Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 07, July-2023

Management of Construction and Demolition Waste Materials - A Review

Dr. Biman Mukherjee[1] , Tanmoy Das [2] , Subhasree Dutta Sikder[3] , Prabal Mitra[4] Swapan Kumar Das[5]
[1] Professor , Department of Civil Engineering, Narula Institute of Technology, Agarpara
[2] M.Tech student, Department of Civil Engineering, Narula Institute of Technology, Agarpara
[3] M.Tech student, Department of Civil Engineering, Narula Institute of Technology, Agarpara
[4] M.Tech student, Department of Civil Engineering, Narula Institute of Technology, Agarpara
[5] M.Tech student, Department of Civil Engineering,Narula Institute of Technology, Agarpara

ABSTRACT

Rapid urbanization has increased the construction activities that generate huge amounts of wastes both during construction and demolition phase. Construction waste generation is recognized as one of the major issues in the construction firm due to its unambiguous effects on the environment in addition to the performance of the construction industry. It could cause great effects on human health and the environment. Demolition waste is waste debris from destruction of a construction. Construction industry in India generates about 10-12 million Tons of waste annually. While retrievable items like bricks, wood, metal are recycled in India, Concrete and masonry waste (>50% of total waste) are not recycled. A defined manual is not available with regulatory authorities for effective management of Construction and Demolition (C & D) waste. This paper reviews the literature and analyses from the C&D waste management strategies in practice around the globe and the role of regulatory authorities in construction and demolition waste management. The paper also studies the properties of demolition waste, its hazardous effects and suggest safe recycling/reuse/disposal methods.

1. INTRODUCTION

1.1. General

Construction and Demolition waste is the waste generated as a result of construction,renovation and demolition of building, roads, and bridges. Construction and Demolition waste management are the activities and actions required to manage waste from inception to its final disposal. The construction firm generates a large quantity of solid waste that is now turning into an environmental problem for future generations. Efforts to decrease the impact of construction and demolition waste (C&DW) are through the process like legal guidelines, and legislation. Therefore, this study pursuit to create awareness of the current reputation of C&D waste management practices in construction projects with the aid of reading relevant latest available articles and journals.

Figure: Contributors of Construction and Demolition waste in a project

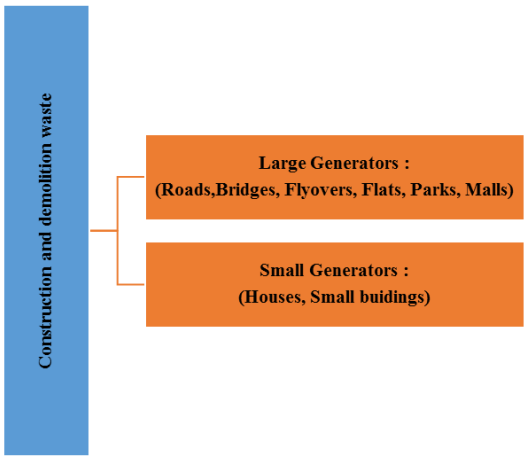


Figure: Source of Construction and Demolition waste

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 07, July-2023

Figure: Demolition waste from a road being redeveloped in Delhi's Zamrudpur village has left no space for people even to walk. Photo: Avikal Somvanshi/CSE

1.2 Indian Construction Industry and Wastes Generated

Central Pollution Control Board has estimated current quantum of solid waste generation in India to the tune of 48 million Tons per annum of which waste from Construction Industry accounts for 25%. Construction waste is bulky, heavy and is mostly unsuitable for disposal by incineration or composting. The growing population in the country and requirement of land for other uses has reduced the availability of land for waste disposal. Re-utilization or recycling is an important strategy for management of such waste. Above all, the fast depleting reserves of conventional natural aggregate has necessitated the use of recycling/ re-use technology in order to be able to conserve the conventional natural aggregate for other important works. Apart from mounting problems of waste management, other reasons which support adoption of reuse/ recycling strategy are reduced extraction of raw materials, reduced transportation cost, reduced capitalinvestment on raw materials, improved profits and reduced environmental impact.

- Constituents of Waste that Arise from Construction Industry in India

Constituent	Quantity generated in Million Tonnes
Soil, Sand and Gravel	4.20 to 5.14
Bricks and Masonry	3.60 to 4.40
Concrete	2.40 to 3.67
Metals	0.60 to 0.73
Wood	0.25 to 0.30
Others	0.10 to 0.15

Presently management of waste from construction industry in India comprises of the following elements:

- Re-use of materials salvaged in good condition during demolition.
- All metal items are sent for re-melting through scrap dealers.
- Disposal of other items to low lying sites.

Concrete and masonry constitute more than 50% of waste generated by the Construction Industry. Recycling of this waste by converting it to aggregate offers dual benefit of saving landfill space and reduction in extraction of natural raw material for new construction activity.

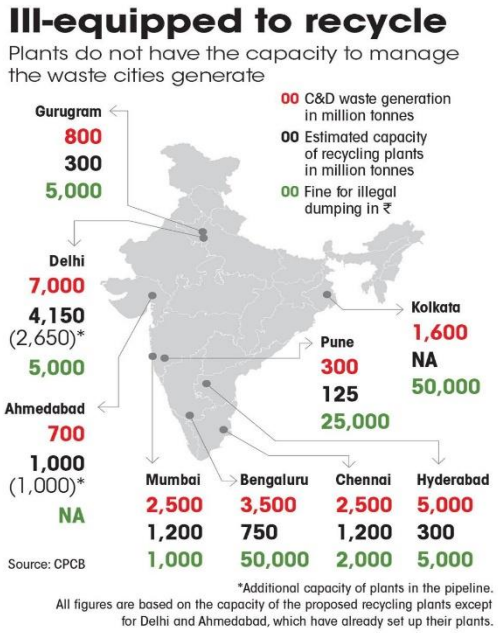
Various surveys conducted on reasons for less usage of recycling processes in India have revealed the following

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 07, July-2023

- 70% of respondents have cited Lack of awareness regarding recycling techniques as oneof the major reasons for not adopting recycling of waste from Construction Industry.
- 30 % of the respondents have indicated that they are not even aware of recyclingpossibilities.
- 67% of respondents from user industry have indicated non-availability of recycledproduct as one reason for not using it.
- The response of industries which had the knowledge and technical know-how of using recycled product indicates that presently, there are no specifications available in the Indian standard codes for the use of recycled material in construction.

1.3. C & D Waste Management Rules, (2015-2016) in India

Municipal Solid Wastes Rules, (2000) notification number S.O. 908(E), issued by the Government of India within the Ministry of Environment and Forests, provides regulationsfor the Municipal Solid Waste generated inside the urban area and the guidelines are more powerful to improve the gathering, sorting, recycling, treatment, and disposal of waste in an environmentally sound manner. [Anupam, Sachan, Ramashanker2014] suggests that in the State of Maharashtra Municipal Solid Waste Rules (2000), the process involved in C&DWM includes sorting, collection, and disposal of debris and bulk waste in its Action Plan. Some composition of C & D wastes provided: by Ministry of Urban Development MoUD include the following. Approximately 10 MT -15 MT (million tons) per year by Ministry of Urban Development MoUD (2000). The quantity of C & D wastes generated annually in India has been estimated 10 - 12 million tons. Considering 30% of C & D wastes and 50% of the concrete as coarse aggregate, the entire recycled concrete aggregate (RCA) in India is of the order of 1.8 million tons per year. Waste generators, generate more than 20 tons/ day or 300 ton/month shall segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar and submit C&DW management plan and get approvals from the local authority before starting construction or demolition work. Table: 2 shows that estimate prepared (2000, 2001, 2010 and 2014) by Central Government [Harish Gayakwad, Neha,2015].



1.4. The History of Construction Waste Management

Recycling of demolition waste was first carried out after the Second World War in Germany to tackle the problem of disposing large amount of demolition waste caused by the war and simultaneously generate raw material for reconstruction.
Considerable research has been carried out in U.S.A, Japan, U.K, France, Germany, Denmark etc. for recycling concrete, masonry, bricks, bituminous and other constituentsof waste from Construction Industry. These studies have demonstrated possibility of using construction waste to substitute new materials of recycling.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 07, July-2023

Work on recycling of aggregates has been done at Central Building Research Institute (CBRI), Roorkee, and Central Road Research Institute (CRRI), New Delhi. The study report stresses the importance of recycling construction waste, creating awareness about the problem of waste management and the availability of technologies for recycling. According to a study commissioned by Technology Information, Forecasting and Assessment Council (TIFAC), 70% of the construction industry is not aware of recycling techniques. The study recommends establishment of quality standards for recycled aggregate materials and recycled aggregate concrete. This would help in setting up a target product quality for producers and assure the user of a minimum quality requirement, thus encouraging him to use it.

2. OBJECTIVE & SCOPE OF STUDY

The objective of this study is to study the properties of demolition waste, its hazardous effects and suggest safe recycling/reuse/disposal methods.

The Scope of the work is limited to collection of literature on demolition waste management which includes properties of demolition waste, its hazardous effects and suggest safe recycling/reuse/disposal methods.

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.

3. LITERATURE REVIEW ON C&DW MANAGEMENT

The current practice of C&D waste management is reviewed from the articles and journals using electronic databases such as Science Direct, Book reviews, and engineering journals. Approximate 15 to 20 papers were reviewed, thereby, identifying existing issues and implementation of techniques in the construction firm. The present work suggests the need for effective C&D waste management on site. This evaluation aids in the identificationof the gaps and limitations in the construction and demolition waste management framework currently in practice.

[Zhikun, Menglian, Vivian, Guizhen , Cuong, 2018] discussed that waste reduction measures such as use in prefabricated components application, design modification at the design stage, sorting and reuse of material at the construction stage by the authorized person.

[Serdar, Aynur, Volkan, 2017] discussed that in general, construction and demolition waste (C&DW) is divided into two types: inert materials (i.e., concrete, bricks, and sand,) and non-inert materials (i.e., plastic, glass, paper, wood, and other organic materials).

[José, David, Harald, Barbara, 2018] A best management practice for CDW in Europe, recycling includes weighing and visual inspection, manual reselection, rejection and diversion to alternative treatments, screening of large materials, magnetic separation, manual separation of plastic, wood, and other waste streams if required, crushing, and screening and secondary crushing.

[Karrar, Pandey2013] investigated the 4R techniques (reduce, reuse, recycle and recovery) used in the waste management process on-site. Reusing of raw materials, using recyclable materials and reducing the use of resources and energy can be applied throughout lifecycles of a construction project - starting from design and extraction of raw materials to transport, use, dismantling, and disposal.

[Markandeya, Kameswari(2015)] discussed the properties of demolition waste, its risky effects and suggests safe recycling/reuse/disposal methods. For effectively use a Construction and demolition (C & D) Waste management plan was formulated, it is important that the nearby governing bodies make the submitting and implementation of this plan mandatory. This ends in a reduction of Environmental Pollution due to C&D waste.

[Serdar Ulubeyli, AynurKazaz, Volkan Arsla 2017] suggested that today, recycling of construction and demolition waste (C&DW) by plants is an inexpensive opportunity to the existing unsustainable disposal techniques such as land filling and fly tipping.

[Robert, Deepika, Rolf, 2017] stated that waste from construction to landfill cause environmental pollution which includes: degradation of land, habitat destruction, contamination of soil and groundwater, and release of methane.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 07, July-2023

4. CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

4.1. Present Global Scenario About Recycling of Construction and Demolition Waste

Recycling of waste from Construction Industry is carried out in U.K, France, Denmark,Germany, U.S.A, Japan, *etc*. The proportion of different constituents varies from countryto country depending upon the material used for construction and the building technology.
The salient features of recycling operations in different countries can be summarized asfollows:
The Regulatory framework in Denmark has significantly helped it to improve recyclingof waste from Construction Industry. Before demolition of the building, the owner of the structure has to apply for permission by filling in detailed form in which he has to identifyeach constituent and estimate the quantity likely to arise. Simultaneously, he has to define the disposal strategy. He has to also identify the waste carrier and environmental problems anticipated during waste disposal along with methodology to control it. After demolition takes place, different materials have to be transported separately. Otherwise it attracts a price penalty or even refusal for movement of material. The disposal of waste to landfill is taxed at high rates, while there is no tax on material sent to recycling. Netherlands has developed specifications covering recycled material to be used as aggregate in concrete. Dutch Government has imposed stiff charge on disposal of waste tolandfill sites. This charge has risen by seven times since 1988.The technology adopted in Denmark is simple and labour intensive, while the plants in Germany incorporate number of machines.

4.2. Innovative Steps To Reduce And Reuse Wastes

Waste prevention: Total amount is reduced, as the construction abstracts to be acquired are in baby abundance and there is beneath wastes to be removed from the site. Assuring able spaces to abundance and administration of construction abstracts toabbreviate assembly of burst materials/waste i.e.; advancement abstracts appropriately until they are accessible to be utilized. Implementing able arrangement of activities.

Reuse of recycled waste: Recycled material, if cannot be acclimated immediately, should be managed in such a way that it's reclaim should be ensured in approaching projects. Recycled abstracts be acutely defined which can be reused or can bereutilized afterwards their advantageous aeon of activity in the building. Special accoutrement or techniques should be activated for reusing in construction of absolutestructures on agnate site.

Precast construction: Precast panels are not alone economical but as well reusable. Use of caked panels as well helps in abbreviation ample bulk of annihilation wastes. This as well comprises antecedent account for designing of barrio for dismantling a construction so that reclaim of the construction apparatus after annihilation can be calmly agitated out

Flexibility in planning: Buildings should be planned and complete in such a address that it can be actual calmly implemented for added uses during it's account period. It is compulsory to accept as to how the construction will be acclimated in it's due advance of time. All assets should be appropriately evaluated including the data of all casework and abrogation it with occupants and users which will ensure thatmodifications, aliment and about-face will be easier and useful.

Prevention of existing buildings: Prior to yield accommodation of annihilation of any absolute building, one have to ensure whether such a construction could be repaired or retrofitted. Huge amounts of waste are generated and lot of amount is to be fabricated to alter it with new materials.

5. CONCLUSIONS

Based on Literature Review the following conclusions are drawn:

1. The Waste Management plan should be implemented in each and every stage of construction which canreduce the Construction and Demolition waste.
2. Minimization of waste in early stage of planning is possible by identifying the source and reasons and with the help of past experience.
3. Proper education and information regarding Construction and Demolition waste is necessary for making recycling successful.
4. Charges should be applied on C & D waste generators and for dispose of waste, land must have occupied.
5. The Municipal bye-laws need to be strictly applied and modified.
6. Construction and demolition waste management can be taken in every stage of construction process.

Construction and demolition waste is a bigger issue in the present's days and it will be increasing in the future also and

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 07, July-2023

effective way is needed to organize and minimize that problem. Indeed, Reduce, Reuse and Recycle [3R's] methodis effective for the recovery. If it is commercially applied the recycling would be both profitable and economical which would also be according to the norms and standardsof environment, health and safety.

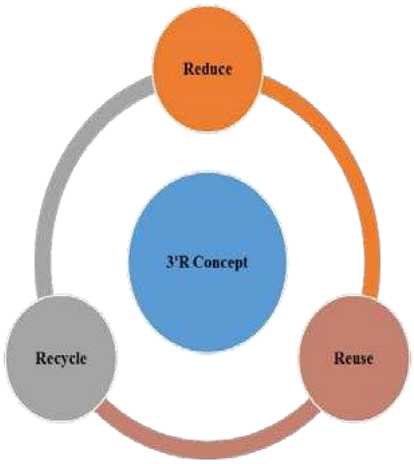


Figure: Construction waste management is 3'R concept

6. ACKNOWLEDGMENT

We are gratefully acknowledge all the reference journal authors based on which this review paper is prepared. We also acknowledge the Prof. (Dr.) Biman Mukherjee, Professor, Department of Civil Engineering, Narula Institute Of Technology whose constant guidance helped us to prepare this Paper.

7. REFERENCES

[1] N.K. Dhapekar, S.P. Mishra, Effective utilization of construction and demolished waste concrete-review, Research Journal of Engineering Sciences, Vol. 6 (7), 2017, 52-57.

[2] Anupam Rawat, A.K. Sachan and Ramashanker 2014 ―Management of Construction andDemolition Waste Materials.

[3] Giulia Borghi, Sara Pantini, Lucia Rigamonti, Life cycle assessment of non-hazardous Construction and Demolition Waste (CDW) management in Lombardy Region (Italy),Journal of Cleaner Production, Volume 184,2018,Pages 815-825, ISSN 0959-6526

[4] Serdar Ulubeyli, AynurKazaz, Volkan Arslan, Construction and Demolition Waste Recycling Plants Revisited: Management Issues, Procedia Engineering, Volume 172, 2017, Pages 1190-1197, ISSN 1877-7058

[5] Rao Akash, Kumar N. Jha and Misra Sudhir (2006). Use of aggregates from recycled construction and demolition waste in concrete. Resources, conservation and recycling - Science Direct., 50, 71-81.

[6] Tam V.W.Y, 2 - Improving waste management plans in construction projects, Editor(s): F.Pacheco-Torgal, V.W.Y. Tam, J.A. Labrincha, Y. Ding, J. de Brito, In Woodhead Publishing Series in Civil and Structural Engineering, Handbook of Recycled Concrete and Demolition Waste, Woodhead Publishing, 2013, Pages 9-24, ISBN 9780857096821.

[7] Saheed O. Ajayi, Lukumon O. Oyedele, Olugbenga O. Akinade, Muhammad Bilal, Hafiz Alaka, Hakeem A. Owolabi, Optimising material procurement for construction wasteminimization: An exploration of success factors, Sustainable Materials and Technologies,Volume 11, 2017, Pages 38-46, ISSN 2214-9937.

[8] Ministry of Environment, Forest and Climate Change, Published In the Gazette of India, Part-II, Section-3, Sub-section (ii), New Delhi, the 29th March, 2016

[9] Bansal S, Singh S.K., "A Sustainable Approach towards theConstruction and Demolition Waste", International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 2, February 2014

[10] José-Luis Gálvez-Martos, David Styles, Harald Schoenberger, Barbara Zeschmar-Lahl, Construction and demolition waste best management practice in Europe, Resources,Conservation and Recycling, Volume 136, 2018, Pages 166-178, ISSN 0921- 3449

[11] Harish. P. Gayakwad, Neha. B. Sasane, 2015 ―Construction and Demolition Waste Management in India‖ International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 02 Issue: 03 | June-2015

[12] Job Thomas, Wilson P. M., 2013 ―Construction waste management in India‖ American Journal of Engineering Research (AJER) e-ISSN: 2320-0847 p-ISSN: 2320-0936 Volume-2 pp-06-09

[13] Robert H.Crawford, Deepika Mathur, Rolf Geerritsen, 2017 ― Barriers to improving the Environmental performance of construction waste management in remote communities, Procedia Engineering, volume 196, pages 830-837, Issn 1877-7058