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Study of Zero Waste Management in Indian Construction Industry

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Abstract - **Construction and demolition waste management has become one of the major environmental problems in many municipalities The building industry is consuming a considerable amount of resources, from the most common material sand to the valuable natural assets like timber. If the life cycle of the material on site, from its transportation and delivery to the end fate, is closely examined, it is generally known that there is a relatively large portion of the materials being wasted because of poor material control on building sites.**
Keywords: **Zero Waste Management, Construction Industry**

I. INTRODUCTION

There are two main kinds of building construction waste, structure waste and finishing waste Concrete fragment, reinforcement bars, abandoned timber plate and pieces are generated as structure waste during the course of construction. Finishing waste (including a wide range of waste materials) is generated during the finishing stage of a building. For instance, surplus cement mortar arising from screeding scatters over the floors inside the building. Broken raw materials like mosaic, tiles, ceramics, paints and plastering materials are wasted because of carelessuse. The packaging of public and household facilities such as gas cookers, bathtubs, washtubs and window frames are also parts of the finishing wastes. The problem of material wastage is not an isolated issue on construction sites. It is also a major environmental concern in Indiaas India is one of the most densely populated cities in the world and its urban area has many high-rise multi-storey residential and commercial buildings. Construction and demolition (C&D) wastes are voluminous and take up a lot of capacity if they are disposed of at landfills.

II. OBJECTIVES OF THE STUDY

The study, consisting of literature review, questionnaire survey and work-site visits aims to identify the causes of material waste on site, find the material wastage level for various trades of building projects and explore ways to avoid or reduce material wastage and zero waste for future building projects.

III. SCOPE OF STUDY

This study focus on the zero waste management at construction site in Coimbatore which are through interview and questionnaire to the contactor and project manager at construction site. This study also By the result analysis the waste minimization, reuse and recycling will be found and the mitigation measures will be provided and to gets more information about method used in zero waste management construction at Coimbatore.

IV. RESEARCH METHODOLOGY

The research was conducted in collaboration with the building industry in Coimbatore. A total of 22construction sites were visited with 10 public housing projects, 10 residential developments and two office blocks from the private sector in 2017 to 2018. A questionnaire was developed and sent by post or email to 250 professionals in the building industry in Coimbatore. The questionnaire comprised six sections with covered a wide range of topics concerning construction waste minimization.

This questionnaire survey was conducted over a period of four months in 2017, and there were 75 respondents with the response rate being 30%. The majority of the respondents were architects (46%) and structural engineers (28%) from private and government sectors as well as academics. The questionnaire responses show that the majority of the respondents (42%) had over 20years of experience in the construction industry. Additionally,16 interviews were arranged and carried out in person by the authors with 23 interviewees (mainly architects and structural engineers) from the private and public sectors. In the questionnaire, the respondents were requested to assign an appropriate rating one scale of 1 to 5, from the highest to the lowest level, to reflect the importance of the factors in each question.

V. WASTE MANAGEMENT FACTORS IN CONSTRUCTION

A. Ranking of causes of waste management factors

Hierarchal assessment of factors was carried out to determine ranking of the factors based on level of significance. It was assessed based on Relative important index (RII) value and calculated for each group of respondent's i.e. contractor, consultant and owners and also the overall respondents as presented. It shows that top 5 most significant factors of delay factor ranked by overall respondents are material market rate, contract modification, high level of quality requirement, project location, depends on the fresher's to bear the whole responsibility. Material

market rate was ranked first (RII) as agreed by the entire respondent.

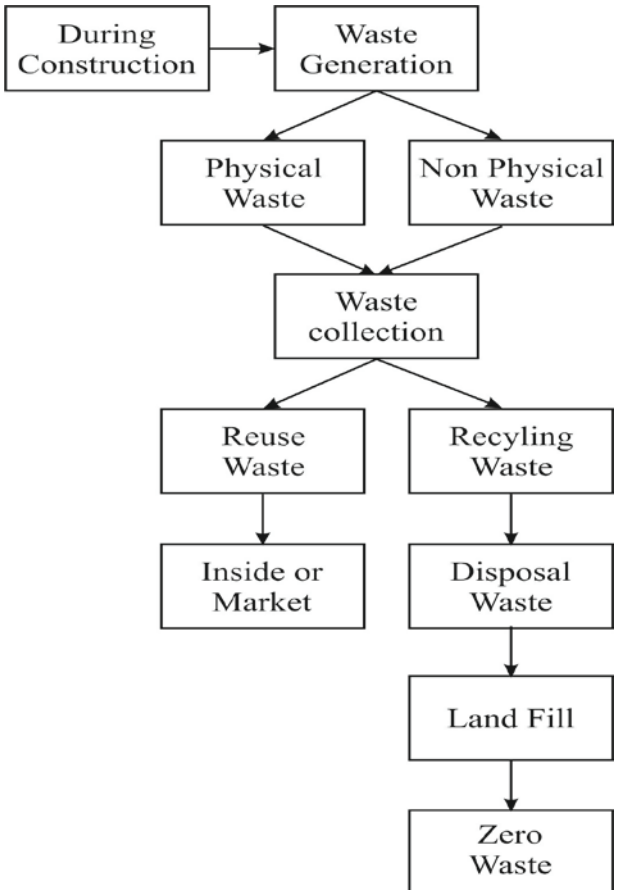

Fig. 1 Waste Management Method

TABLE I CASUSE OF WASTE

S.NO	CASUSE OF WASTE	RII	RANK	REMARKS
1	Frequent design changes	4.05	17	-
2	Design errors	3.79	18	-
3	Lack of design information	3.70	20	-
4	Poor design quality	3.45	26	-
5	Slow drawing distribution	3.42	28	-
6	Incomplete contract document	3.40	29	-
7	Complicated design	3.35	30	-
8	Inexperience designer	3.32	32	-
9	Error in contract documentation	3.1	36	-
10	Interaction between various specialists	3.0	37	-
11	Poor coordination of parties during design stage	2.8	38	-
12	Last minute client requirements	5.9	2	-
13	Wrong material storage	5.8	3	-
14	Poor material handling	5.6	4	-
15	Damage during transportation	5.42	5	-
16	Poor quality of materials	5.38	6	-
17	Equipment failure	5.371	7	-
18	Delay during delivery	5.287	8	-
19	Tools not suitable used	5.103	9	-
20	Inefficient methods of unloading	5.002	10	-
21	Materials supplied in loose form	3.254	33	-
22	Workers' mistakes during construction	6.574	1	-
23	Incompetent worker	3.24	34	-
24	Poor attitudes of workers	1.54	59	-
25	Damage caused by workers	1.38	64	-
26	Insufficient training for workers	3.61	21	-
27	Lack of experience	2.62	41	-
28	Shortage of skilled workers	4.21	16	-
29	Inappropriate use of materials	3.48	25	-
30	Poor workmanship	5.47	77	-
31	Worker’s no enthusiasm	2.14	45	-
32	Inventory of materials not well documented	1.37	65	-
33	Abnormal wear of equipment	2.11	46	-
34	Lack of awareness among the workers	1.59	57	-
35	Too much overtime for workers	2.44	43	-
36	Poor planning	3.54	23	-
37	Poor controlling	4.86	12	-
38	Poor site management	3.45	26	-
39	Poor supervision	4.78	14	-
40	Inappropriate construction methods	4.56	15	-
41	Lack of coordination among parties	3.74	19	-
42	Poor information quality	2.76	40	-
43	Late information flow among parties	3.57	22	-
44	Scarcity of equipment	1.84	50	-
45	Lack of waste management plans	3.34	31	-
46	Resources problem	1.09	72	-
47	Rework	2.44	43	-
48	Waiting periods	3.54	23	-
49	Communication problems	4.87	11	-
50	Outdated equipment	1.12	71	-
51	Non availability of equipment	2.48	42	-
52	Lack of knowledge about construction	4.81	13	-
53	Long project duration	3.22	35	-
54	Lack of influence of contractors	1.55	58	-
55	Lack of environmental awareness	1.67	55	-
56	Leftover materials on site	1.97	48	-
57	Waste resulting from packaging	1.29	66	-

58	Poor site condition	1.51	61	-
59	Congestion of the site	1.08	73	-
60	Lighting problem	1.74	52	-
61	Difficulties accessing construction sites	1.84	50	-
62	Unforeseen ground conditions	1.54	59	-
63	Interference of others crews at site	1.74	52	-
64	Ordering errors	2.0	47	-
65	Items not in compliance with specification	1.22	69	-
66	Error in shipping	1.45	63	-
67	Mistakes in quantity surveys	0.98	74	-
68	Supplier errors	1.27	68	-
69	Wrong material delivery procedures	1.97	48	-
70	Over allowances	1.46	62	-
71	Frequent variation orders	1.29	66	-
72	Different methods used for estimation	1.72	54	-
73	Waiting for replacement	0.78	81	-
74	Effect of weather	0.87	79	-
75	Accidents	1.93	49	-
76	Pilferage	0.41	76	-
77	Lack of legislative enforcement	2.8	38	-
78	Vandalism	0.72	75	-
79	damages caused by third parties	0.86	80	-
80	Festival celebration	1.22	69	-
81	Unpredictable local conditions	1.64	56	-

TABLE II ESTIMATED COMPOSITION OF CONSTRUCTION WASTES IN INDIA

Waste Type	Percent(%) by volume
Dimension lumber	25
Gypsum wall	15
Masonry and tile	12
Cardboard	10
Manufacture wood	10
Asphalt	6
Other wastes	5
Fiber glass	5
Other packaging	4
Plastic and foam	4
Metal	4
Total	100

TABLE III ESTIMATED COMPOSITION OF DEMOLITION WASTES IN INDIA

Waste Type	Percent(%) by volume
Wood products	25
Masonry and tile	12
Others	5
Concrete	5
Total	100

VI. CONSTRUCTION WASTE MANAGEMENT

Construction waste has a major impact on the environment and is becoming a worldwide problem. In India, due to the commercial building and housing development and also the demands in implementing major infrastructure projects, there is a large amount of construction waste is being produced by the construction sector. Waste became more harmful to health and to natural environments as a result of waste quantities accumulated and increased. Therefore, the construction waste management is an important area of concern in the construction industry of India. Construction waste management is to enhance a builder‟s operation and image, as well as the image of the entire home building industry. The construction waste management plan implemented represents the first steps in developing a holistic strategy for minimizing waste generation from the construction process.

Waste management also includes handling of waste, which including treatment, storage and disposal. Moreover, it is important to know the composition and quantity of the waste so that disposal can be handled in a planned manner. Waste minimizing is not only to reduce production costs but also to reduce liability at the same time. The general contractor bears some responsibility for any waste generated from unauthorized or illegal disposal of wastes, particularly potentially hazardous wastes at jobsites and to protect the company from any potential liability.
In order to reduce the total disposal cost, reduce and recycling are the most effective ways to manage the construction and demolition wastes. Besides that, it is important that the contractors should use materials efficiently to avoid pay twice for the materials wasted on job sites. Furthermore, resource conservation also should be considered. Contractors is responsible to do their part to conserve natural resources and landfill space by looking at their waste stream and seeing resources instead of refuse.

There are four options of the management of construction and demolition waste, which is source reduction, reuse, recycling and land filling.

VII. SOURCE REDUCTION

Source reduction involves the use of processes, practices or products to reduce or eliminate the generation or the toxicity of pollutants and wastes. Source reduction includes, but is not limited to, material substitution, process substitution and process elimination, source reduction involves reducing the amount of material used through more careful estimating to eliminate waste.

Reduction is the most efficient method to minimize the generation of solid waste. Source reduction does not incur costs for waste handling, recycling, and disposal for waste that is never created. Hazardous materials are usually the main target for reduction. Moreover, the rising of hazardous

waste disposal costs would encourage the contractor to reduce it.

VIII. REUSE

Reuse techniques is defined as re-employment of materials to be reuse in the same application or to be used in lower grade applications. Once the wastes generated cannot be reduced or unavoidable, reuse techniques is a desirable option.

A variety of reusable and unused materials could be found in construction activity such as lumber of different sizes, piping, plywood, asphalt shingles and so on. The re-use of products or materials that would otherwise become waste can provide a range of social, economic and environmental benefits. Many building materials may be reusable during renovation projects where a new building is built following the demolition.

IX. RECYCLING

Recycling is the reprocessing of a reclaimed material and converting it into a new material or use. Reuse and recycling opportunities for construction and demolition wastes depend on the markets for the individual materials comprising the wastes and the ability to process the commingled waste or separate the individual materials.

The benefits from waste recycling are not solely environmental, but economic and aesthetic as well. Recyclable materials have differing market values depending on the presence of local recycling facilities, reprocessing costs, and the availability of virgin materials on the market. In general, it is economically feasible for construction sites to recycle those waste materials.

Significant strides have been made in the recycling over the years and it is possible to believe that there will be greater amounts of construction and demolition waste be recycled in the future due to the environmental concerns, increasing cost for the disposal of construction and demolition waste by landfilling, higher tipping fees and the success of entrepreneurs in processing both source-separated and mixed wastes.

X. ZERO WASTE

Disposal is the “no alternative” option because it is the last functional element in the solid waste management system and the ultimate fate of all wastes that are of no further value, construction and demolition waste is commonly managed via land filling. There are some management concerns that must be considered such as environmental impact, public concerns and the adaptability for multiple uses in the waste management system.

In the management of existing landfills, the major concern is to ensure that proper operational procedures are followed carefully and routinely. The basic issues for the planner and manger are:

1. Justification of need for a landfill
2. Evaluation and community acceptance of the landfill location
3. Landfill design and cost-effectiveness
4. Management policies and regulations

XI. CONSTRUCTION WASTE RECYCLING

Recycling is the removal of material from waste for reprocessing. Recycling is recognized today as a solid waste management strategy that is preferable to landfilling or incineration and environmentally more desirable.

Recently, increased awareness of the environment, concern over guaranteeing sustainable development, and aware of the need to organize waste management have all contributed to enhancing the image of recycling as an important instrument to attain these environmental objectives. The recycling of waste materials has many benefits, which will indirectly protect the natural environment.

In almost all communities in the country today, there is a growing concern for recycling and the environment. The true success of a construction and demolition waste recycling operation must be determined by establishing the scale of the operation to be implemented and its resulting economics (Peng et al., 2010). Before establishing a waste recycling operation, it is important to identify all possible alternatives.

A. Advantages of Recycling

Recycle technique is defined as utilizing wastes as raw materials in other applications. It takes less energy to process recycle materials than it does to use virgin materials.
The advantages of a construction and demolition recycling program include:

1. Avoid trash collection and disposal fees
2. Save resources and money through deconstruction
3. Improve organization’s public image
4. Make new products from old materials
5. Improve the market for recycled content products
6. Help community meet local and state waste reduction goals

XII. CONCLUSION

Construction waste management is required for a country to develop in a sustainable manner. It helps to address issues related to environment, social and economy. Once the root causes of waste generation are notified, it can either be avoided or minimized to benefit the world for better future. This study has identified significant factors contributing to waste in construction projects. By identifying the significant factors in construction process, construction players are able

to notice the best ways to apply new practice for reducing material waste, time delay and cost overrun in any project. Based on the results and findings of this study, the following recommendations are made to reduce the construction waste generation in any construction projects. The aim of this study is to investigate the waste recycling and reuse in the construction industry. It can be concluded that generally the construction personnel are Zero waste of the construction waste. The objectives stated in chapter one which are to identify the construction materials that can be recycled and reused, to identify the methods used to dispose of the construction waste in India and to identify the advantages of recycling the construction waste have been met. Finally concluded to Zero waste in construction industry.

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