Evaluation of Safety Level at Construction Sites in Sri Lanka

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Abstract
This study investigates the safety practices that were adopted in the construction industry in 2004 with a view to improve the safety standards. Analysis shows that in Sri Lanka, about 25% of the total labor accidents were from the construction industry, and the fatal accident rates in construction industry were higher than other industries. Questionnaire survey was also employed to accomplish the objective and results revealed that skilled and unskilled labourers do not have adequate knowledge about safety and safety signs or equipment, and further it shows that few labourers who use safety equipments without toplevel commitment have had accident experience in construction sites elsewhere. The vigilance of safety signs among the employees were checked by showing twelve essential signs, and results revealed that the most of M1 and M2 employees identify the considerable amount of signs; on the other hand it was very low among the workers lower than M4 level. Survey group felt that most of the sites are below the required standard in term of safety. Finally, this study highlights and recommends the important issues and measures that could be used to improve the safety level in construction sites in Sri Lanka.

Introduction
There are a large number of skilled and unskilled labourers attached to the construction sites in all over the world. Like other developing countries, in Sri Lanka, safety at construction sites is one of the complex issues, and the accident rate in construction sites is higher when compared with the other industry⁵. There are several justifying factors that support the need for effective construction safety programmess. Due to lack of safety program, the labourers are facing problems even for getting proper compensation. Since, the construction managers have sole responsibility for delivering the project goals, at-least they should be held responsible for the failure of safety performance. In Sri Lanka, there are very limited legislation particularly for health and safety of the workers at construction site and there is no mechanism to measure the safety level at construction site. If there is a tool for measuring safety level at construction sites then it will be used as tool for any one to measure and compare the safety level between constructions sites. In order to identify construct the mechanism, the contributing parameters should be well evaluated. The contributing parameters directly related to the current practices and ability of the construction industry to cope with the situation including labourers' knowledge. Therefore in this study it was decided to evaluate the safety of the construction sites considering these parameters.

Objective
Research on accident and safety at construction sites has received a considerable attention in developed countries, but sufficient research works have not been carried out in Sri Lanka. Therefore, this study has been carried out with an intention of analyzing and evaluating the safety level at construction sites in Sri Lanka. The main objectives of this project were divided into two:
1. to analysis the present and past accidents statistics in the construction sites, and
2. to investigate the current practices hence to increase the ability of the industry to cope up with the safety measures.

Construction industry and safety regulations
The national registration and grading of contractors was started from January 1939 by Institute of Construction Training and Development (ICTAD) in Sri Lanka. The registration of construction contractors is grouped into ten categories based on financial and man power consideration. The contractors have also been registered under the fields of specializations such as Building construction, Highway construction, Bridge construction, Water supply and
Drainages construction, Dredging and Reclamation construction, and other specified heavy construction. In 2004, the total numbers of registered contractors in the nine provinces of Sri Lanka are given in Table 1 as per ICTAD[21]. Project handling capacity decreases with from M1 to M10.

Table 1. Total number of registered contractors in each province of Sri Lanka

<table>
<thead>
<tr>
<th>Grade</th>
<th>Financial Limits (X = Project Cost in Rs. Million)</th>
<th>Central</th>
<th>North central</th>
<th>North</th>
<th>North western</th>
<th>Eastern</th>
<th>UWA</th>
<th>Southern</th>
<th>SAB</th>
<th>Western</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>X ≥ 300</td>
<td>23</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td>300 &gt; X ≥ 150</td>
<td>13</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M3</td>
<td>150 &gt; X ≥ 50</td>
<td>18</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M4</td>
<td>50 &gt; X ≥ 20</td>
<td>25</td>
<td>69</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5</td>
<td>20 &gt; X ≥ 10</td>
<td>18</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M6</td>
<td>10 &gt; X ≥ 5</td>
<td>55</td>
<td>122</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M7</td>
<td>5 &gt; X ≥ 2</td>
<td>243</td>
<td>902</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M8</td>
<td>2 &gt; X ≥ 1</td>
<td>102</td>
<td>305</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M9</td>
<td>1 &gt; X ≥ 0.5</td>
<td>148</td>
<td>292</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M10</td>
<td>0.5 &gt; X</td>
<td>701</td>
<td>1980</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: List of building construction contractors-2004, Institute of Construction Training and Development (ICTAD), Sri Lanka

The Factories Ordinance No. 45 of 1942[22] together with the amendment in 1946 has been in operation since 1st of January 1950. The amending Act. No. 54 of 1961, the Law No. 12 of 1976, and the regulations made there under, have further strengthened the legislative provisions to ensure the safety, health and welfare of workers in factories of Sri Lanka. In addition to these certain other premises, which do not come under the factory definition, are also brought in within the term factory by special definition as given in ICDAD publication[22].

Construction accident trend in Sri Lanka

A simple form of accidents trend is given in Table 2, and the number of accidents in construction industry is considerably higher[13]. There were 12 fatal injuries in 1993 and similar figure in 1994. The number of fatal accidents was minimum of 3 in 1996 and maximum of 16 in 1995. The difference in fatal accidents between 1995 and 1996 is considerably higher than other years. The reasons for these fatal accidents include fall, struck-by or struck-against objects, lifting and carrying, machinery, electricity, transport, and fire and/or explosion.

Table 2. Accidents in Construction Sites in Sri Lanka

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal Accidents</td>
<td>12</td>
<td>12</td>
<td>16</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Total Accidents</td>
<td>292</td>
<td>230</td>
<td>77</td>
<td>57</td>
<td>114</td>
<td>138</td>
<td>113</td>
<td>95</td>
<td>76</td>
<td>75</td>
</tr>
</tbody>
</table>

Survey overview

Although some official accident statistics in construction sites are available in Sri Lanka, the under-reporting rate is expected to be quite high. Therefore available data are not as comprehensive and complete, as compared to those available in most developed countries. Unreliable evidence suggests that many of the accidents, especially non-injury or slightly injured accidents, were settled without any official report being filed. As a result, a questionnaire survey was planned and deemed to be the most appropriate method to gather the
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necessary information needed for this study. Due to resource and time constraints, the survey was limited to a sample size of 80 contractors. Further 200 laborers were interviewed at convenient locations within the construction sites. These interviews were conducted between April and August of 2004 by engineering undergraduate students of the University of Ruhuna in Sri Lanka. Although conscious effort has been made to ensure that the sample is as representative as possible, there is no simple and feasible way to check for potential sampling bias. Therefore, this study should be considered as exploratory albeit one that is able to provide insightful and useful information.

During analysis, each contractor (employer) and three construction employees were given unique identification numbers, and the responses to each question given by the respondents of both categories (employer and employees) were then transferred to two different data sheets. The questionnaires provided a multiple-choice answer to each question. At first, the overall characteristics were obtained by considering all data together, without distinguishing grades, and then the contractors and workers were grouped as given in Table 3.

Table 3 Surveyed contractors and workers

<table>
<thead>
<tr>
<th>Contractor group</th>
<th>Grades of Registration</th>
<th>Surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Contractors</td>
</tr>
<tr>
<td>A</td>
<td>M1, M2</td>
<td>27</td>
</tr>
<tr>
<td>B</td>
<td>M3, M4</td>
<td>22</td>
</tr>
<tr>
<td>C</td>
<td>M5, M6</td>
<td>31</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>80</td>
</tr>
</tbody>
</table>

The group characteristics were obtained by considering the data pertaining to each category. The analysis is based mainly on overall characteristics by combining all contractors. Survey was conducted among 200 employees (workers both skilled and unskilled). Survey indicates that 56% of workers age limit had a top sealing of forty years, and most of them had been educated below G.C.E. (O/L).

Workers' Accident Experience

The survey results show 89 workers had past accident experience. Table 4 shows the causes or sources which creates accidents. These types or categories of accident occurrences were used in governmental accident records that were available with the labour department.

Table 4 Source for the construction accidents

<table>
<thead>
<tr>
<th>Group</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
<th>A5</th>
<th>A6</th>
<th>A7</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>4</td>
<td>9</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>C</td>
<td>-</td>
<td>9</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>14</td>
<td>27</td>
<td>8</td>
<td>4</td>
<td>6</td>
<td>23</td>
</tr>
</tbody>
</table>

Where:
- A1: Contact with or electric Discharge
- A2: Trapped by collapsing or over turning objects
- A3: Struck by a falling object
- A4: Struck by a moving object
- A5: Trapped in or between object
- A6: Fall of person from height, and
- A7: other reasons

As shown in Figure 1, a higher percentage (30%) of the construction accidents occurred as a result of struck by falling objects. The category A7 includes the labourers affected while handling and lifting building materials. Low percentage of accidents happen by trapped in between two objects.

Figure 1. Causes for construction accidents in construction sites
[notation for A1 ~ A7 given in Table 4]

Use of Safety Devices at Construction Sites

Workers willingness to wear the safety devices was tested among skilled and unskilled workers and results are given in Figure 2.
Figure 2. Willingness to wear safety equipment

Result indicates 53% of the workers generally like to wear safety devices without any commitment from their top management. Some workers said they never wear any safety equipment, others said that they wear due to pressure from the top management; almost 47% of the workers do not have the safety knowledge. Group-A workers have far better safety knowledge than other groups. A comparison shows that skilled workers take more precautions than the unskilled workers.

Knowledge of Safety Signs
Knowledge of safety devices or signs among the workers was checked and results are shown in Figure 3. Twelve important safety devices or signs which were generally used for improved safety were shown to the workers in the construction sites, and asked them to identify those signs. Those signs includes three prohibited signs such as smoke and naked flames prohibited, do not extinguish with water and pedestrian prohibited; nine mandatory signs such as wear eye protection, wear hearing protection, wear head protection, wear foot protection, wear hand protection, wear respirator, wear safety harness/belt, use adjustable guard and wash hand. The total number of signs each worker identified was noted down, and group results were given below in Figure 3, for skilled and unskilled workers.

Figure 3. Percentage of workers identified signs

The result is clearly indicating that Group-A workers both skilled and unskilled identified many signs than others. Only one worker out of two hundred identified all the twelve signs and nearly 17% in Group-A, 27% in Group-B and 62% in Group-C workers identified less than four safety signs.

Limitations
Due to constraints like time and fund availability, the number of questionnaires conducted from workers and construction managements were limited to 200 and 80, respectively. The survey was conducted in Greater Colombo area, Ampara and Trincomalee districts. Most of the sites visited were building construction. This research project was limited to considerably larger project, cost over 5 million as per costs based in year 2002-4. Therefore in future studies small projects will also be taken into account.

Results
The Study[3] reported that the percentage of fatalities and non-fatalities of construction accidents with respect to all industrial accidents were 25% and 4.5%, respectively. The numbers of non fatal
accidents show a decreasing trend while fatal accidents show an unchanged trend over the year. Thus, the safety practices were evaluated by two different questionnaires; one among workers and other one among management of the construction sites. Similarly safety level also seems to have a strong correlation with the project handling capacity of the contractor. It was found that most of the M1 and M2 contractors (Group-A) were following safety legislation and care safety, health and welfare of their employees, but these are considerably low among the lower level of contractors. Dangerous site conditions were observed in 42% of the sites visited by the survey group. Such sites should consider appropriate measures to improve the situation. About 82% of the sites had at least a first-aid box or facility. It seems that only about 70% of the contractors have indicated that their employees are insured against accident while at work. Since accidents are likely to occur at any site, promotion of insurance to all employees should be aimed at by establishing a proper mechanism. About 53% of the construction firms have indicated that they have a safety policy and 57% have indicated that they maintain an accident record book. Usage of the personal protection tool/equipments at construction was very low. Only 17% of the workers wear safety helmets, gloves, safety shoes and uniforms at all time. The rest of the workers, either use them sometimes or never use them. This indicates a very low level of safety measures adopted for personal protection at construction sites. Perhaps, this may be due to the working culture in this country, however, this situation needs to be improved and hence it may be necessary to make aware that needs to adopt a higher level of personal protection. Further, group-A workers have more knowledge about safety signs and safety measures than other groups workers. Frequent safety awareness programs were conducted by most of the group-A contractors than the others. Moreover group-A workers have more opportunities to deal with safety equipment and measures.

Recommendations

This study revealed that safety level at construction sites in Sri Lanka could be further improved by providing safe environment at work places by a strong government policy and enforcement. Vital safety improvements must be made from top to bottom level in the field of construction. This study suggests the following recommendations to improve the safety at construction industry:

1. When a client awarding a contract, client should see the contractor’s past safety records as well as fund allocation for safe working environment at construction site.
2. The contractor should plan the safety measures before starting the work. One could easily do this by using the checklist similar to the one given in the study.
3. When a main contractor deals with a subcontractor in the case of labour supply, the subcontractor should clearly identify risk and subsequent safety measures that have to be taken up in case of an accident.
4. Labour supplying sub-contractors should also provide at least a basic knowledge about the safety to their workers, by educating the advantages of wearing safety devices. There should be periodical safety awareness programmes among the workers.
5. The workers must learn and have adequate knowledge in basic first aid activities.
6. In Sri Lanka, there is no agency for monitoring the site safety; so labour department should appoint a committee to check the site safety aspects. Factory inspecting engineers should frequently visit all the construction sites under their jurisdiction. Study provide a check list, by using this check list an inspecting engineer or a contractor can check the site for improving safety level.

Conclusion

Accident statistics in Sri Lanka show that the majority of them are fatal and serious accidents. The total number of accidents in construction sites remain unchanged or it shows a downward trend. Stuck by falling objects was a serious nature to have an accident than other kinds. The survey conducted for the employees shows that they do not have adequate knowledge about safety or safety equipment. Even few labourers who make use of the safety equipment without the engagement from the top level management have had accident experience in construction sites elsewhere. Labourers working in good contractors have more opportunity to use safety devices than the others.

References

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