



WASTE MANAGEMENT OF THE CONSTRUCTION PROJECT

¹Hit.G.Raval, ²Ankit.S.Patel, ³Jayraj.V.Solanki

¹PG Student, ²PG Coordinator, ³PG Head

¹Civil Engineering Department,

¹ U.V. Patel College of Engineering, Ganpat University, Kherva, Gujarat, India

Abstract : In every field of work, Construction wastage of few or various things are bound to happen. Construction industry is one of the industries which produces waste on a large scale and it is increasing by every passing year. In India, the demolition and construction waste are expected around 150 million tonnes per year. Many foreign countries are way ahead of us in management of waste as they recycle the produced waste. The reason behind studying this topic is to focus on waste and to reduce the waste due to which large amount of cost can be saved in any infrastructure. In some regions, the engineers and contractors are also not aware of the waste management, so, it is high time to create an awareness about this. In this research study, an actual site was taken and a feasibility study was done. Further, it came to light that the some of them decided some amount of planned waste but in real world scenario it was much more. So, to fill that gap, in this study where that unplanned waste goes is to be identified. The methodology used in the work, was done by questionnaire survey and site observation. The forms were filled up by the experts who gave their remarks accordingly. The analysis of all the data which was collected, was done by a method known as Frequency Analysis method. Lastly, this research study concluded that, there were total number of 34 factors were chosen in which 15 factors were highly affected. In which, the top three factors were (1) Planned waste costs and actual waste costs should be calculated (2) Delays in the work of the contractor (3) No Punishment for labour more wastage.

Index Terms – Waste management, Construction waste, Cost reduction, Waste minimization.

I. INTRODUCTION

The largest industry in India is agriculture. Second is the construction industry. The unskilled working class in the population of India depends on construction work. The construction industry in India is a major player in the economy and environment. India's population is projected to increase from 419 million in 2014 to 600 million by 2030. According to the Housing Scheme launched in 2015, the amount of construction waste will increase in fast moving cities.

There is a significant increase in growth and redevelopment in India. Construction wastage accounts for 40% of the growing waste in India. Construction waste is increasing due to lack of waste management. European countries are growing for waste management. Which is used for recycling construction waste. In many developed countries such as Germany, France, USA, UK and Japan 80 to 85% use recycling method.

Construction & demolition waste production in India is 150 million tons per year. The campaign was launched in 2014 as per Swachh Bharat Mission to reduce waste. In which Site Waste Management Plan (SWMP) for construction waste was framed and submitted to local authority. According to SWMP C&D Waste generation in Mumbai is 2500 t / day, Delhi 4600 t / day, Bangalore 875 t / day, Chennai 2500 t / day, Kolkata 1600 t / day, Jaipur 200 t / day, Ahmedabad 700 t / day.

It is necessary to consult an expert to remove construction waste and determine its quantity. To reduce construction waste, a study has been done to create awareness among project managers, engineers, contractors as well as to provide training to laborers as well as to prevent environmental damage and to eliminate the problem of construction waste as well as to reduce construction waste and save cost.

II. OBJECTIVES

The primary objective of this study is to understand the present practice of waste management of the construction project, apply and analysis of techniques on site reduce waste material and saving cost of construction work.

III. NEED FOR STUDY

This study focuses on reducing waste and saving costs from any construction work. Calculating the amount of waste as well as the factors affecting it to reduce waste. To make engineer and contractor aware of this issue. Training workers for waste management to reduce construction waste. Also pay attention to the impact on the environment. This phase will help to pre-plan for wastage at the construction site in the future.

IV. SUMMARY OF THE LITERATURE

Table 1 Summary of the Literature

Sr No	Year of Publication	Name of Author	Name of Topic	Name of Journal/Publication
1	2008	Dania A, Kehinde J, Bala K	A STUDY OF CONSTRUCTION MATERIAL WASTE MANAGEMENT PRACTICES BY CONSTRUCTION FIRMS IN NIGERIA	Institutional Review Board
2	2013	Job Thoas, Wilson RM	CONSTRUCTION WASTE MANAGEMENT IN INDIA	American Journal of Engineering Research
3	2015	Reza Esa M, Halog A, Zuhaira Ismail F	WASTE MANAGEMENT IN CONSTRUCTION INDUSTRY-A REVIEW ON THE ISSUES AND CHALLENGES	Interational Conference on Environmental Research and Technology
4	2015	Zenith Shah	ANALYSIS OF CONSTRUCTION AND DEMOLITION WASTE FOR INFRASTRUCTURE PROJECTS	Researchgate
5	2016	Dachowski R, Kostrzewa P	THE USE OF WASTE MATERIALS IN THE CONSTRUCTION INDUSTRY	Published by Elsevier Ltd
6	2016	Rani M, Gupta A	CONSTRUCTION WASTE MANAGEMENT IN INDIA	International Journal of Sciences Technology and management(IJESRT)
7	2019	Kolaventi S, Tezeswi T, Siva Kumar M	AN ASSESSMENT OF CONSTRUCTION WASTE MANAGEMENT IN INDIA: A STATISTICAL APPROACH	Researchgate.net
8	2021	Shitaw Tafesse	MATERIAL WASTE MINIMIZATION TECHNIQUES IN BUILDING CONSTRUCTION PROJECTS	Ethopian Journal of Science and Technology
9	2021	Yahya K, Boussabaine A	ECO-COSTS OF SUSTAINABLE CONSTRUCTION WASTE MANAGEMENT	Researchgate
10	2021	Kolaventi S, Momand H, Kumar M	IMPLEMENTING SITE WASTE- MANAGEMENT PLANS, RECYCLING IN INDIA: BARRIERS, BENEFITS, MEASURES	Institution of Civil Engineers Publishing

V. LITERATURE REVIEW

Author (Tafesse, 2021) research in Material Waste Minimization techniques in building construction Project. In This paper, it has been researched that construction waste reduction in Ethiopia, using waste management and waste management technology. In which a questionnaire survey was conducted to reduce waste.

Author (Reza Esa et al., 2015) Research in Waste Management in Construction Industry - A Review on the Issues and Challenges.. In This Paper, it has been researched that increasing construction waste in Malaysia as well as illegal dumping due to the availability of landfill. So, to stop illegal dumping as well as to reduce waste, issue related construction waste and challenge related construction waste articles were studied.

Author (Dachowski & Kostrzewa, 2016) research The Use of Waste Materials in the Construction Industry. Use of waste material. In which block of 40 × 40 × 100 mm cement, HIPS, foamed glass, sand, water is made. Using plastic in cement reduces the density. Adding HIPS increases strength. Adding foam glass is beneficial in absorbing the product.

Author (Kolaventi et al., 2019) research in an assessment of construction waste management in India: A statistical approach. Case Study has shown how much wastage is done in the paper and Questionnaire survey has been done. In which things like identification of recycling material as well as punishment for illegal disposal of waste are described.

Author (Analysis of Construction and Demolition Waste for Infrastructure Projects, 2015) Zenith Shah research in Analysis of Construction and Demolition Waste for Infrastructure Projects. The Case Study method in the Paper conducted a study to reduce construction and demolition waste by stating that recycling method should be used to reduce construction waste as well as people from project manager to labourer should pay attention to reduce construction waste so that Reduces C&D waste.

Author (Yahya & Boussabaine, n.d.) research in Eco-costs of Sustainable Construction Waste Management. The paper focuses on the UK environment and studies construction management techniques including research on recycling method, transportation, energy, waste recycling, waste disposal as well as waste packaging costs and implementation of eco cost model.

Author (Dania et al., n.d.) Research in A Study of Construction Material Waste Management Practices by Construction Firms in Nigeria. This paper provides information on waste management in Nigeria. paper provides information on waste management. In which the government should make a law. As well as teaching on the issue of waste management in educational institutions and rewarding companies for managing construction waste. Questionnaire was created for issues like project questionnaires to project workers in big cities like Lagos, Kaduna and Abuja.

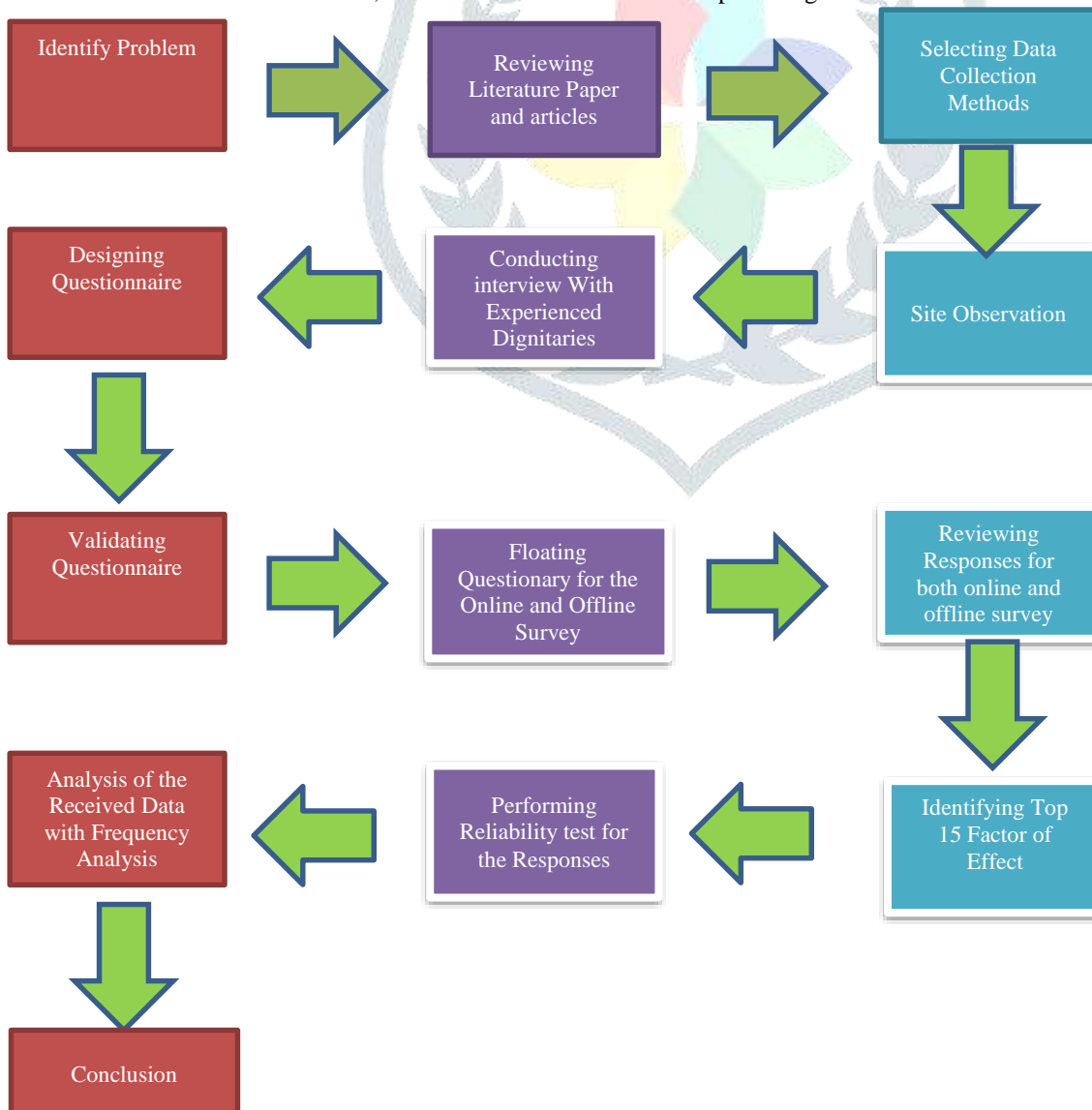
Author (Rani & Gupta, n.d.) Research in Construction Waste Management in India. In the paper study has been done on removal of construction waste by C and D operation method as well as reduce, recycling and reuse method.

Author (Kolaventi et al., 2021) research in Implementing Construction Waste Management Plan, Recycling in India: Barriers, Benefits, Measures. paper collects data on current barriers to implementation of C and D waste and Solid Waste Management Plans (SWMP) and collects data through questionnaire survey and case study to identify the benefits of SWMP implementation. According to the respondents, there should be fines and taxes for waste management. Studies are being done on recycling law, reduction of GST for recycling product as well as implementation of SWMP.

Author (Thomas & M, n.d.) Research in Construction Waste Management in India. In this paper has been studied to reduce waste using 3R Concept method (Reduce, Reuse, Recycling). Emphasis has also been placed on green building construction.

VI. RESEARCH METHODOLOGY

The problem of increasing construction waste was understood as an analysis in the Literature Review Paper and the article which serves as the basis for the research. In which data collection method was selected. In which project manager, engineer, contractor was interviewed by observing on residential site, they were made aware of this issue and the questionnaire was designed to be validated by a government officer, a project manager and a more experienced engineer. Responses were taken through online and offline surveys. Which was analyzed using reliability test as well as frequency analysis method out of which top 15 factors were identified. Out of which conclusion, recommendations and future scope were given.



VII. DATA COLLECTION

Data collection is the process of gathering information for research. In-depth in this research. Literature Review, Article and Internet resources are used for analysis. As well as a Residential Site Project is taken. In which Qualitative method and Quantitative method are used. Qualitative Approach: Questionnaire for the Open interview was generated by Reviewing various studies, Literature Review, article and observation based on the topic. Quantitative Approach: Questionnaire survey for the Quantitative research method is structured based on Likert Scale Analysis after results that were analyzed in the Qualitative research. To collect data, I went to a residential site where I interacted with the employee and took and observed the data of material waste and became a factor. In which I asked 50 questions of the factor out of which the officer accepted 34 questions. In this research, Triangulation Method is adopted for in depth analysis. Qualitative Method, Residential Site Observation and Quantitative Method.

a) Questionnaire Design

For the purpose of questioning, A query was formed after Residential Site observation, reading the literature, journal papers, publications, certain research design books, legal actions.

Details of Residential Project:

Name of Project: Seventh Bliss

Location: Behind Jaguar Land Rover, Gota, Ahmedabad 382481

Type of Project: Residential Building

Basic Information: G+13

Architects Name: Vipul Bhai Patel

Structural Consultant Name: Janvi Consultant

Planned Wastage & Actual Wastage Calculation

Table:2 Planned wastage quantity of Reinforcement work

Size	8 mm	10 mm	12 mm	16 mm	20 mm
Weight (kg)	41,925 kg	40,456 kg	53,430 kg	32,968 kg	26,975 kg
Total Rate	27,67050 Rs	26,45,822 Rs	34,83,636 Rs	21,42,920 Rs	17,53,375 Rs
Wastage : 4 %					
Total Wastage Weight : 7,830.16 kg					
Total Wastage Rate : 5,11,712.12 Rs					

Table:3 Actual wastage quantity of Reinforcement work

Size	8 mm	10 mm	12 mm	16 mm	20 mm
Weight (kg)	41,925 kg	40,456 kg	53,430 kg	32,968 kg	26,975 kg
Total Rate	27,67050 Rs	26,45,822 Rs	34,83,636 Rs	21,42,920 Rs	17,53,375 Rs
Wastage : 6 %					
Total Wastage Weight : 11,745.36 kg					
Total Wastage Rate : 7,67,568.18 Rs					

Table:4 Planned wastage quantity of Concrete work

Material	Concrete
Weight	1430 cu m
Total Rate	69,35,500 Rs
Wastage	3.9 %
Total Wastage Weight	55.77 cu m
Total Wastage Rate	2,70,484.5

Table:5 Actual wastage quantity of Concrete work

Material	Concrete
Weight	1430 cu m
Total Rate	69,35,500 Rs
Wastage	3.9 %
Total Wastage Weight	55.77 cu m
Total Wastage Rate	2,70,484.5

Table:6 Planned wastage quantity of Flooring work

Material	Tiles	Cement	Sand
Quantities	61568 Pc	546 bag	29.9 ton
Total Rate	1,76,08,448 Rs	1,91,100 Rs	15,249 Rs
Wastage Quantity	3,078 Pc	5.46 bag	598 kg
Wastage	5 %	1 %	2 %
Total Wastage Rate: 8,82,637.98 Rs			

Table:7 Actual wastage quantity of Flooring work

Material	Tiles	Cement	Sand
Quantities	61568 Pc	546 bag	29.9 ton
Total Rate	1,76,08,448 Rs	1,91,100 Rs	15,249 Rs
Wastage Quantity	4926 Pc	8.19 bag	897 kg
Wastage	8.6 %	1.5 %	3 %
Total Wastage Rate: 15,17,650.49 Rs			

Table:8 Planned wastage quantity of Brick work

Material	Bricks	Cement	Sand
Quantities	3,42,316 Pc	1024 bag	45.5 ton
Total Rate	27,38,528 Rs	3,54,900 Rs	23,205 Rs
Wastage Quantity	13,692.64	40.56 bag	1.365 ton
Wastage	4 %	4 %	3 %
Total Wastage Rate : 1,24,433.27 Rs			

Table:9 Actual wastage quantity of Brick work

Material	Bricks	Cement	Sand
Quantities	3,42,316 Pc	1024 bag	45.5 ton
Total Rate	27,38,528 Rs	3,54,900 Rs	23,205 Rs
Wastage Quantity	21,565 Pc	43.60 bag	2.047 ton
Wastage	6.3 %	4.3 %	4.5 %
Total Wastage Rate: 1,88,832.19			

Table:10 Other work wastage

Fabrication Work	4.2 %
Plumbing Work	2 %
Electrical Work	1.5 %
Furniture Work	6 %
Painting Work	3.6 %

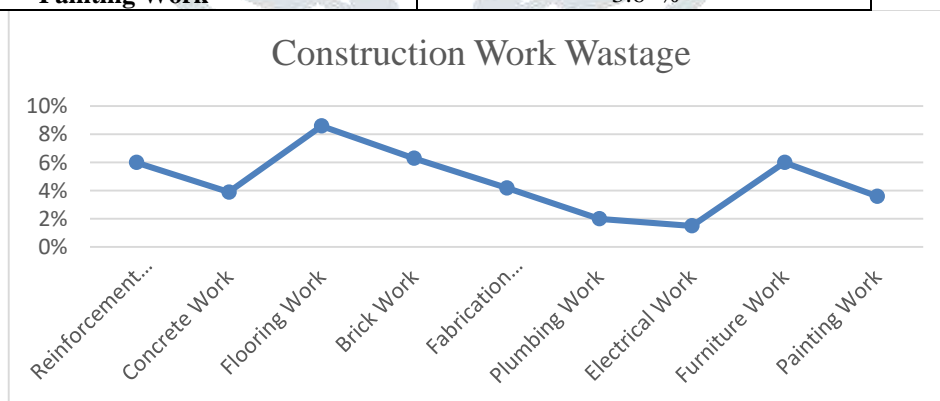


Figure:1 Construction Work Wastage

b) Sample Size Determination:

Sample size calculation is necessary for determining the size of the Population to whom the Questionnaire survey will be distributed.

$$SS = \frac{z^2 * p * (1-p)}{e^2}$$

Equation:1 Sample Size

Where,

Z = Statistic value for the confidence level (e.g., 1.96 for 95% confidence level)

P = Percentage picking a choice, expressed as decimal (0.5 used for sample size needed)

C = Confidence interval, expressed as decimal (e.g., 0.12)

Hence, sample size turned out to be 66.

IV DATA ANALYSIS & RESULTS:

a) Method for Data Analysis :

Data analysis is the part of analyzing data after data collection. Data analysis summarizes the data. In which data analysis is done by the required method. From which conclusions and future scope can be formed. Data analysis is an important part of research. Frequency Analysis method was used for data analysis. In which the survey was conducted. The top 15 factors were selected using this method on the response of 66 subscribers from different companies.

b) Reliability Test :

Reliability was tested in Microsoft Excel. Cronbach's Alpha Formula was used to determine the reliability of the scale. In which the value of Cronbach's Alpha ranges from 0 to 1. If the value is found close to 1, it indicates very reliable data.

Table:11 Reliability Test

DESCRIPTION	VALUES
The number of test Items	34
Sum of the item variance	34.06596737
Variance of total score	297.0369605
Cronbach's Alpha	0.912141744

Cronbach's Alpha Value Was **0.912** Which Shows Immense Reliability of the 5 Point Scale Drafted for the Questionnaire.

c) Frequency Analysis Method:

(1) Profession of the Respondents

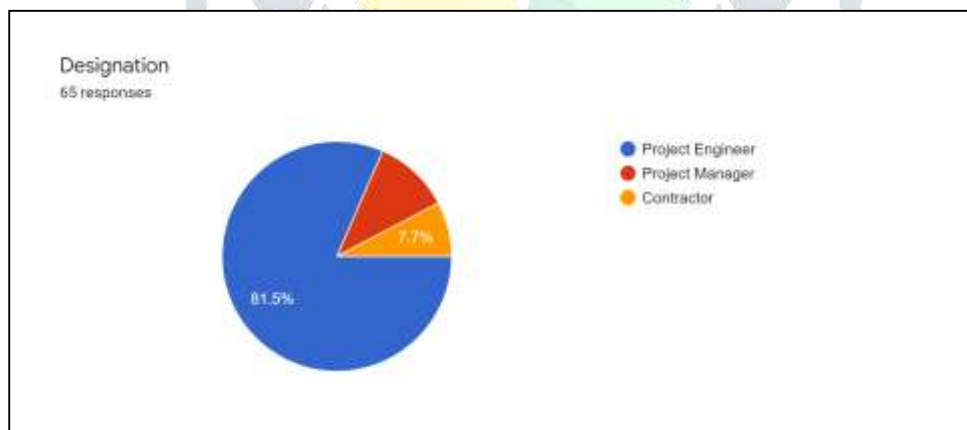


Figure:2 Profession of the Respondents

(2) Experience of the Respondents

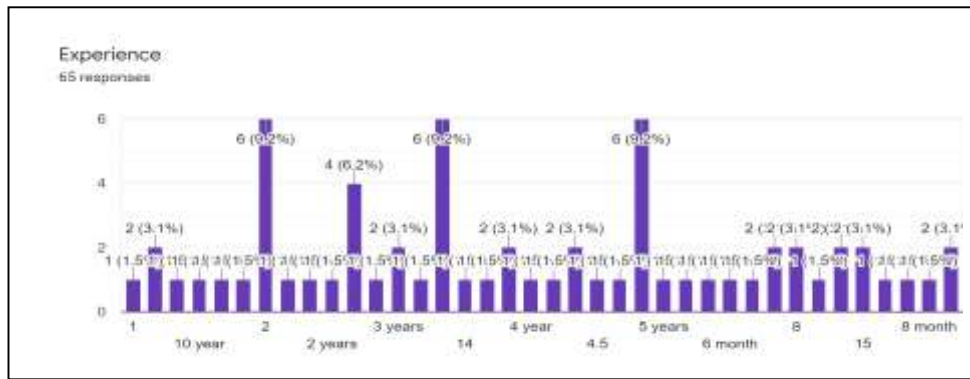


Figure:3 Experience of the Respondents

(3) Frequency Index Analysis

Table:12 Frequency Index Analysis

Sr No	Factors	Strongly Agree	Agree	Neutral	Dis Agree	Strongly Dis Agree	Percentage
1	On site not available waste management team?	23	25	10	4	4	44.12%
2	No Advance planning reduce waste?	18	28	10	8	2	44.24%
3	Not follow guidelines of Reducing Construction waste?	13	28	15	9	1	36.96%
4	Cost advantage then you should look into Construction waste?	16	37	11	2	0	39.69%
5	No Punishment for labour more wastage?	15	22	15	11	3	49.38%
6	No Calculation for construction wastage?	16	21	12	14	3	40.35%
7	More attention waste of steel baar can saving amount?	27	27	8	4	0	36.66%
8	Not Proper material storage?	21	21	11	8	5	46.36%
9	Damage to tiles in flooring work?	12	28	17	6	3	47.78%
10	No rules to prevent illegal dumping?	13	25	18	7	3	48.48%
11	Recycling method should be used?	26	29	6	2	3	37.87%
12	Material waste due to climate change?	14	29	14	7	2	46.06%
13	Delays in the work of the contractor?	18	18	15	10	5	49.69%
14	Changing the design?	16	30	13	6	1	43.63%
15	Lack of proper monitoring by the waste management team?	18	34	11	2	1	39.99%
16	Lack of leveling in brick work?	18	26	16	5	1	43.33%
17	Not paying attention in cutting ?	18	27	10	9	2	44.84%
18	Gap in shuttering work causes waste of concrete ?	22	30	8	2	3	39.08%
19	Non heap of sand in proper place ?	16	34	11	4	1	41.82%
20	Unskilled labour causes Construction waste?	20	31	9	5	1	40.60%
21	Excessive waste of material an effect on cost?	20	40	5	1	0	36.06%
22	Inexperienced staff?	16	24	15	7	4	47.57%
23	No supervision while conducting material storage?	20	29	10	5	2	41.81%
24	Not waste management will affect the environment?	12	29	14	10	1	47.57%
25	Excess waste in tiles attention should be paid to works and transportation?	17	30	13	6	0	42.42%
26	Waste due to non-consultation of experts?	13	37	12	2	2	42.73%
27	Planned waste costs and actual waste costs should be calculated?	7	22	21	13	3	54.84%
28	Not camera system in material storage?	27	31	6	0	1	47.56%

29	Issue of construction waste not seriously project manager and engineer ?	16	27	12	9	2	46.06%
30	Lack of contractor awareness?	20	27	10	8	1	42.72%
31	Excessive Storage of material?	14	27	16	9	0	46.06%
32	Lack of regulations?	17	34	9	5	1	41.51%
33	Workers should be trained?	23	34	7	1	1	36.66%
34	Compulsory waste management team in construction project?	34	19	10	2	1	34.84%

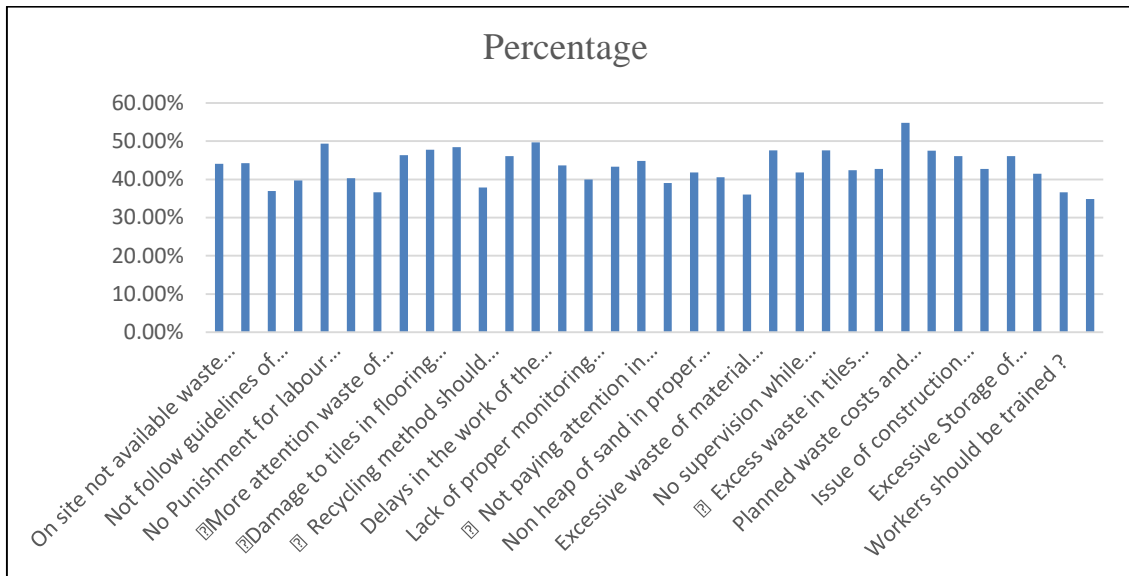


Figure:4 Percentage of Frequency Analysis

Frequency Analysis For all the 34 Factor that were asked in the Survey For the Category of Major Factor Waste Management of the Construction Project. After the Analysis of the Factors, Calculation Were Sorted from Highest to least and these Were the Factors that had Waste Management of Construction Project.

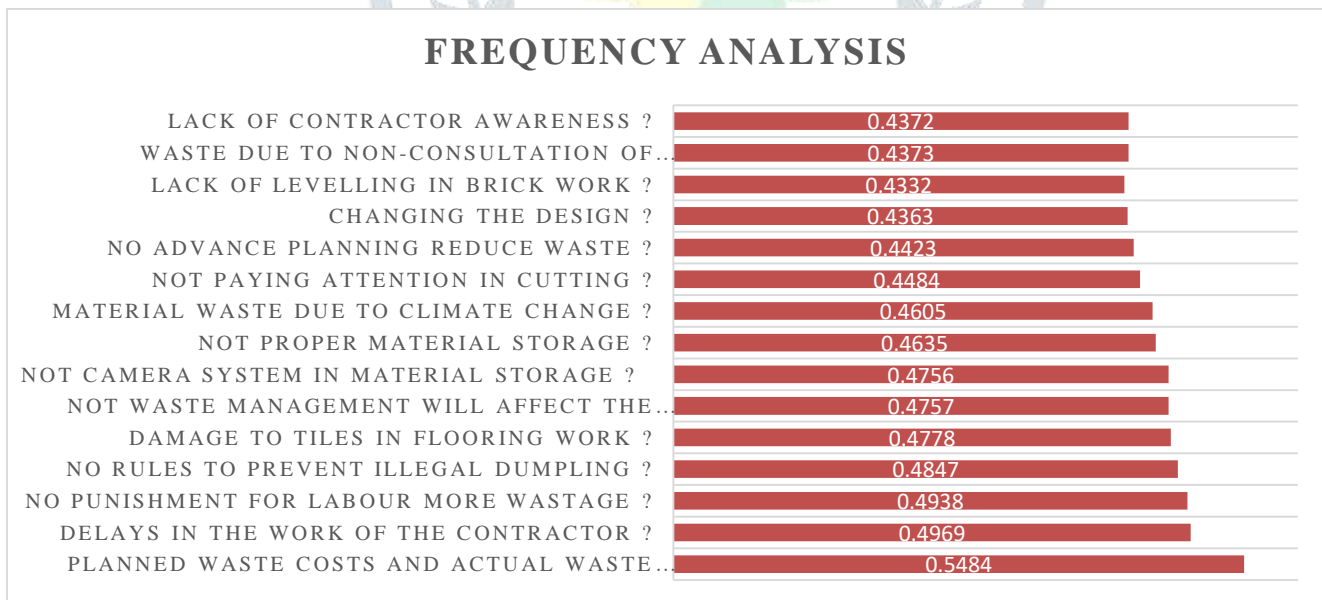


Figure:5 Top 15 Factor

V Conclusion

From this study it was concluded that materials are wasted in the construction industry and by reducing that a lot of costs can be saved. If work is done on proper waste management system a lot of benefits can be given to the company. This paper calculates the planned waste cost in a residential construction project And the actual waste cost of actual wastage is calculated. In which the actual waste cost was higher than the planned waste cost So research was done on it from which 34 factors came out which were responsible for excessive wastage in construction activities. Highly effected factor was 70.3%, normal effected factor was 17.8% and low effected factor was 12%. In which Top 15 Factor were identified according to Frequency Analysis Method.

Planned waste costs and actual waste costs should be calculated, Delays in the work of the contractor, No Punishment for labour more wastage, No rules to prevent illegal dumping, Damage to tiles in flooring work, Not waste management will affect the environment, Not camera system in material storage, Not Proper material storage, Material waste due to climate change, Not paying attention in cutting, No Advance planning reduce waste, Changing the design, Lack of levelling in brick work, Waste due to non-consultation of expert, Lack of contractor awareness.

If the government makes rule that the waste management team should be compulsory in the construction project, then reducing the wastage will benefit the company a lot in costs. And the environment will also benefit.

a) Future Scope

At present the government is paying enough attention to waste. So, the demand for construction project of waste management team will increase in future. In which the demand for supervisor for supervision will increase. The demand for waste management experts to train labour will increase. This will create employment opportunities and benefit the construction company.

VI References

- 1) *Analysis of Construction and Demolition Waste for Infrastructure Projects*. (2015). <https://www.researchgate.net/publication/281062658>
- 2) Dachowski, R., & Kostrzewa, P. (2016). The Use of Waste Materials in the Construction Industry. *Procedia Engineering*, 161, 754–758. <https://doi.org/10.1016/j.proeng.2016.08.764>
- 3) Dania, A. A., Kehinde, J. O., & Bala, K. (n.d.). *A STUDY OF CONSTRUCTION MATERIAL WASTE MANAGEMENT PRACTICES BY CONSTRUCTION FIRMS IN NIGERIA*.
- 4) Kolaventi, S. S., Momand, H., Tezeswi, T. P., & Kumar, M. V. N. S. (2021). Implementing site waste-management plans, recycling in India: Barriers, benefits, measures. *Proceedings of the Institution of Civil Engineers: Engineering Sustainability*, 175(1), 30–51. <https://doi.org/10.1680/jensu.21.00032>
- 5) Kolaventi, S. S., Tezeswi, T. P., & Siva Kumar, M. V. N. (2019). An assessment of construction waste management in India: A statistical approach. *Waste Management and Research*. <https://doi.org/10.1177/0734242X19867754>
- 6) Rani, M., & Gupta, A. (n.d.). *CONSTRUCTION WASTE MANAGEMENT IN INDIA*.
- 7) Reza Esa, M., Halog, A., & Zuhaira Ismail, F. (2015). *Waste Management in Construction Industry-A Review on the Issues and Challenges Circular Economy for the Sustainability of the Wood-based Industry: The Case of Caraga Region, Philippines View project Circular Economy and Environmental Management in Textile and Fashion Industry View project*. <https://www.researchgate.net/publication/277711259>
- 8) Tafesse, S. (2021). Material waste minimization techniques in building construction projects. *Ethiopian Journal of Science and Technology*, 14(1), 1–19. <https://doi.org/10.4314/ejst.v14i1.1>
- 9) Thomas, J., & M, W. P. (n.d.). Construction waste management in India. *American Journal of Engineering Research*, 2013. www.ajer.org
- 10) Yahya, K., & Boussabaine, A. H. (n.d.). *ECO-COSTS OF SUSTAINABLE CONSTRUCTION WASTE MANAGEMENT*.