Site Safety of Sri Lankan Building Construction Industry

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Abstract

The negligence of safety leads to loss of productivity, accidents, poor health issues and several disadvantages to construction industry. Therefore this study focused on safety planning, precautions, regulations and adoption of safe construction practices in the building construction industry and clarifies the problems on site, which prevent the improvement of safety at site. Identifying the issues related to building construction site safety and propose measures to improve the site safety of the Sri Lankan building construction industry are the main objectives of this study. This study also reveals the level of awareness of personnel to the ordinances related to construction safety.

The study was carried out through personal interviews, questionnaire surveys and discussions with industrialists and policy making bodies. The detailed questionnaire survey was conducted among the professionals in building construction industry. Relevant legislations, ordinances and required safety provisions were collected from various institutes and departments. A fair response to the surveys was received through meeting industrialists in person rather than postal and email questionnaires.

The questionnaire survey answers were ranked in numerical order and interpreted using graphical and tabular outputs. This study was able to reveal the status of the site safety standards that exists in the building construction industry of Sri Lanka and propose recommendations to improve the safety of Sri Lankan building construction industry.

Keywords: Site Safety, Building Construction, Sri Lanka

1. General Background

Occurrence of accidents is common in the construction industry and safety is a critical issue compared to other industries. Every accident leads to tragedies such as injury or death to persons, damage to property and the environment and associated direct and indirect costs and effort. Economically it is important as it also lead to delays in the construction process. The delays and total expenses following an accident are usually much higher than the original cost of establishing and maintaining safety standards. Therefore it is understood that the safety evaluation and control save money.

Importance of safety is much appreciated thus it deals with several distinct concerns. Humanitarian concern should be taken into account because it causes death or adverse health effects. Site safety should be well maintained in good standards to convince the industry without any risk on professional, institutional and social perspective. Abiding to the legislation and safety policies enacted for construction works protects legal and regulatory issues although the degrees of safety measures are highly attributable to productive economic concerns.

2. Objectives of the Study

- To identify the issues related to building construction site safety
- To propose measures to improve the site safety of the Sri Lankan building construction industry.

3. Literature Survey

Table 1: Non-fatal Accidents on Construction Sites in Sri Lanka from 1983 to 1990

Classifications	**Year**							
Sex	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
Male	287	154	53	69	41	95	106	113
Female	-	-	-	-	-	-	-	-
Causes								
Fall from height	82	67	31	27	21	19	19	24
Fall of objects	101	38	7	16	1	30	39	33
Struck on stationary objects	18	11	-	2	5	6	10	5
Struck by moving objects	4	5	5	1	-	14	17	17
Struck on moving objects	24	13	-	-	-	-	-	1
Caught in between	36	9	2	2	3	15	7	19
Exposure to heat	4	1	-	-	1	-	-	-
Exposure to electricity	2	1	8	5	6	-	-	-
Exposure to harmful substances	11	4	-	8	-	-	-	-
Other causes	5	5	-	8	-	-	-	-
Age								
Below 19 yrs	6	3	15	21	15	1	1	1
20-29	105	49	5	16	11	28	40	32
30-39	67	51	19	15	8	51	44	45
40-49	37	20	7	9	1	12	17	31
50-59	27	6	6	6	6	3	4	2
60 & above	-	3	1	2	-	-	-	-
Unspecified	45	22	-	-	-	-	-	2

Source – Sivapaskaran (1991) : Country paper, Sri Lanka.

Table 2: Fatal Accidents on Construction Sites in Sri Lanka from 1982 to 1990

Classifications	**Year**								
Category	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
Managerial staff	1	4	-	-	-	3	-	-	-
Masons	1	2	1	1	-	1	-	-	1
Carpenters	7	3	2	-	-	-	-	-	-
Plumbers	-	1	-	-	-	-	-	-	-
Electricians	1	1	-	-	-	-	-	-	-
Painters	-	1	-	-	-	-	-	-	-
Mechanics	-	-	1	-	-	-	1	-	-
Operators	1	2	-	2	-	1	-	-	-
Drivers	3	1	-	-	-	-	-	-	-
Labourers	26	14	4	12	3	5	1	1	-
Causes									
Fall from height	14	11	4	4	1	3	-	-	1
Fall of objects	1	1	-	-	1	1	1	-	-
Fall from vehicles	9	8	1	1	-	2	-	-	-
Electrocution	-	-	1	-	-	-	-	-	-
Struck by moving objects	8	8	1	2	-	-	1	-	-
Caught in between	8	1	1	8	1	4	-	1	-
Drowning	-	-	-	-	-	-	1	-	-
Age									
Below 19 yrs	4	5	1	2	-	-	1	-	-
20-29	8	4	3	7	2	3	1	1	-
30-39	3	4	-	1	-	3	-	-	-
40-49	6	5	2	3	1	3	-	-	-
50-59	3	1	2	-	-	-	-	-	1
60 & above	-	1	-	1	-	-	-	-	-
Unspecified	16	9	-	1	-	2	-	-	

Source – Sivapaskaran (1991) : Country paper, Sri Lanka.

It has been revealed that the highest number of people affected was labours and the two main causes were falling from height and fall of objects on persons. Root causes of these accidents were found to be,

- Carelessness
- Ignorance and lack of training
- Lack of discipline
- Distraction
- Poor communication

4. Methodology

The study consisted site observations, questionnaire surveys among contractors, conducting interviews and discussions with leading construction industry organisations and other industrialists. Consultant organizations were also interviewed because the contractors like to safeguard themselves by providing a good picture on safety provisions in their sites. Further visits to construction related institutes and departments enhanced the knowledge in prevailing degree of safety consideration given to construction industry.

These investigations were conducted in person rather than postal correspondences. The Questionnaire was prepared in marking system and answers were ranked in numerical order and interpreted using statistical methods. As the surveys were conducted by site visits, it was able to find important safety issues, problems encountered in sites and to observe the real panorama of site safety condition in construction sites.

Information collections were successfully carried out at Sri Lanka Standards Institution (SLSI), The Institute for Construction Training and Development (ICTAD), Department of Labour and its division, National Institute of Occupational Safety and Health (NIOSH). The institutes have authority to control standards, provide training and legitimise occupational safety in the construction industry.

5. Analysis of surveyed data

5.1 Accident Statistics

According to the available information at the Labour Department, the statistics of fatal and non fatal accident reports are shown below. Every year 2500 to 3000 accidents were reported to Industrial Safety Division of Labour Department. Out of those accidents 40 to 60 were fatal and around 30% were due to constructions methods.

Table 3: Fatal and Non-fatal Accidents on construction sites in Sri Lanka from 2000 to 2007

Type of Accidents	Year							
	2000	2001	2002	2003	2004	2005	2006	2007
Fatal	16	19	13	13	12	14	15	19
Non-Fatal	138	123	121	86	45	50	89	113

(Source: Department of Labour)

According to their data most of the fatal accidents were reported to labour department, but only 50 to 60 percentages of non fatal accidents were reported. The rest of the construction accidents were not reported mostly as the relevant employers and managers in the industries do not know the requirements and the reporting procedures.

5.2 Losses incurred by accidents

International Labour Organisation (ILO) estimates that the losses due to accidents in GDP (Gross Domestic Products) amounts to 4 percent. The direct losses due to accidents are from medical expenses and compensation for workers. The Department of Health has to bear the medical expenses as the free medical facilities are given by Government.

The indirect losses will effect to employee, employer and government. Physical pain, mental effects and loss of valuable time are the main losses to employee. Other than the mentioned his family members have to spend their time for treatment at hospital, travelling and also to help the victim in case of injuries to organs. The victim might lose his earning capacity also. In case of fatal accident dependant have to envisage enormous difficulties.

5.3 Causes of accidents

Accident in industries occurred while performing tasks by workers due to improper work methods, unsafe behaviours, hazardous machine, hazardous material and hazardous working environment. Investigations and analysis of accidents revealed that 90% of accidents are from unsafe acts or behaviours. The common unsafe behaviours found at industry are, operating without authority, working with moving machinery, working without personnel protective equipment, wearing dangling clothes, unsafe lifting carrying and placing, using hand instead of using tools, unsafe handling of hazardous materials.

5.4 Safety details at site and awareness of safety

About 26% of contractors said they give instruction always before starting any works and 53% of contractors sometimes give the instructions. 21% of contractors never given or very rarely gave the instructions to workers. The safest construction method is adopted by 58% of contractors from their opinion while 16% of contractors sometimes adopted safest methods and 26% of contractors very rarely adopted into safest construction methods.

Scaffolds and ladders are most common devices found in building construction industry, used in order to work at height. Labours are well familiar to work with these devices and the safety precautions are found in very lower statistics. Around in one third of practices surveyed, replies found very poor and not sure about their safety.

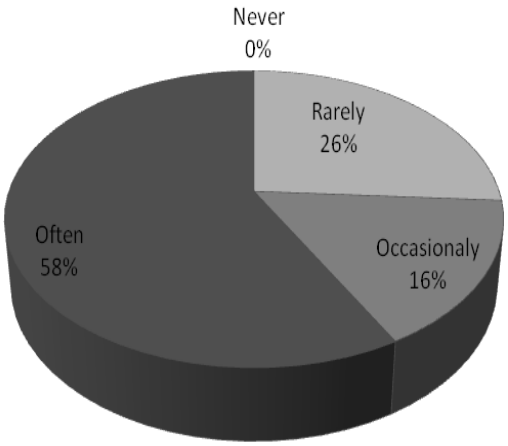

Fig. 1: Adoption of safest construction methods

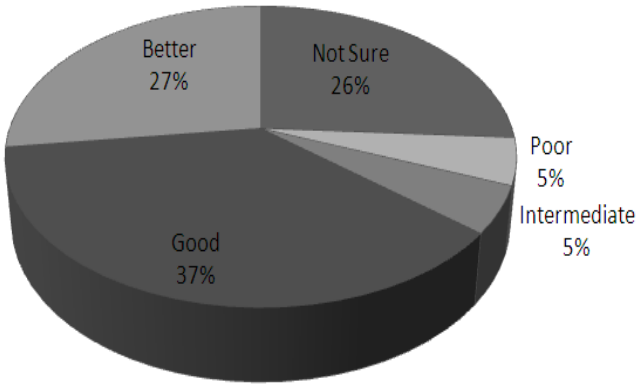

Fig. 2: Scaffolding and ladder safety

While using lifting appliances and the works of demolition & site clearance, site safety was good at half of the visited sites. Even though it received a better status at the sites to 26% and 16% respectively to the works mentioned. One third of the visited sites were given better safety precautions to electrical works while another one third of the sites were found good in the works. The survey recorded 5% of sites having poor safety systems to electrical works.

Meanwhile the responses of the queries to the works of Excavation and Earthworks, Roof Works and the Works using Compressed Air were about 60% good and the poor consideration were in very less amount. Welding works should be carried out with care with personnel protective equipments. But the responses left half of them good and only 21% found better situation, even 11% were not sure about their safety.

As same as the safety situation is intermediate wherein the works produce noise and vibration. While a considerable amount of sites, more than 15% found poor on this situation. This is a pathetic situation of likely to lose hearing ability and actual situation of such kind of work practiced in the Sri Lankan

building construction industry. Only a 20% of construction sites were given better safety precautions to handling hazardous substances and the level found good and intermediate in one thirds of the sites.

Site layout is helpful to the safest construction in the site; about 24% of contractors said they have better site layout and around 65% of contractors have sufficiently good site layout. Site clearance is carried out after the end of each working day at one third of the visited sites and nearly half of the contractors occasionally do clearance. But 21% of contractors very rarely do clearance after the end of day. Better safe access to site is given by 32% of contractors while two third of contractors provided considerably well enough safe access. But 5% of contractors provided very poor safe access to their site. All contractors have well equipped first aid box but most of workers did not know how to use that when an accident occurred. 16% of contractors have their own fire extinguisher and having ambulance is very poor.

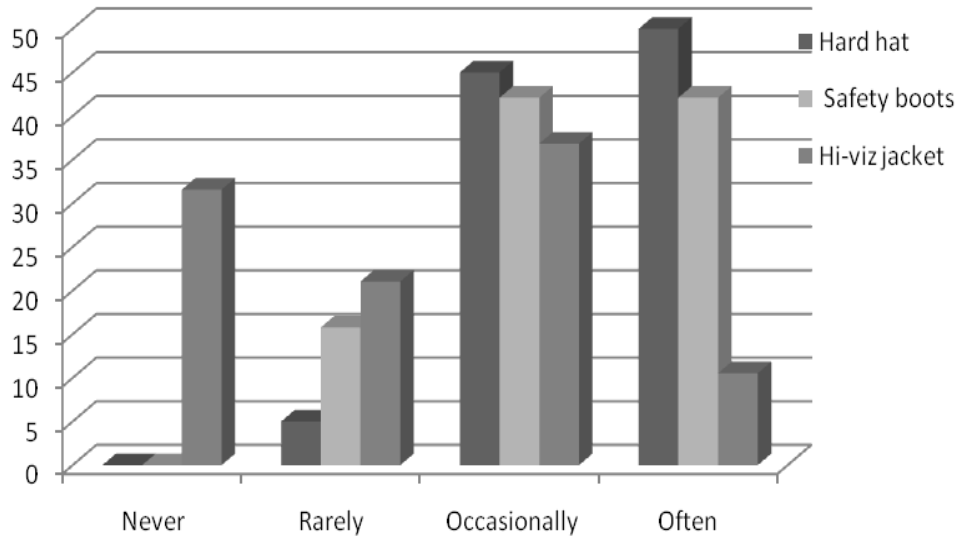

Fig. 3: Usage of Personal Protective Equipments (PPE)

Hard hat is often used in construction sites and safety boots also occasionally used in sites. But Hi-viz jacket is rarely used in construction sites. Rather than this all safety gloves, ear plugs and safety glasses also very rarely used in construction sites.

5.5 Safety planning and management

In Sri Lanka, Labour Department provide the safety regulations under act of factories ordinance. Contractors have been checked whether they aware on it or not. But most of the contractors not well known about this and received the reply that they followed some regulations for safety which were instructed to them in earlier. 74% of contractors have safety policies for their sites. Almost all C1 and C2 contractors have their policies, but most of them were not much aware of that. 24% of contractors did not have any policies or not sure about that. 16% of contractors never carried out any safety planning before. 84% of contractors carried out safety planning in different stages.

5.6 Accident methods and problems that prevent the improvement of safety

Major accident methods have been collected in the construction industry during the survey and listed below how they have been encountered. Most of the accidents were occurred due to improper handling of equipments and fall of objects from height.

Table 4: Accident methods

Accident methods	Proportion (%)
Fall of person	42
Fall of objects	68
Struck on stationary objects	58
Struck by moving objects	47
Exposure to electricity	37
Exposure to harmful substances	32
Exposure to heat	42
While handling equipments	84

Proportion (%) is the percentage of contractors that consider the particular accident method as the most common accident method. i.e. ex: 42 % of the surveyed contractors consider fall of person as the most common accident method whereas the balance 58 % of contractors do not consider this method as the most common method. Most of contractors did not follow proper accident reporting procedures. Only one third followed the proper reporting often and informed the Labour Department while another did it rarely. Some 21% of contractors reported accidents occasionally.

Table 5: What contractors do after an accident?

Action	Proportion (%)
First aid given at site	89
Take to the hospital	63
Inform victim's house	16
Grant paid leave to victim	32
Pay compensation	21
Report to Labour Department	11

Finding reasons to deviate from safe methods was one of main objectives of this survey. A significant percentage of contractors amounting to 58% said their poor safety methods were due to limited funds while the remaining 42% of contractors did not consider that the lack of fund prevent the improvement of safety in their sites. Actions and/or reasons with the proportions for the deviation from safe methods is given below,

Table 6: Problems that prevent for the improvement of safety in sites

Problems that prevent improvement	Proportions (%)
Limited funds	58
Poor knowledge	37
Unskilled labours	74
Construction delays	47
Working environment	47
Negligence of safety precaution	37
PPE are not available	26
When the job is small	37

5.7 Problems Associated with the Improvement of Safety

Contractors were asked about the problems that they have within the organisations which prevent further improvement of safety. Most of them replied about the financial problems. Some of the answers are listed below,

- Financial problems within the organisation.
- Poor allocation for the personal protective equipments.
- Lack of facilities to train the workers
- Lack of consideration by the top management.
- Ignorance by the site Engineer and other technical staff.
- Difficulties in getting experienced workers because of low salaries
- Lack of site co-ordination
- Lack of consideration by the client and Engineers
- No proper safety policy available for the organisation.

6. Outside construction organisations

The Institute for Construction Training and Development (ICTAD) deals much with construction industry with grading of contractors, providing training and advisory services. The institute is an organization set up by the government of Sri Lanka to develop and promote the domestic construction industry, contractors, professionals and work force etc. Customer oriented training programmes are arranged by Construction Equipment Training Centre (CETRAC) on request of clients on several categories including industrial safety. ICTAD had taken over the management of CETRAC and maintains reputation in training of industry workers and professionals for the maintenance and management of construction equipment and other engineering disciplines.

Training courses conducted at Operator Training Centre (OTC) cover safety, maintenance and operating techniques of construction equipments. As the trainers are highly competent, those are expected to account in safe construction methods.

Ministry of Labour Relations and Foreign employment is detailed with the task of managing both productivity and occupational safety and health also drafting relevant legislations so as to safeguard all working population in the form of an act for safety, health and welfare at work. A main division, Occupational Safety and Health consist of three sub divisions namely, Industrial Safety Division, National Institute of Occupational Safety and Health and the other is Occupational Hygiene Division. Thereby the Factories Ordinance is enforced to ensure safety, health and welfare of workers in the industry through carrying out several activities such as inspection, investigation and analysis of accidents and conducting safety awareness programmes. Safety auditing of factories and preparation of curriculum on safety, health and welfare for educational institutions are also carried out.

Sri Lanka Standards Institution (SLSI) manages the OHSAS 18001 Certification Scheme (Occupational Health and Safety Management System), which is an assessment specification enables an organization to control its occupational health and safety risks and improve its performance by minimizing employee related risks. Leading construction organizations are registered with OHSAS 18001 safety systems standards and undergone annual audit to comply with standards.

7. Conclusion

Questionnaire survey has been circulated within the building construction industry and most of the replies were successfully received though the survey carried out in person rather than through mail. The site visits were very effective to observe the actual safety situations of a construction site. Construction sites are subjected to pre announced quality assurance checks conducted by institutions and during the period, site safety conditions are strictly followed and standards are complied. Therefore actual safety conditions are not taken into the registry. But during the questionnaire survey the general safety level at site was portrayed.

The responsibility of the state in safeguarding most valuable and essential life of workers is highly depends on occupational safety and health. Ministries and institutes are detailed with productivity,

occupational safety and health. Certain authorities enact the acts and institutions order to follow regulations. Construction industry related acts and ordinance are collected and described for the betterment of the industry through following site safety.

Eventually comparing the survey results and expected degree of expectations site safety in construction industry is neither in better situation nor a poor situation. In the long run of the development of an organization, safety standards are kept following closer to standards. Most reputed and public quoted construction organizations are registered to safety system standards. Even in circumstances there are safety engineers appointed at sites to assure the standards.

8. Recommendations

As the construction industry contributes substantially towards the economic growth of the country, finding drawbacks is essential for its development. Quality, productivity and occupational safety and health are parameters on which the economy, development and elevation of living standards of a country stands. With the identification of related issues to building construction site safety measures are proposed to improve the situation. Before the commencement of works there should be a good plan. Accidents may occur due to inadequate safety practices in excavation work, working at height, manual work, electrical work, working with chemical substance etc.

Site planning should give safe access to the site. Providing fences will keep the unauthorized persons away. Warning signs are important at places to instruct workers to be cautious. Declaring proper walking and vehicle paths lead to safe access to working places. Keeping the site tidy and clean does not give room to vectors that carry disease. Day lights should be provided during dark.

Preliminary works for a foundation, underground structures or services has to be commenced with excavation. Stability of the ground can be verified by a competent person. During excavations adequate timbering should be provided and if the ground is unstable piling, close boarding or sheeting is required. Safe distance for the adjacent structures from the trenches should be determined with adequate precautions. Wherever the different levels exist, those must be protected for falling persons and objects to lower level. Appointing a well trained person to supervise the site is very crucial. The person should be vigilant in the case of heavy rain, interruption to work, damages to supports etc.

Working at heights is a common work found in construction works; it is needed to have a temporary structure supporting platforms. Scaffold must be erected by a competent person it should be closely kept to the work place. Although a safe means of access to working places should be provided. It is necessary to wear personnel protective equipments such as safety belts, helmets and boots. When working at roofs the precautions of working on scaffolds should be applied. Moreover edge protection, fence at opening and footboards are important to use.

Skilled labours and expert workmen are recommended for manual works. The use of personal protective equipments should be supervised. Usage of quality and correct type of tools will give a productive output. The tools should be properly stored and damaged tool should not to be used unless repaired.

Electric shocks, fire hazards, injuries caused during welding works are a type of burning and shock accidents. A common problem of electrical leakages can be avoided by not using temporary electrical connections. Ensure the correct type of electrical apparatus and check whether it is earthed. Protect the electrical cables from laying at wet grounds and on sharp edges and avoid reaching overhead lines. During the arc welding works ensure the earth connection to the frame. The welder and his assistants should wear suitable eye protectors and jackets. This welding area should be well screened from other works.

Keeping a well occupied first aid box ready to give first aid at site is a must. Whenever accidents occur at site, first aid should be given to the person and has to be admitted to a nearby hospital. Granting paid leave and paying compensation will protect the victim's welfare and abide by the ordinance. Accident reporting must be registered to the labour department because of evaluation and researches.

During the questionnaire survey and discussions, contractors expressed that lack of funds contribute to lesser amount of safety precautions given. Therefore it is recommended here to include an adequate amount of money to make safety precautions either in conditions of contract or in bill of quantities (BOQ). There are no safety requirements or audits done by contractor grading process. It is the right time to include the safety requirements for the grading of contractors at national body, the Institute for Construction Training and Development. Further, the survey recommends to appoint a well trained personnel in all construction sites responsible for site safety and include this requirement in the act to be enacted.

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