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Obligation and Violation of Safety Standards in Construction Industry of Pakistan

Engr. Muhammad Yousaf* Dr. Ahmad Bilal khattak
School of Management, Riphah International University, Islamabad Campus, Pakistan

Abstract
In developing countries like Pakistan, construction is one of the most hazardous industrial sectors. Every year, thousands of workers received serious injuries and accidents and this uninterrupted dilemma is growing day by day. Due to this alarming position, there is a need to evaluate the construction accidents along with their causes related to them. This research presents the identification of the factors contributing to construction accidents in Pakistan and suggests key prevention measures on the basis of statistical analysis. A survey questionnaire has been developed and used for the data collection. In total, 164 respondents ranging from foreman to unskilled labor were approached and the questionnaires were filled. Response rate was excellent resulting in 143 valid responses. The results were analyzed and ranked. The accidents are attributed mainly due to. (a) tool accidents; (b) fall from height; and (c) struck by material. Results indicated that management factors largely contributing to the accidents causation rather than workers factors or social factors and need serious consideration. Based on the results of the analysis, prevention measures are recommended which includes: (i) involvement and commitment of top management; (ii) safety education in terms of training for all managers and supervisors; (iii) awareness and identification of unsafe work practices (iv) necessity of personal protective equipment and first aid equipment; and (v) reporting and maintaining injuries and accident records. This work may be useful for the construction practitioners to minimize the accident rate at High rise building construction Projects.

INTRODUCTION

One of the most hazardous industries all over the world is construction (Kartag 1995; Carter and Smith 2000: Whitlaw 2001). In developed countries, Safety in the construction industries is strictly legal and implementation of safety management systems that designed to minimized the accidents at work places.. However, In developing country such as Pakistan there is poor safety management. It is commonly known that construction industry have serious implications for both in financial and in humanitarian terms. Many problems may causes during construction accidents, such as demonization of workers; disturbance of site activities; Progress of project delay; and the overall cost affect adversely, Outcomes and reputation of the construction industry. Construction in developing countries is more labor intensive than that in the developed areas of the globe, involving 2.5-10 times as many workers per activity (Koehn et al 1995) Appropriately defined classification categories are also important in forming the basis for effective accident prevention programs (Hinze et al. 1998). (Whitington, 1992) the management and organizational factors of construction accident analyze to attempted. A serious problem in the construction industry had always been safety. In the United States, Construction industries was reported that 25% of all occupational fatalities, when they made up only 10% of the United States‘ work force (National Safety Council 1997). In Kuwait, the industry accounts for 45% of all occupational fatalities (Kartat and Bounz 1998) and in Hong Kong the industry accounts for more than a third of all Construction industry participating with 2.5 GDP playing a huge role in the economy of Pakistan. Construction industry employed 6.29% directly and 30-40% indirectly of the total work force of Pakistan (*Survey of Pakistan 2006)*. According to the federal bureau of statistics the employed persons of distribution percentage is suffered injuries and of age 10 at the rate of 13.21% in 2006, 14.55% in 2007 and 14.93% in 2008 indicating the increase year after year. The rate of accidents and occupational injuries in construction threating increase.

OBJECTIVES

The objectives of this research are as follows:-

- To overview the theories of accidents and OSHA standards.
- To assess obligation and violation factors contributing to construction accidents in projects by conducting a questionnaire based survey, to obtain necessary knowledge for analysis.
- To suggest key prevention measures for construction accidents on the basis of statistical analysis, to improve construction safety.

JUSTIFICATION

It‘s a fact that large share of construction work being performed by human resources has always proves and led to increased number of site accidents. In developing countries like Pakistan, Recent technological improvements respond to construction industries. Lack technology and attentions, however, has resulted in an unsafe and poor quality construction environment. Since no work yet being done in Pakistan relating to accident analysis and its

prevention in construction industry; this research point out to attempt the study of accident patterns (qualitatively) for different building projects and then analyze them by using a quantitative approach. On the basis of the study some appropriate recommendations are suggested that could be helpful in reducing the site accidents.

METHODOLOGY

Personal data of injured worker

The first section of the questionnaire is concerned with some personal information of the injured worker involved in the accident. It includes the characteristics of an injured person i.e. his age, job status, marital status, education, years of experience and income per day (in Pak rupees).

Accidents Category and Site Condition

In section 2 the questionnaire is related to the nature and type of accident that occurred to the injured worker and different site condition that caused that accident on the construction site. The type of accidents includes:

- By electricity,
- Accident by crane,
- Explosion of gas,
- Structure failure,
- Fall from height,
- Struck by material,
- Tool accident,
- Fall from roof opening,
- Fall from roof opening,
- Fall from ladder,
- Falling object from height and others.

This part also includes the time at which accident happened the day time, during breaks, during overtime or during nights the weather condition of the site at the time of the accident (e.g., hot, humid, cold) the season of the year .All these questions were related to the site and conditions that the worker has experienced when he got injured.

Ranking of Factors Contributing to Construction Accidents

The first two parts of the questionnaire is related to the worker and site condition he has faced when the accident happened, In total, 20 causes of accidents were than finalized and they were categorized in to three groups: These are factors of management site related.; factors of worker related; Social and factors of project related, the detail of each group are as follows.

i. Management Site related factors

In this group, the factors are under the control of site management and that are contributing highly in cause of an accident. These factors are:

i. Safety procedures were not clearly specified.
ii. For the specific task tools were not used correctly.
iii. Lack of supervision of safety engineers.
iv. Regulation of safety were not followed.
v. Safety engineer on site not available.
vi. Safety items were not available on construction site.
vii. Weekly safety meetings were not held.
viii. Lack of implementation for workers job safely.
ix. After completion the task, lack of motivation for workers.

ii. Worker related factors

This group highlights the workers related factors, and indicates human and behavioral aspect that are causing or leading to the construction accidents. Six factors are there in this group which is as follows,

i. The worker was suffering from health problems.
ii. Physical fatigue caused the accident.
iii. The workers accidents occurred due to lack of training.
iv. The lack of satisfaction of workers to the nature of job.
v. Workers was not wearing personal protection items(PPE).

iii. Social and project related factor

This final factor comprises of;

i. Housing, living and transportation facilities not giving for the workers.
ii. The job of task was too difficult to perform.
iii. The worker had not enough sleeping hours.

In each group, all the factors were written in form of a statement and each worker is asked to answer in a range

from Strongly Agree to Strongly Disagree. (Likert Scale) This range is measured on a scale of 5 with 5 being the highest and 1 being the lowest as shown in the Table.

Table: Response Ranges (Likert Scale)

Response	**Impact**	**Ranked**
High Disagree	lowest effect	1
Moderate Disagree	low effect	2
Neutral	Neutral	3
Agree	High effect	4
High Agree	Highest effect	5

DATA COLLECTION

Since most of the workers have the basic reading and writing skills, some of the questionnaires were also interviewed by the researcher personally. On both the projects, special assistance was provided to the researcher by the site engineer and safety supervisors to acquire maximum feedback. Total 164 workers were approached on both the Projects 143 valid responses out of the whole was achieved for the study analysis.

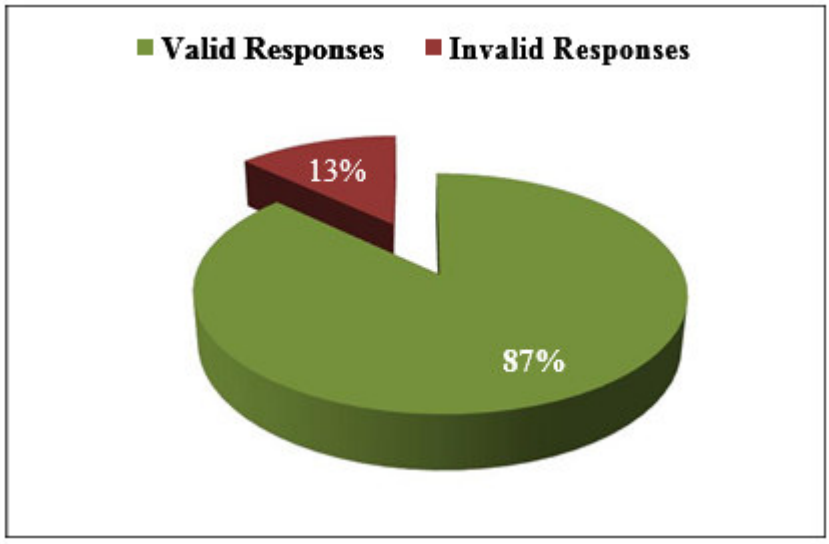

Figure: Response rate chart

Results and Analysis

Statistical techniques are employed for the analysis of the data collected from the requisite survey conducted by the researcher. Various statistical tools were used to analyze the characteristics of the injured worker and accident site conditions in order to highlight the key safety issues. The factors attributing to site accidents are analyzed on the basis of Likert Scale with range of 1-5 and ranking of different factors were determined by Relative Importance Index RII), suggested by Kometa et (1994). This method has been used by Chan and Kumaraswamy (1997),. The ranking of each factor has been analyzed by using the following expression.

Relative importance index = $\frac{\sum a_i x_i}{AxN}$ Eq. (1)

Where a_i is a constant expressing the weight of the i^{th} response and x_i is the frequency of the i^{th} response of the total responses for each cause, i is the response category index where i=1, 2, 3,4 and 5 respectively. In this case 1 is not significant and 5 is extremely significant, A = the highest weight (i.e. A = 5 in this case), and N = total number of respondents (i.e. N = 143 in this case). The Value of Rll is ranged between 0 to 1.

A total of 143 responses were collected from the site workers. The survey through face to face interviews was conducted during the period of October, 2015 to April, 2016 with the help of Site Safety supervisors because of language barriers between the Author and the site workers.

CHARACTERISTICS OF THE INJURED WORKER

The first part deals with the general information about the injured worker, their personal characteristics including (age, marital status, job title etc.). Brief of each of these are described as under,

i. Age wise Distribution

Table: Accidents in terms of Worker's Age

Question	Criteria	Frequency	Percentage (%)
AGE (Years)	less than 18	14	10
	18-25	44	31
	26-35	52	36
	36-50	23	16
	Above 50	10	7

Table shows the percentage distribution of the accident in terms of workers ages. 36% of the sample (52 cases) is involved in accidents with an age bracket of 26-35 years old, while 31% (44 cases) are 18-25 years old, 16% (23 cases) are between 36-50 years old, and 10% (14 cases) is younger than 18 years old. The Graphical representation is represented in Fig indicating that out of the total sample size the maximum percentage for cases involved were in the middle age ranging from 26-35. It also indicates that 10% of the cases were less than 18 years old. It is pertinent to mention here that according to the labor law of Pakistan workers less than 18 years old are not allowed to work on the construction site, clearly shows the violation of the laws.

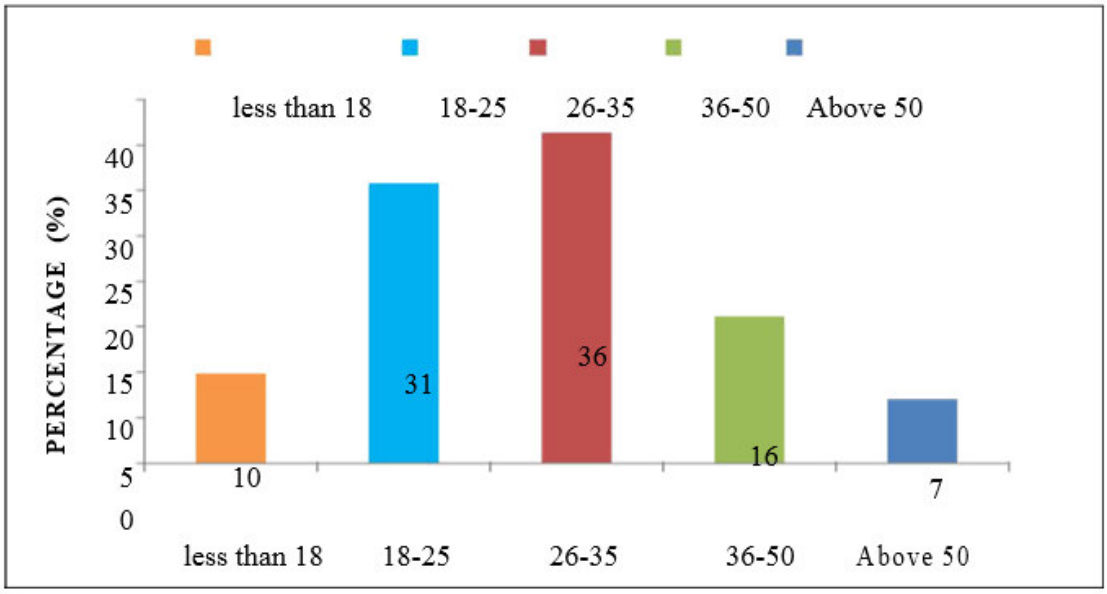

Figure: Age of the workers

ii. Marital Status

As illustrated in the Fig.4.2 57% (81 cases) of the workers involved in accidents are married and 43% (62 cases) are single which is not an unusual trend. However, it should be a concern with a reason that in Pakistan the married workers on the sites have to look his whole family individually.

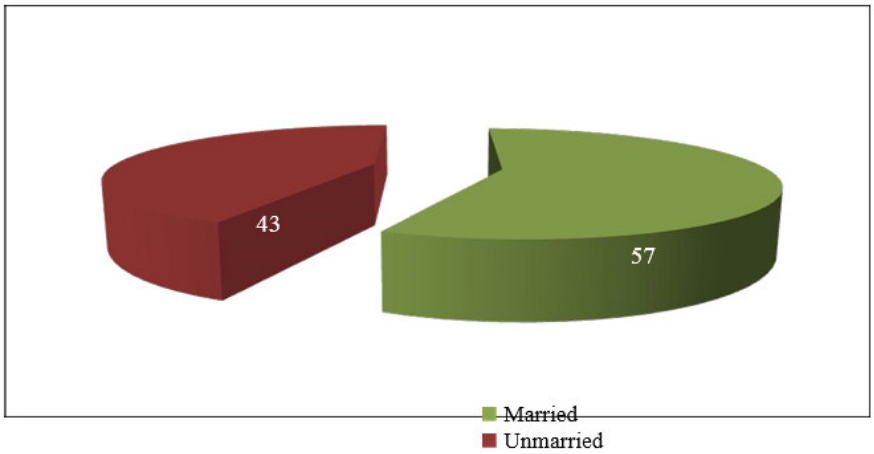

Figure: Marital status of the workers

iii. Job title

The workers in terms of their job that includes Foreman/Technician, Skilled Labor, Unskilled Labor, Helpers, is shown in the following Table:

Table: Accidents in terms of Personal Data (Job Title)

Question	Criteria	Frequency	Percentage (%)
Job Title	Foreman/Technician	20	14
	Skilled Labor	46	32
	Unskilled Labor	74	52
	Helper	3	2

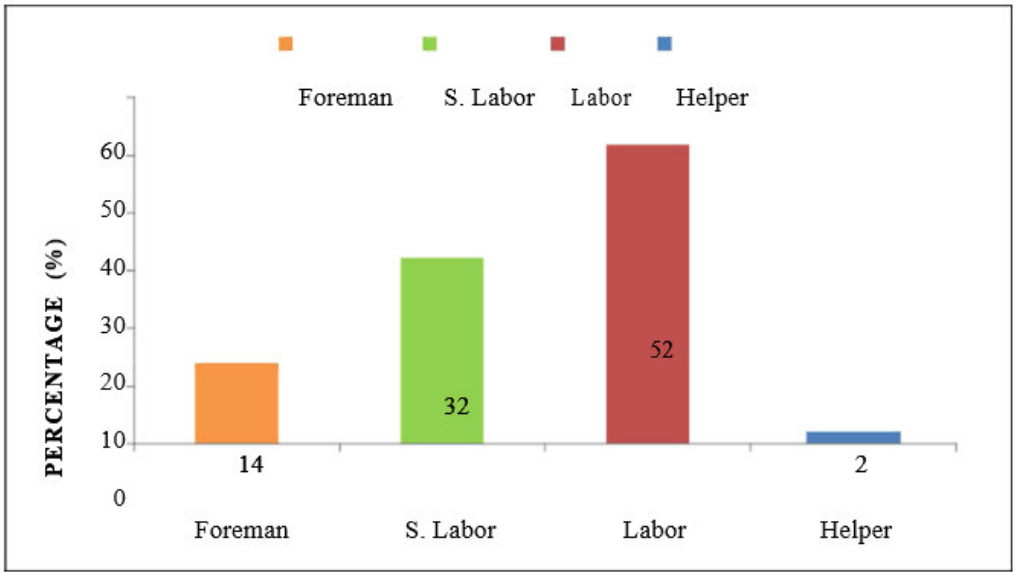

Figure: Job title of the workers

Table Shows the graphical representation that 74(52%) are unskilled labor while 46(32%) are skilled labor and 20 (14%) are Foremen/Technician and 3(2%) are helpers.

iv. Education

Table: Accidents in terms of Personal Data (Education)

Question	Criteria	Frequency	Percentage (%)
Education	Illiterate	26	18
	Basic/Primary	48	34
	Secondary	62	43
	Diploma	7	5

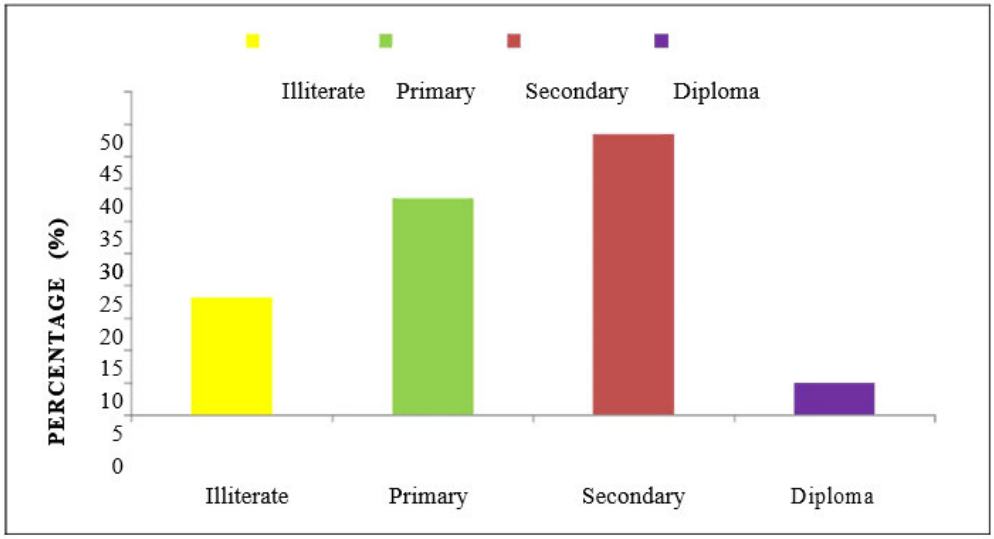

Figure: Education of the workers

Education plays a vital role in the improvement and decrease of accidents at the sites. As shown in the Table 1-c, the data distributions in terms of education indicates that more than 50% of the workers have only basic primary education up to 4th or 5th standard. This shows that less the education, more will be accidents. Out of the 143 workers, only 5% have diploma degree, which clearly depicts the lack of education on these construction projects. The workers having secondary education(6th Standard to matriculation) were (62) 43%. 48% of the workers of the total sample were educated and have reading and writing skills.

The results illustrated from Fig . are very common in developing countries like Pakistan where education for workers is not considered as an important factor rather the focus and emphasis is on the level of skill.

v. Years of Experience

Table: Accidents in terms of Personal Data (Years of Experience)

Question	Criteria	Frequency	Percentage (%)
Years of Experience	1-5	28	20
	6-10	61	43
	11-15	25	17
	16-20	12	8
	More than 20	17	12

Table indicates that maximum percentage of accidents lies in the criteria between 06-10 years of experiences while 20% of the sample was in the range of 1-5 years' experience, 17% in the range of 11-15 years, 12% with workers having experiences more than 20 years and 8% in between 16-20 years experiences. The maximum number of accidents were in the experience range of 1-10 years which is more than 60% of the sample size shows that the less the experience the more will be chances of accident. Also there is gradual decrease in the accident as indicated by the graph in Fig.4 from 6-10 years to 16-20 years (i.e. 43% to 8%) respectively but there is sudden increase to 12% with workers having experience more than 20 years showing that with age 50 or above chances of accidents increases. As elaborated in Fig1.more than 50 years old have a percentage of 7% of the sample along with 16% of workers having ages between 36-50.

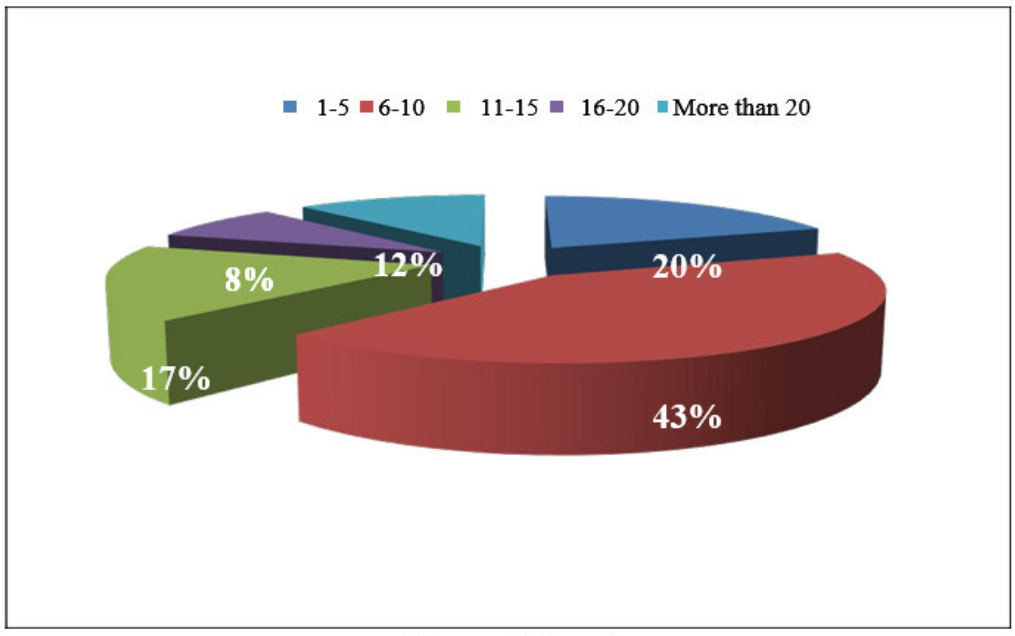

Figure: Years of experience of the workers

vi. Income Status

Table shows that the sample of distribution income/day, where 77(53%) of the sample have income/day between 200-350Rs, 52(36%) have (350-500) Rs/day, 10(7%) sample with more than 500 Rs/day and 4(3%) with less than 200 Rs/day.

Table: Accidents in terms of Personal Data Income/day (Rs.)

Question	Criteria	Frequency	Percentage (%)
Income/day (Rs.)	less than200	4	3
	200-350	77	53
	350-500	52	36
	More than 500	10	7

It is concluded from the above results that the frequency of accidents increase with a decrease in the level of skill. The results also indicate that the max strength of unskilled labor was there at the two projects conducted by the researcher. Table 1b illustrating that 54% of the sample was unskilled labor having income between 200-350 Rs/day mostly.

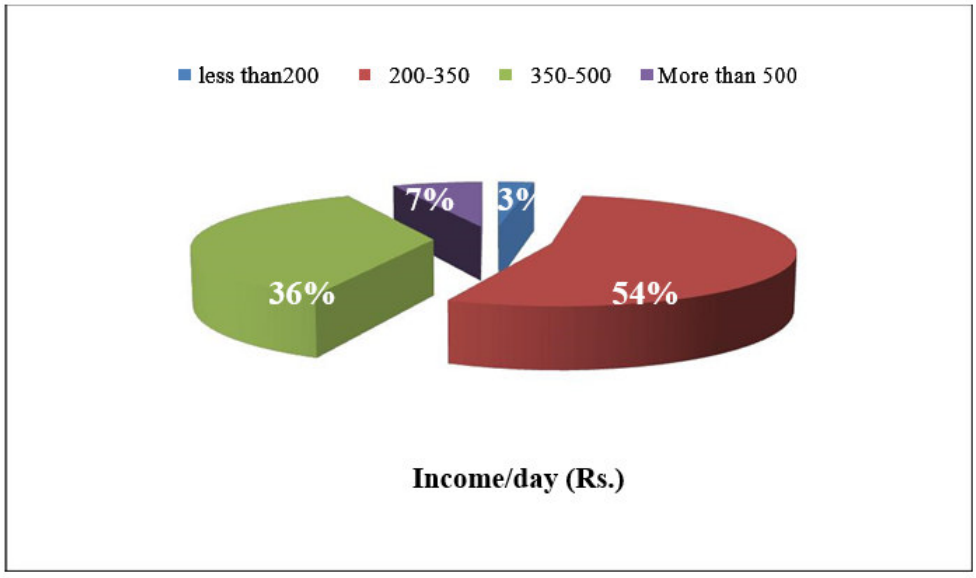

Figure 4.6: Income/day (Rs.) of the workers

ACCIDENTS AND SITE CONDITION

Types of Accidents

Table: Accidents Types and Numbers

Question	Criteria	Frequency	Percentage(%)
Income/day (Rs.)	Contact with electricity	7	5
	Crane accident	3	2
	Gas explosion	2	1
	Structure failure	1	1
	Fall from height	30	21
	Struck by material	27	19

Question	Criteria	Frequency	Percentage(%)
	Tool accident	55	38
	Fall from roof opening	4	3
	Fall from ladder	5	3
	Falling object from height	5	3
	Others	3	2

Table shows the distribution of accidents types. The maximum percentage of 38% of the sample was accidents due to tools while 21% was fall from height and 19% was injured by struck of material. As shown in the Table unsafe or improper use of tools cause many injuries, The possible reasons are due to lack of inspection of tools & adherence to site safety procedures or manuals Furthermore, many serious accidents results from fall from (height, roof opening and ladder). This is due to no safety training program for the workers. While interacting with site officials it was revealed that there were no laid down procedure for the assigned job.

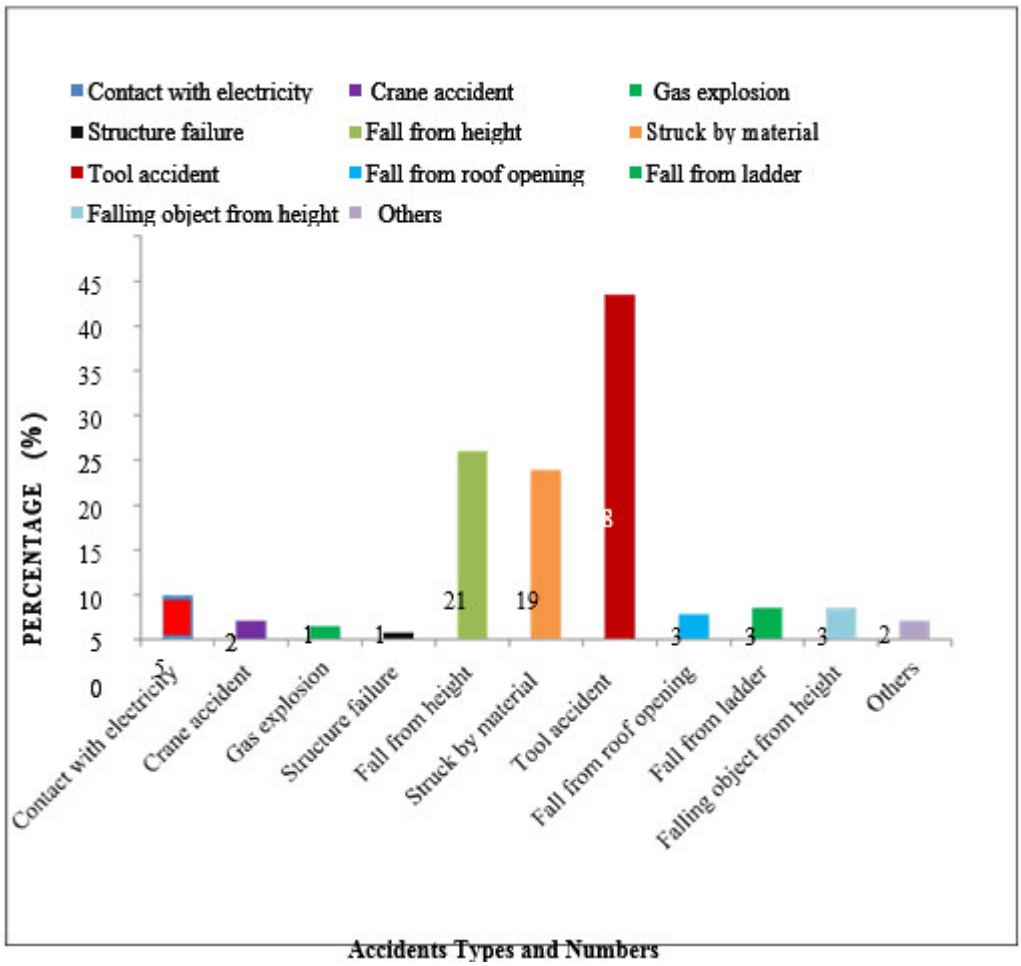

Figure: Accidents Types and Numbers of the workers

i. Time of Accidents

Table : Accident time over a Period (day)

Question	Criteria	Frequency	Percentage(%)
The Injured worker was Working	First hour of working	49	34
	During the working Day	42	29
	During Breaks	9	6
	Last hours of working	22	15
	During Overtime	21	15

The results of survey showed that injuries took place randomly. Table shows that 49(34%) of the accidents occurred during the working first hour while 42(29%) of the construction accidents happened during the normal working hours, 15% of the accidents occurred in the working day of last hours and overtime respectively and 9(6%) of the accidents occurred during breaks. The results showed that the least productive period is during the start of the day because the workers have to regain their rhythm and momentum of work, which increases the chances of errors and mistakes.

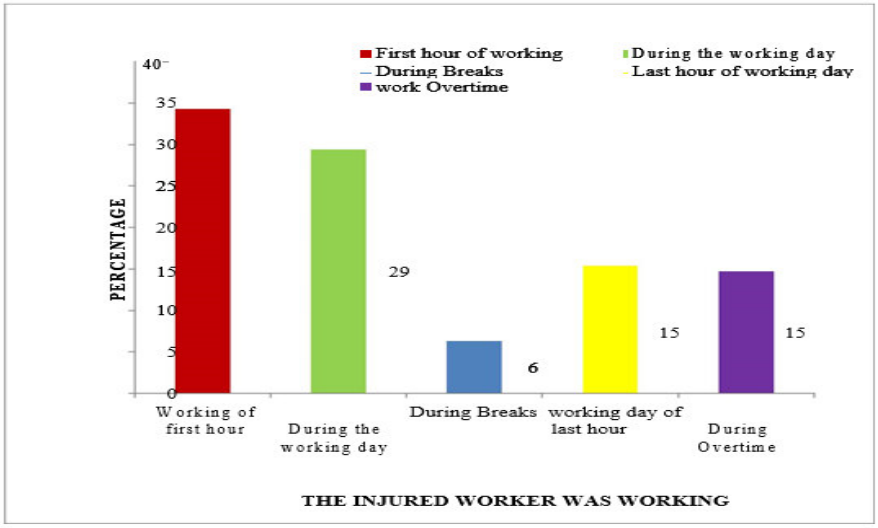

Figure : Working Time for the Injured Worker

ii. Weather conditions

Table: Weather Condition

Question	Criteria	Frequency	Percentage(%)
Weather Conditions	Hot	88	62
	Cold	34	24
	Humid	8	6
	Rain	13	9

The results in Table illustrates the weather conditions for the occurrence of accidents. The maximum percentage of the accidents occurred in hot weather conditions (Temperature range 34C-50C) i.e. 88(62%) 34(24%) of the workers were effected in the cold climate

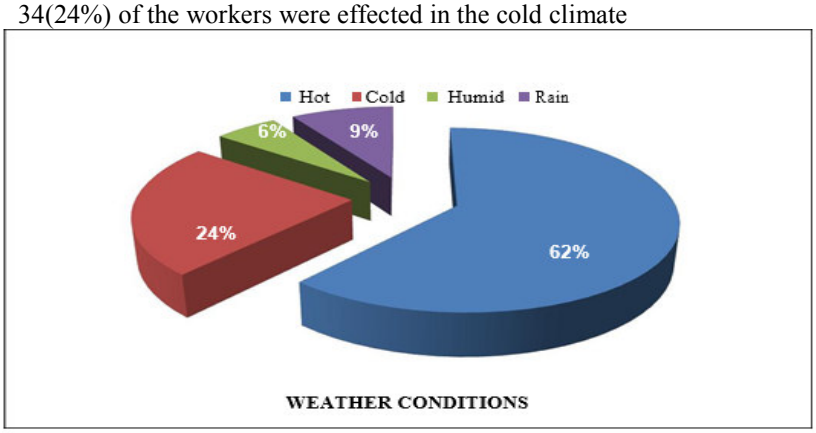

Figure : Weather Conditions

iii. Season

Table : Seasons of the Year

Question	Criteria	Frequency	Percentage
Season	Summer	98	69
	Winter	39	27
	Fall	2	1
	Spring	4	3

Table shows that the 98(69%) of the construction accidents happened in summer, 39(27%) in winter, 2(1%) in fall and 4(3%) in spring respectively. During summers the possible causes which affect the workers' health are heat exhaustion and dehydration. Furthermore, cold weather does affect the affect accident compare to others seasons.

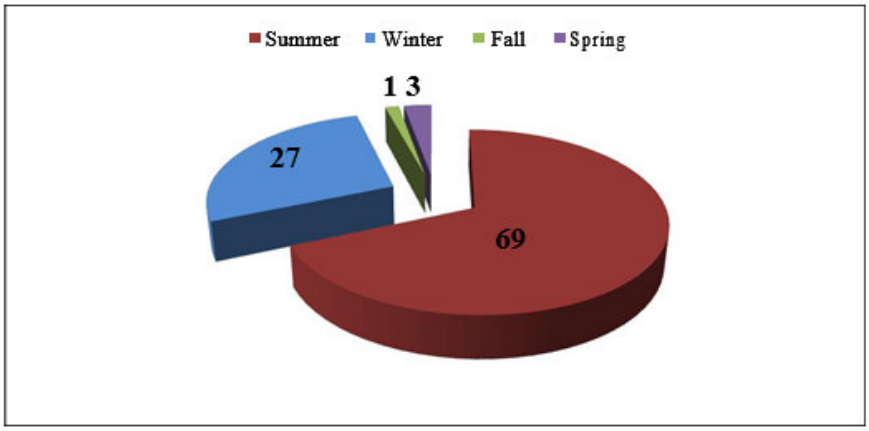

Figure : Seasons of the Year

RANKING FACTORS OF CONSTRUCTION ACCIDENTS

Table: The Ranking Factors of Construction Accidents contribution.

Ranking Factors of Construction Accidents contribution									
	Factors Of accidents		**High Disagree**	**Moderate**	**Neutral**	**Agree**	**High Agree**	**RII.**	**Rank.**
	1	Appropriate personal safety procedures were not specified	17	30	23	48	25	0.648	8
	2	For the specific task tools were not used correctly	9	36	21	52	25	0.667	6
	3	Lack of Supervision Of safety Engineer	8	22	29	45	39	0.719	2
	4	Regulation of safety were not followed	12	29	43	32	27	0.646	9
	5	No safety engineer at site.	32	38	36	28	9	0.522	11
	6	Safety items were not available on site	24	37	33	36	13	0.568	17
	7	Regardless of labors ability management pushing work	13	29	27	44	30	0.669	5

Factors of Accidents			Highly Disagree	Moderate	Neutral	Agree	Highly Agree	Rll.	Rank.
	8	No weekly Safety Meetings	27	42	35	28	11	0.536	18
	9	No training program for the	10	32	56	35	10	0.604	13
	10	No written/known procedure for the assigned job is available	6	25	24	46	42	0.730	1
	11	After completion the task, lack Of motivation	8	33	30	39	33	0.678	4
Factors	12	The worker was suffering from health problems	7	25	33	52	26	0.691	3
	13	Physical fatigue caused the Accident	15	36	37	38	17	0.608	12
	14	Worker was rushing the work	16	25	33	39	30	0.659	7
	15	Accident occurred due to Misjudgment.	19	38	31	39	16	0.593	15
	16	No satisfaction Of workers	15	37	41	34	16	0.599	14
	17	Personal Protection items(PPE) Not wearing by Workers	13	35	36	32	27	0.635	10

Ranking Factors of Construction Accidents contribution

		Factors of Accidents	Highly Disagree	Moderate	Neutral	Agree	Highly Agree	RII.	Rank.
Job & Social Factors	18	Transportation Living facility Unsuitable for The workers	24	33	40	33	13	0.569	16
	19	Job or task was too difficult to Perform by workers.	28	50	40	18	7	0.497	19
	20	Sleeping hours Not enough for Workers	49	55	22	13	4	0.415	20

Table shows the accidents factors as postulated by the workers at relative importance indices (RII) at the construction sites located in Pakistan. Seven of the top ten factors relate to site Management group, while three factors were related to the Workers.

1. The assigned job is not available for written/known procedure. 0.73
2. Lack of supervision of safety Engineers. 0.719
3. The worker was suffering from health problems. 0.691
4. After completion of the task, Lack of motivation. 0.678
5. Pushing of work regardless of laborer's abilities by managements. 0.669
6. For the specific task tools were not used correctly. 0.667
7. Worker was rushing the work. 0.659
8. Appropriate personal safety procedures were not specified. 0.648
9. Regulation of safety were not followed. 0.646
10. Personal protection items(PPE),not wearing by workers. 0.635

CONCLUSIONS

The goal of this research is the basic knowledge about High rise construction building accidents and determine the causes of construction building accidents, by conducting a questionnaire based survey, Statistical analysis understand the characteristics and determine the factors of construction accidents contribution.

- Tools accidents are the most common type of accident (38%), falling from height (22%) and Struck by material (18%).
- During the summer season and first hours of the day accidents most occur.
- Most of accidents occurs due to unskilled labor and there literacy rate was very low
- Construction accidents occurs due to Management and Project nature factors, while the workers social factors and job were having no big effect, which is an unexpected result.The Ranking of the accident factors Both workers and supervisors agreed.

From the statistical technique (RII), the main causes for top ten factors contributing to the accidents discussed in brief:

RANK: 1 The assigned job is not available for written/known procedure.
- No Safety Training
- Involvement of Top Management

RANK: 2
- Lack of supervision of safety Engineers
- Lack of technical safety knowledge

RANK: 3 The worker was suffering from health problems.

- Negligent & Casual behavior towards health
- High work load

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