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Construction Waste Management

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Abstract**—** *Management of waste is an essential aspect of sustainable building. In this context, managing waste means eliminating waste where possible; minimizing waste where feasible and reusing materials which might otherwise become waste. Solid waste management practices have identified the reduction, recycling and reuse of wastes as essential for sustainable management of resources. All or part of the construction and demolition waste stream is unlawfully deposited on land, or in natural drainages including water, contrary to regulations to protect human health, commerce and the environment. Effective management of building-related waste requires coordinated action of governmental, business, and professional groups and their activities. This paper determines the factors contributed to the generation of construction waste. Mapping technique was applied for identification works and interview was conducted to create zero waste management. These seven factors were based on the co-ordination namely-Design, Handling, Worker, and Management, Site condition, Procurement and External factor. The significant factors of each category of waste were determined. These findings will help contractors to avoid, reduce and recycle the physical and non-physical wastes. Furthermore, the paper has put forward some recommendations for better improvements in construction*.

Keywords**—** *Construction wastes, reduce waste*.

I. INTRODUCTION

Construction and demolition debris (C&DD) means those materials resulting from the alteration, construction, destruction, rehabilitation, or repair of any manmade physical structure including houses, buildings, industrial or commercial facilities, and roadways. Construction industry has been developing rapidly around the world. The development has led to serious problem in generation of construction wastes in many developing countries and expectation of the natural resources to large extend. Construction and demolition waste management has become one of the major environmental problems in many municipalities. It has been a pressing issue in India since the late nineties due to the running out of disposal sites to manage the huge amount of waste generated. 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.

II. OBJECTIVES OF THE STUDY

The study, consisting of literature review, questionnaire survey and work-site visits that 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 THE STUDY

This study deals with minimization and re-use of construction wastes. The way of study is conducted through questionnaire and interview to the contactors and project managers at construction site to get some information. By the result analysis, mitigation measures and various methods to be found out to control the generation of waste in construction.

IV. TYPES OF 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. Broken raw materials like mosaic, tiles, ceramics, paints and plastering materials are wasted because of careless use. The packaging of public and household facilities such as gas cookers, bathtubs, washtubs and window frames are also parts of the finishing wastes. The construction wastes includes the materials like

- Concrete
- Asphalt
- Wood
- Metals
- Glass
- Brick
- Insulation
- Nails
- Electrical Wiring
- Rebar
- Gypsum Board
- Plasterboard
- Carpet
- Plumbing Fixtures
- Piping
- Dredging Materials
- Tree Stumps
- Rubble

There are two main kinds of building waste-
Construction Waste
Demolition Waste

V. CONSTRUCTION WASTE

Construction waste is normally combined with demolition waste and described as "construction and demolition" (C&D). For the purpose of this study, C&D waste is defined as the

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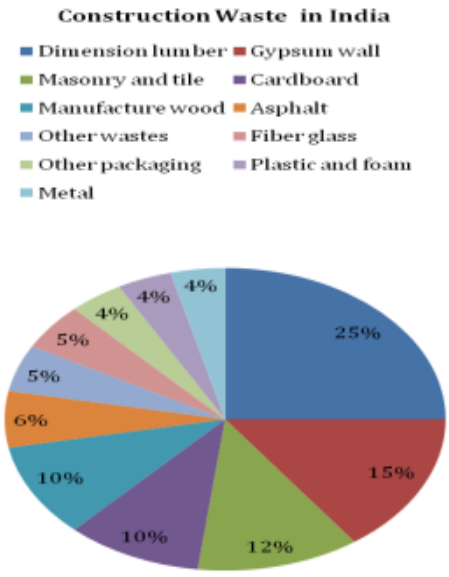
waste resulting from new construction, remodeling, or the demolition of a structure. However there are some differences between construction and demolition waste. Construction waste loads were usually transported to the landfill in open top roll-off containers, dump trucks, or open trailers. The construction loads tended to be lighter, less weathered, more homogeneous (all wood, dry wall, etc), and contained more cardboard boxes (usually from fixtures) than the demolition waste loads. In most cases it was relatively easy to visually differentiate between the construction and demolition loads. These loads contained some new material and some demolition materials. In those cases, the load was analyzed and the waste components assigned percentages. For instance a remodeling load might be estimated to be 60% construction and 40% demolition. The materials within each of these components were then estimated.

VI. Construction Waste Components

	Large Metro		Small Metro		Rural		State Average	
Materials	%	%	%	%	Tons	Tons	Tons	Tons
Wood	46	47	40	45	112,908	4447	8,253	100,208
Drywall	21	20	24	21	51,558	2,630	3,461	45,467
Masonry	14	16	15	15	36,290	1,681	2,837	31,772
Metal	1	3	3	1	3,266	305	476	2,485
Plastic	4	2	2	4	9,608	195	411	9,002
Cardboard	9	6	7	8	20,778	740	1,113	18,925
Other	5	5	10	6	13,721	1,109	950	11,662
Total	100	100	100	100	248,192	11,172	17,500	219,520



VII. Estimated Composition of Construction Waste 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

VIII. Demolition Waste

The demolition component of C&D is quite different from the construction component. Construction waste materials tend to be more homogeneous (all new wood, or new drywall, etc.) and for the most part are easier to separate and recycle. The demolition waste materials tended to be mixed with a variety of materials, and more difficult to separate and recover. Demolition loads fit into two broad categories; remodeling and debris. The remodeling loads were often mixed with new construction materials. Residential remodeling loads had a higher percentage of wood while commercial remodeling projects contained more metal. Most remodeling loads arrived in open top roll-off containers or were self-hauled in pick-up or trailers. Debris loads were essentially structures that were knocked down by heavy equipment and loaded onto dump trucks for transport to the landfill. Debris loads usually contained masonry materials (dirt, rock, concrete, and brick) that were mixed with wood, roofing, carpet, drywall and small amounts of metal. The materials were mixed and usually shredded, broken, and smashed. Therefore debris loads are much more difficult to recover materials. In many cases, a debris load consisted of dirt, rock, or masonry materials. These masonry loads were very heavy and tended to skew the overall numbers.

The following materials were observed and estimated as part of the demolition waste

- Wood
- Drywall
- Roofing
- Masonry

Wood waste from the demolition or remodeling of a structure. The wood was typically weathered, painted, and in many cases attached to some other material. Gypsum wallboard, which has been removed from a structure. Shingles that were tom off of existing roofs in anticipation of putting new shingles on the structure.

In most cases these shingles were delivered to the landfill in dump trucks or trailers and not mixed with any other materials. Inert materials such as brick, concrete, rock, and dirt that were removed from a demolition site. These materials were normally mixed with other demolition materials such as wood, drywall, etc.

- Metal
- Carpet

Metallic items that were removed during the remodeling or demolition of a structure. Carpeting that was removed and disposed of during the remodeling and or demolition of a structure. Any other materials, not listed above, that was removed and disposed of during the remodeling and or demolition of a structure. These included insulation, roofing insulation board, plastics, and small amounts of MSW or bulky items.

IX. Demolition Waste Components

About 13 percent of the solid waste in Missouri landfills is demolition waste. This percentage varies greatly from metropolitan areas to rural areas. As was the case in

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construction waste, the metropolitan demolition component is much higher than rural demolition waste. Unlike the construction waste component, the percentage of demolition waste materials (wood, dry wall, etc.) differed greatly from metropolitan areas to rural areas.

I. Roofing waste was significantly higher in rural areas. The age of many structures may be older in rural areas than the metropolitan areas, thereby requiring more repairs (tear off and re-roofing).

2. The percentage of masonry (dirt, rock etc.) was significantly less in rural areas. Ordinances and enforcement on demolition projects in rural areas may be less restrictive than metropolitan areas. Also, some masonry loads (dirt and rock, etc.) may be illegally disposed in rural areas.

3. Wood waste was significantly higher in small metropolitan areas. During the observation period several trucks containing wood debris from a flood related demolition project were recorded. Unusually large amount of demolition debris received during the observation period may have inflated the amount of this material normally received by the landfill.

The table on the following page illustrates the distribution of demolition waste materials in Missouri landfills.

	Large Metro		Small Metro		Rural		State Average	
Materials	%	Tons	%	Tons	%	Tons	%	Tons
Wood	31	136,045	47	29,980	33	26,827	33	192,852
Drywall	6	27392	5	3471	10	8413	7	39,276
Roofing	22	92,866	21	13,155	37	30,096	24	137,117
Masonry	28	123,924	19	12,100	7	5,770	24	141,794
Metal	4	16,651	2	1,073	3	2,265	3	19,989
Carpet	4	15,779	3	2,188	7	5,843	4	23,810
Other	5	21,961	3	1,653	4	3,027	5	26,641
Total	100	436,426	100	63,620	100	82,241	100	582,287

X. Ways For Reducing Construction Wastes

Many opportunities exist for the beneficial reduction and recovery of materials that would otherwise be destined for disposal as waste.

1. The methods of reducing the generation of wastes in construction is by elimination of waste and minimization of waste.

2. Construction industry professionals and building owners can educate and be educated about issues such as beneficial reuse, effective strategies for identification and separation of wastes, and economically viable means of promoting environmentally and socially appropriate means of reducing total waste disposed.

3. Organizations and governments can assume stewardship responsibilities for the orderly, reasonable, and effective disposal of building-related waste, promotion of public and industry awareness of disposal issues, and providing stable business-friendly environments for collecting, processing, and repurposing of wastes.

4. Businesses can create value through the return of wastes back to manufacturing processes, promoting and seeking out opportunities for incorporation of recycled materials into products, and prioritizing reduction of building-related wastes through efficient jobsite practices.

XI. Waste Minimization

Waste minimization is a process of elimination that involves reducing the amount of waste produced in society and helps to eliminate the generation of harmful and persistent wastes, supporting the efforts to promote a more sustainable society. Savings and environmental good that is achieved through waste minimization and recycling, it helps to achieve the goal in right time which leads overall business development. Being able to prove that you have succeeded in the past is therefore essential. Having a goal and measuring your results provides that proof.

XII. Reuse

To reuse is to use an item again after it has been used. This includes conventional reuse where the item is used again for the same function, and creative reuse where it is used for a different function. By taking useful products and exchanging them, without reprocessing, reuse help save time, money, energy, and resources. In broader economic terms, reuse offers quality products to people and organizations with limited means, while generating jobs and business activity that contribute to the economy. 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.

XIII. Recycling

In contrast, recycling is the breaking down of the used item into raw materials which are used to make new items. Recycling is the process of converting waste materials into reusable objects to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, energy usage, air pollution (from incineration) and water pollution (from land filling) by decreasing the need for "conventional" waste disposal and lowering greenhouse gas emissions compared to plastic production. Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse and Recycle" Recyclable materials include many kinds of glass, paper and cardboard, metal, plastic, tires, textiles and electronics. The composting or other reuse of biodegradable waste such as food or garden waste is also considered recycling. Materials to be recycled are either brought to a collection centre or picked up from the curbside, then sorted, cleaned and reprocessed into new materials destined for manufacturing. Some materials can be reused. For example, doors and windows in good, resalable condition might substitute for new products, or be donated and or sold for use on another project, a form of beneficial reuse.

Materials and products which cannot efficiently and effectively be eliminated, minimized or reused ultimately are collected, and unless managed, will probably be disposed at the lowest cost. In many areas of the country, disposal fees at solid waste landfills are substantially higher than the cost of

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separation and recovery, including the disposal cost for residues.

XIV. Benefits of Recycling Debris from Construction

Recycling and reuse of buildings and materials can yield significant economic and environmental benefits. Reuse promotes historic preservation, conserves both energy and resources, and contributes to the local economy. Half of this amount could have been reused or recycled.

Recycling of materials can save significant money for the state and other purchasers, generate additional trade prospects, save energy by performing recycling at site, and preserve thinning resources. According to the studies carried out, recycling is performed at a small scale that needs to be enhanced to obtain the advantages of recycling.

For example, the recycling of asphalt is essential because the roads are being increasingly deteriorated due to the manifold increase in traffic load and volume, reduced funding, and the increased requirement for an efficient transportation system. To reiterate the cost reduction, a paving project of a 4-inch overlay by using conventional materials was estimated at Rs.55,000. The same task could be completed at Rs.32,000 through the use of recycled materials, resulting in a savings of Rs.13,000. Similarly, there are substantial savings in other fields from the use of recycled materials.

XV. Zero Waste Management Using Landfill

It is a site for the disposal of waste materials by burial and is the oldest form of waste treatment (although the burial part is modern; historically, refuse was just left in piles or thrown into pits). Historically, landfills have been the most common method of organized waste disposal and remain so in many places around the world. Some landfills are also used for waste management purposes, such as the temporary storage, consolidation and transfer, or processing of waste material (sorting, treatment, or recycling) so that it can be used for a specific purpose, such as for building houses.

Benefits of Zero Waste to Landfill Certification:

The benefits of being independently certified as zero waste to landfill include:

- Certified to a recognised standard
- Better management of waste resources
- Ability to demonstrate commitment to the environment
- Improved corporate social responsibility
- Cost savings
- Legal compliance
- Increased business opportunities from environmentally aware customers
- Marketing opportunities
- Use of zero waste to landfill logo

XVI. Questionnaire Structure

The questionnaire was tested with survey for clarity. The questionnaire survey is divided into two parts. The first part consist of general information like type of company, experience value of their project etc and the second part consist of the construction waste management factors for evaluation. Waste management factors for this study are classified into seven categories namely,

1. Design
2. Handling
3. Worker Workers' mistakes
4. Management
5. Procurement
6. Site condition
7. External Factor

XVII. Conclusion

Construction involves hard work, resulting in massive amounts of waste. As a result, waste management is essential to the industry. This is true whether the project is building something completely new, renovating buildings, or restoring structures. Waste management in the construction industry is important for the reasons of city and health codes, construction site safety, to make a favorable impression and to protect the environment. City codes and health codes exist specifically to make sure that companies are managing the resulting waste in the correct way by exhibiting a waste management plan in place. Collection of waste materials will only make a construction zone dangerous and this is especially true for construction projects that are along busy roads or interstates. Construction work needs clear, workable space in order for workers to get around and perform their jobs safely. A construction project typically involves demolition, sizing materials, and other tasks that result in a lot of debris. Unfortunately, these results in ugly and cluttered looking work sites. To avoid that, proper waste management is a great way to differentiate your construction company from others around town who do not comply with proper waste disposal. Finally, proper waste management will help the environment instead of destroy it. Following the proper way to dispose of construction waste prevents illegal dumping, improper dumping of hazardous materials, as well as other harmful practices that harm the environment. As a result, you are also raising environmental awareness. Having waste management guidelines can lead workers and others to pay more attention to their trash habits both on-site and at home.

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