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Construction Safety in Indian Scenario and Technological Advancements in Safety Tracking

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Abstract - *Poor safety in Construction Industry results in human life and financial losses. Construction Industry is termed as the most hazardous industrial sectors. Developed Countries have adopted strict safety measures so as to minimize or eliminate accidents at construction sites. Occupational safety in developing countries is lagging behind the developed countries due to various aspects such as improper safety regulations and standards, lack of safety training and safety is considered on the lower priority. Higher priority is given to completion of work compromising the quality and safety of the work. The study consists of data collected from various major contractors, experienced in major construction projects and the safety practices observed in the industry. Causes of hazards, safety trainings, safety equipment, organizational safety policy and workers attitude towards safety is highlighted below. The study is done after several visits at construction sites and interviewing the site engineer regarding the safety rules adopted at the site to minimize or eliminate the accidents.*

1. INTRODUCTION

Construction industry is the largest employing industry and still the most dangerous one. In developing countries high priority is given to completion of work at low cost, thus compromising the safety of the site. But in construction industry highest degree of safety cannot be ensured like other industries. Hundred percent safe environment cannot be provided. In India there are around 7 lakh firms in this industry. As per the survey conducted by National Sample Survey Organization in 1999-2000 there were about 17.62 million workers in India. Safety is a very important aspect as occurrence of accident on site leads to loss of productivity, human suffering, loss of reputation for people associated with the project, statutory problems.

2. CAUSES OF ACCIDENTS

Accidents are caused due to unsafe act by victims, unsafe act by co-workers, unsafe conditions created by the worker, unsafe condition created by use or combination of the above. Unsafe act is an act of commission (doing something unsafe) or act of omission (failing to do something). Unsafe acts are due to overconfidence, disregard of instructions, failure to use PPE (personal protective equipment's). Unsafe conditions is one in which the physical layout of the workplace or work location, and the status of tools, equipment and/or material are in violation of contemporary safety standards. These conditions are due to lack of proper planning, deficient enforcement of safety, absence of safety equipment, unsafe methods of safety, absence of safety equipment, unsafe methods or sequencing, unsafe site conditions.

2.1. Poorhouse Keeping

Falls and slips occur on the construction site due to poor housekeeping. A site has poor housekeeping if the work area isn't tidy and has sharp objects, tools, construction waste lying around.

2.2. Excavation

A person may fall into the excavated pit or earth may fall on the workers working in the construction pit. Earth may fall if the shoring isn't in place. And shift in the shoring should be investigated and corrected. The excavated earth should be kept at least 1m away from the pit so as to avoid it from falling in.

2.3. Working at Height

Highest accidents occur due to working at height. Accidents occur while working on height due to improper use of ladders, incorrect scaffolding and negligence on the safety rules. Installation of defective ladders or improper installation of ladders should not be permitted. While working at height accidents occur due to collapse of scaffolds, fall from scaffolds or fall of materials from scaffolds. Improper safety harness, lack of confidence while working at height can cause accidents. Not only the workers working at height, but even passerbys are at risk due to any negligence.

2.4. Electrical Accidents

Burns, shocks, fire and electrocution are included in this hazard. Such accidents occur if electrical equipments are used in wet or damp areas, if electrical connections are overloaded or left free on the ground. Short circuit may

occur if proper maintenance of electrical equipments is not done or defective parts are used in the equipments. Hampering the electrical circuits during Excavation or civil works should be taken care of.

2.5. Lifting or Rigging

Heavy loads are lifted and shifted using the cranes and sometimes in the process the cranes overturn. Overturning of crane leads to great financial loss, human life and structural loss. Minor crane accidents often happen due to bad communication between the operator and signal man.

2.6. Hazards in Confined Space

While working in confined spaces (spaces having limited access when subjected to deficiency of oxygen, toxic and flammable gases or substances, etc) there might be heat, electrical, radiation hazards if importance of confined space is not defined. Lack of facilities provided in the confined spaces reduces the hazard facing ability.

Fig -1: Construction worker fatalities by event of exposure

3. GUIDELINES FOR SAFETY PRACTICES

In paramount of growing concerns regarding safety in Industry there are some guidelines that are set up to be followed at construction sites for increasing safety standards.

3.1. Management Leadership:

The highest authorities of the company need to provide leadership, vision and resources for effective health and safety programmes. They need to make it worker safety and health core value of their organization. They should visibly communicate their safety and health commitment of continuously improving standard to workers. They are ought to lead by examples through their own actions.

3.2. Worker Participation:

The effectiveness of safety program depends on the proper participation of workers. Successful programmes educate the workers of the potential hazards that are associated to their job. For any effective programme the workers should have access to important details of the programme and feel comfortable to give in their inputs.

3.3. Hazard Identification and Assessment:

Hazard identification and assessment is very important in any safety and health program. This is due to the fact that unanticipated hazards can arise due to various factors. The failure to identify these hazards is one of the primary causes for construction injuries and illness. The responsibility of the workers and employees is to collect and review data related to hazards on the site. They also need to conduct regular inspections of job sites to keep track of occurrence of hazards. They should also look into various dangerous consequences and group them together and identify the trend in their occurrence. For every hazard the severity and the likelihood needs to be found out to determine it's risk factor.

3.4. Hazard Prevention and Control:

Effective controls protect workers from hazards; help avoid injuries, illnesses, and incidents; minimize or eliminate safety and health risks. The employers are responsible for developing a hazard control plan to determine the implementation of controls. There should be a hierarchy of orders developed by employer for identifying and controlling hazards. They also need to develop plans to protect workers during emergencies and non-routine times. They need to continuously monitor the effectiveness of existing controls and determines if new method are required. Continuously review new technologies for cost effectiveness and better productivity.

3.5. Education and Training:

This is an important part of health and safety programme as it gives employers and workers greater understanding of the programme and help them contribute to it's development and implementation. They also help them be updated with knowledge about hazards and controls as it helps them becomes more productive and work safely.

3.6. Program Evaluation and Improvement:

The continuous evaluation of health and safety programme is required to verify their implementation and later on its effectiveness. Whenever the results of these evaluation identify areas to improve the programme , the concerned

authorities should implement the changes and monitor the effectiveness of the change.

3.7. Communication and Coordination for Employers On Multiemployer Worksites:

Generally in construction industry, contractor hires various sub-contractors who have different workers working at various projects. Therefore it is important that all the various section of workers coordinate and work and their safety is preserved.

4. WHY ARE THESE GUIDELINES NOT FOLLOWED IN INDIA

The Indian Construction Industry is comprised of huge number of companies which fall into different brackets of expertise. It is observed that the above guidelines are usually only followed by the top-tier companies and its implementation is hardly observed in the low tier firms. Even in the top tier companies the full implementation of these guidelines is not observed at all their sites. This implementation of guidelines in the industry is not seen because of the following reasons

4.1. Cost of Implementation:

This is one of the biggest factors that the implementation is not observed in India. The low-tier companies cannot afford the cost of hiring professionals for safety implementation and monitoring. They don't have enough capital to afford personal protective equipment for their workers. Safety is less of a priority in budget allocation for projects. This is similar case in almost all companies in India.

4.2. Worker Negligence:

The workers come from different background and are not well-educated regarding safety. They don't understand the risk to their lives due to lack of safety practices. Even after being educated about the risk, they don't tend to follow the practices. They find it a hindrance to their work. Only after experiencing the fatality of such conduct they understand it's value which sometimes can be too late.

4.3. Lack of Implementation of Legislation:

There are different laws set up by the government for the safety standards, but the implementation isn't monitored completely. Corruption at different levels of the implementation has made it easy for defaulters to get away with it. The workers are not aware of their rights and methods to fight for infringement of their rights.

4.4. Engineer Negligence:

The different engineers working on sites don't take safety seriously and don't take proper efforts for the following of the safety plan of the site. They are not strict with sub-contractor and workers who do not follow proper safety norms.

5. A CASE STUDY

To determine the frequency of accidents occurring at a construction site, we have considered a construction project with the details of the man hours worked, accidents and man-days lost in a particular calendar year. Table 1. contains all the details.

Sr. No.	Month	Man-hours worked	F*	R**	Man days lost
1	January	3510080	0	1	525
2	February	3010556	2	4	936
3	March	3361075	1	1	320
4	April	3210567	1	2	143
5	May	3141728	2	1	650
6	June	3141736	1	2	782
7	July	3240882	0	6	846
8	August	3238769	0	4	538
9	September	3145648	2	2	3144
10	October	3125040	0	3	476
11	November	3141890	2	6	1563
12	December	3232152	0	0	257
	Total	38500123	11	32	10180

Table-1: Information from site.

*F: Fatal Injuries
**R: Lost time injuries not leading to fatality

- Fatal injuries are the injuries in which the injured person require immediate medical attention. These injuries may lead to death of the worker.
- Lost time injury is the injury which requires very litte medical attention while the worker may return to work quickly
- A reportable lost time injury may result in worker's absenteeism for more than 2 days.

Fatality Rate = (number of Fatal injuries/Man hours worked)*1,000,000
Fatality Rate = (11/38500123)*1000000 = 0.286

Severity Rate = (Man days lost due to lost time injuries/Man hours worked)*1,000,000

Severity Rate = (10180/38500123)*1000000 = 264.415

Frequency Rate = (Number of reportable lost time injuries/man hours worked)*1,000,000
Frequency Rate = (43/38500123)*1000000 = 1.117

- Fatality Rate is defined as number of fatal injuries per total man hours worked in 1 million working man hours. In this case, it is 0.286
- Severity Rate is defined as the Man days lost due to lost time injuries per total man hours worked in 1 million working man hours. In this case, it is 264.415
- Frequency rate is the number of reportable lost time injuries (fatal & non fatal) per total man hours worked in 1 million working man hours. In this case, it is 1.117

6. SAFETY TRACKING

Construction is an exhaustive process which involves active participation of all the unskilled labour. Construction often compel workers to expose themselves in a life threatening situations like working at a certain height or working in a toxic condition or the unrelenting danger of falling objects. So, safety of everyone involved in a construction project is of paramount importance. It is the job of a safety officer to ensure that the required safety standards are met. With automation coming into play in each and every sector, latest advancements in safety around the world are beyond comprehension. Optimum safety tracking is important to ensure that the construction work is carried out in a safe environment. One accident can push back a project significantly, not only in terms of cost and time, but it also plays out in the psyche of the existing workers. A safety officer should analyze the data from different safety tracking system and should take the corrective steps accordingly. Listed below are some latest technological advancements which are already in use around the world and should also be used extensively in India.

6.1. Eye tracking technology:

This technology has undergone rapid strides forward in the last decade or so. It works on a predictive model and is often helpful in determining the effectiveness of training or to identify hazards. Hazard identification is important to tackle all the safety related issues on a construction site. Most of the accidents on a site are due to human errors. Identification of the number of these errors coupled with its causes can assist in improving safety on a construction site b)y educating the workers of these errors. Eye movements are primary indicators of worker's attention and tracking these movements can help identify the level of attention of workers and kind of errors they are likely to make. This eye tracking data is merged with subjective situation awareness. It is a reliable way of determining the errors that can be committed by workers and thus preventing accidents or mishaps by combining information with the experience and characteristic traits of workers with real time attention data. It can be used to identify the workers which are at risk. It can also be used for measuring effectiveness of training ant to design the appropriate training to be provided to the workers. It can also help in determining the workers with reduced level of attention and training them appropriately.

6.2. Smart Vest:

Working in a hot environment with temperature ranging above 35-40 degree Celsius can often lead to serious injuries. Many workers have also died to excessive heat on a construction site. Construction workers are severely stricken by stress due to heat, particularly due to heat produced by body due to numerous physically demanding tasks performed by the worker under hot and humid conditions. Several cities in India are hot and humid and construction work being carried out in such cities is often affected by excessive heat. Therefore, it is important to tackle such heat related problems to relieve workers from injuries or stress attributed to heat. Introduction and development of smart vest help to fight these problem a bit more effectively. Latest development in these vests has been done at RMIT University, Australia. Sensors have been provided in the vest which record the body temperature and heart rate of the workers and notify them directly by sending the data to the registered smartphone in case of any irregularity. A safety officer can take the steps accordingly and can advise the worker to take rest in case of any anomaly. Researchers around the world are also working on vests that can alert the vehicles approaching and also the workers working on a a busy construction site. This GPS type positioning can forewarn the workers of an approaching vehicle and also can contribute to keep them out of danger. If the two technologies mentioned above are combined and provided in a single vest can revolutionize safety of workers on a construction site. This vest will be very helpful in a city like Mumbai, where workers often work on roads with heavy traffic in a hot and humid climate.

Fig – 2: Safety Vest

6.3. Hard Hats:

Construction workers often work in a hazardous environment. This environment often lead to emission of Carbon monoxide which is detrimental to the health of a worker. Carbon Monoxide is poisonous and often is the cause for suffocation of the victims by binding up oxygen transporting sites in hemoglobin, thus not allowing oxygen to reach the body. Nausea, fatigue and headache are some of the symptoms. Over the years, hard hat has protected innumerable amount of lives by protecting the head from the falling objects on a construction site. Recently, researchers at Virginia Tech developed a hard hat with an alarm system and technology that would measure the blood oxygen level and notify in case of falling oxygen level thus preventing Carbon Monoxide poisoning. This technology is still at a nascent stage and can change the safety of workers working in an oil refinery completely in a positive way.

Fig- 3: Hard hats

7. CONCLUSION

Different types and reasons of hazards/accidents and their causes are explained above. In India the largest employing industry, Construction Industry needs to overcome the causes of hazards. 98% of the accidents can be avoided by adopting proper safety techniques. The simplest method to adopt safety is by leaving the work to the trained competent person only. The current situation of safety in Indian Construction industry is in a very dire state. There is lot of malpractices going on and no adherence to the stipulated guidelines is observed. On a positive note, the situation is improving as people are being aware of importance of safety and government is becoming stricter with its law implementation. But it is a long way away from reaching the minimum international standards. Technological advancements has also included GPS based tracking system. GPS tracking helps in notifying the safety officers in case a worker is working at a significant height without guard rails or respective precaution and he can then tell the worker about the impending danger. GPS tracking also helps in notifying the construction vehicles like crane or a transit mixer on a truck about the collision that would happen between the two in case of the lack of visibility because of the improper storage of the construction materials. These are some of the many new technologies which are enhancing the safety of construction workers around the world. In addition to that, harness of suitable standards should be provided to all the workers working at a height and scaffolding should be checked thoroughly before giving the green light for the workers to start. Workers should be educated about the common structural and engineering principles like the time needed for hardening the concrete or early removal of shuttering. Safety training should also be given to workers to make them aware about the safety and the hazards involved while working on a site and the implications it might have on their life. They should be made aware about the importance of safety. Safety inspection should be done frequently by the safety officer. The above mentioned technologies are still not used extensively in India. High cost of implementing such technologies might be the reason for that. Construction firms and builders should be made aware about the benefits of using such technologies as life is a gift which should not be wasted by compromising the safety of these workers that have committed themselves to a construction project.

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