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Analysis of Scaffolding Safety in Construction Site and Preventive Actions for Implementation of Safety

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Abstract--- *The economy Construction industry is the second largest revenue generating industry next to agriculture in India, Most of the construction sites lack safety in construction One of several risky workstations includes the building sites. They consist of most risky works like lifting material, scaffolding for working at heights. Major cause of accidents at these sites for any workforces is doing hazardous jobs. Most of the accidents are happening because of unsafe acts and falling from heights at construction work places. Construction industry depends on massive labour forces in India and this industry seldom follows the safety policies laid by the government. The workforces do not know the dangers of construction sites since safety procedures are not followed properly and observed constantly. Accidents and incidents and injuries are high since the awareness of risk involved is not known by the employees. Rules and regulations of safety are not trained well and followed. In this paper a survey is taken on the management of safety in construction industries. Questionnaire is framed for industries to cover different levels of workforces. This study is concentrated specifically the issues related to scaffolding. Outcomes of the questionnaire surveys are worked for four different construction sites. Safety was educated to workforces through training programmes related to scaffolding. Understanding ability of the workers were collected previously and subsequently at the end of the program of training and outcomes got were exposed to statistical analysis to the learning program.*

Keywords--- *Scaffolding in Constructions, Scaffolding Safety, Safety Questionnaire.*

I. INTRODUCTION

Highlight We are aware that falling from heights while working in multi-storeyed or single storied is principal cause for construction industrial labour for minor or major accidents and accounting for major fatalities in construction sites all the time. Scaffolding is the major cause of accidents causing construction worker fatalities. When examined for fatalities in work sites of 359 in 2014, about 16% of fatalities were from faults of scaffolds. Most of the high rise building workers is performing work in heights on scaffolding. Specifically many workers working on heights of scaffolds are possibly unprotected to a many risks such as sudden falling, electrocutions and exposed to dropping items. OSHA assess that majority of all construction labourers perform most of work on scaffolds all the time.

There are always more chances for major and minor accidents to happen in a construction working place. There are many influencing causes to occur such accidents. To know the reasons and influencing factors for accidents in construction industry the study of 177 accidents is taken as analysed by the author (A Hoaet al 2017). Investigation of a set of accidents in scaffolding is taken for finding reasons for fatalities. There are three major factors influencing.

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They are technical, human causes and organisational causes. It is observed that 50% of the cases were due to organisational errors. Remaining cases are due to human and technical causes. In all these cases of three reasons cases are analysed carefully for reasons for all the cases. Significant causes are identified for all the cases of accidents. Most of the cases bear the reason involving scaffolding (A Hoaet al 2017)

For the continuous working of construction industry safety is important and to prevent accidents and to protect existence of work force in construction industry. Due to inadequate or absence of safety put into practice, different stages of accidents from minor and major injuries are finally leading to death happening (Solís-carcaño and Arcudia-abad, 2013; Fung et al., 2010). So to reduce on-site work accidents the significant control steps are necessary for the associated hazard identification (Rozenfeld et al., 2010).

A safety analysis is conducted in the building of construction sites at Coimbatore of Tamil Nadu based on the questionnaire survey consisting of twenty six features of safety for the workforce of 315 members at various levels. The outcomes of the survey are useful for further action like training on safety for improving safety in construction industries. Knowledge base such as training for safety, health and environment of work force at construction site is the prime motive. The safety training consists of two sets of questionnaires prepared. Questionnaires are hand outs of self-instructional elements useful to teach 315 members of the industries. One was distributed before and one after the education of safety program which were used to assess the knowledge increased by workers through a statistical test tool.

II. METHODOLOGY

As For this study, the scaffolding safety management system of site chosen for study includes non-technical or administrative organisation system and technical category management system. Literature survey is useful in deciding questionnaires and general observation of risk evaluations in construction workplaces. a questionnaire in its related field with health, administration and technical like scaffolding questions totaling to 16 questions. The questions of safety training to improve safety system include working criterions of workforce, strength and personnel and other place hygiene, personal safety devices, and risk finding factors, and safety of labours and the other factors under technical which are scaffolding firmness, security part of, scaffolding access, scaffolding height and width.

Table 1: Questionnaire for the Workers Working at Site

1	Is Scaffold erection coordinated by a competent person
2	Scaffold constructed & maintained according to certified engineered specifications and drawings.
3	Scaffold components are secured tightly and enough present.
4	Competent person in charge of erection/inspection?
5	Has the scaffold been inspected before each use (i.e., green tag and red tag system)?
6	Platform planking tied down securely.
7	Is the spacing of 2.4 meters and 3.0 meters for heavy and light duty purposes in planking area maintained.
8	Distinct ladders being used for climbing up and down the scaffold.
9	Cautionary devices/sign boards fixed over walking areas or road connections (blinking lights, reflective ribbons, or area is protected off).
10	Is provisions are made clearance from power cables as per requirement of Safety Legislation.
11	Use of helmet secured by adequately tightening the ratchet and chin-strap
12	No use of mobile when working at height
13	Checks for edge hard barrigation (if not available highlights to supervisor about the unsafe condition)
14	No throwing/ dropping of material from height
15	Is the scaffold height greater than three times its minimum base width?
16	Are the platforms at least a nominal width of 50 cm (20 inches)?

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The booklet of the questionnaire was prepared for the construction site at Coimbatore. Most of the questions were of yes or no type. The questions were a “yes” or “no” type and the counting of yes and no were stepped for analysis work.

III. SAFETY TRAINING FOR WORKERS FOR SCAFFOLDING SAFETY

Because The use of safety instruction program was done through a method of good safety methods. A self-teaching learning instruction of safety training is distributed for the staff starting from manager to labour levels. Analysis of the data of workers was evaluated. The result of the data revealed that the awareness to safety was poor and not up to the mark. There are more no of negative correlation values in Table2. This predicts the safety awareness is lacking. So a need arisen to educate the workforce on safety on scaffolding. So a module was prepared very relevant for improving safety of workforce. This includes general worker safety, and safety of scaffolding environment. This module will be useful in educating the workers how to be safely involving themselves free from accidents and how to work on scaffolding especially in construction industry and in general to know awareness about safety at heights also for the workers. One of construction sites, which scored the least score were selected and 315 workers at various levels from of the construction sites were selected for the training program. The main aim of the training is to impart knowledge of safety labours on heights on scaffolding.

Table 2: Points Obtained in Before Training Related to Scaffolding Questions with Reference to the Values of Mean and Correlation Coefficient

QUESTIONS	TOTAL NO OF PEOPLE ENQUIRED	MEAN BEFORE TRAINING	CORRELATION COEFFICIENT
1	315	3.74	0.73
2	315	3.96	-1.012
3	315	3.71	-5.88
4	315	2.20	-4.417
5	315	2.36	-0.08
6	315	2.35	-1.59
7	315	1.40	-4.39
8	315	1.77	-5.86
9	315	2.39	0.012
10	315	1.72	-1.76
11	315	2.60	-4.83
12	315	2.47	-3.24
13	315	.65	-1.006
14	315	4.13	-2.92
15	315	1.26	-8.62
16	315	1.17	-2.12

IV. EFFECTIVENESS OF THE PROGRAM

The After collecting the questionnaire initially to know the status of workers, second time the questionnaire after safety training is over to know the safety awareness, again issued to the workers to know improvement in safety training. The questionnaire provides safety in general, security and regarding safety of scaffolding, inspection at work site and security of scaffolding, working on scaffolding. Scaffolding questions totaling 16 yes or no types of answers is

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distributed. Then, each workers answer to the questionnaire. Points were collected and evaluated after the training and compared for the effectiveness of training and level of knowledge of the worker force. The statistical values like mean, standard deviation and correlation coefficient of the questionnaires before and after the training were tabulated and the two tailed -test analysis results were analysed. Table 2 shows the results of workers before training. Overall points obtained by the working force as a result of training is shown table3.

Table 3: Points Obtained in after Training Related to Scaffolding Questions

QUESTIONS	TOTAL NO OF PEOPLE ENQUIRED	MEAN AFTER TRAINING	CORRELATION COEFFICIENT
1	315	8.20	5.22
2	315	7.32	1.23
3	315	6.77	2.275
4	315	6.76	6.018
5	315	6.72	3.44
6	315	6.55	6.23
7	315	5.71	3.89
8	315	5.84	7.18
9	315	7.39	2.13
10	315	7.14	2.22
11	315	8.22	3.83
12	315	8.10	8.94
13	315	8.04	1.78
14	315	9.56	6.97
15	315	6.85	2
16	315	6.790	5.76

V. RESULTS AND DISCUSSIONS

To analyze safety management system for a construction industry, questionnaire response sheets received from workers were put for the results such as mean, standard deviation, and correlation coefficient. Consequently, the training program for workers was performed to the workers themselves as self-sustained module focusing on improving safety culture of workforce, learning technical and office administrative knowledge and, enlightening sufficiently on prevention of accidents. The module of training was focusing mainly on protective wares of individual workers which protect individuals. The training programme also concentrate on prevention of accidents on working on heights. The questionnaire was established to cover the above aspects of safety. There is marked improvement for their safety learning indicated success of the training of safety to workers. Results of analysis for the training program are shown in Table 2, 3 and 4. The results after the training programme on safety is encouraging and supported by some of the authors (Anil Kumar et al.,(2013),Anil Kumar et al.,(2015) :Williams Jr et al.,(2010). The results showed positive correlation indicating the success of training on safety of the workers. The knowledge level of the working force on scaffolding safety is depicted as more than average from the two tailed test for the construction site

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Table 4: Points Obtained and Comparison between before and after Training Related to Scaffolding Questions

QUESTIONS	TOTAL NO OF PEOPLE ENQUIRED	MEAN		CORRELATION COEFFICIENT
		BEFORE TRAINING	AFTER TRAINING	
1	315	3.74	8.20	0.688
2	315	3.96	7.32	0.844
3	315	3.71	6.77	0.929
4	315	2.20	6.76	0.777
5	315	2.36	6.72	0.801
6	315	2.35	6.55	0.774
7	315	1.40	5.71	0.792
8	315	1.77	5.84	0.224
9	315	2.39	7.39	0.696
10	315	1.72	7.14	-0.044
11	315	2.60	8.22	0.601
12	315	2.47	8.10	0.716
13	315	.65	8.04	0.108
14	315	4.13	9.56	0.484
15	315	1.26	6.85	0.334
16	315	1.17	6.790	0.310

Table 5: Result Analysis of Scaffolding Questions Before and After Training

Before Training values for the scaffolding questionnaires	Mean	2.36
	Standard deviation	1.87
After Training values for the scaffolding questionnaires	Mean	7.24
	Standard deviation	1.737
Correlation coefficient		0.56
t-value		15.96

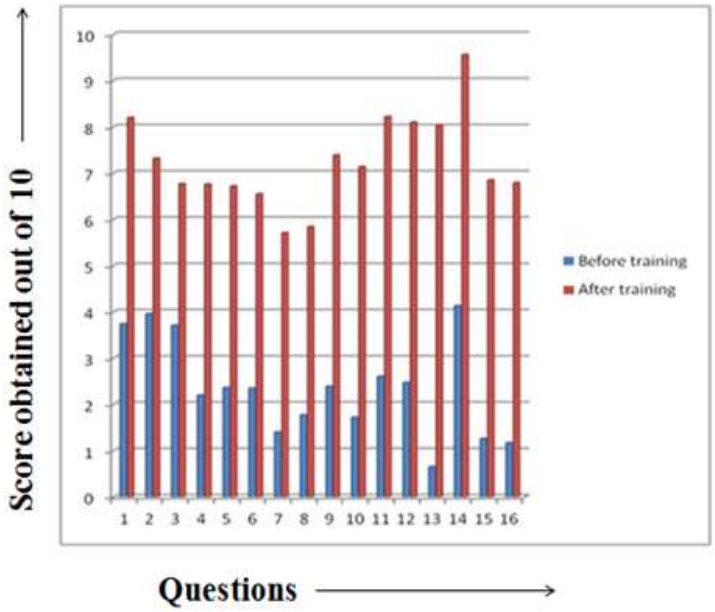

Figure 1: Graph Showing difference between before and after Training

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Consolidated mean value resulted before and after the training of safety by workers of site is 2.36 and 7.24. The table depicts the statistical values like the standard deviation values obtained initially and finally at the end of training as 1.87 and 1.737 respectively. Correlation coefficient before and after trainings for workers at site are 0.56 and 15.96respectively. The effectiveness of the training on safety is shown in Figures 1.The average points scored by workers are higher after safety training. From the decrease in standard deviation after training shows the effectiveness of the safety training. The test significance value indicates the performance of training program.

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