening fatalities is increasing day by day.

3.2 Current construction safety status

After completing the physical survey during construction the workers were asked some question. 25 numbers of respondents were participated in this questionnaire. They were trying to say the actual scenario but sometimes they felt afraid. They were asked about the reason of fear. They answered that the source of income of their family was only labouring and they felt to loss their work if they would give the actual information. Some workers present in the onsite told that they were experienced small or large accident where they did not get the proper treatment and compensation. Even they were not allowed to take rest to recover from the injury.

Table 1: The main safety and facilities for workers which are not practicing at Bangladesh.

Item	Yes	No	Percent for not practicing
Pure water supply	20	5	20%
Clean and sanitary latrines	5	20	80%
Facilities of washing and bathing	17	8	32%
Availability of first aid box	0	25	100%
Secure covering and fencing of floor opening	0	25	100%
Head protection	0	25	100%
Foot protection	0	25	100%
Hand protection	0	25	100%
Eye protection	0	25	100%
Face protection	0	25	100%
Fall protection	0	25	100%

Ear protection	0	25	100%
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According to the BLA (Bangladesh Labour Act)-2006 and BNBC-2006, the facilities and safety which is mentioned in above for workers must be provided. But there was no application in practical field. From table 1 it is found that the personal protective equipment (PPE) is not practicing yet. This is the responsibility of contractor to provide the all safety equipment to the workers in order to build up a safe construction environment. The workers said the author that when the inspector came to visit the existing condition for reporting, they are only asked if any faults found or lack of accuracy. They also added that the inspector did not asked why they were not using boots, hand gloves, helmets etc. From the conversation they thought that inspector has lack of awareness about workers safety. In the case of pure water, washing, bathing, fencing floor opening, clean and sanitary latrines, the facilities were very poor which is mentioned in above.

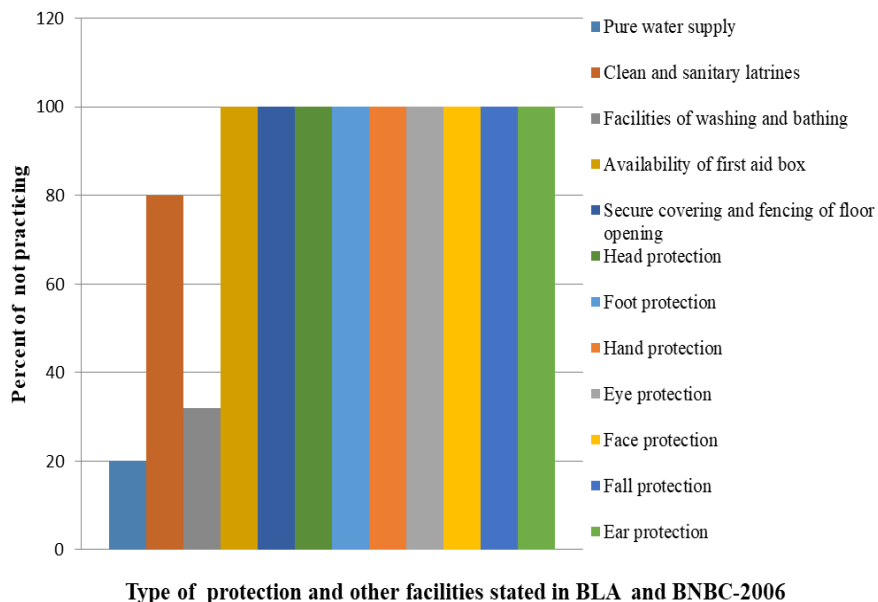


Fig. 9: Current safety status in construction sites at Bangladesh

3.3 Main reasons/factors that influence the safety performance

Now which are main reasons that influence safety performance which has been mentioned in figure 9 is a main issue. In order to find out the answer of this question the survey was conducted among workers, engineers, project managers and contractors in Bangladesh. Total 37 numbers of respondents participated in this survey and question was thrown to the respondents. Some participants tried to skip the main point but they were shown the legal evidence which were found from the qualitative survey. The main reason was then ranked based on the factor index.

Table 2: The main factors that influence construction safety performance at Bangladesh

Type of Safety Factors	TWV	FI	Rank	Mean Deviation	$(FI-\mu)^2$
Lack of attention of top management	150	4.054	8	0.345	0.119
Lack of personal care	147	3.972	9	0.263	0.069
Lack of safety awareness	171	4.621	2	0.912	0.831
Shortage of enforcement of safety regulations	175	4.729	1	1.02	1.04
Lack of safety training	169	4.567	3	0.858	0.736
Errors in scaffolding fixing	122	3.297	14	-0.412	0.169
Lack of coordination of top management	152	4.108	7	0.399	0.159
Shortage of safety sign	114	3.081	17	-0.628	0.394
Communication gap	107	2.891	19	-0.818	0.669
Errors in equipment	115	3.108	16	-0.601	0.361
Safety culture	166	4.486	4	0.777	0.603
Lack of budget for labor safety	164	4.432	5	0.723	0.522
Lack of expertise knowledge	135	3.648	11	-0.061	0.003
Errors in inspection	141	3.811	10	0.101	0.01
Lack of safety policy	117	3.162	15	-0.547	0.299

Lack of coordination between project participants	130	3.513	12	-0.196	0.038
Emphasize the temporary purposes	109	2.945	18	-0.764	0.583
Errors in decision making	95	2.567	20	-1.142	1.304
Contractor's proximity to gain excess profit	161	4.351	6	0.642	0.412
Lack of emergency steps	129	3.486	13	-0.223	0.049

The table 2 and figure 10 show the factor index of each factor. The main reasons of not practicing construction safety were identified based on factor index. The higher the factors index the higher the impact. According to the table 2 it is shown that the first and main reason of not practicing construction safety is the shortage of enforcement of safety regulation. In Bangladesh the whole responsibility to enforce the construction safety regulation according to BNBC 2006 is upon RAJUK (Capital Development Authority). But the lack of enforcement of safety rules and lack of punishment of contractor and owner turns the construction sites as more hazardous.

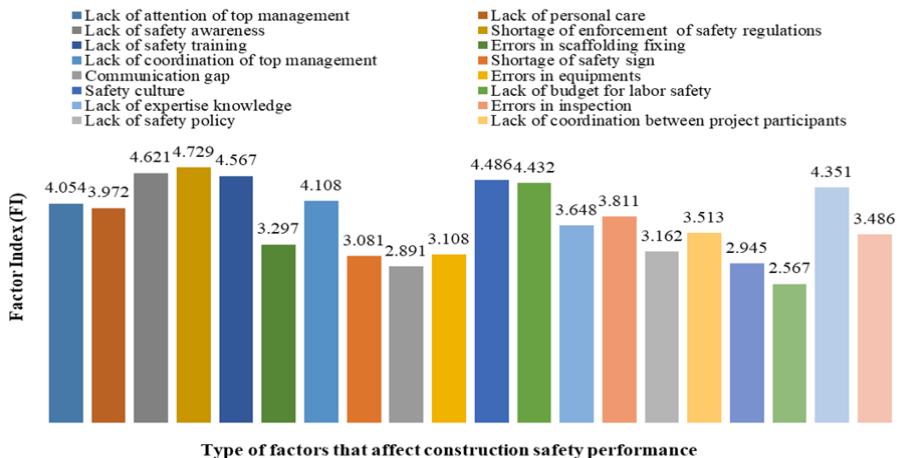


Fig. 10: Reasons for not practicing construction safety at Bangladesh

The second main reason is the lack of safety awareness among the top management, contractor as well as workers. Workers do not feel the necessity of

safety for their own. They do not aware what happen if the construction safety is absent. They do not understand about the fatalities in construction. As a result the number of fatalities is increasing tremendously. Not only the workers but also the contractor and top management are not aware about construction safety. The third main reason is the lack of safety training among the site manager, contractor's agent and workers. There is no safety policy, safety program and lack of onsite safety training. As a result workers cannot know the serious impact of accident and rate of construction fatalities is increasing.

4. Conclusions & Recommendations

Raising the standard of living of people is related to the development of a country. Without building infrastructures such as modern commercial and residential centres, this is not possible and hence construction industry has considered as a very dominating sector. The safety condition in the construction sites is comparatively poor which was found by the survey and this industry is experienced by high fatality rates due to negligence of safety issues.

The summary of results and discussion are as follows:

- Workers are not provided personal protective equipment (PPE) according to the data analysis and from physical survey.
- In the case of fall from height, there is no protective measurement for the workers. But the working environment is running in this way from the beginning.
- The main reason for not practicing safety rules are lack of enforcement of safety laws, lack of safety awareness among the construction stakeholder and lack of safety training respectively.

The recommendations that help the future studies are as follows:

- This survey was conducted at Bangladesh around five construction sites. The additional geographical area can be surveyed so that the result will be obtained more accurately.

- The correlation between construction stakeholder and causes of not practicing safety rules can be added as additional parameter.
- Other statistical tools such as SPSS can be tried for analysis to get a comparison of the results.

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