

Trends of Safety Performance in Construction and Civil Engineering Projects in Pakistan

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Abstract:

The major construction and civil engineering projects are sponsored by public sector in Pakistan. The users contracting and bidding procedures do not offer a significant space to the aspect of safety performance in construction and engineering projects. The prevalent measures of safety are after- the- fact measures - that means safety is given importance once casualties have actually been occurred. Such practices or measures are termed as inductive, reactive, trailing, down stream or lagging indicators. This is so because they are based upon retrospective data. As the country has undergone through massive development in engineering, construction and infrastructure sectors, safety aspect has been transformed from lagging indicators to leading indicator. Companies and organizations have started focusing on good safety performance under safety climate and culture. In this paper, a sincere research effort has been made to assess and analyze the health and safety performance of various constructions firms as well as overall construction engineering industry of Pakistan. In order to achieve this objective, various structured interviews and survey questionnaire were designed. The data collected from industry specific respondents has been analyzed using statpro software. The salient findings of this study are as follows; the majority of the casualties are Fall of Individuals from Heights, Electric Shocks, Caught in between the Plants, Machinery and Confined Spaces and Struck by an Object or Machinery. Similarly there is no positive mindset from top down, non application of safety laws, lack of safety management plan, lack of safety and health of workplace, inadequate arrangement of first aid, lack of personnel's protective equipment and absence of accident reporting mechanism.

The major recommendations of the study are as follows; At industry level, safety rules should be as regulated and re-defined, documented and enforced. Moreover provision of personnel protective equipment, training of entire organization, safety management plan under safety officer, adequate first aid at sites, efficient reporting mechanism and safety awareness of employees and workforce will also improve the existing situation. It is also recommended that more research should be carried out in order to evolve a comprehensive safety management policies.

Keywords: Construction, civil engineering, Pakistan, safety

1. Introduction:

Civil engineering industry is regarded as one of the most important sectors which has significant impact on health and safety of the working population. It is also considered as the most hazardous and physical exposed to casualties. [Abdel Hamid,2000]. Despite the fact the industry has undergone revolutionary transformations under globalization but regretfully its record in safety performance continuous to be very poor [Cohen,2000]. Since construction engineering projects involve large quantum of labor and workforce, it is more prone to casualties and injuries, as compared to other contemporary industries [Hasnain,2008]. This situation is compounded by bad working environments, confined spaces, unsafe work methods, equipment and produces [Farooqui,2007]. This phenomenon and tendency is not uncommon in developed countries however the intensity of poor safety performance in developing economies. [Rowlinson,2003]. The only solution to improve the situation lies in imparting training and utilization of comprehensive safety programs [Samelson,1982]. With the recent massive technological developments across the globe, on one hand, has contributed extensively in terms of productivity of civil engineering sector, but at the same time, has posed a more challenging as well as highly unsafe working conditions [Huang,2000]. As result of this latter phenomenon, the industry is still criticized widely due to construction engineering accidents and associated damage inflicted to work force, machinery, equipment and morale of labor. The profitability and productivity achieved gets mollified due to these factors [Ahmed,2000]. In order to respond to the increased need for safety programs and its implementation due to technological advancement, the developing countries must make it an integral part of regulatory framework. In developed world, for example, the workers compensation rates are a function of the loss experience of a

contractor. Each labor hour is affected through the reflection of those losses in the experience modification rating [Flin,2000]. A contractor who adopts good safety practices achieves competitive advantage over the contractor who do not pay due importance to safety program and safety measures. An unsafe contractor is always liable to pay huge penalties in shape of insurances. Under these circumstances, the aspect of safety has approved as key cost driver for construction companies in the developing and developed world. Similarly business survival is solely dependent on safe and healthy work environment in the industry. It is also a healthy trend that owners are reluctant in permitting the contractors for bidding work as long as they do not possess acceptable EMRs. It can be inferred and concluded that costs can be controlled by creating a safe work environment. It should be mandatory for all actors of civil and construction engineering industry, to adopt and implement safety in order to achieve good safety performance and avoid fatal casualties.

Contrary to this, Pakistan has still to offer a proactive response to recent technological improvements, because a huge portion of construction work being executed by human toiling which has led to increased number of fatalities and casualties. It is envisaged that approximately 6-7 percent of labor is directly associated with construction and civil engineering industry. As far as safety non conformance is concerned, the main reasons are, lack of development of construction sector in terms of modernization and industrialization, lack of professional constant management practices which has led to unsafe project site but have also resulted into construction delays, cost overruns, loss of productivity, out dated contracting system having no provision for safest, insufficient security and insurance mechanisms, claims, litigation and adversarial business relationships.

As compared to the past, the current decade is experiencing tremendous development in Pakistan. Numerous infrastructure and development projects are in progress and some are under planning. These projects will definitely bring good name and fame for Pakistan the comity of nations. All efforts should be harnessed under safety paradigm in order to subvert or avoid bad impression of the industry. With this milestone for glorious era, however, there are still numerous challenges ahead. The single most challenge which needs to be negotiated is the safety at sites. It is highly important that all occupational injuries and fatalities should be given serious attention. It is also need of the hour, to inculcate the higher level of awareness among all primary stakeholders, including the work sites.

Researchers have suggested that it is more suitable and advisable to undertake for assessment exercises for implementation of safety management in the construction engineering projects. These are an important benchmark for formulating safety management policies and strategies, appropriate and commensurate with project specific environments.

With this rationale, this research is aimed and focus onto the local construction and civil engineering companies and public service departments based in Pakistan.

The orthodox measures only become effective once casualty has been occurred. It can be said that these are inductive, reactive, trailing, downstream and lagging indicators. It is the need of an hour to adopt leading indicators by addressing key kinks and battle necks.

Conclusions and recommendations in relation to safety performance of Pakistani Civil Engineering and data accumulated have been statistically analyzed by statpro software.

2. Scope and Objectives

This is a unique issue which has been analyzed through in-depth research and objectives were set as under:-

- To identify the major categories of casualties and injuries.
- To identify current assessment and need for safety training.
- To evolve options to help improve current shortfalls in safety performance and recommended suitable measures to avoid untoward safety incidents.

3. Literature Review

In the developing economies, though recent technological advancement have been made and inflicted positive implications over productivity but unfortunately cultivated unsafe and highly volatile challenging environment. (Farooqui et al, 2007).

Rowlinson (2003) indicated that between 1989 and 1992, 256 people were fatally injured in Australian Construction Industry. The statistical data highlights that fatality rate was 10.4 per 100,000 workers, quite similar to fatality rate for road accidents. Huang (2000) conducted a study which stated that 3,000 construction workers are killed in work related accidents each year. Similarly in Hong Kong, 275 accidents per 1,000 worker per year recorded in 1994, this figure stood at 150 in 2000 (Rowlinson, 2003). Abdel hamid(2000) states that majority of construction and civil engineering projects do not possess adequate medical support like first aid, and protective equipment. More over, Huang(2006) points out towards failure of owners in ensuring health and

safety of labor and construction primary stakeholders. There is total lack of management support for ensuring safety at jobsites. Kohen(1995) indicates the hierarchical obstacles being faced by construction sector of developing economies. There is a gap between professional constructors, civil engineers and design professionals and the bureaucracy. As long as this neglected aspect is not given due consideration, the performance and productivity of construction and civil engineering industry can not be achieved to its optimum level. Suazo(1993), suggested certain regulatory measures adopted by United States on occupational health and safety. This becomes equally applicable for the developing countries to adopt customized rules, regulations and laws in order to resolve on site safety and health issues .Rizwan(2011) highlighted safety factors which retard the performance of constructors and civil engineers because of inadequate funds, lack of personnel protective equipment and lack of training. Nexus to this, Sarah(2011) indicated the level awareness towards safety performance by workers and employees in their own capacity. According to this researcher, workforce does not get motivated rather there is need to develop and foster safety culture in them. The safety culture can only be created when there is a fair degree of management support and sufficient allocation of funds to counter safety challenges. The same issue has been discussed by Suchismita(2011) who proposed future directions and options on similar lines. Sam Wamuziri(2008) also states that by improving safe work environment coupled with adequate health and safety measures will altogether alter and change the company's culture. Thus the productivity, performance and safety record of the company will be better. Chia Kuang Lee(2012), studied the performance and profiles of grade seven constructors and highlighted certain safety factors which directly affect the performance of these constructors.

4. Research Methodology.

This research was spanned over two phases i.e.; data collection and data analysis. For the purpose of data collection, a questionnaire was designed after studying pertinent literature as well as visiting of several construction project sites. The questionnaire was divided into two parts. In part A, general information about respondents was asked so that reliability and validity of the data can be ensured. Moreover in case of missing data or untrue information, outliers can be eliminated. In part B, specific questions were asked. These questions were grouped into four domains, and each domain composed of several related sub questions on health and safety issues.

First the authors discussed about the questionnaire and its all contents with industry related civil engineers, contractors, construction managers, architects, design professionals, suppliers, sub-contractors and supervisors for ascertaining and confirming whether this questionnaire was enough for data collection. After through discussions with renowned and well reputed industry professional constructors , builders and designers like M/S Ahmad Zaka & Associates, M/S Amin Tariq & Associates, M/S Suhail Ahmad & Associates, M/S Shami Associates, M/S Tijaarat Developers and M/S Adeel Associates, the questionnaire was approved with minor modifications and adjustments.

In the next step, the authors carried out random sampling for the selection of the respondents. A total of 150 questionnaires were distributed among respondents. The panel of authors received 100 completed questionnaires, which comes to about 66.67 percent of response. Once this major milestone was achieved, the authors analyzed the data by using statpro software.

5. Results and Discussions.

The data collected from the respondents, has been put into following domains:-

5.1 Injuries and Fatalities

5.1.1 Categories of injuries

In this category, the respondents were asked to rank and prioritized the enlisted categories. The data revealed following sequence and priority as shown in fig -1 below:-

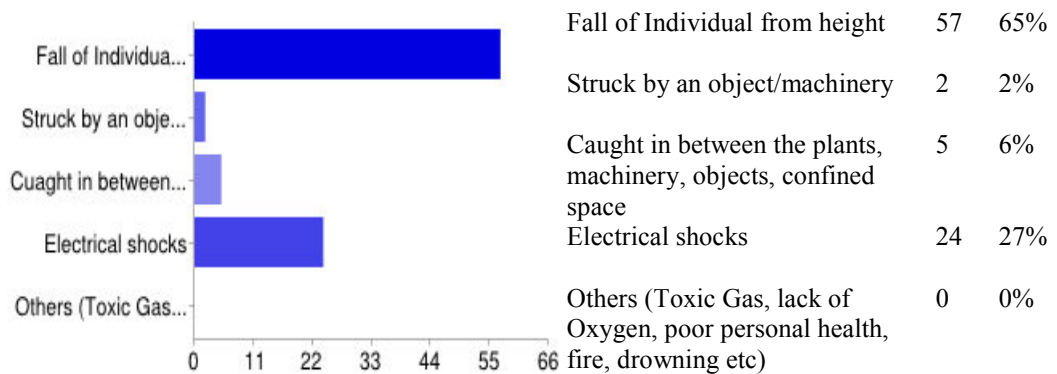


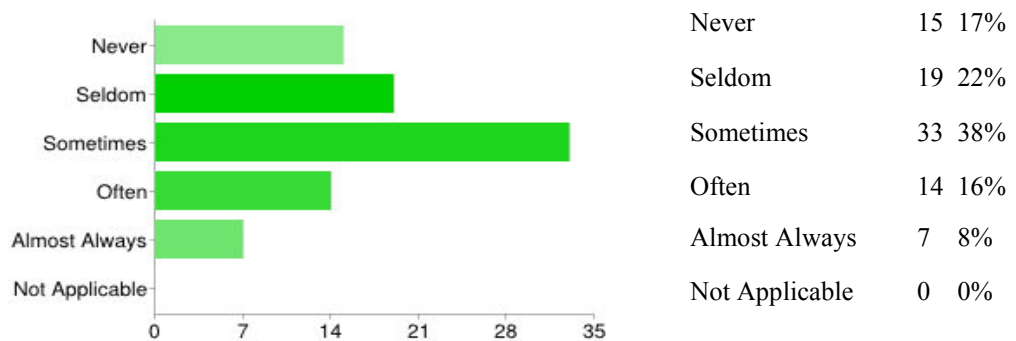
Figure 1: Categories of Injuries.

The majorities of the respondents believe that fall from heights is the most significant injury having higher probability of occurrence in civil engineering projects. The next category is electric shocks due to open and loose connections and wiring networks spread out in under construction civil engineering projects. The remaining category are; caught in between the plants, machinery, objects, confined spaces and struck by an object or machinery.

5.2 Safety Training Needs

5.2.1 Safety in the Mindset

Under this category, the major components of respondents were top managers, middle managers, supervisors and workforce. The data analysis revealed statistical order shown in fig -2(a,b&c) below:-



Fig

Figure 2 (a): Mindset of Top and Middle Management.

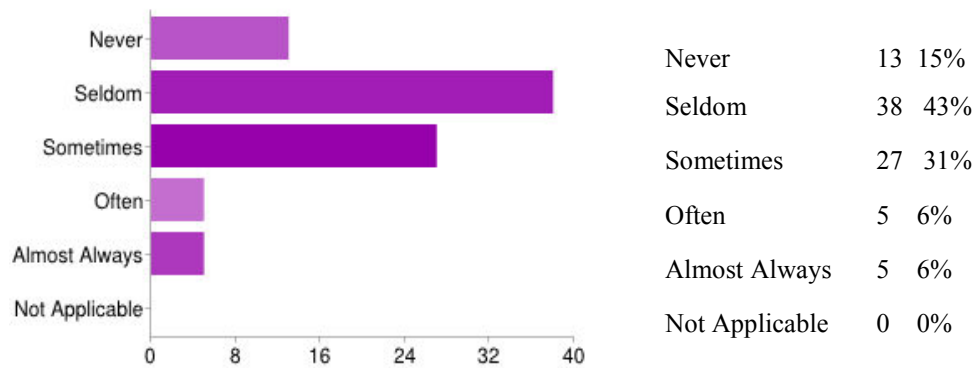


Figure 2 (b): Mindset of Supervisors.

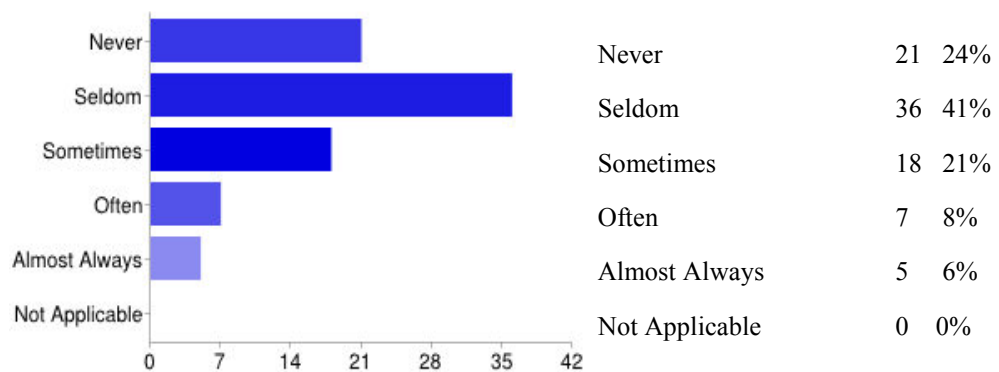


Figure 2 (c): Mindset of Employees.

The response rate is not healthy. This domain was grouped into three areas of safety importance, inclination towards safety, indoctrination of safety concepts in the minds. The results indicate that this aspect is grossly neglected. There is not even a bare minimum resolve to address safety issued in civil engineering projects.

5.2.2 Application of Construction Safety Laws, Rules and Regulations

As long as there is no regulatory law for implementation of health and safety in construction engineering projects, human casualties can not be controlled. The data revealed that 34 percent of respondents opine that occasionally these do exist but not implemented in true letter and spirit. 29 percent say that there are seldom adopted while 17 percent declined the existence of safety rules. The detailed results are shown as following:-

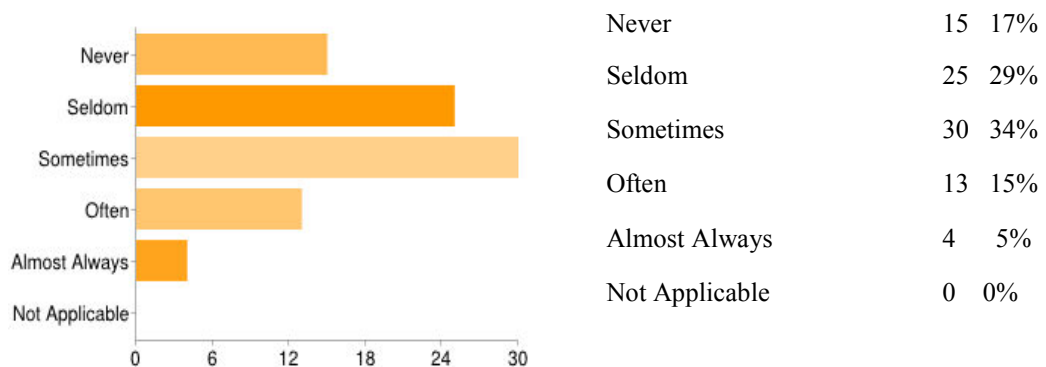


Figure 3: Application of Safety Laws.

5.2.3 Construction Safety Management Plan

Typically this plan covers following areas for resolving on job safety problems:-

- Management Responsibilities
- Employees Responsibilities
- Safety Policies
- Safety Committee
- Safety Inspections Program
- Safety Audits
- Safety Training Plans
- Selection and Control of Sub contractor
- Contract Documents

The majority of respondents opined that the plan does not exist in civil engineering projects. The results can be seen as under:-

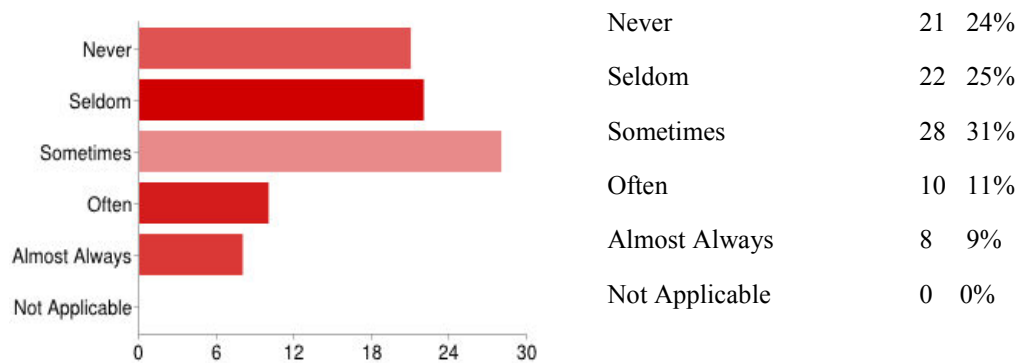


Figure 4: Implementation of Safety Management Plan.

5.3 Safety and Health at Workplace

5.3.1 Safety Against Major Causes of Accident

In civil engineering projects, main causes of accidents are, falls from heights, struck by an object or machinery, caught in between plants, machinery, objects and confined spaces, electrical shocks and other causes (like toxic gas, lack of oxygen, poor personal health, fire or drowning etcetera). Under this domain it has been made ascertain whether top management provides ample resources and opportunities to safeguard against any eventuality. Unfortunately this part is seriously neglected. The total response count remained 88, out of which only 9 percent confined the availability of resources by executives, which can be seen in fig 5(a) below:-

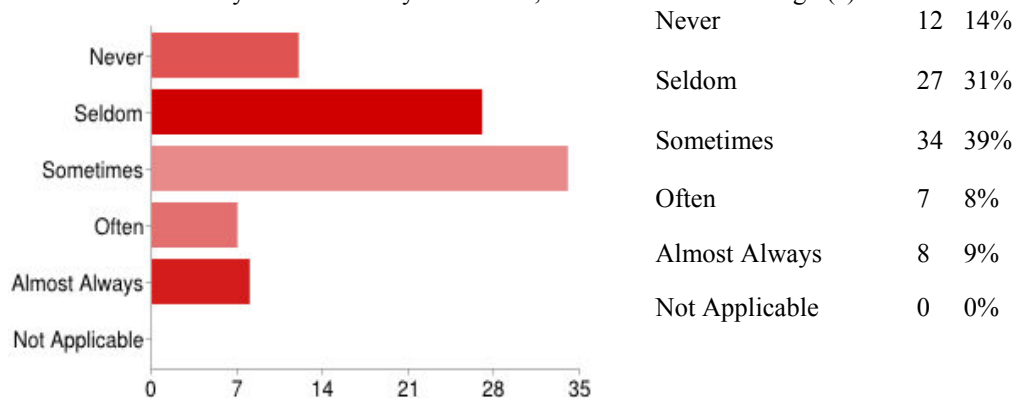


Figure 5 (a): Provision of Resources by Top Management.

On similar line, the authors tried to explore whether middle management establish any safety implementation culture and strategy. Ironically such intentions have not been observed according to data received. Only 6 percent of respondents confirmed that existence of such strategies and culture in their firms and companies.

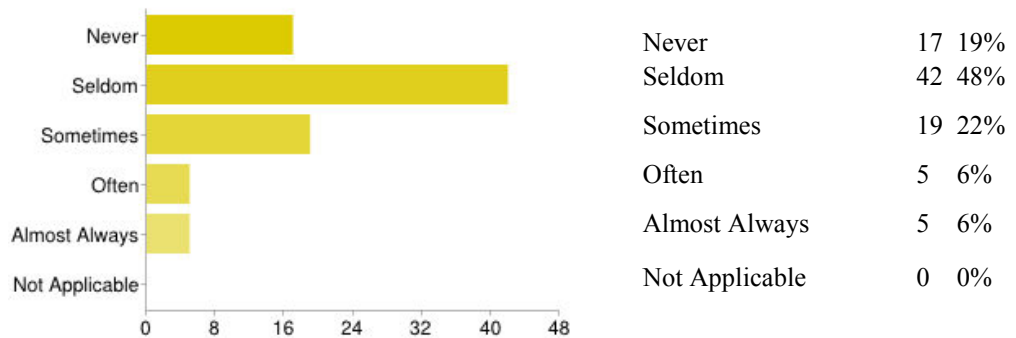


Figure 5 (b): Implementation of Safety Culture and strategy by Middle Management.

In third step, authors tried to establish if the supervisors understand, implement and supervise the safety measures 22 percent of respondents state that sometimes this practice is resorted to but 6 percent confirm that there is no understanding and vision for safety implementation in their companies, which is amply clear from fig5(c).

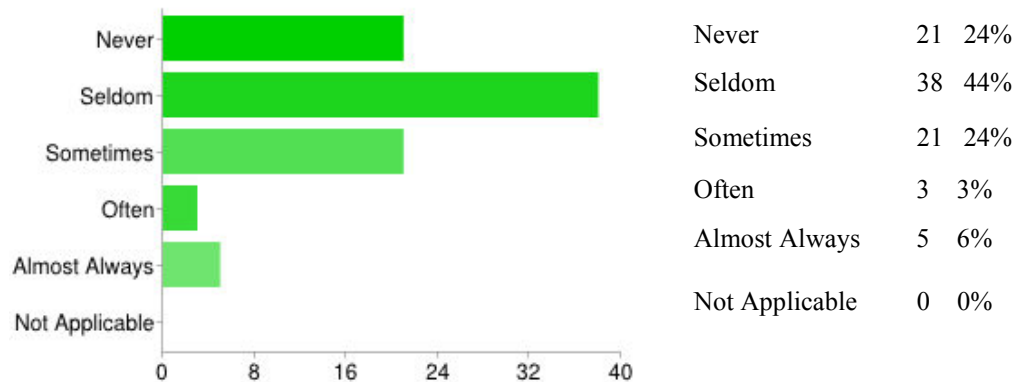


Figure 5 (c): Safety Measures Adopted by Supervisors.

In the fourth stage, it was ascertained whether workers follow any safety instruction under guidance or on their own. The data does not show any healthy response.

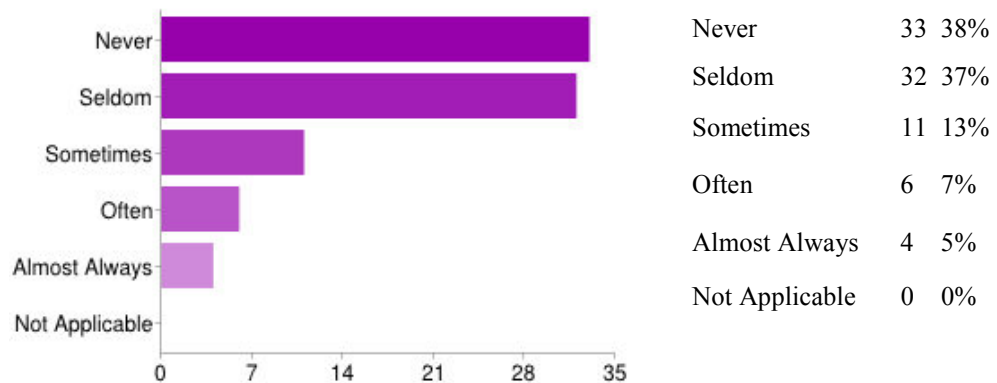


Figure 5 (d): Safety Measures by Workforce.

5.3.2 *Housekeeping in Construction Engineering Companies and Organization*

It is suit essential to keep jobsites, offices and residential areas clean and tidy from construction wasted and debris. The authors analyzed the responses collected from top management, middle management, and workers. Again it was not a healthy picture which is one of the concern related to occupational health and safety. The results are plotted on fig 6(a,b,&c).

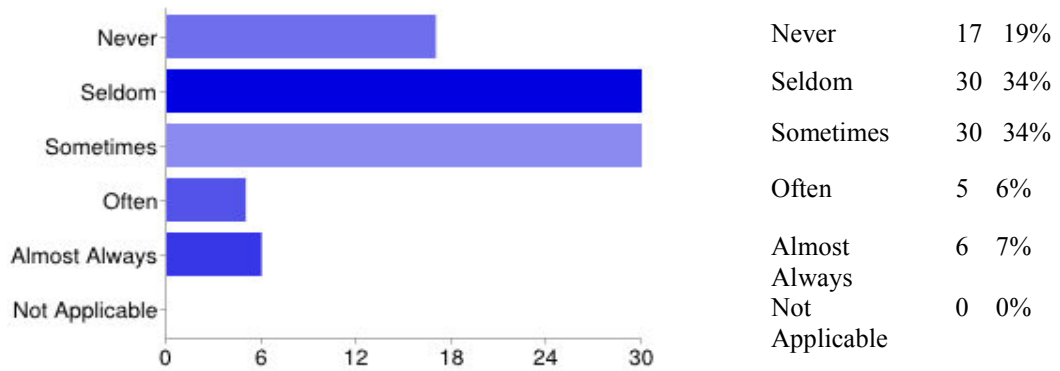


Figure 6 (a): Roll of Top Management in Health and Safety.

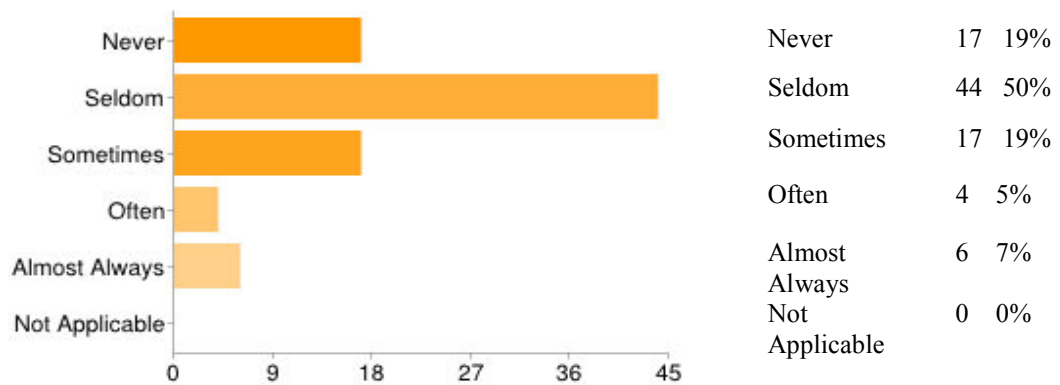


Figure 6 (b): Roll of Middle Management in Health and Safety.

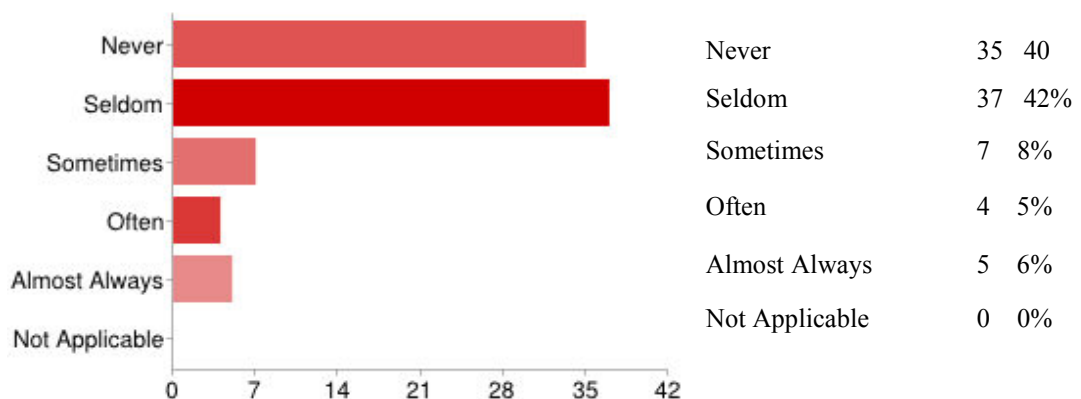


Figure 6 (c): Roll of Supervisors / Labors in Health and Safety.

5.3.3 Provisions for First Aid

Construction engineering industry is out of the most vulnerable industries which involves huge number of human beings. The workforce is highly vulnerable to serious working environments and varying level of casualties. Hence it becomes mandatory for civil engineering firms and companies to make necessary medical arrangements in order to thwart such happenings. The authors gathered data from top down of the companies and results have been plotted in succeeding fig 7(a,b&c).

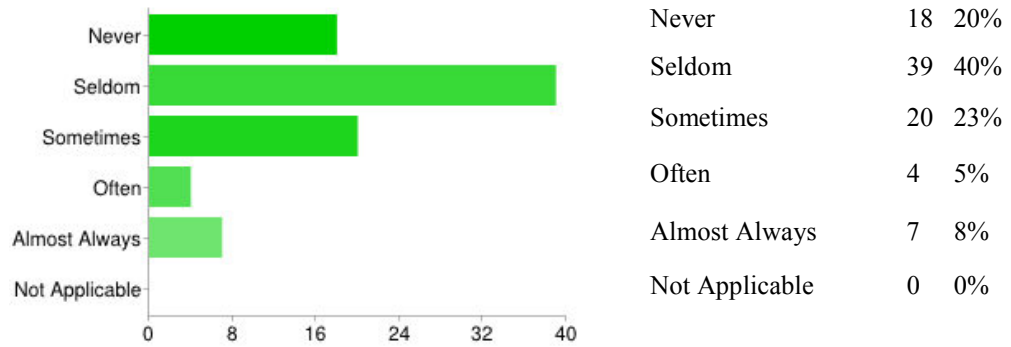


Figure 7 (a): Provision of First - Aid by Top Management.

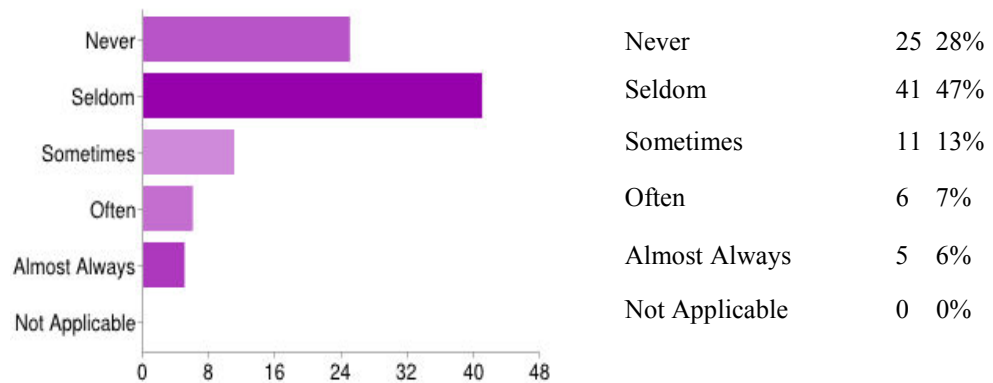


Figure 7 (b): Provision of First – Aid by Middle Management.

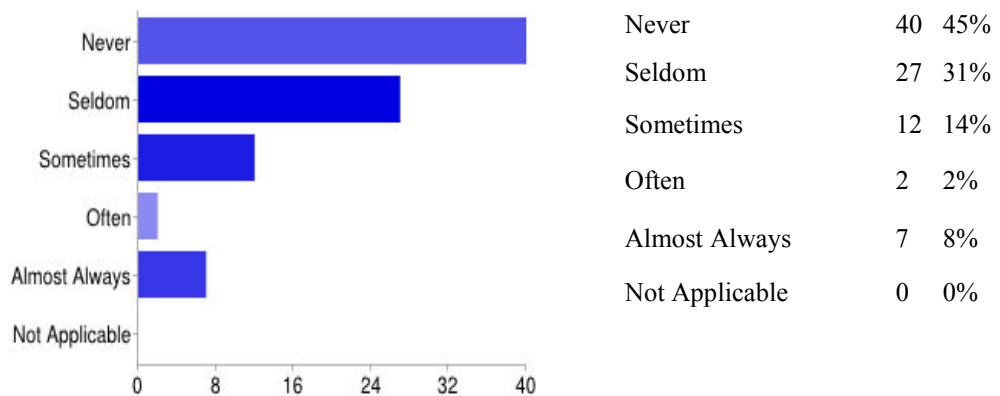


Figure 7 (c): Provision of First – Aid by Supervisors.

5.3.4 Provision of Personnel Protective Equipment

Personnel protective equipment is necessary while working under rough conditions like extreme heat or cold environments, welding works, toxic gases and windy weather conditions. Personnel protective equipment which is commonly used in engineering projects comprised of gloves, safety belts, face visors, gum shoes, reflecting jackets and head phones. The data revealed that this aspect is not being given due consideration.

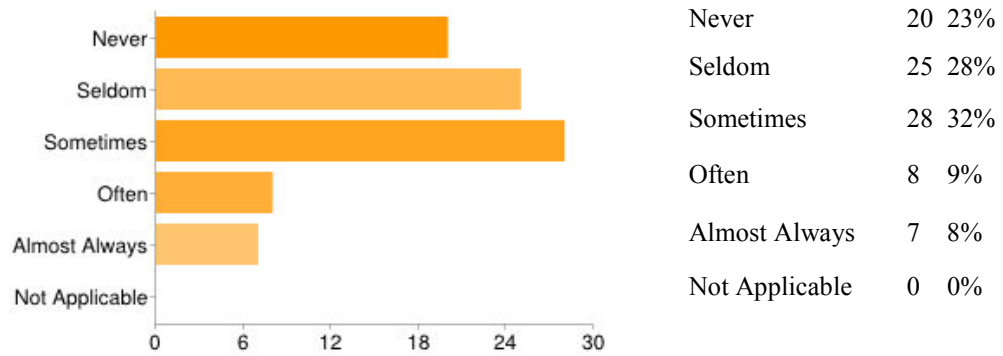


Figure 8 (a): Willingness of Top Management in Provision of PPE.

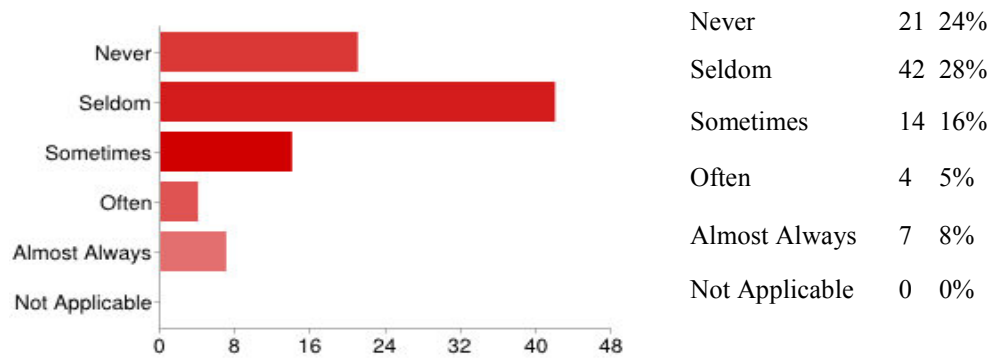


Figure 8 (b): Willingness of Middle Management in Provision of PPE.

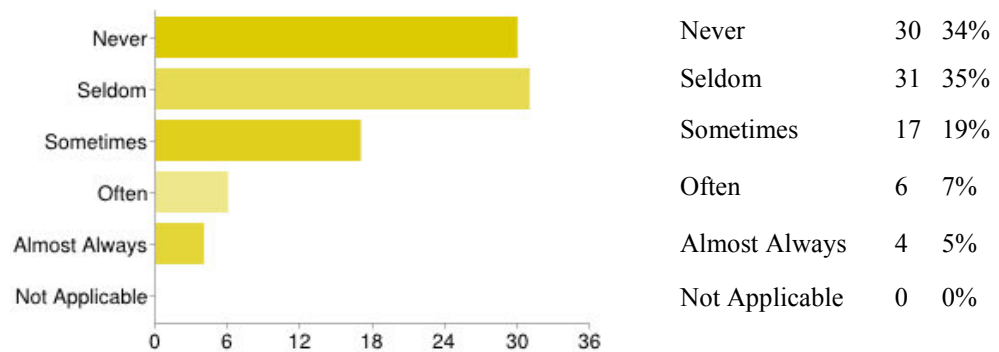


Figure 8 (c): Role of Supervisors in ensuring use of PPE.

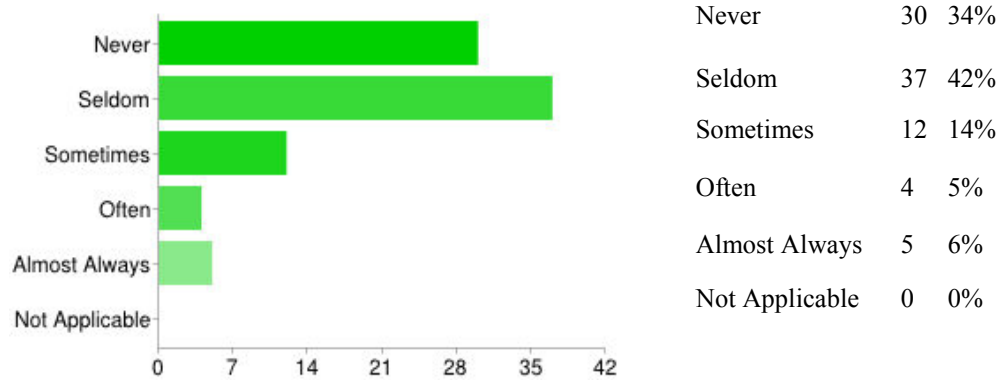


Figure 8 (d): Training of Worker in use of PPE.

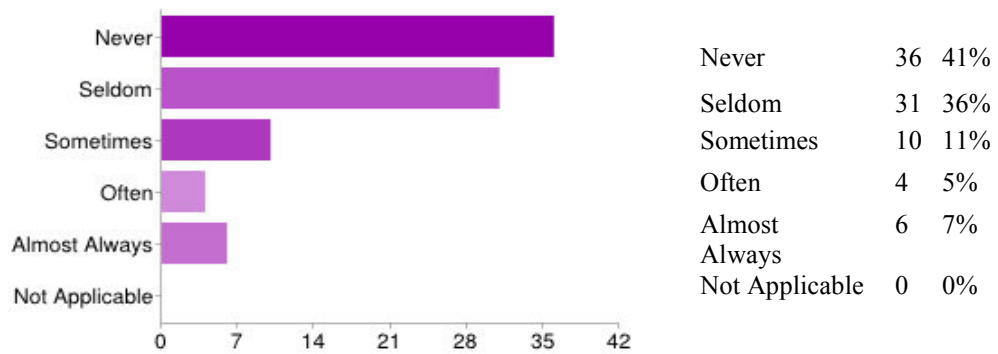


Figure 8 (e): Opinion of Workers on Effectiveness of PPE.

5.3.5 Accident Reporting Mechanism

In developed countries, a safety officer administers the construction safety management plan in construction with project or construction manager. The technologically and methodologically advanced countries have implemental safety clauses and provisions under the contract. The majority of the respondents (from top management to employees) do not portray a good picture as described in fig 9(a,b,c,d,e&f).

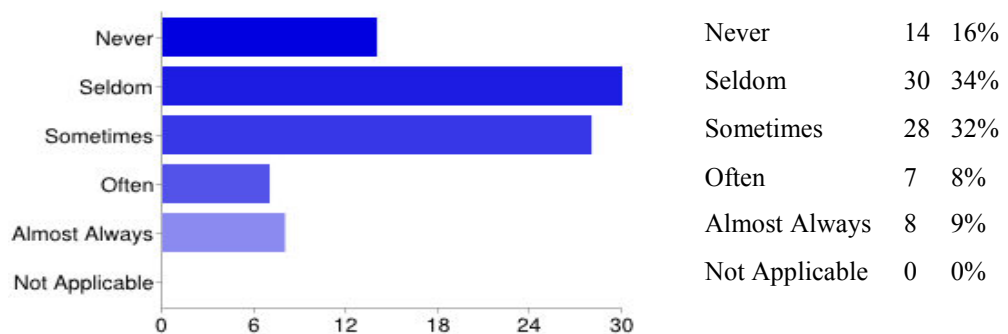


Figure 9 (a): Existence of Written Reporting System.

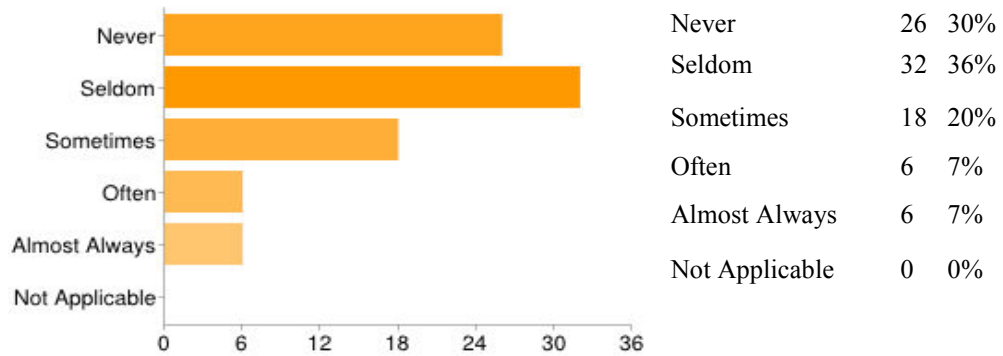


Figure 9 (b): Priority to Accident Compilation.

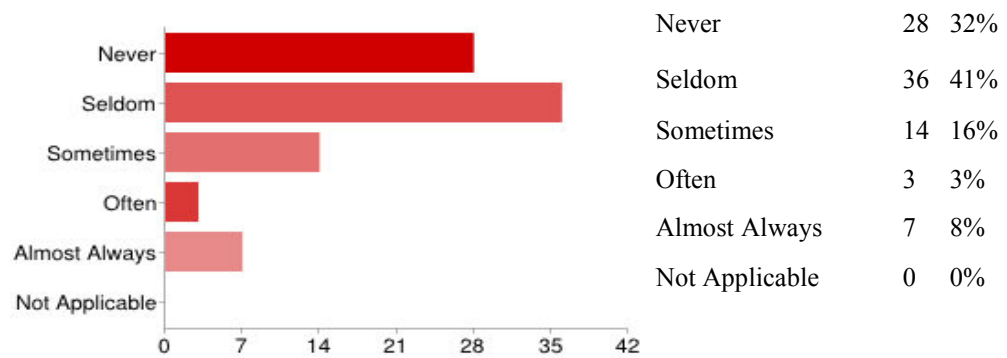


Figure 9 (c): Land of Concern over Investigation of Accidents.

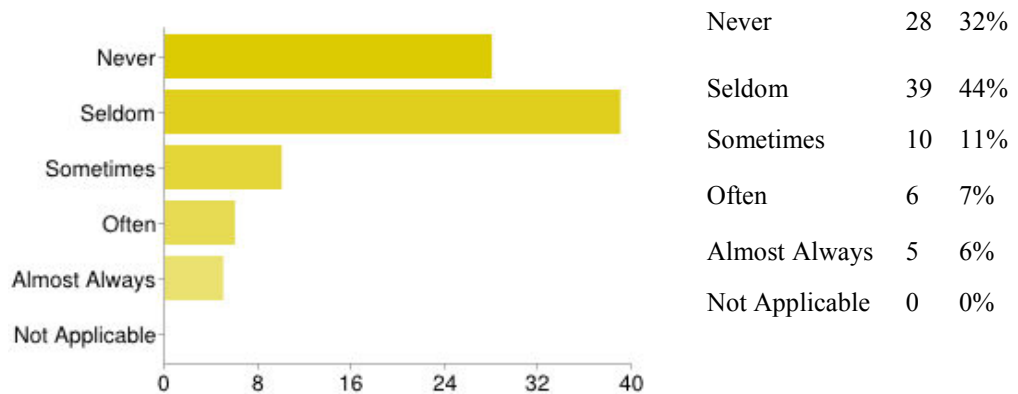


Figure 9 (d): Accident Compilation by Supervisors.

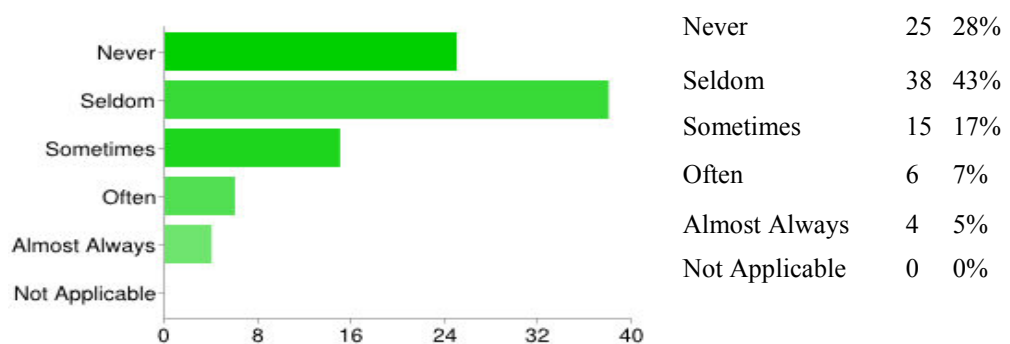


Figure 9 (e): Accident Reporting by Supervisors.

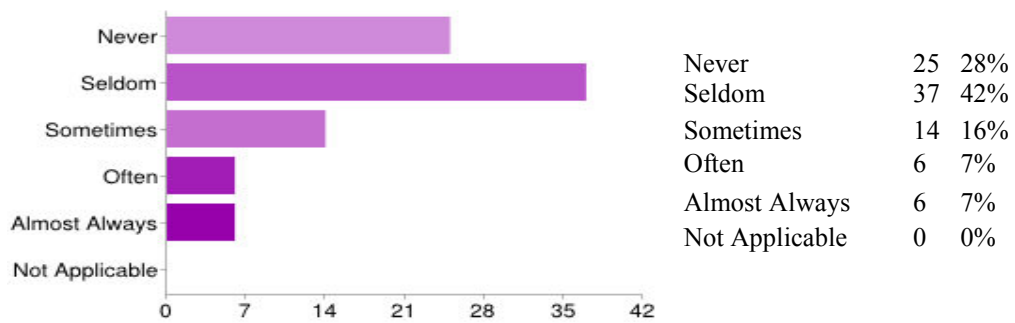


Figure 9 (f): Accident Reporting by Workers.

5.4 Safety Training – Delivery System and Method

5.4.1 Safety Training Delivery System

Safety training delivery system has been proposed differently for management and employees. For top management, it is advisable to include in the professional institutes curriculum so that civil engineering be trained in safety point of view from initial start. Then remaining in adequacies can be recouped and met through special training courses, as shown in fig 10(a). The middle managers should have basic training during vocational and technical training followed by special cadres and courses. Lastly the supervisors and workers should be trained during on job and special courses as highlighted in fig 10(b,c&d).

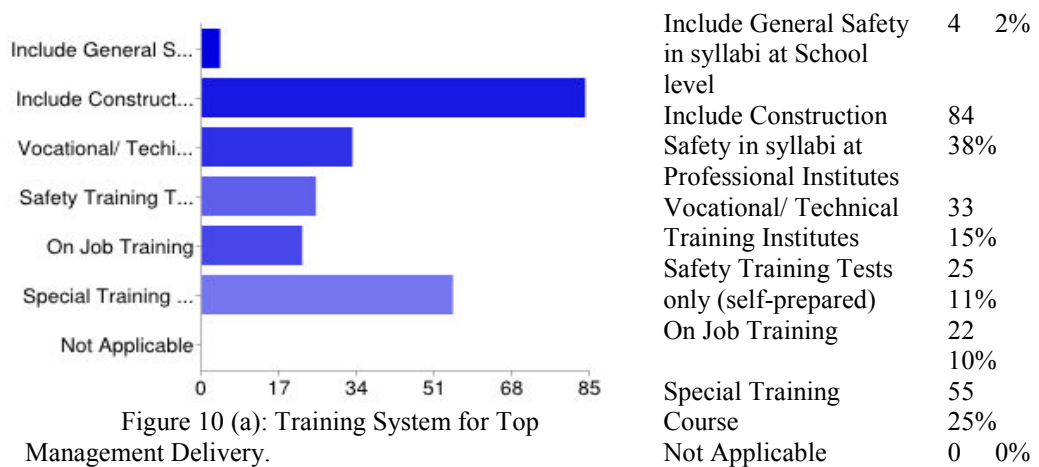


Figure 10 (a): Training System for Top Management Delivery.

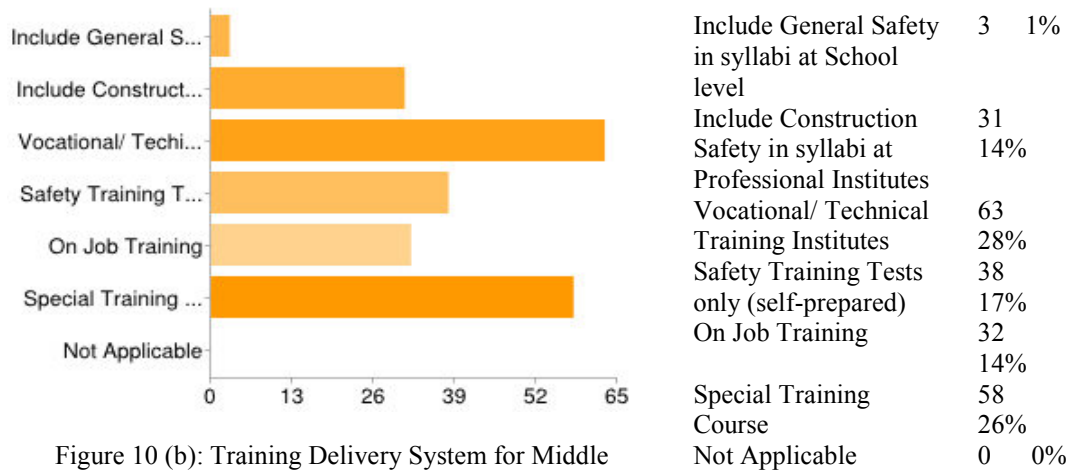


Figure 10 (b): Training Delivery System for Middle Management.



Figure 10 (c): Training Delivery System for Supervisors.

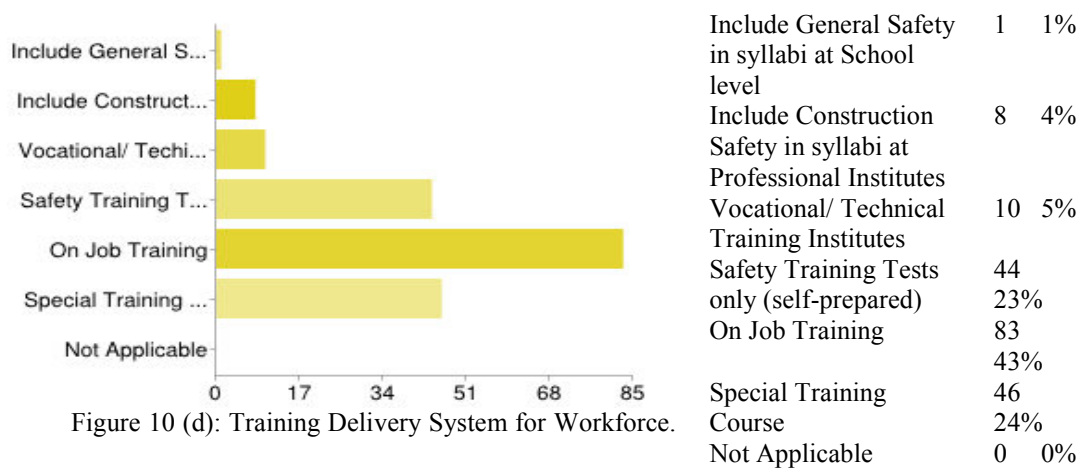


Figure 10 (d): Training Delivery System for Workforce.

5.4.2 Safety Training Methods

Since management and labor have different levels of vision, academic knowledge, technical know – how and understanding of safety concept. Accordingly training methods will also vary from upper and middle management to men on floor. The results can be seen on fig 11(a,b,c&d).

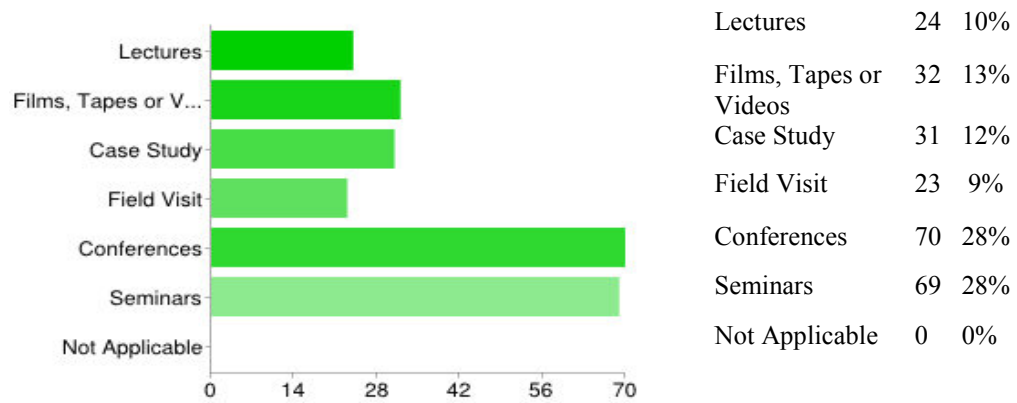


Figure 11 (a): Training Methods for Top Management.

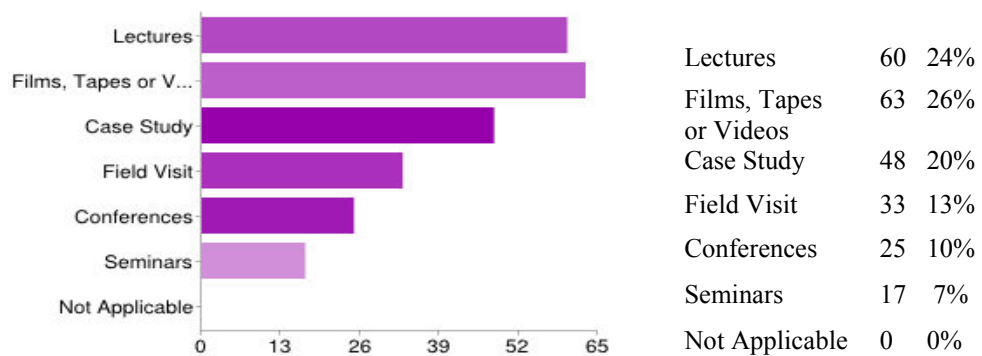


Figure 11 (b): Training Methods for Middle Management.

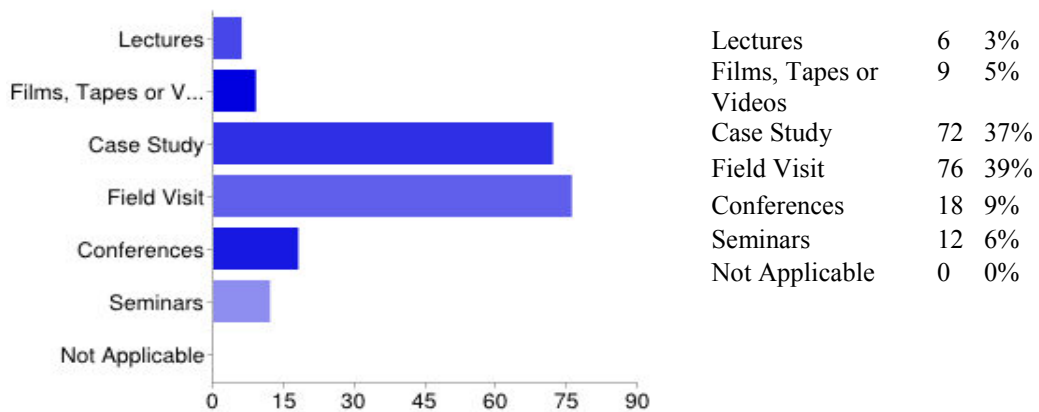


Figure 11 (c): Training Methods for Top Supervisors.

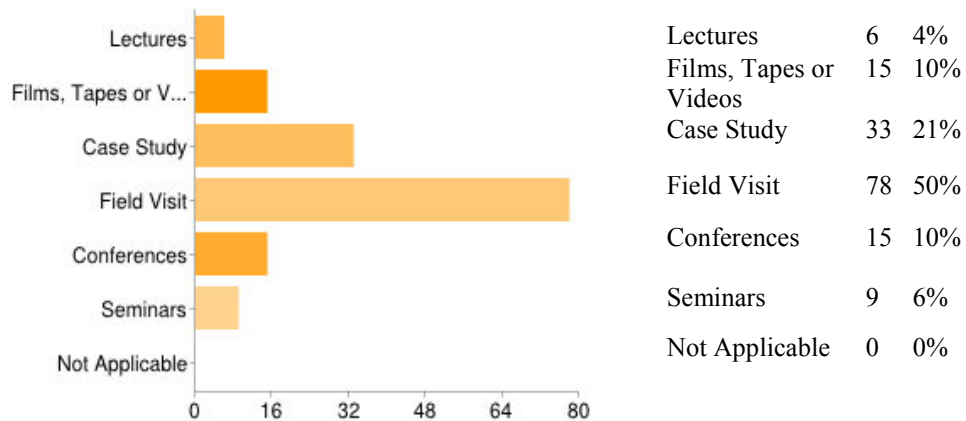


Figure 11 (d): Training Methods for Workforce.

6. Findings and Conclusions

From the results and discussions, followings are the conclusions:-

- 6.1 Fall from the height is the most significant category which must be addressed properly during constructions engineering projects.
- 6.2 There is need to inculcate more awareness on safety aspect across the company department.
- 6.3 There is also need to enforce construction safety laws, rules and regulations.
- 6.4 It has been observed that there is no trend or precedence of construction safety management plan in Pakistan Construction Engineering Industry.
- 6.5 Safety health at workplace is among the gray areas where no emphasis is laid on safety against major courses of accidents, housekeeping, first-aid, provision of protective equipment and accident reporting mechanism.
- 6.6 In order to improve the concept of safety in company wide scenario, safety training be imparted to top management and down the ladder.
- 6.7 These will vary according to technical know how and basic knowledge of safety of management and employees.

7. Recommendations

Health and safety is one of the souring issue which has never been given due consideration by neither public sector nor private sector of construction industry. In order to improve upon this neglected area, following recommendations are suggested:-

- 7.1 *Revision of Contracting and Bidding Procedures*
 The current contracting and bidding procedure do not allow enough space and importance to health and safety at workplace. In order to not only avoid casualties at jobsites but to improve the image of Pakistan construction engineering industry, it is mandatory to incorporate relevant safety clauses into the official procedure in vogue. This will give this area, a legitimate position and will also allow contractors to add bid estimate for ensuring safety and health at jobsites.
- 7.2 *Establishment of Health and Safety Regulatory Authority*
 Presently there is no such authority which exercise its power and influence for implementation of construction safety laws, rules and regulations. It is need of the time to establish an effective and efficient health and safety regulatory authority to monitor and regulate relevant policies.
- 7.3 *Training of Employees*
 All employees including the top management should undergo safety and health related training with a sole purpose to create safety awareness and safety consciousness. This can be through customized or tailored courses, workshops, seminars, conferences or field demonstrations.
- 7.4 *Sufficient Allocation of Funds*
 It has been observed through survey that majority of the construction firms and organizations do not allocate dedicated funds to administer health and safety in their projects. Those

respondent companies, who have implemented health and safety program, have allocated even less 1 percent of project budget. It is recommended that sufficient funds may be made available for this stated purpose.

7.5 *Construction Safety Management Plan*

Occupational health and safety can not be administered without construction safety management plan (CSMP). This is a subsidiary plan regulated and implemented under the overall construction project management plan. Efforts should be made to incorporate CSMP in every construction engineering projects.

7.6 *Provision of First Aid at Jobsites*

Top management should ensure provision of adequate first aid to their employees and workforce so that they receive immediate treatment in case of casualties during work.

7.7 *Provision of Personnel Protective Equipment*

While working under extreme weather conditions or hazardous areas, the necessity of personnel protective equipment becomes manifolds. Hence labors and staff must be provided with shielding and safety equipment like; gloves, face visors, safety belts, reflective jackets, gas masks and other jobsite related equipment.

7.8 *Establishment of Accident Reporting Mechanism*

In order to provide prompt medical support and avoid casualties, a quick reporting system is mandatory which should be linked with upper management. A vibrant and well crafted reporting system will eradicate majority of incidents and accidents.

7.9 *Housekeeping*

In order to ensure health of workforce, management must ensure cleanliness of jobsites, offices, living area and messing areas from wastes, debris or unhygienic materials. A clean and tidy environment elevates the productivity level of employees and workforce.

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