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Investigation Regarding Safety Concerns on Construction Sites in Punjab, Pakistan and Their Remedial Measures

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ABSTRACT

In the last two decades, there has been tremendous increase in construction projects for the development of Pakistan. Safety at construction sites is one of the most important performance indicators in the construction industry. This study was aimed at collecting data from construction sites regarding safety requirements at different stages of the construction projects. Data was accumulated from 25 different projects of Punjab region by supplying questionnaire to the site engineers and managers involved in the construction work assigned to different national and local contractors. The questionnaire was revised by discussion with the senior personnel and experienced engineers to collect useful information about the necessary safety requirements. Mainly the questions were concerned with the environmental policies and safety measures required against hazards. The collected data was processed and conclusions drawn to recommend that the construction companies comply with the ISO 14000 standards related to environmental management.

1. Introduction

The protection of labour is one of the necessary tasks in a construction project. Construction industry is continuously evolving new techniques and tactics for rehabilitating better facilities [1]. Different researchers have presented different causes for site accidents. Toole [2] has precisely enlisted the main hurdles that result in catastrophic failure of a project. These are some of the points that he proposed:

- Inadequate working performance of unskilled labour.
- Unavailability of safety tools like safety glasses, face shields, boots with slip-resistant and puncture-resistant soles, heavy duty rubber gloves for concrete, hard hats and earplugs/earmuffs.
- Hazardous conditions of the surrounding.
- Inappropriate precautions.
- Carelessness of the staff involved in project activities.

Construction projects involve billions of investment and if accidents occur then the consequences cause terrible economic drawbacks. These calamities and disasters result in casualties which are a huge misfortune for the project as well as stakeholders. In 1996, Everett and Frank stated that this percentage loss is roughly 7.9% to 15% of the total budget [3]. According to Coble and Hinze [4], the repayment and indemnity for labour costs 3.5% of the total cost of project. The consequences of these setbacks are catastrophic and these kinds of mishaps are a big blow to financing sector and they also challenge the prestige and credibility of construction business.

In the last few decades, computing has taken the responsibility of providing better techniques for safeguarding human resources. Different software like High Confidence Software and Systems (HCSS) and Field ID have been developed by IT experts to ensure protection of manpower. Professionals are being trained in this software to acquire our objectives of providing a safe environment to the workforce [5].

Langford [6] has recognized the condemning and reproving factors that change and govern the behaviour of construction workers. He inferred some conclusions and hypothesized these points:

- Proper instructions must be given to technical and non-technical staff and their drilling must be done.
- The consciousness and cognizance of safety heads and in-charges should be requisite for maintaining a safe domain of project.
- The organizations must modernize their staff and tools [7].

Health and safety are one of the sensitive issues that must be tackled for saving lives and economic budget [8]. We can deduce from this discussion that tutelage and

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monitoring of workforce is the need of the hour. This training can only guarantee safety and health [9-10].

Considerable amount of research has been done all over the globe involving factors affecting safety on engineering projects. Hwang [11] did research on green commercial building projects in Singapore by conducting a questionnaire survey from 25 local companies and concluded that green commercial building projects faced risks of design change and poor construction quality less criticality than their traditional counterparts, but that the adoptions of green ideas, materials, and technologies has posed additional risks to green commercial building projects. Mok et al. [12] key challenges in major public engineering projects by a network-theory based analysis of stakeholder concerns and contributed to a new angle, the network perspective, of analysing stakeholder concern interdependencies and their practical implications on major engineering projects. Heralove [13] looked at the possibility of using value engineering in highway projects. He explained that three main reasons of delay in Engineering projects are that they do not achieve expected project goals, secondly, project delivery is not within a reasonable amount of time, and finally, costs are not in line with their budget limits and concluded that this can be improved using the appropriate value engineering process at the right time. Saunders [14] worked on the determinants of uncertainty on safety-critical projects and concluded that most commonly mentioned determinant of project uncertainty was environment, followed by complexity, capability and information. Yusof [15] investigated the determinants and impacts of Environmental Practices (EP) in construction projects and on the performance of construction firms of Malaysia. The results indicated that organizational support, customer pressure, and regulatory pressure have a positive impact on implementing EP in construction projects and that implementing EP has a positive effect on the environmental and economic performance of construction firms.

2. Research Methodology

The prime objective of the study was to collect data from construction sites regarding safety measures adopted and then to process this for further recommendations. The work was developed in two phases.

The first phase in research methodology adopted in this work was to collect data from various construction projects in the Punjab region. Data were collected through a questionnaire filled in by getting information from site engineers/managers involved in the execution of the project. Information was extracted by discussions with the concerned personnel. Data consisted of information about the companies/organizations and the trained staff employed for the project and some useful information on safety requirements. The companies that were contacted to get the information can be categorized as follows. The budget levels of companies contacted are categorized as described by the Pakistan Engineering Council (PEC).CA category is the highest category defined by PEC with no limit, CB has a maximum contract limit of Rs. 4000 million whereas C1 has a maximum contract limit of Rs. 2500 million.

Table 1: Projects description

Project Type	No. of Projects	Budget Level
Type A	10	C1
Type B	5	CB
Type C	5	CA
Type D	5	C1

A series of questions had been included about the safety risks and the measures taken by the management of the project to reduce those risks. Mainly questions were about environmental policies and safety measures normally required against hazards.

Secondary objective of the study was to analyse the collected data. Safety measures taken at different construction projects were discussed and conclusions were drawn. On the basis of conclusions, recommendations were made to maintain the minimum standards of safety at construction projects.

3. Analysis and Discussion

3.1 Presence of Transmission lines, Cables and Railway crossings

The data was collected at planning, execution and maintenance stages to avoid any mishap. At the planning stage, the expected project sites were visited and at different sites, different types of hazards were observed. High transmission lines and cables were among the top hazards, as shown in Fig. 1, because transmission lines carry electricity at voltages between 44 and 735 kV (44,000 – 735,000 V), it is extremely dangerous to approach these un-insulated high-voltage transmission lines.

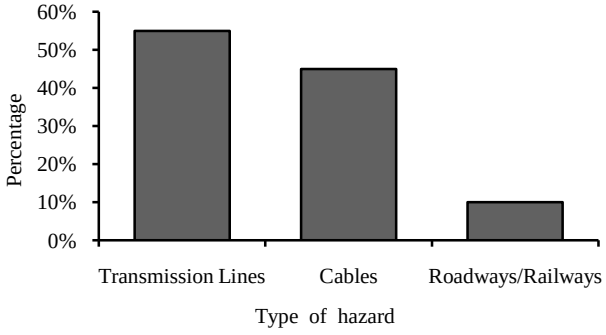

Fig. 1: Presence of transmission lines, cables and Railway crossings

At most of the sites during planning stage, the High transmission lines observed were 55%. Out of the remaining Hazards, cables and crossing across roadways and railways had the percentage 45 and 10 respectively. This showed that before the execution of the project some percentage of budget had to be reserved for safety against these hazards but unfortunately 40% companies have reserved no budget, 40% kept it at 2% and 18% kept it at 5%.Installation of sign boards to warn workforce of such hazard can be the solution for such sort of issues.

3.2 Presence of Open Drains, Arsenic Materials and Gas Plants

It was observed that open drains were found at almost every site visited as shown in Fig. 2.

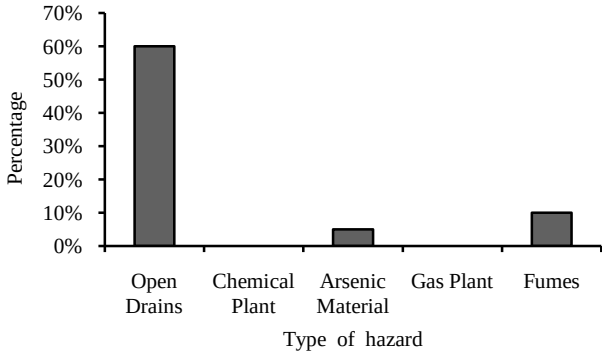

Fig. 2: Presence of open drains, arsenic materials and gas plants

The data revealed that almost 60% of the sites had open drain hazard. Further, results showed that arsenic and fumes were present at 5% and 10%, respectively. This showed that no safety measures were taken against such drastic hazards at 75% of the sites which is quite alarming and needs attention. Sign boards should be put in place at such locations with necessary training on understanding different sign boards to avoid accidents.

3.3 Natural Calamities

Fig. 3 shows that 55% the projects studied have predetermined the hazards of rain, 32% for earthquake whereas only 5% sites hazards like floods and landslides were considered which need serious consideration.

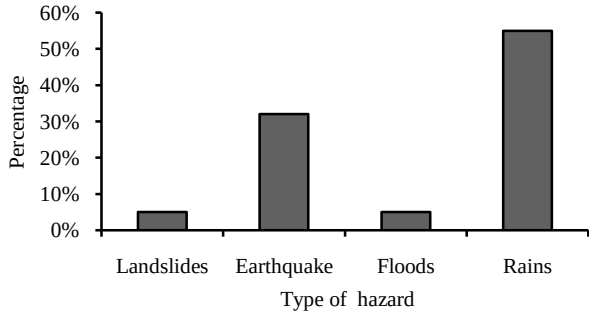

Fig. 3: Natural calamities

A separate section of human resource should be made in companies whose sole responsibility will be to predict natural calamities, if any, to save human lives involved.

3.4 Environmental Policies Considerations

ISO 14000 specified standards for the environmental management which helps organizations to

a. Reduce adverse effects of their operations on the environment.

b. Acquiesce with the applicable laws and other environmental requirement.

Fig. 4 reveals that environmental policies considered at most of the projects were not according to ISO 14000. Almost 40% of the companies studied had environmental policies according to ISO 14000 and 60% had not considered it. Such companies should be banned to handle engineering projects as such companies violate international standards set for air and noise pollution control which eventually will ruin our environment and hence ruin life on our planet.

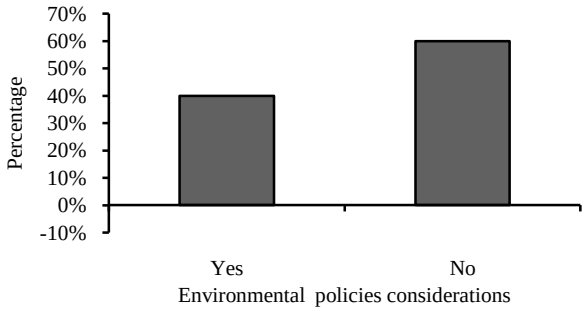

Fig. 4: Consideration of environmental policies at construction sites

3.5 Safety equipment availability at construction sites

Safety appliances are mandatory requirement at all construction sites. It was found that 90% sites provided safety helmets, gloves and safety boots. Safety belts were supplied at 40% projects and safety goggles at 32% only. Working suites which are essential items were provided by 28% projects. Action needs to be taken against companies which skip necessary safety procedures by imposing heavy fines and penalties.

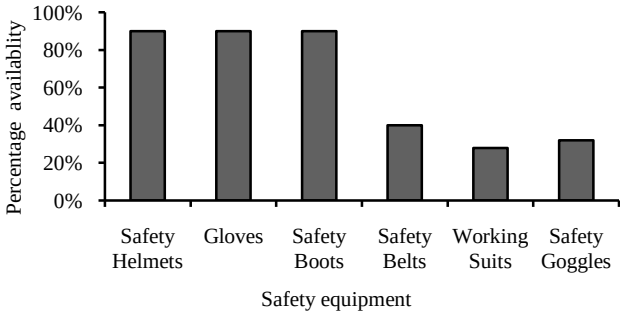

Fig. 5: Provision of safety equipment at construction projects

3.6 Safety Measures Availability Against Construction Hazards

Accidents due to falling from height, Electrocution during excavation are quite common at construction sites. Fig. 6 indicates that facilities were available at 32% sites against falling from heights, 45% against excavation accidents; 27% each for safety from heavy machinery and hits by falling objects and only at 18% projects took measures against electrocution which is very important for the safety of work force. Safety measures should be made mandatory on all construction sites and license for those companies should be cancelled which violate safety procedures. Full-time paramedic and doctors should be made available at sites to deal with such emergency scenarios.

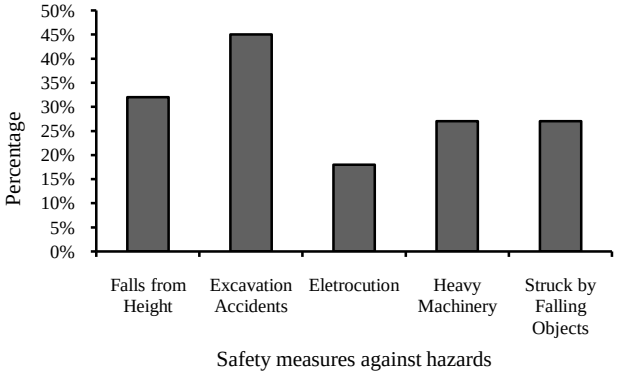

Fig. 6: Availability of safety measures against construction site hazards

3.6 Safety Measures Against Engineering Materials and Health Hazards

Manual handling activities are performed in every minor or major project and safety against such materials is important and it was observed that 68% of the sites studied had provided safety. For chemicals 18% sites had provided safety and only 5% sites provided for solvents. Moreover, not a single site had provided safety for asbestos material which shows negligence on behalf of the authorities. Such activities should be kept to a minimum and machines should be used to deal with handling of dangerous materials that may be harmful to the workforce.

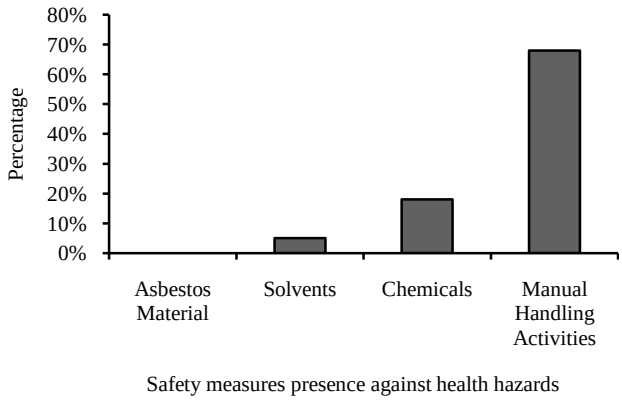

Fig. 7: Availability of safety measures against health hazards

3.7 Safety Measures at Working Area

Protection against areas of roadways and walkways, holes, trenches and fork work are very important at construction sites. Holes are common in every project Precautionary measures at construction sites such as at excavation are required. Around 64% of the companies studied had provided protection for holes and trenches, 41% for unprotected sides and edges. In the areas of runways or walkways there was 18% protection and in fork work, being common activity in construction, it was just 5% and requires to be properly safeguarded. There should be proper sign boards or barriers to avoid accidents.

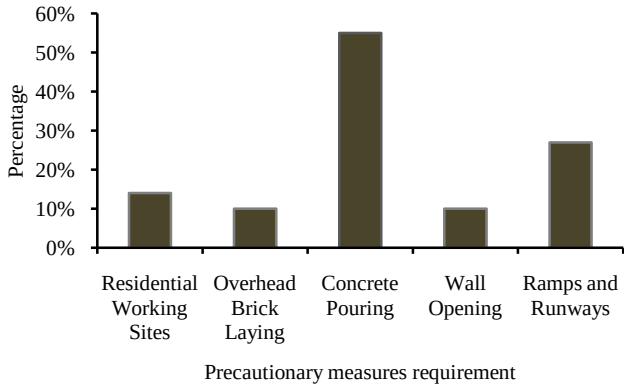

Fig. 9: Precautionary measures against construction materials

Concrete pouring is a main activity at most construction sites so precautions are important. Fig. 9 shows that 55% of the companies studied had provided precautions against it, 27% against ramps and runways; only 10% each for overhead brick laying & wall opening and 14% for residential working sites. Precautions should be made mandatory on all construction sites. Trainings should be arranged for labour handling construction activities which should be aimed at reducing the risks involved.

3.8 Protection Against Environmental Hazards

Noise, vibration, dust and temperature are regular hazards in Civil Engineering work. These should be protected against because noise harms ears, dust can harm our eyes & lungs and high temperature can have negative effect on our overall health. Fig. 10 shows that 32% of companies had safety measures to prevent noise, 68% for dust, 5% against vibration and temperature. Just 14% of the sites had safety protection which is quite non-serious attitude of the client and should be noted with concern.

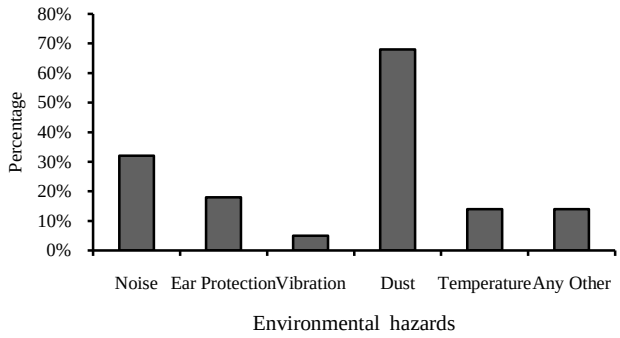

Fig. 10: Protection against environmental hazards

3.9 Protection Against Health Hazards

Provision of safety against the above mentioned materials is essential at all construction projects but it was observed that 27% of the companies studied had protective measures against irritant materials while 14% had protection against allergies, 23% for toxic materials and just 5% for fibro-genic and carcinogenic materials. If no protection is made against such hazards, workforce may get ill which will eventually result in delay of projects.

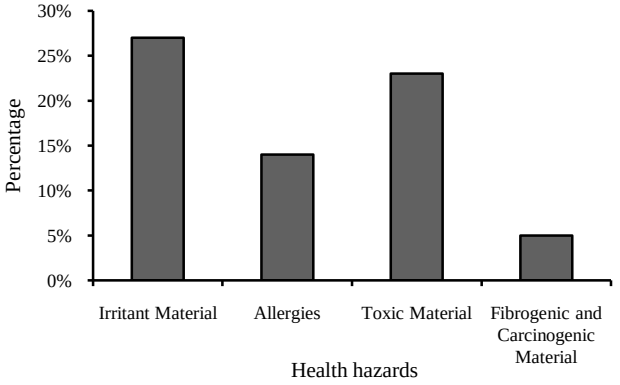

Fig. 11: Protection against health hazards

3.10 Human Safety Environmental Training

Human Safety Environment (HSE) is providing training programme that educate workers and partners about safety, health and environmental issues at the workplace. Training programmes can be arranged to educate people about short-term requirements, such as for behavioural improvement. It can also be part of long-term planned programmes. It is necessary to ensure that people are properly trained, qualified and skilled to perform the job efficiently & safely.

Half of the companies studied i.e. 50% had given HSE training to the workers at the projects and 50% had not provided HSE training which indirectly affects the efficiency of the projects. Such trainings may be arranged on regular basis and should be made mandatory for all employees to attend.

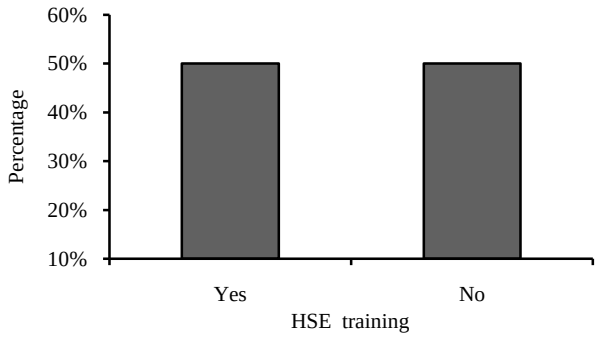

Fig. 12: Provision of HSE training

3.11 Health and Safety Meetings

Health and Safety meeting are required to be held regularly on weekly or monthly basis so that workers are trained for their better health. Around 27% of the companies investigated had health and safety meeting weekly and 36% had on monthly basis while 36% had no health and safety meeting for the workers which indirectly affects the workforce.

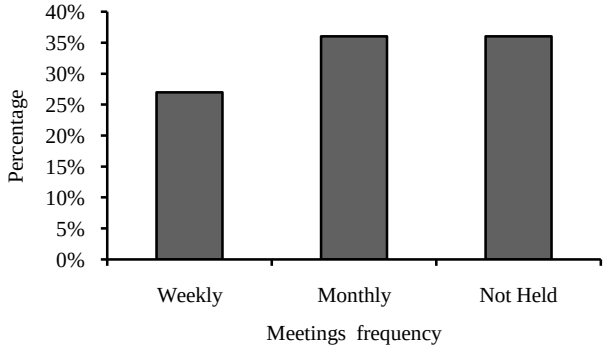

Fig. 13: Health and safety meetings frequency

At different sites, different types of hazards were noticed. At most of the sites, during planning stage, the hazard of High transmission lines were observed at 55% of the sites. Hazards of cables and crossing across roadways/railways were found at 45%, and 10% of the sites respectively. High transmission lines should be shifted/relocated as they can cause problems for human safety. Similarly, cables and railway crossings should also be made safe so that traffic can pass without any type of problem. There should be proper sign boards or barriers to avoid accidents.

It has been observed that sites are not made safe against open drains, arsenic and fumes which are quite dangerous for the labour force and the general public. Negligence against open drain is seen at 60% sites and 5% & 10% of the sites respectively failed to pay attention to arsenic and fumes. It should be made mandatory to reserve some percentage of the budget for natural calamities like rains, earth quakes, floods and landslides

but it is quite alarming that 40% companies have not reserved any budget while 40% kept only 2% and 10% considered only 0.5% for utilization against such calamities.

It has been observed that for 50% of projects investigated in this work, ISO 14000 are not being followed and thus environmental policies are neglected which can have negative impact on the society &the environment. At construction sites safety against noise, dust and temperature is an essential component as these can affect human health. Unexpectedly, only 32% of the projects studied provided proper protection against these essential issues. Further it is noted that no attention is given against toxic and irritant materials which are harmful for human health.

It was observed with concern that HSE training programme policy was not followed at 50% of projects studied and health and safety meetings are only being held at 36% of the projects.

4. Conclusions

On the basis of the collected data from 25 different government sponsored projects in the Punjab region of Pakistan, it can be concluded that serious attention is required for most of the projects especially from health and safety point of view. For better awareness of employees and contractors, HSE training programmes that educate the employees/workers to understand safety measures on construction projects and re-education of the workforce needs to be arranged. Moreover such trainings should be made mandatory for all employees to attend. For the improvement of health and safety policies on projects regular weekly/monthly meetings should be held. Where machinery and labour is at work, sign boards should be used to avoid major accidents. Similar sort of strategy can be applied at locations where there is threat to human life.

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