Construction and Demolition Waste Management

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ABSTRACT - The necessity for waste management in India arises from the fact that the country is a developing nation with a correspondingly rising rate of garbage production. Population growth, the expansion of the information technology industry, the emergence of new infrastructure projects, and the rise of industrialisation have all contributed to the rapid expansion of the construction sector. The excessive waste of materials during construction is a significant source of financial stress for builders. Having trash around has negative effects on our health, our ecology, our aesthetic sensibilities, and our appreciation of art. The local building sites in India are notorious for their enormous loss of material, poor management of materials, and lack of awareness regarding the reduction and proper utilization of waste materials. Recycling as much as 80%-85% of Europe's total construction waste would have significant economic benefits. They use simple, effective recycling technologies that reduce material waste significantly. There is a pressing need to address the problem of waste management, since trash can have serious negative effects on our nation. Due to a lack of discipline, attention to detail, regulatory oversight, and strict administration, accurate waste material estimates are not possible in India. In this paper, we'll look at one approach to dealing with the problem of building debris. To learn about construction and demolition waste management, how to cut down on waste, and the process of doing so are central to this project. As material waste is decreased, supply increases, the growing population's needs are met, and fewer resources go to waste. In addition to the well-known causes of waste, such as carelessness with product sizing, inadequate contractor input, and inadequate building expertise, there are many other potential contributors. The building and construction sector is responsible for a sizable proportion of the garbage produced. As a result, reducing construction waste has become a hot concern among governments around the world. The construction industry saves money when waste is eliminated because of lower deposition costs and cheaper expenses for obtaining virgin materials. Here, the government's primary sustainability-related policy domains are outlined for the reader. The 3R concept of reuse, reduction, and recycling is discussed in further depth in this study as a technique by which to better manage garbage.

Keywords:- Construction Waste, Management Techniques, Demolition and Waste Management.

I. INTRODUCTION

1.1 Introduction of CDW

Debris from building and demolition projects, as well as any harmed materials from these projects, are considered construction and demolition waste (CDW). The construction industry is a major waste propagator worldwide. Although landfilling is the most cost-effective and socially acceptable auctioning adjustment for C&D wastes, recycling should be the primary emphasis of waste management because to the extreme demands being placed on landfill space. Recycling and waste management should be conducted in a socially and environmentally beneficial manner.

Construction and demolition waste management may improve environmental conditions, pollution control, land care, and activity resources. There are no readily available abstracts detailing the quantity of C&D garbage produced in India. This is due to the fact that no regulations have been established by relevant organizations. For new projects to be built at reasonable prices, construction and demolition abstracts that meet acceptable norms of superior for the purpose must be made legally enforceable. Recycling construction and demolition debris is a cutting-edge new method used in manufacturing. The marketability and attractiveness of green buildings with sustainable characteristics are boosted by the use of concrete made from C&D waste. The use of C&D waste fabric can help make buildings more energy efficient by reducing the amount of electricity used inside. In the wake of World War II, Germany was the first country to actively pursue the recycling of nuclear waste. Since then, research plans initiated in a number of nations have shown sufficient

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affiance for expanding use of construction waste as a basic in new concrete. C&D debris includes remnants from building demolition, such as broken pavement, rubble, and shards of concrete and brick. Buildings, arches, airport runways, and concrete roadbeds all provide potential sources of Recycled Aggregate (RA). The use of such aggregates in concrete results in what is known as recycled accumulated correct concrete (RAC).

1.2 Waste Generation In Construction Industry

The construction business has seen phenomenal expansion over the past decade all around the world. Rapid construction and demolition trash production is likewise a major issue. Bulk generators and retail or small generators are the two main categories of waste producers. Figure 1 provides a breakdown of the many types of suppliers. The construction industry and the real estate business produce the most trash. The infrastructure development sector includes building and maintaining transportation systems like roads, bridges, and flyovers. Housing, industrial, and commercial building construction, as well as the removal of illegal constructions, etc., are all part of the real estate sector. The term "retail" or "small generators" refers to businesses with fewer than ten employees or to individual home-building crews. Fig. 1 shows the sources of construction and demolition debris during a project. Every member of the team is responsible for ensuring that their activities throughout the project are well-planned to produce as little waste as possible.

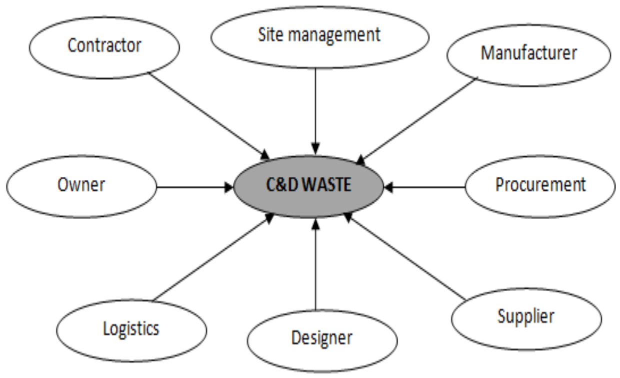

Figure 1 Contributors of C& D waste in a project

India invests the most in the construction business. According to the eleventh five-year plan, it is the second largest economic activity after farming. The Indian construction industry has a significant environmental impact. The building sector consumes a significant amount of raw materials and finished items. It generates a large number of job opportunities. Construction is assumed to have a large impact on the economy based on an analysis of how the forward and backward links of construction affect the economy [2]. Changes in the building industry have contributed to the country's economic progress. Money spent on construction accounts for over 11% of India's Gross Domestic Product (GDP). Because of the government's recent decision to allow 100% foreign direct investment in real estate development projects, our construction industry is expected to grow at a quicker rate in the next years. Research from the Technology, Information, Forecasting, and Assessment Council -TIFAC (2000) suggests that $847 billion will be spent on building projects across the country during the next five years, from 2006 to 2011. Material costs account for between 40 and 60 percent of the total cost of a building project, as determined by an examination of the various ways in which construction projects are financed in India. The building sector produces a substantial quantity of material waste, which has a high monetary value. Millions may be saved if India implemented effective waste management policies. Important for any development, but especially one that aims to reduce its environmental impact, reduce carbon emissions, and conserve resources [3]. The annual C&D garbage output in India is predicted to range from 11.45 million to 14.69 million tons (TIFAC, 2000). FIGURE 3: A breakdown of C&D waste in India, showing the breakdown of its numerous components. Over half of all construction and demolition (C&D) debris is made up of concrete, brick, and masonry. This highlights the need for a C&D waste management strategy for these materials.

1.3 Innovative Steps To Reduce And Reuse Wastes

Waste prevention: The overall cost is lower because there is less debris to haul away and fewer essential building materials to purchase. Making sure there are adequate places to store and manage building supplies to cut down on the production of waste materials (i.e., advancement materials) until they are needed. Putting together a feasible plan of action[2].

Reuse of recycled waste: If recycled materials can't be utilized right immediately in a project, they should be preserved and maintained properly so that they can be reused in the future. It is critical to clearly identify which architectural materials are recyclable so that they can be reused or repurposed once their useful lifespan has expired. Specific tools and methods must be used to reuse resources in the construction of new, identical buildings on the same site.[3].

Precast construction: In addition to being cost-effective, precast panels can be used multiple times. Using glazed panels also aids in cutting down on the excessive quantity of trash left over after the destruction process. This also includes a background report on the planning of a neighborhood for the demolition of a building, to make sure that the recovery of the building's equipment following its destruction goes off without a hitch.[4]

Flexibility in planning: Buildings should be planned and built in such a way that they can be used for other things while they are still standing. It's important to agree on how the building will be changed before the time comes[5]. All assets should be properly evaluated, including the data of

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all casework and sharing it with residents and users. This will make it easier and more useful to make changes, fix things, and switch things up. [6].

Prevention of existing buildings: If a structure can be fixed or retrofitted, then it shouldn't be destroyed until absolutely necessary. Extreme quantities of trash are produced, and equally massive volumes of fresh materials must be manufactured to deal with it.[7].

1.4 OBJECTIVE AND SCOPE OF STUDY

The research team hopes to learn more about the characteristics of demolition debris, the dangers it poses, and effective strategies for recycling, reusing, and disposing of this material.

The work's scope is confined to the compilation of material on the management of demolition trash, including an examination of the qualities of such waste, the hazards posed by it, and the safest possible recycling, reuse, and disposal options.

The scope of this work is also

- "To study demolition waste management strategies of different countries.
- To study the role of regulatory authorities in demolition waste management.
- To suggest improved methods of recycling/reuse/disposal of demolition waste.
- To suggest the modifications required in regulations in vogue for demolition waste disposal".

The Waste Management Plan should

• "Estimate types and quantities of C&D wastes generated during each phase of the Job.

• Identify how each waste will be managed and marketed.

• Provide an estimate of the overall job recycling rate.

• Lay out plans for training, meetings, and other communications related to job-site waste management".

• "Provide troubleshooting instructions and contact information".

All of this preparation can (and should) be done ahead of time to ensure that recycling is an integral part of the construction process. A Waste Management Plan should be written and authorized by the owner, architect, and contractor at least one month before the demolition or ground breaking date.

II. LITERATURE REVIEW

2.1 Quantifying Demolition and Renovation Waste Generation

Two of the biggest issues with managing demolition debris are improper waste classification and a lack of financial incentives for separation. Demolition waste categorization is more involved than new construction and renovation waste classification (Marrero et al. 2011).

These issues are major hurdles everywhere, but notably in underdeveloped countries. Determining the volume and make-up of demolition debris is crucial for calculating the viability of recycling demolition materials. When comparing building, demolition, and rehabilitation, demolition is typically the one that results in the most waste (Bergsdal et al. 2007). According to studies, building destruction and rehabilitation remain a major issue on a global scale (Lu et al. 2016). The growing urbanization of China, for instance, has made demolition the country's primary source of waste in the early 2010s.

2.2 Investigating Reduction Potential of C&D Waste in other Phases Especially Design Stage

Several studies (Hao et al., 2008b; Ajayi et al., 2017) and articles discuss ways to improve recycling and garbage management on-site. However, little effort is taken to manage waste during the building's other stages. It's important to remember that bad planning is a major contributor to the mountain of trash produced by the building industry (Osmani et al. 2008). Therefore, it is crucial to tackle waste at the source, or design-out waste, with appropriate effort and high recognition. The potential for significant waste reduction exists, and might be realized, if the design process for value engineering design solutions were standardized. In addition, Bossink and Brouwers (1996) show that several stages of construction, including design, procurement, construction, and operation, each produce their own unique types of C&D waste. Further study could be done into including waste management in all phases, notably the design stage, as C&D waste reduction is the most important aspect of construction waste management.

2.3 Integrated Management Systems for C&D Waste

There have been a number of legislative and regulatory initiatives passed and put into effect to encourage the management of C&D waste. Wong and Yip (2004) conducted a study in Hong Kong and discovered that (1) more than half of respondents said their projects did not take any efforts to collect and sort C&D wastes and (2) roughly two fifths of projects did not use recycled building materials in construction. Because of the complexity of the construction industry and the interdependencies among key decision-makers, it is essential that the many players' interests be coordinated through an integrated management system. C&D waste management can benefit from the system dynamic approach by better comprehending feedback and feed forward interactions (Hao et al. 2008b). System dynamics has been applied successfully in many areas of project management, therefore following the waste stream as it passes through the various stages of the waste management system would allow for consideration of more dynamic characteristics, such as social, economic, and

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environmental variables. An integrated management system that aids decision-makers in achieving optimal management performance may be the result of future studies.

2.4 Examining Waste Management by the Application of Big Data

"Official statistics from statistical yearbooks and government publications, existing research, and survey data from interviews and questionnaires make up the three main sources of data cited in the literature study. The quality and quantity of the data have a profound impact on the analysis that follows".

There has not been enough high-quality data in previous research analyzing C&D waste management performance. Big data, with its characteristics of data volume, velocity, and diversity, could be applied to C&D waste management to help with this issue. The construction sector has acknowledged the value of big data analytics in predicting the possibility of poor managerial performance (Lu et al. 2015). The integration of big data and geography is the subject of active study.

"So, a number of researchers are interested in integrated management systems that use the Global Positioning System (GPS) or the Geographical Information System (GIS). With the help of an automatic data collection system and data mining technology, decision-makers can look at how well waste is managed both on-site and off-site and then take the right steps to reach their long-term goal".

2.5 Research Gaps

Using content analysis, we present a framework for understanding C&D waste management that unifies these five foci. Academics might pay more attention to the possibility for waste reduction during the design phase, as well as waste estimation during the renovation and demolition phases, to reduce the amount of C&D trash generated. Pre-processing might use more investigation into topics like the reverse logistics of building materials and the best way to disperse C&D waste-handling facilities. There is a need for more research into waste management practices including using recycled aggregate in high-strength concrete and reusing building components. Long-term effects on the environment could be the primary focus of performance evaluations of recycled building materials. Although general management has been extensively discussed, insufficient attention has been paid to the incentive mechanism to improve implementation, operating strategies of the C&D waste management system, and profit distribution among stakeholders.

"Table 1. Summary of literature review by others"

Research	Source	Period	Analysis perspectives
Agrawal et al. (2015)	Articles belong to the leading publishers including Elsevier, Emerald, Springer, Taylor and Francis, Wiley and Informs	1986–2015	• Descriptive analysis • Material evaluation: inter-coder reliability for research categories and research gap analysis using the values of alpha by SPSS • Detailed analyses: the currentgaps and future directions for research
Osei-Kyei and Chan (2015)	Target 27 publications	1990–2013	• Annual publications of CSFs for PPP projects • Authors' origin/country and active contributors • Countries with the most PPP CSFs studies and their impact on the countries PPP practices • Methodologies adopted • Findings for each publication from studies on PPP CSFs
Roehrich et al. (2014)	Thomson's ISI Web of Knowledge	1990–2011	• Analysis I: patterns of publication • Analysis II: emerging PPP research themes across macro, meso and micro levels of analysis
Song et al. (2016)	Web of Science (WOS) core collection database	January 2000 to July 2015	• Co-author analysis • Co-word analysis • Co-citation analysis • Annual publication trend
Yuan and Shen (2011)	Selected 87 journal articles	2000–2009	• Measuring main authors' contributions to C&D waste management research • Number of published papers

III. CONSTRUCTION AND DEMOLITION WASTE (CDW)

3.1 Waste Generation

"Source reduction, waste estimation, and demolition waste generation are the three main subtopics within the research topic creation of C&D waste. Thirty-seven articles examine C&D waste reduction from the viewpoint of construction materials, such as identifying major sources or causes of on-site waste generation, quantifying waste reduction potential through supply chain integration or with the aid of modern construction methods like prefabrication (Jedidi and Moalla, 2018), and waste minimization at the design stage". The estimation of waste creation is the subject of 36 studies. One key metric for gauging overall trash production is the waste generation rate. The use of big data suggests that the precision of such studies will grow substantially in the not-too-distant future. The generation of demolition debris is further broken down into three components. Several researchers examined the impact of different demolition techniques on the quantity of debris left behind. Recent years have seen an uptick in study of

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selective destruction. Future studies will concentrate on generation as a variable in C&D waste management because of its importance.

3.2 Waste Pre-processing

Since 2000, there hasn't been much interest in waste pre-processing. Only 29 articles have been written about it, and most of them talk about (on-site) sorting processes or separation techniques, reverse logistics in the construction industry, and where C&D waste recycling facilities/plants should be located. Reverse logistics of C&D waste is a new area of research in the construction industry, and this shows that C&D waste research is becoming more interdisciplinary.

3.3 Waste Disposal

C&D waste disposal encompasses a wide range of subtopics, including construction waste reuse, recycling, and recovery, the mechanical behavior and physical qualities of recovered materials, and the economic and technical study of recycling systems. Here's a more in-depth examination:

(1) Most research has been done on recycled materials like recycled aggregate, recycled concrete, and recycled wood, especially the properties of recycled concrete aggregate.

(2) Since earthquake-damaged buildings only make up a small part of C&D waste, only a small number of papers look into them.

3.4 Performance Assessment

Since 2000, evaluating how well waste management is done has been getting more and more attention. As was already said, this type of article is mostly about how C&D waste management affects the environment. This includes things like leaching, carbon footprint accounting, energy use, and greenhouse gas emissions. Most of the time, these assessment indicators are used to measure how well C&D waste is managed and to compare different ways to treat C&D waste. It's important to note that developed countries like Spain, Australia, and Germany pay close attention to how well C&D waste is good for the environment.

3.5 General Management

People have talked a lot about human variables in recent years, such as how the way construction contractors think and act affects how well they manage C&D waste. Another subtopic is on sustainable waste management technologies and best practices. This includes determining how well the C&D waste management instrument operates and what factors influence its performance. Researchers from all over the world are particularly interested in government regulations such as landfill pricing schemes. Some articles also discuss the benefits and drawbacks of managing C&D waste in certain places. A detailed examination of the research on this topic reveals that questionnaires, interviews, and case studies are the most commonly used methods of conducting research on it.

IV. CONCLUSION

Over the past 18 years, there has been a proliferation of scholarly works devoted to the study of C&D waste management. Through careful analysis of author contribution, study methodology, and research topic, this article aspires to provide a thorough picture of the current status of research.

This study adopts a three-stage screening technique, first filtering using a search engine, then screening artificially, and last extensively analyzing the literature to pick articles for further analysis. After all is said and done, the Scopus search engine provides access to 579 English-language papers published on the topic of C&D waste from 2000 to 2017. evidence that

(1) The number of publications on C&D waste keeps going up every year, which shows how popular this area of research is;

(2) As for research agencies, the top three with the most authors are The Hong Kong Polytechnic University (Hong Kong), Universidade de Lisboa (Portugal), and Universidad Politécnica de Madrid (Spain);

(3) Using an adjusted formula that takes into account how important the corresponding author is, Professor De Brito J. from Instituto Superior Técnico gets the highest score of 10.55, followed by Professors V. W. Y. Tam and C. S. Poon;

(4) “experiment, modelling and survey are the most popular research methods;

(5) statistical analysis is the most used data analysis method with the number of 351 papers”;

(6) When it comes to research topics, C&D waste disposal has been the most important one, with almost 50% of the topics being about it.

Both the sources of the data and the ways they were analyzed are not perfect in this study. First, the papers that were chosen for analysis came from the peer-reviewed literature database Scopus. During repeated filtering processes, some relevant articles and conference papers could be missed because of the limits on document type and language. Second, panel members' personal opinions play a role in how the chosen articles are put into groups.

V. SUGGESTIONS FOR WASTAGE CONTROL

The following are some ways that waste can be reduced and costs saved on the project: Waterproofing with broken bricks is possible. Sand with a coarser grain size can be utilized as a flooring material. You can utilize the shards of tiles that have broken off to construct ramps leading up to the major entrances. Steel scraps can be fashioned into

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useful cut bars (cross reinforcement) Stones of marble can be used to make a transparent overlay for slabs. In most cases, recycled aggregates are the best option for backfilling. Accuracy in tracking supplies is essential. Expenditure on materials needs to be rationalized. It's imperative that the rules for storing materials be adhered to. The suggestions made here are useful in real life. They have the potential to significantly cut down on wasteful spending on the job site, which in turn can boost the contractor's bottom line. Additionally, they help the environment because less waste means fewer resources used.

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