A STUDY ON SAFETY MANAGEMENT IN CONSTRUCTION PROJECTS

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Abstract : Safety is a very important part of construction projects for the workers. Study in construction industry improves the safety performance. The main objective of safety management is to identify the critical success factors which are responsible for the execution of safety management in construction projects. The Indian society and economy have suffered human and financial losses as a result of the poor safety record in the construction industry. Safety management is essential for the desired changes in system of work and attitude. It develops a sense of safety in work activities. It helps in acquiring basic knowledge of hazards and precautions. There are many safety problems in the construction industry, such as lack of knowledge about the necessity of earth connection for power tools and lack of knowledge about cables protect from mechanical damages. Most large firms do have a safety policy on paper, but employees generally are not aware of its existence. Nevertheless, a number of major constructors exhibit a concern for safety and have established various safety procedures. They also provide training for workers and maintain safety personnel at the job site.

Index Terms - Safety, Safety Management, Safety performance, Construction, Projects.

I. INTRODUCTION

The construction industry continues to play a major role in the development of our country and it is more labor-intensive than that in the developed areas of the globe. The construction industry seems to suffer from general inability to manage workplace health and safety to a level. In any case, it is additionally the most hazardous and risky businesses because of the novel idea of its items and the procedures involved. All development laborers must manage the absolute most dangerous and basic working conditions looked by representatives in any industry.

Security culture is being occupied with numerous associations as a way to decrease the potential for debacles, mischance and wounds. A positive wellbeing society can be a powerful apparatus for enhancing security in an association and making great climate in the workplace. Increasingly in the most recent decade, specialists have demonstrated enthusiasm for an examination on wellbeing of workers.

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II. RESEARCH OBJECTIVE

Following are the main objectives of research:

1. To identify the factors affecting safety management through Literature review.
2. To conduct a Questionnaire Survey among the construction firms in mid Gujarat to identify the causes and rank them by Relative importance index (RII) method.

III. MAJOR FINDING FROM LITERATURE

Following are the various major findings of the reviews as follows:

1. There is lack of knowledge about how to use equipments on site and also lack of management.
2. Owners of large projects should more actively participate in construction safety management in each stage of project execution including project design contract selection, contract development, the construction phase, selecting safe contractors, and developing the safety culture on the projects through safety training and safely recognition programs.
3. Employee perceptions, safety behaviours, and environmental or situational features can be accessed through safety climate surveys, peer observations and systems audits/inspections.
4. The construction site should have good and structured safety practices namely safety policy, education and training, site safety inspection, safety auditing, safety meeting, site safety organization, personal protective equipments, emergency support and safety measuring devices, fall protective systems, and safety promotions.
5. Warning signs, guides or reflector should be displaced where necessary on site.
6. Construction Company should look to improve their policy or the construction design so as to cope with the environmental factors.
7. Behaviour based safety management should be proposed to rectify the human ware failures.
8. Project management personnel should contribute to safety climate development by improving their conceptual skill as long as they include safety as one of the important aspects when performing their roles.
9. Continuous safety development should include 6 steps. These steps involve creating safety regulation, identify hazard, assess and evaluate risk, decide precaution, record findings, and updating finding in relation to the work condition.

IV. QUESTIONNAIRE DESIGN

The questionnaire design took into the consideration the objectives of the study with the aim to answer the research question. The Research questions were referred from the literature, and finalized with the help of the most experienced professionals, helps to identify the right questions required and present them in a clear format and also Special care was done for phrasing the questions that are easily

understood by the respondents. A content involved in the questionnaire was divided into two major sections. The initial part is about general information about the respondent, such as (1) Name, (2) Designation of the respondent, (3) Year of experience, (4) Contact address, and furthermore respondents were asked about factor influencing adoption of safety management in a construction firm. A 5- point scale was used to understand the perception of practitioners as 1. representing No importance, 2. Less importance, 3. Average importances 4. High importance, 5. Very high importance as indicated by the degree.

V. REASEARCH METHODOLOGY

The questionnaire design took into the consideration the objectives of the study wThe research methodology for this study has adopted questionnaire survey to identify factors affecting Safety Management in Gujarat region. To identify Safety Management factors, literature reviews, discussion with experts were carried out. From the existing literature on the construction industry, it was possible to identify certain major effects. A questionnaire was then drawn up. As the outcome of the review 80 factors were identified. These questionnaires were distributed to Engineer, Project Manager, Contractor, and Safety Engineer of a construction firm. The data from the questionnaire was analyzed using Microsoft excel. The perspective of the respondent has been analyzed to rank the factors based on their Relative important index. Relative important index method was used for hierarchal assessment of factors and found out the top most significant factors.

The questionnaire was designed so that it is easy to read and responses are easy to fill in. A scale of measurement will be applied for data measurement in the questionnaire survey. These sections were designed to obtain the responses on a scale that indicates the relative importance of various factors. Ordinal scale use in this study involve Very high importance (V.H), High importance (H.I), Average importance (A.I) ,Less importance (L.I),No importance (N.I) . However, abbreviation replaces with numbers i.e 1 for No importance; 2 for Less importance; 3 for Average importance; 4 for High importance and 5 for Very high importance. This will be adopted to understand the perception of personnel of the respondent involved in construction projects. The questionnaire has been given personally to the respondents and communicated to fill without hesitation or with no bias. In the study Relative Important index (RII) have been employed and calculated for ranking of factor affecting Safety Management in construction project. The RII is used to rank the different factors. These rankings make it possible to cross-compare the relative importance of the factors as perceived by the two groups of respondents. All the numerical scores of each of the identified factors were transformed to relative importance indices to determine the relative ranking of the factors. Higher the value of RII, more important is the factor affecting Safety Management on construction in the Central Gujarat region.

VI. DATA COLLECTION

Engineer, Project Manager, Contractor and Safety Engineer of this Gujarat region were targeted for the survey. The details of various firms and their contacts were obtained through the internet and personal references. 91 samples of responses were to be collected from Engineer, Project manager, Contractors and safety engineer. As the response rate is very low, the questionnaire was distributed to the various parties more than the sample size requirement. A total of 120 questionnaires were distributed to different respondents in mid Gujarat. The response rate was slow and timely reminders were also required. This study has received 91 responses. This was more than the required sample size. The Table-1 and figure-1 shows a stakeholder wise response rate as follows.

Table 1 Stakeholder Wise Response Rate

Stakeholder	Targeted Sample Size	Response Received	No Response	Response Rate (%)
Engineer	39	31	8	79.48
Project Manager	25	18	7	72
Contractors	37	13	7	81.08
Safety Engineer	19	12	7	63.15
Total	**120**	**91**	**29**	**75.83**

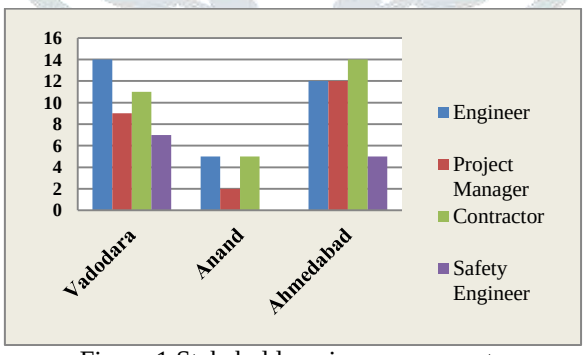

Figure 1 Stakeholder wise response rate

VII. DATA ANALYSIS

Relative Importance Index Technique

Relative Importance Index method used to determine the relative importance of the various factors among various parties. The Five-point Likert scale was adopted and it ranged from 1 (No importance) to 5 (Very high importance). This was transformed to Relative Importance Indices (RII) for each factor as follows:

$$RII = \frac{\sum W}{A*N}$$

Where W is the weighting given to each factor by the respondents (ranging from 1 to 5), A is the highest weight (i.e, 5 in this case), and N is the total number of respondents. The RII value had a range from 1 to 5 and higher the value of RII, more important was the cause of delays. The RII rankings made it possible to cross compare the relative importance of the factors as perceived by the four groups of respondents (i.e., Engineer, Project manager, Contractor and Safety Engineer). Each individual cause's RII perceived by all respondents should be used to assess the general and overall rankings in order to give an overall picture of the factor affecting Safety Management.

The ranking of factors has been done based on the relative important index (RII) value calculated for each group of respondent i.e. (i.e., Engineer, Project manager, Contractor and Safety Engineer) and also the overall respondents. Appendix-1 shows RII ranking of factors provided from Engineer, Project manager, Contractor and Safety Engineer. The table2 shows the top most significant factor influencing Safety Management, their RII value and rank obtain from overall respondents.

Table 2 Significant factors of Safety Management ranked by overall respondents

Id No.	Factors	RII	Rank
C1	Safety shoes	0.80	1
E2	Condition of hand tools	0.76	2
A9	Safety materials displayed on the site	0.72	3
C2	Wearing suitable hand gloves	0.71	4
D16	Safety nets	0.71	5
E8	Valid licenses	0.71	6
C9	Protection of material from weather and rain	0.71	7
C3	Wearing full body safety harness	0.70	8
E3	Availability of tools	0.70	9
E4	Power tools with earth connection	0.69	10
C4	Workers using suitable PPE	0.69	11
E5	Handles of the tools free from splits/cracks	0.69	12
E12	Clear wood shavings, dust and chips	0.69	13
C12	Electrical circuits free from overloading	0.68	14
E7	Seat belt	0.68	15
E10	Drilling area	0.68	16
A3	Safety plans and safety procedures	0.68	17
A10	Site safety instructions	0.68	18
C5	Inspection of PPE	0.68	19
E11	Grinding machines	0.68	20
A1	Safety policy	0.67	21
C6	Lifting accessories for manual handling	0.67	22
E9	Speed limit	0.67	23
C16	Safe access in excavation area	0.67	24
C13	Availability of fire extinguishers	0.67	25
B9	Sufficient lighting	0.67	26
C8	Availability of persons to fight fire	0.67	27
A8	Specialized training	0.66	28
B11	Collection/disposal of waste materials	0.66	29
C11	Fire precautions	0.66	30
C22	Inspection of Excavations for cracks	0.66	31
D15	Workers with safety harness	0.66	32
B8	Access wide enough	0.65	33
E6	Vehicles inspected and current license	0.65	34
B7	Visibility of entrances	0.65	35
B10	Site kept neat and tidy	0.64	36
C10	Adequate ventilation	0.64	37
A7	Safety orientation	0.64	38
C21	Adequate lighting	0.63	39
C17	Excavated material 1 m away	0.63	40
E1	Storage of tools	0.63	41
B12	Stored materials and equipments	0.62	42
B15	Easy access to Electrical control	0.62	43
D10	Temporary screens	0.62	44
A2	Awareness of the safety policy	0.62	45
D14	Usage of full body harness	0.62	46
C19	Dewatering	0.61	47
C7	Training in material handling	0.60	48
D3	Scaffolds erecting on level ground	0.60	49
D13	Staircases with temporary railings	0.59	50
B6	Emergency telephone numbers	0.59	51
D12	Proper walkway	0.58	52
C26	Protecting Cables from mechanical damages	0.58	53
D5	Proper access to reach platforms	0.58	54
D8	Attachment of tags	0.58	55
C15	Excavation permission	0.58	56
D9	Good condition of welding cables	0.58	57
C23	Entry of water into the pits	0.57	58

B5	Team trained in emergency response	0.57	59
C25	Confined space	0.57	60
D4	Fixing of handrails, mid rails and toe boards	0.57	61
D7	Scaffold permission	0.57	62
C27	Inspection and records of Insulations	0.56	63
D2	Scaffolds erecting under the supervision	0.56	64
D6	Scaffolds base to height ratio	0.56	65
B14	Adequate water supply	0.55	66
A6	Safety committee on the site	0.55	67
D1	Scaffolds design	0.55	68
D11	Storage Gas cylinders	0.54	69
A5	Availability of safety professional	0.54	70
C24	Precautions while removing materials	0.54	71
C18	Excavation edge free from falling material	0.54	72
A4	Safety organization	0.53	73
B13	Toilets regularly cleaned	0.53	74
C14	Stacks protected from collapse	0.53	75
C20	Precautions against material falling	0.52	76
B1	First aid center available	0.44	77
B2	First aid with medicines and accessories	0.42	78
B4	Availability of Emergency vehicle	0.38	79
B3	Availability of Qualified doctor/nurse	0.36	80

From the analysis of results, it was found that the above factors are ranked high by respondent. These most significant factors discussion more details follows provided by the Engineer, Project Manager, Contractor and Safety Engineer.

VIII. CONCLUSION

This research is intended to identify the factors affecting safety management on construction firms. This study investigates all possible factors through a structured questionnaire distributed in three cities of Gujarat: Vadodara, Anand, Ahmedabad. The survey results are subjected to analysis, and the ranking of factors is calculated using the Relative Important Index (RII) Method.

Eighty factors considered for the study were categorized in five different groups as Initiating Stage, Planning Stage, Execution and Controlling Stage (Level-1), Execution and Controlling Stage (Level-2) and Execution and Controlling Stage (Level-3). Total of 120 questionnaires were distributed, and 91 questionnaires (81.67% response rate) were returned. Because engineers, project managers, contractors and safety engineer have vast experience in construction, their adequate experiences were a proper suggestion to study about the various factors affecting safety management on construction sector.

The results from calculations of RII Method from different stakeholders' point of view indicate that the most important factors affecting safety management on construction firms are: Safety shoes, Condition of hand tools, Safety materials displayed on the site, Wearing suitable hand gloves, Safety nets, Valid licenses, Protection of material from weather and rain, Wearing full body safety harness, Availability of tools, Power tools with earth connection, Workers using suitable PPE, Handles of the tools free from splits/cracks.

In addition, the agreement/disagreement among respondents was checked using Spearman's rank correlation coefficient, which states that there is strong agreement among respondents regarding ranking of factors affecting safety management.

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