Assessment of Causes of Construction Waste Generation and Its Minimization Practices for Surat

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***Abstract*— Waste is recognized as a major problem in the construction industry. Not only does waste have an impact on the efficiency of the construction industry but also on the overall economy of the country. It's proved that the construction material waste has a negative effect on the environment as well as its effects on the whole economy of our country. This research work is carried out with the objective of the study is to identify the causes of material waste and their attitudes & perception towards construction waste management in Surat city. The data was collected by structured interview and questionnaire survey from engineers, contractors & project managers. Analysis of data is done by mean and ranking method and means were compared by one-way analysis of variance (one-way ANNOVA).**

Keywords: Constructions Waste, Construction Waste Management, Mean Score Method, One-Way ANOVA

I. INTRODUCTION

Material, Manpower Money and Machine play crucial role in construction projects and building materials account for 60to 70% of the project cost. Hence even 1% of material wastage will have huge negative impact on cost of construction and economy of the country. However construction industry in India generates about 10-12 million tons of waste annually.

Identifying sources of material waste not only have financial and environmental benefits but also shows the areas which need improvisation and also helps to finish the project on time showing how we can avoid rework. Hence effort can be made to reduce the overall cost of project by waste minimization or maximum utilization of resources. The causes responsible for waste generation, major construction waste materials and practices of waste minimization will be recognized through interactions made with SMC Surat, Project managers and former research work literatures.

II. RESEARCH OBJECTIVE

To identify the major causes of Construction Waste and their attitudes and perception toward construction waste management for Surat city in south Gujarat.

III. LITERATURE REVIEW

As a part of literature survey, various papers were studied critically to identify causes of material waste and their attitudes & perception towards construction waste management.

Ismail et al. (2014) has determine significant factors and groups of factors affecting on construction waste generation & identified 81 factors for causing construction waste and clustered in 7 groups of factors namely Design, Handling of Materials and Equipment, Workers, Management, Site Condition and Procurement and External. Sasitharan et al. (2012) identified various factors causing construction waste in Malaysia and analyze the data by SPSS tool. Adewuyi et al. (2013)identified the causes of construction waste generation on building sites in Rivers State, Nigeria and analyze the data collected by Mean score method, ranking method and Man-Whitney U test. Prof. B. Prakash et al. (2014) Identified causes of waste which contributes for generation of construction waste by literature survey and site visits. Analysis of data was done by Mean & Ranking method and One Way Analysis of Variance (ANOVA) was done to compare means of all groups. Said Saker Al-Moghany (2006) identified major causes of waste in construction and presenting comprehensive analysis of these causes and determining the severity of each cause and waste minimization strategies.

IV. STUDY AREA

Surat a city in India has taken for this study. Geographical location of this city has presented in Fig. 1. The data for the present paper has been taken for the study of construction waste management in Surat by taking guides from Surat Municipal Corporation.

Figure 1: Surat City (source: news.bbc.co.uk)

V. QUESTIONNAIRE DISTRIBUTION AND RESPONSE

Totally 300 numbers of questionnaire were distributed to project managers, engineers and contractors of Surat city. 158 out of 300 Responses were collected (Response rate is 52.66%).

VI. ANALYSIS AND RESULT

1) Mean And Ranking Method

The Mean Score method is used to obtain the level of significance and importance of causes of material waste generation on building sites and their attitudes & perception towards construction waste management in Surat City, Gujarat. The rating of the respondents was converted into actual scores. This can be illustrated mathematically as follows:

$$\text{Rank Sum (s)} = \Sigma_n W$$

$$\text{Mean Score (ms)} = \frac{\Sigma nW}{N}$$

Where,
S = Rank sum, ∑ = summation, n = the highest attainable rating
W = corresponding weight of rank category,
N = total number of respondents, m. s = Mean score
The decision rule is that any factor whose mean falls between 0.5 – 1.49 is regarded as "not important", 1.5 – 2.49 is slightly important, 2.5 – 3.49 is moderately important, 3.5 – 4.49 is very important and 4.5 – 5.0 is regarded as extremely important.

- **Analysis**

For each causes mean was calculated and they are ranked ascending order based on mean value with respect to their group. This was done to identify causes which contributes most to material waste in that group. Top factors were shown below after analysing.

Table 1: Top 10 Causes of Material Waste

Rank	Cause of Materials	Sum	MS
1	Design changes and revisions	685	4.34
2	Ineffective planning and scheduling of the project	673	4.26
3	Last minute client requirement (resulting in rework)	662	4.19
4	Rework due to workers mistakes/Poor workmanship	649	4.10
5	Lack of a quality management system aimed at waste minimization	639	4.04
6	Lack of waste management plan	630	3.98
7	Lack of onsite materials control	613	3.88
8	Inadequate stacking and insufficient storage in inventory	597	3.78
9	Severe weather conditions	586	3.70
10	Poor coordination and communication within the parties involved in the project	575	3.64

Table 2: Top 5 Importance of Construction Waste Recognition

Rank	Importance of Construction Waste Recognition	Sum	MS
1	It helps the contractor to prepare accurate schedules to procure materials	701	4.43
2	To know the exact required quantities for project execution	688	4.35
3	It encourages companies and firms to decrease waste	672	4.25
4	To reduce waste disposal issues	656	4.15
5	It participates in increasing the national income in construction industry	644	4.08

Table 3: Top 5 Barriers to Implementation of Waste Management

Rank	Barriers to Implementation of Waste Management	Sum	MS
1	Lack of technical skills	712	4.50
2	High dependency of design specifications on in-situ materials & components rather than standardized & industrialized prefabricated components	699	4.42
3	Lack of training	689	4.36
4	Poorly defined individual Responsibilities	673	4.26
5	Long implementation period	664	4.20

Table 4: Top 5 Waste Minimization Measures

Rank	Waste Minimization Measures	Sum	MS
1	Training of construction personnel	688	4.35
2	Minimizing design changes	681	4.31
3	Reusing some of waste materials on site	675	4.27
4	Recycling of some waste materials on site	672	4.25
5	Proper storage and handling of materials on site	666	4.21

Table 5: Top 3 Severely Wasted Material on Sites

Rank	Material	Sum	MS
1	Steel	724	4.59
2	Cement Concrete	707	4.48
3	Bricks	686	4.34

2) ONE-WAY ANOVA

In statistics, **one-way analysis of variance** (**one-way ANOVA**) is a technique used to compare means of three or more samples (using the F distribution). This technique can be used only for numerical data.

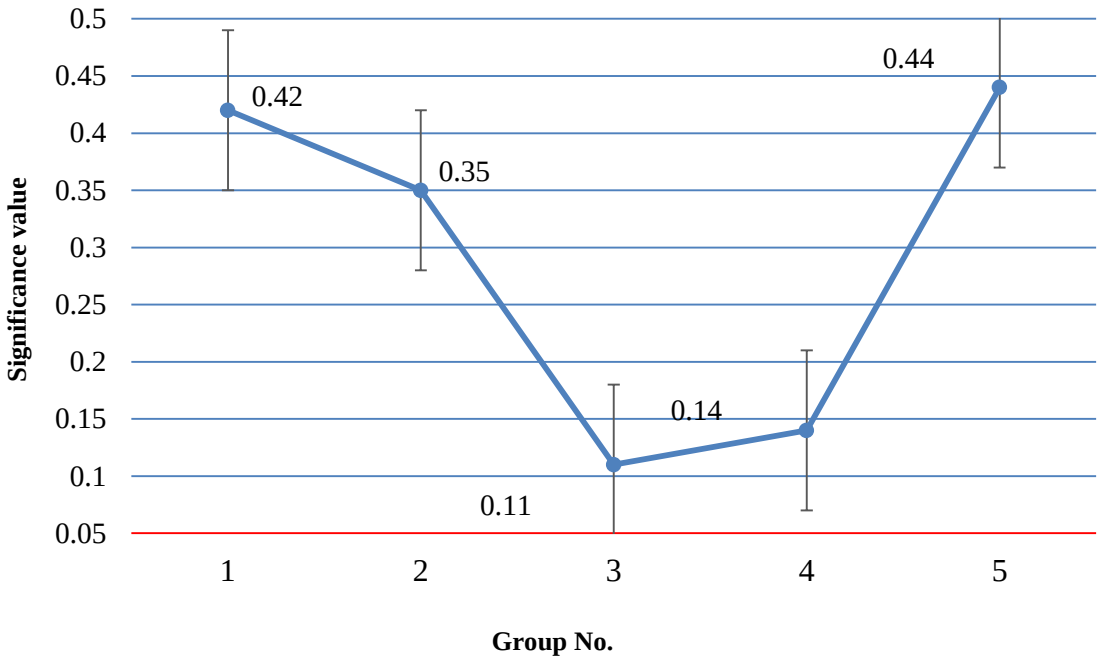
The ANOVA tests the null hypothesis that samples in two or more groups are drawn from populations with the same mean values. To do this, two estimates are made of the population variance. These estimates rely on various assumptions. The ANOVA produces an F-statistic, the ratio of the variance calculated among the means to the variance within the samples. If the group means are drawn from populations with the same mean values, the variance between the group means should be lower than the variance of the samples, following the central limit theorem. A higher ratio, therefore implies that the samples were drawn from populations with different mean values

- **Analysis:**

One way Analysis of Variance was done to compare means of all groups (dependent) against different types of respondents (Independent). Here are the hypothesis set for the analysis

H_o: There is no statically significant difference between means of all the variables.

H_a: There is statically significant variation in means of all variables.



Graph 1: Significance level for ONE-WAY ANOVA

As we can see in above graph all the groups have significance level greater than 0.05. Hence test fail to reject null hypothesis. In words there is no statistically significant difference between means of these groups even though respondents are different.

VII. CONCLUSION:

Based on this study we can able to draw the following conclusions:

There are many reasons of construction waste occurs at various construction projects but the most sever some are identified by mean and ranking method like changes in design, Ineffective planning and scheduling of the project, Lack of a quality management system aimed at waste minimization, lack of waste management plan etc. as we know that changes and modifications in the construction projects often done by client suggestion so this influence severely on any waste leftovers, it should be mandatory that proper waste management plan should be ready with a well-defined quality management system so nothing should be haphazard and a systematic flow of work execution with proper planning can be seen which ultimately help in managing all above causes of waste generation.

If construction waste can be recognized then proper utilization of waste can be done and some above shown issues or barriers to implement the waste management policies can be effectively operated by giving proper training to the construction personals, recycling some of the major construction materials so waste minimization measures can be taken care at sites and majorly used materials like steel, cement concrete and brick which are made from natural materials can be saved so ultimately natural materials can be saved.

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