

# Study of Effective Implementation of Reuse and Recycling of Construction and Demolition Waste Practices in India

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## ABSTRACT

The construction sector worldwide is consuming a maximum amount of natural resources and energy. In this respect, the need for reuse and recycling of materials waste had increased over the years due to many infrastructural developments because of increase in rapid population and expansion. For environmental protection, some measures, like limiting the use of finite resources and managing waste disposal, has led to promote to recycle these materials at the end of their service life. For instance, many landfills are approaching their full capacity, with many planned to be closed over the next couple of years. This report presents a case study on the implementation of the construction and demolition waste management practices in the Indian construction sector. The scope was not only limited to the housing but also high-rise structures. It is estimated that the waste generated by the housing sector is approximately 17% of the gross materials used, which is about 10 to 12 million tons/year, and 32% of such waste has the potential for reuse and recycling. However, the high-rise building construction generates construction waste in a large quantity of more than 20 million tons/years which shows a high inherent for reusability and reprocessing.

**KEYWORDS:** Construction and Demolition Waste, Waste Management Practices, Indian Construction Industry, Reuse and Recycling, Potential Embodied Energy

## 1. INTRODUCTION

Construction waste or debris is any type of waste or debris from the construction process. There are different government agencies have simple definitions about construction waste. For example, the United States Environmental Protection Agency (EPA) defines construction and demolition materials as “debris generated during the construction, renovation and demolition of buildings, roads, and bridges.”

Construction and demolition materials are created during the process of construction of a new building or structure or when renovating or demolishing an existing building or structure. These materials are usually heavy materials used in large volumes in modern construction, such as concrete, steel, wood, asphalt, gypsum etc. Construction waste frequently includes hazardous materials that require to be

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disposed of differently than most construction waste, such as fluorescent lights, wires, batteries and electrical equipment.



Fig -1: Construction and Demolition Waste from Industry

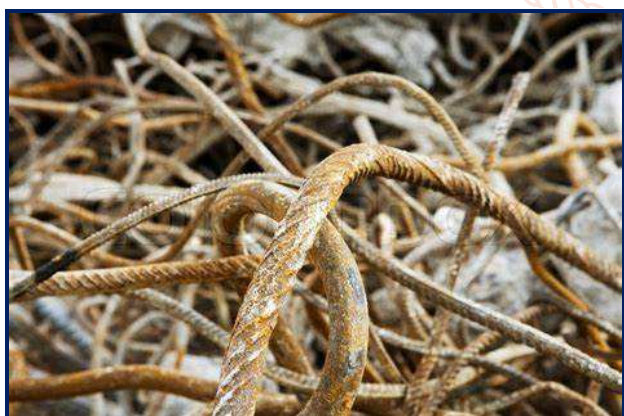


When these waste products are created, they are dealt with by exporting to a landfill, recycling materials for new use, waste incineration, or direct reuse on site, through integration into construction or as fill dirt. In dealing with construction and demolition waste products, it is often hard to recycling and repurposing because of high cost of processing. Businesses recycling materials must compete with often the low cost of landfills and new construction commodities. In a report including data from 25 participating states in the United States, the percentage of total solid waste in the US that was caused by construction and demolition (C&D) waste materials was 22%.

**A. Types of Construction and Demolition Waste**

There has been a massive increase in construction and demolition waste created over the last 32 years in the United States. In 1995, 180 million tons of construction and demolition debris by weight were created and had risen to 650 million tons by the year 2020. This is a 350% increase, but it is important to note that since 2016 the EPA has kept records of how the waste is disposed of. In 2020, 650 million tons of waste was created due to construction and demolition, and 150 million tons of it resides in landfills. This means that about 80% of waste is now retained and repurposed in the industry, but there is still more waste being transported to landfills than the entire amount of waste created in 1995.

**1. Steel Reinforcement:** - Steel is used as reinforcement as well as structural integrity in the vast majority of construction projects. The main reason of steel is wasted on a site is due to irresponsible beam cutting and fabrication issues during demolition.



**Fig -2: Steel Reinforcement as Construction and Demolition Waste**

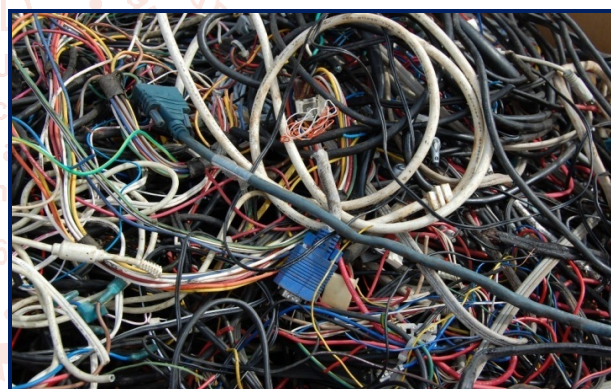
**2. Premixed Concrete:** - Premixed concrete has one of the lowest waste indices when correlated to other building materials. Many site managers cite the difficulties controlling concrete delivery amounts as a major issue in accurately quantifying concrete needed for a site. The deviations from actually constructed concrete

slabs and beams and the design amounts necessary were found to be 5.8% and 2.9% larger than expected, respectively. Many of these issues were attributed to incomplete form layout or lack of precision in excavation for foundation piles.



**Fig -3: Premixed Concrete as Construction and Demolition Waste**

**3. Pipes and Wires:** - It is often very challenging to plan and keep track of all the pipes and wires on a site as they are used in so many different areas of a project, especially when plumbing as well as electrical services are routinely subcontracted.

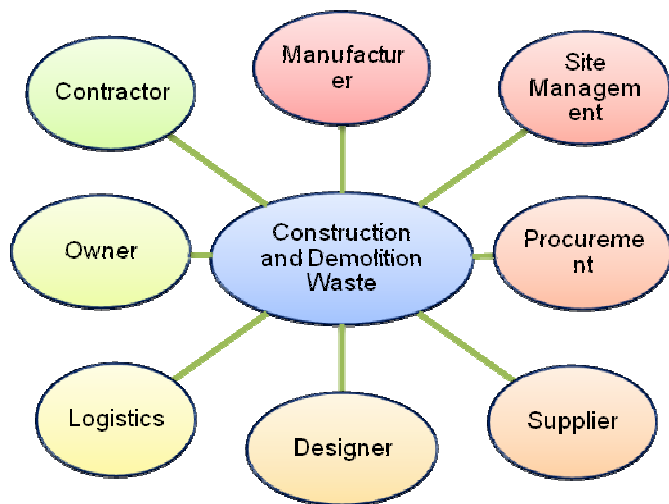


**Fig -3: Wires as Construction and Demolition Waste**

**4. Timber:** - Waste timber does not only come from demolition sites, but also from the construction industry (scaffolding, leftovers, on-site reject), from packaging, industrial and municipal waste, etc.



**Fig -3: Timber as Construction and Demolition Waste**



**Fig -4: Contributors of Construction & Demolition Waste in a Project**

## B. Construction and Demolition Waste Generation in India

The construction industry in India is continuous growing. It has been growing annually at the rate of 12 per cent over the last 12 years as against the world average of 6.0 per cent and is already at 12% of the GDP. The built-up area is expected to surge almost five times from 22 billion sq. ft in 2006 to approximately 105 billion sq. ft by 2032. The Union Ministry of Forests and Environment (MoEF) has acknowledged that there is no any systematic database on construction and demolition waste. However, we can infer from same data from Technology Information, Forecasting and Assessment Council and Centre for Science and Environment. Just for year 2014:

- India has constructed 5.90 billion sq. m of new additional floor space from 2006 with almost one billion sq. m.
- Approximately 55 kg per sq. m of waste is generated during construction. India must have generated 55 million tonnes (MT) of C&D waste.
- 350-550 kg per sq. m of waste is produced due to demolition. About 290 MT more C&D waste would have been generated due to demolition and rebuilding of 7% existing building stock annually.
- 50-60 kg per sq. m of waste is generated due to building repair. About 195 MT of C&D waste would have been generated due to repair or renovation of 1/3<sup>rd</sup> of existing building stock.

## C. No Reuse in India

Lack of uniformity, not listing the construction techniques and cost-effective recycled building material in the Indian Standard Codes and/or the Schedule of Rates (SOR), poor policy push and lack of awareness and deficit of experiments are the key barriers.

The Bureau of Indian Standards permits use of aggregates other than natural aggregates in plain cement concrete under IS: 456-2000 and BIS does not allow the use of any new material and dynamism can be taken by any authority to permit the use of recycled material according to director general of BIS.

## 2. RESEARCH METHODOLOGY

The principal aim of this study is to investigate the real-time reuse as well as recycling of construction wastes generated in Indian residential (housing and multi-story) projects. Promotion of recycling and reusing of construction and demolition waste in India will not only reduce the burden on the consumption of natural resources, but it will also reduce the embodied energy, which may become critical.

### A. Aim of the Study

To study how the construction and demolition waste can be utilized in building practices in order to have sustainable development.

A. **Save Environment:** Reduce air, water and noise pollution, health hazard etc.

B. **Save Energy:** Energy saved in the production of the construction material from natural resources.

C. **Enhance Economy:** Potential high value of recycled material not tapped and gets buried in deep landfills or illegal dumps leading to economic loss. Reduce demand and supply gap in these sectors and save the natural resources. Reduce the valuable waste going to landfill.

### B. Objectives of the Study

1. To identify various sources of construction and demolition waste generation and the type of waste that can be generated.
2. To study the current situation regarding reuse and recycling activities in different cities of India. Current problems and states of the current waste management program, the critical index of waste minimization regarding the method used the effect of reuse and recycling, main problems encountered during reuse and recycling, and factors considered to encourage the reuse and recycling of construction waste materials at the project site. (Case study for different cities)
3. To develop and implement new techniques for minimization recycling of construction and demolition waste.
4. To collect additional information on real-time reuse and recycling of generated waste and the problems encountered and their impact on construction wastes and way forward.



### C. Scope of the Study

The paper will mainly cover the reutilization of construction and demolition waste generated from demolition, new construction renovation in building practices with a focus in Indian context. Ongoing practices of construction and demolition waste management and advantages of reusing this waste will be approved to support the topic.

- Reduction of C&D Waste:** Less waste leads to few disposal facilities, this leads to less environmental issues. Regenerate an existing structure in place of planned demolition. Using deconstruction techniques rather than demolition of a building.
- Reuse of C&D Waste:** It doesn't require any further processing to convert into a useful product. The items which are usable directly to be screened out from the waste and put into the possible use without further processing.
- Recycling of C&D Waste:** Once the waste generated from construction and demolition activities has been divided and reusable items are taken out, the remaining is available for further processing i.e. recycling into next useful stage.

### E. Different Projects for Case Studies

**Table -1: Overview of the Investigated Projects**

Project	Project Name	Location	Project Type
Project 1	Bora Residential	Delhi	Residential Building
Project 2	Akshar Business Park	Mumbai	Commercial Building
Project 3	St. Pauls' School	Kolkata	Institutional Building
Project 4	V. N. Natrajan Industries	Chennai	Industrial Building
Project 5	Jayadeva Flyover Bridge	Bangalore	Infrastructure Project
Project 6	Krishna Apartment	Nashik	Residential Building

### 3. DATA COLLECTION AND ANALYSIS

#### A. Residential Project in Nashik

Nashik is estimated to generate about 50-100 tons per day (TPD) of construction and demolition waste.

To address the Construction & Demolition waste, NMC has

- NMC has prepared a DPR to understand quantity, quality and sources of C&D waste,
- Consultation with various stakeholders as well as understanding their concerns,
- Developed separate tenders for collection as well as transportation as also for processing and disposal of C&D waste,
- District administration has already allocated land at Nashik East, Nashik West, Nashik Road, Satpur, Cidco and Panchavati for C&D waste processing.

- Re-buy of Processed Material:** Purchase recycled-content building materials by authorized contractor. In each new construction 10% to 20% material (minimum) should be used recycled C&D waste materials.

### D. Methodology of the Study

The different phases of this project of work are shown in the following diagram. The figure simply describes the experimental strategy of this study step by step.

- Review the existing literature and to identify various sources of construction and demolition waste,
- Select different projects from different cities in India for conducting case studies,
- Develop techniques for minimization by reuse and recycling of construction and demolition waste,
- Study of management of construction and demolition waste in India,
- Reuse and recycling methods of construction and demolition waste,
- Interpretation of results and conclusion.
- References.



**Fig -5: Demolition of Infrastructure Project in Nashik (Trimbak Naka to Ashok Stambh Road)**

The Nashik Municipal Corporation's (NMC) bid to appoint a private agency for collection and

transportation of construction and demolition waste in the city has received very poor response. Not a single agency had come forward for the bidding, forcing the municipal corporation to extend the date of submission by a period of 21 days. The NMC will provide land for recycling the waste near Satpur, Cidco and Panchavati.

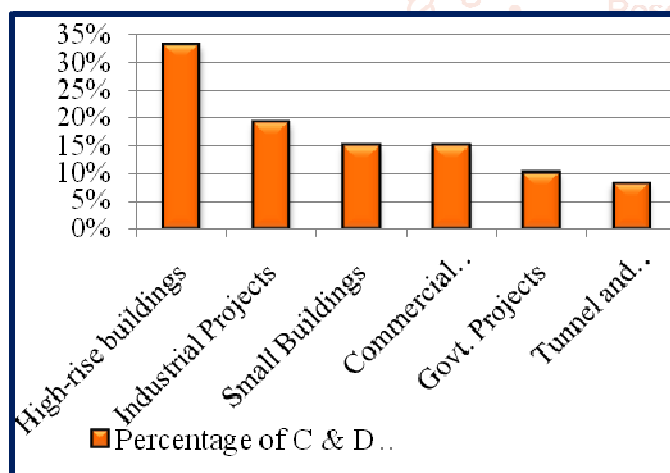
**Table -2: Constituents of Construction and Demolition Waste Generation in Nashik**

Constituent	% of C&D Waste Distribution
Building	45-50
Roads	15-20
Bridges	8-10
Power	5-8
Railway	8-10

**B. Composition of Construction and Demolition Waste Generated in India**

**Table -3: Construction and Demolition Waste from different Projects**

Project Type	Percentage of C & D Waste Generated
High-rise buildings	33%
Industrial Projects	19%
Small Buildings	15%
Commercial Buildings	15%
Govt. Projects	10%



**Chart - 1: Composition of C & D Waste from Different Projects**

**C. Case Study of Construction and Demolition Waste Recycling Plant in Delhi**

Delhi estimates generation of about 3200 to 4200 tons per day (TPD) of C&D waste. The primary responsibility of disposal of C&D waste is on the generator of the waste. Municipal Corporation of Delhi (MCD) is responsible for the transportation and disposal of unclaimed waste (Delhi Municipal Corporation Act, 1957). In Delhi itself, it has three construction & demolition waste recycling plants set up by IL&FS Environment, at Burari (2000 TPD capacity), Shastri Park (500 TPD capacity) and

Mundka (150 TPD capacity), the government projects have utilized only 200,000 tonnes of recycled material per annum even as the C&D waste generated has reached 1.5 million tonnes per annum.

The C&D waste recycling industry is in a very nascent stage in India. The dare is to ensure that C&D waste comes to the recycling plants as segregated input, and the recycled products are select for use in construction field.

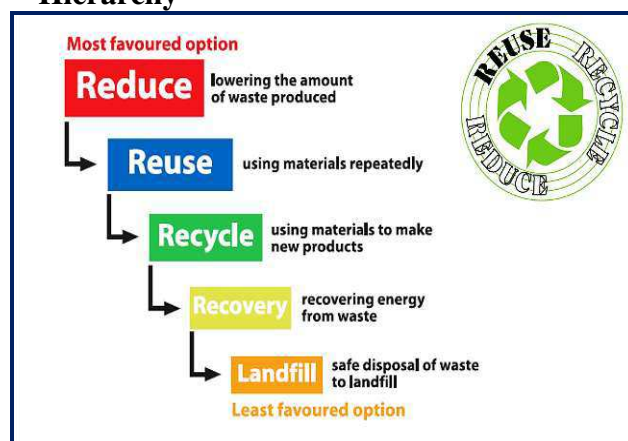


**Fig -6: C&D Waste Recycling Plant in Delhi**

The pilot project envisages an appropriate collection mechanism for C&D waste generated in the city, its transportation to the designated processing site, processing of the waste and recovering of the land by filling up, leveling and compaction. Being the first such project of coordinated management of C&D waste in the country, it will set an example, which can be replicated by other cities in India. Hence the learning from this pilot project is of great importance.

The project has been set up on a PPP basis at Burari on approximately 7 acres of land provided by the MCD for a period of 9 to 10 years. The PPP model created for addressing the collection, processing and destruction of C&D waste is successful as it serves the dual purpose of saving of landfill space on the one hand, and also developing a market for C&D waste recyclables.

**D. The 3 R's of Sustainable Waste Management Hierarchy**



**Fig -7: Hierarchy of C&D Waste Management**



## E. Elements of Construction Waste Management

- a) Planning
- b) Waste Audit
- c) Waste Classification as well as Disposal
- d) Waste Handling Requirements
- e) Economic Consideration

## F. Implementation in Construction and Demolition Waste Management Rules, 2016

- a) Application
- b) Duties of waste Generators
- c) Duties of Service providers and Contractors
- d) Duties of State Government and Local Authorities
- e) Duties of Central Pollution Control Board, State Pollution Control Board or Pollution Control Committee
- f) Standards for products of construction and demolition waste
- g) Duties of Central Ministries
- h) Facility for processing / recycling Facility

## 4. CONCLUSIONS

This study has developed concepts for the reutilization of construction materials, including waste debris, by means of recycling into other components which are useful in construction field. From the study, I can also conclude that recycling and reusing the construction and demolition waste is better option over disposal or destroys and can also be feasibly implemented into building practices. Case studies mentioned in the study concluded that the ways and profits of using the construction and demolition waste in building practices. In the high-rise building construction, more than 77% of the generated waste was composed of concrete and aggregate. In contrary to high-rise building construction, the housing construction generated more than 85% wood as the waste. The composition of plastic, glass, ceramic, and the packing products was found quite low in all types of projects (<1%) 0.85% of the waste generated at the high-rise building sites was exported for recycling, whereas only 25% of the waste was exported from housing sites for recycling. In India, there is a lack of information regarding the quantity of C&D waste reused and or recycled. The case studies showed that the low rate of reuse and recycling of waste is due to many issues and threats.

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## REFERENCES

- [1] Kamyar Kabirifar, Mohammad Mojtahedi, Changxin Wang and Vivian W. Y. Tam, "Construction and Demolition Waste Management Contributing Factors Coupled with Reduce, Reuse, and Recycle Strategies for Effective Waste Management: A Review", Journal of Cleaner Production, Volume 263, 1 August 2020.
- [2] R. Janani and V. Kaveri, "A Critical Literature Review on Reuse and Recycling of Construction Waste in Construction Industry", Science Direct, 2020.
- [3] Zhuo Tang, Wengui Li, Vivian W. Y. Tam and Caihong Xue, "Advanced Progress in Recycling Municipal and Construction Solid Wastes for Manufacturing Sustainable Construction Materials", Science Direct, Resources, Conservation & Recycling: X, 2020.
- [4] Kagei Shieny Nadarason, Sasitharan Nagapan, Abd Halid Abdullah, and Riduan Yunus, "Recycling Practices of Construction and Demolition (C&D) Waste In Construction Industry", Journal of Advance Research in Dynamical & Control Systems, Volume 10, No. 6, pp. 281-289, December 2018.
- [5] Mei Mah and Takeshi Fujiwara, "Environmental Impacts of Construction and Demolition Waste Management Alternatives", Chemical Engineering Transactions, 63, pp. 343-348, May 2018.
- [6] Jianguo Chen, Yangyue Su, Hongyun and Jindao Chen, "Managerial Areas of Construction and Demolition Waste: A Scientometric Review", International Journal of Environmental Research and Public Health, 2018.

- [7] Ankur Bansal, S. Bishnoi and Geetika Mishra, “Recycling and Reuse of Construction and Demolition Waste: Sustainable Approach”, ResearchGate, December 2016.
- [8] Randolph Miranda, Chanchal Tike and Kshipra Vadake, “Study of Construction and Demolition Waste Management in India”, International Journal of Scientific Engineering and Science, Volume 1, Issue 11, pp. 50-52, 2017.
- [9] Abdullah Alrabea, “Construction Waste Management”, ResearchGate, March 2016.
- [10] Markandeya Raju Ponnada and Kameswari P, “Construction and Demolition Waste Management – A Review”, International Journal of Advanced Science and Technology, Volume 84, pp. 19-46, November 2015.
- [11] W. Y. Ng and C. K. Chau, “New Life of the Building Materials- Recycle, Reuse and Recovery”, Science Direct, 7th International Conference on Applied Energy – ICAE, pp. 2884 – 2891, 2015
- [12] Shishir Bansal and S K Singh, “A Sustainable Approach towards the Construction and Demolition Waste”, International Journal of Innovative Research in Science, Engineering and Technology, Volume 3, Issue 2, pp. 9226-9235, February 2014.
- [13] Job Thomas and Wilson P. M., “Construction Waste Management in India”, American Journal of Engineering Research (AJER), Volume 2 pp. 06-09, 2013.
- [14] Muluken Yeheyis, Kasun Hewage, M. Shahria Alam, Cigdem Eskicioglu and Rehan Sadiq, “An overview of Construction and Demolition Waste Management in Canada: a Lifecycle Analysis Approach to Sustainability”, Springer, March 2012.
- [15] H. P. Yuana, L. Y. Shen, Jane J. L. Hao and W. S. Lu, “A Model for Cost-benefit Analysis of Construction and Demolition Waste Management throughout the Waste Chain”, Resources, Conservation and Recycling 55, Elsevier, pp. 604–612, June 2010.

