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CONSTRUCTION WASTE IDENTIFICATION AND PRACTICE FOR IMPROVEMENT

Raj K.Chavda[1] ,Ms. Neetu Yadav[2],Mr. Keyur P. Shah[3]

[1]*M. Tech. Student & SNPIT & RC, Umrakh ,*
[2]*Assistant Professor & SNPIT & RC, Umrakh ,*
[3]*Assistant Professor & SNPIT & RC, Umrakh ,*

Abstract— Construction and demolition waste is a major source of urban solid waste, frequently accounting for 10–30% of the total waste disposed of at landfills in many cities around the world. C & D waste is becoming one of the most serious environmental problems .Looking towards the seriousness of issue this research has been carried out with concern of, to identified the major construction waste, issues related to generation of construction waste and practices for waste minimization. The study is followed by a questionnaire survey. The analysis of questionnaire has been done by using RII(Relative Importance Index) and SI(Severity Index). total questionnaire distributed 180 among which we have received feed from 100 project managers, engineers and contractors. The outcome of study is help to mitigate the quantum of construction waste and to improve the practices. This study has been done for Surat city from Gujarat State only.

Keywords— Construction & Demolition waste, Practice, Questionnaire, R I I, SI

I. INTRODUCTION

India is developing country and now days with the rapid growth of infrastructure demand of construction sector is increasing. The amount of generated waste has been increasing in most of the countries due to an increased demand for housing and infrastructure and rapid growth of towns and cities. Construction and demolition waste defined as a mixture of surplus materials arising from any excavation, civil or building construction, site clearance, demolition activities, road works and building renovation in shot Waste occurs within the entire lifecycle of buildings and structures. It is very difficult to dispose of C&D waste as it contains hazardous matters such as asbestos, heavy metals, persistent organic compounds, and volatile organic compounds when compared to the household waste. Unfortunately, in some countries, C&D waste is sometimes dumped into forest, streams, and ravines, which in turn may cause erosion, contaminate wells, water tables and surface waters, attract pests, and create fire hazards Material wastage will have huge negative impact on cost of construction and economy of the country. Moreover, construction activities cause loss of soil, loss of agricultural land and air pollution. However construction industry in India generates about 10-12 million tons of waste annually. The construction industry negatively affects the environment as it exploits natural resources, irreversibly transforms the natural environment, accumulates pollutants to the atmosphere, and consumes the world's nonrenewable energy sources and minerals.

II. OBJECTIVE

- To Identify various factors effecting on construction waste.
- To analysis the best construction waste management practice.

III. LITERATURE REVIEW

Yashuai Li studied on waste management model which is generated for building construction Projects. Quantity of various waste has identified and a mathematical model integrate the mass balance principle, work break down structure, Material quantity takeoff. The mass balance principal and material flow analysis are utilized to investigate the waste generation process for different kinds of material. The conversion ratio are used to help contractors calculate the weight and volume of materials and waste for transportation. The proposed waste estimation model integrates work breakdown structure. According to study they found that construction waste is generated from four broad categories, namely, construction materials, packaging materials, extracted materials, and target building elements.

Gul Polat identify the root causes of waste materials during new construction. Total 34 waste causes has been identified and made questionnaire that consists of 41 questions. In further investigation waste has been categorized in 7 main groups, which are: 1) design and contract documents-related factors, 2) procurement-related, 3) handling-related factors, 4) storage-related factors, 5) workers-related factors, 6)site management and supervision-related factors, and 7) external factors. The analysis of questionnaire has been done by Cronbach's alfa(α) and Relative importance indices(RII) method.

Giulia Borghi evaluate the environmental impacts associated with the non-hazardous CDW management system implemented in Lombardy Region (Italy) by applying the LCA methodology. He studied on Recycled aggregates (RAs) mixture of Cement, tiles and ceramics, bituminous mixture, gypsum based waste and mixed non- hazardous waste. Mixed RAs is produced by recycling plants could be used in several engineering application. About the quality of RAs, it should be considered that, in order to be used as secondary materials in civil and road construction works.

Ruane Fernandes de Magalhaes research on the best practices to reduce waste in the said projects, stressing the role of decision-making in the design stage and the effective management of construction processes in public sector. He analyzed 14 projects and Identify waste production by construction stages and for Reduce CW generation he has done qualitative and quantitative survey by the use of questionnaires. After study he made a list of 33 best practices with ten deployments applicable to design stages and project management.

Yakkaluru Peddavenkatesu studied on construction waste generation at different types of construction sites like commercial, residential and industrial sites was studied and the data regarding waste generation sources and average waste generation was done. He classified construction Waste material in 3R (Reduce, Reuse, Recycle) principle due to this we can minimize cost of project. After identify the causes of waste he concluded solutions for increase efficiency of waste minimization.

IV. RESEARCH METHODOLOGY

Research methodology of this study contains three main steps. The first step include literature Survey. The literature review was conducted through books, research papers, journals, internet, etc. As the outcome of this step is to identify factors causing waste and find out best practice for waste minimization. Second step include the questionnaire survey conducted by total 100 contractors, site engineers and project managers. The questionnaire is prepared in two parts, The first part contains the personal details of respondent is name, contact number, designation, field experience etc. And second part contains the cause of C & D waste and current practice for waste minimization. Questionnaire is distributed to Surat city. Third step contains result analysis and concludes with Severity Index(SI) method and Relative Importance Index(RII) method.

V. SURVEY OF FACTORS CAUSING WASTE & PRACTICE FOR WASTE MINIMIZATION

Design of questionnaire survey. A questionnaire survey is designed by identified 34 waste causing factors and 26 practice for waste minimization in Surat. The questionnaire carries both the instruction and questions to respondent and provides an enough space for respondents to write down any comments or remarks. The author considered both the subject content and wording of each question in term for shared vocabulary and clarity. Each question is stated in a way as to be as precise, short, simple as possible. There are two main parts in the questionnaire:

1. **Part I:** This part included a general introduction of respondents and description of the analysis method.
2. **Part II:** This part included a listing of the identified 34 waste causing factors in 7 groups 1) design and contract documents-related factors, 2) procurement-related factors, 3) handling-related factors, 4)storage-related factors, 5) workers-related factors, 6)site management and supervision-related factors, and 7) external factors and 26 practice for waste minimization. For each respondents having four option as follows:

For Severity Index "Extreme", "Often", "Great", "Moderate".
For RII "Very important", "Important"' "Somewhat important", "Less important"
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VI. ANALYSIS AND DISCUSSION

TABLE I
COMBINE RESULT OF SI AND RII ANALYSIS OF FACTORS AFFECTING TO GENERATION OF WASTE.

MAIN FACRORS	SR NO	FACTORS CAUSING WASTE	SI	RII
A. Design & contract documents	A1	Errors in contract documents	75.00	0.753
	A2	Design and construction detail errors	72.50	0.725
	A3	Design and detailing complexity	70.50	0.708
	A4	Frequent design changes and charge orders	80.75	0.820
	A5	Selection of low quality material	75.50	0.755
B. Procurement	B1	Purchasing Materials not complying with Specification	74.50	0.748
	B2	Suppliers and shipping errors	66.00	0.660
	B3	Mistake in quantity take offs	74.00	0.748
	B4	Over Allowance (i.e.: difficulties to order small quantities)	58.50	0.585
c. Handling	C1	Damage during transportation on site	53.75	0.543
	C2	Materials supplied in loose form	54.25	0.538
	C3	Unnecessary material handling on site	62.25	0.625
D. Storage	D1	Improper storing methods	74.00	0.743
	D2	Inappropriate site storage area leading to damage	72.00	0.728
E. Workers	E1	Damage caused by workers due to lack of experience	84.25	0.853
	E2	Worker mistake during construction	68.00	0.680
	E3	Too much overtime for workers	63.00	0.630
F. Site management and supervision	F1	Use of incorrect material resulting in their disposal	67.25	0.673
	F2	Unused materials and products on site	70.50	0.698
	F3	Waste from cutting uneconomical shapes	79.00	0.790

	F4	Scarcity of equipment	60.00	0.603
	F5	Inappropriate construction method	63.25	0.625
	F6	Congestion of the site	67.75	0.683
	F7	Poor lighting of the site	66.00	0.660
	F8	Delays in passing information on types and sizes of materials to be used	84.00	0.843
	F9	Lack of supervision	76.75	0.760
	F10	Lack of on-site material control	76.50	0.768
	F11	Lack of waste management plans	72.50	0.723
	F12	Lack of environmental awareness	68.25	0.680
	F13	Damage caused by subsequent trades	62.75	0.623
G. External	G1	Weather condition	79.25	0.790
	G2	Unpredictable local condition	60.00	0.595
	G3	Damage caused by third parties	56.75	0.563
	G4	Theft or vandalism	60.00	0.600

TABLE 2:
COMBINE RESULT OF SI AND RII ANALYSIS OF PRACTICE FOR WASTE MINIMIZATION

SR. NO.	PRACTICE FOR REDUCE WASTE	SI	RII
1.	Appropriate method must be adopted for dealing and packing material	79.25	0.793
2.	Central areas for cutting and storage	65.50	0.655
3.	Develop an organization structure for waste management	69.50	0.708
4.	Education and training for waste management on site	80.25	0.810
5.	Estimate quantities of waste requiring offsite disposal	62.25	0.625
6.	Estimating/ordering practice	61.75	0.610
7.	Identification of available recycling facilities	64.50	0.643
8.	Increase in overhead cost	59.25	0.585
9.	Individual value judgment	83.00	0.843
10.	Monitor and audit waste management programme	74.50	0.750
11.	On site waste recycling	72.25	0.723
12.	Operation on site sorting of construction and demolition materials	65.00	0.650
13.	Practice of well-known effective waste management method	79.50	0.835
14.	Promotion of waste minimization measures	61.75	0.618
15.	Proper site layout planning	57.50	0.550
16.	Propose disposal outlets	65.00	0.653
17.	Propose methods for onsite reuse of materials	76.00	0.765
18.	Propose methods of processing, storing and disposal of hazardous waste	83.25	0.838
19.	Purchase management	89.00	0.860
20.	Reused materials must be identified and dialed separately	77.50	0.775
21.	Sustainable development awareness	62.25	0.623
22.	Use of information technology on site	80.25	0.780
23.	Use of metal formwork	72.75	0.800
24.	Use of Non-Timber Hoardings	60.00	0.585
25.	Use of prefabricated building components	68.25	0.608
26.	Waste must be stored at suitable location on site	79.25	0.843

TABLE 3:
TOP 10 FACTORS CAUSING WASTE BY SEVERITY INDEX

SR NO	FACTORS CAUSING WASTE	SI
E1	Damage caused by workers due to lack of experience	84.25
F8	Delays in passing information on types and sizes of materials to be used	84.00
A4	Frequent design changes and charge orders	80.75
G1	Weather condition	79.25
F3	Waste from cutting uneconomical shapes	79.00
F9	Lack of supervision	76.75
F10	Lack of on-site material control	76.50
A5	Selection of low quality material	75.50
A1	Errors in contract documents	75.00
B1	Purchasing Materials not complying with Specification	74.50

TABLE 4:
TOP 10 PRACTICE FOR WASTE MINIMIZATION BY SEVERITY INDEX

SR. NO.	PRACTICE FOR REDUCE WASTE	SI
1.	Purchase management	89.00
2.	Propose methods of processing, storing and disposal of hazardous waste	83.25
3.	Individual value judgment	83.00
4.	Education and training for waste management on site	80.25
5.	Use of information technology on site	80.25
6.	Practice of well-known effective waste management method	79.50
7.	Appropriate method must be adopted for dealing and packing material	79.25
8.	Waste must be stored at suitable location on site	79.25
9.	Reused materials must be identified and dialed separately	77.50
10.	Propose methods for onsite reuse of materials	76.00

TABLE 5:
TOP 10 FACTORS CAUSING WASTE BY RELATIVE IMPORTANCE INDEX

SR. NO	FACTORS CAUSING WASTE	RII
E1	Damage caused by workers due to lack of experience	0.853
F8	Delays in passing information on types and sizes of materials to be used	0.843
A4	Frequent design changes and charge orders	0.820
F3	Waste from cutting uneconomical shapes	0.790
G1	Weather condition	0.790
F10	Lack of on-site material control	0.768
F9	Lack of supervision	0.760
A5	Frequent design changes and charge orders	0.755
A1	Errors in contract documents	0.753
B1	Purchasing Materials not complying with Specification	0.748

TABLE 6:
TOP 10 PRACTICE FOR WASTE MINIMIZATION BY RELATIVE IMPORTANCE INDEX

SR. NO.	PRACTICE FOR REDUCE WASTE	RII
1.	Purchase management	0.860
2.	Individual value judgment	0.843
3.	Waste must be stored at suitable location on site	0.843
4.	Propose methods of processing, storing and disposal of hazardous waste	0.838
5.	Practice of well-known effective waste management method	0.835
6.	Education and training for waste management on site	0.810
7.	Use of metal formwork	0.800
8.	Appropriate method must be adopted for dealing and packing material	0.793
9.	Use of information technology on site	0.780
10.	Reused materials must be identified and dialed separately	0.775

VII. CONCLUSIONS

Base of the overall assessment and ranking of factor by combining sample of Engineers and Contractors the following concluded:

This study was developed from the need to reduce environmental and economic impacts caused by material waste in urban infrastructure projects. Identification of the most important causes of waste generation is the first and key step in waste management. This study aims to identify the importance levels of the root causes of material waste during new construction and aiming the identification of best practices to support the design stage. To achieve this goal were used as methodological instruments: literature review; document analysis; and application of qualitative and quantitative survey with experts. After analyzing the data, it was possible to make some considerations. These findings are very reasonable as C&D waste is directly related to the design, procurement, and construction processes. Since design-bid-build is the most commonly preferred project delivery system in the Indian construction industry, design changes, change orders, and conflicts in design and contract documents are frequently experienced, which in turn may bring about huge amount of

waste generation during the construction phase. Moreover, although the purchasing function plays a critical role in the overall project performance, it is generally neglected in the construction industry. Poor purchasing function may result in problems such as purchasing materials not complying with specifications, mistakes in quantity take-offs, and over allowances, which may cause waste generation. Since the large majority of the construction workers are uneducated, unqualified, and inexperienced, huge amount of waste generation is highly expected due to the mistakes of the workers. Moreover, on-site fabrication is preferred rather than off-site fabrication in the Indian construction industry. Since most of the construction activities are carried out on site, the performance of site management and supervision becomes critical. If the performance of the site management and supervision is poor, generation of huge amount of waste becomes inevitable in this type of production.

VIII. RECOMMENDATION

From the above study, the identified factors causing waste and practice for waste minimization is very helpful to project managers, contractors and site engineer for any construction projects which can help to taking care at every stage of construction for reduce construction waste and make the project economical, sustainable construction and satisfactory work for all the stakeholders.

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