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Overview of Construction and Demolition waste and challenges identified to tackle the issue

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Abstract – *The paper aims at providing an overview of the current situations of construction and demolition waste management practices in India. It describes the current waste generation in the construction industry and the limitations in implementing construction and demolition waste management strategies. It examines the various causes of environmental degradation and sustainable issue due to wastes generated from construction and demolition activities. Measures are discussed to implement effective strategies with a focus on avoiding waste, reusing material, processing and recycling construction and demolition waste. It also shows the waste concern and criteria specified in Green Rating Systems to reduce construction and demolition waste. The objective of the paper is to formulate strategies on waste minimization through construction and demolition Waste Management Planning.*

Key Words: *Construction and Demolition waste, Sustainable, Recycling, Green Rating Systems, Waste Management Planning*

1. INTRODUCTION

With the increase in the urban population, there has been an increase in the construction sector to meet the growing demand. Extensive use of cement, sand and aggregate in the construction sector consumes a huge amount of energy and natural resources. A substantial quantity of demolition waste is generated once the life cycle of a building ends. Even during the execution phase, there is wastage of materials due to negligence and improper handling of materials during construction. The conventional way of treating construction and demolition waste is to dump the waste at the landfill site, but the scarcity of landfill sites leads to dumping of waste at an illegal location shows major concern for the proper handling of these wastes.

Improper handling of construction and demolition waste also poses a serious threat to the environment. Accumulation of these wastes without sorting leads to the risk of site contamination because the waste sometimes contains chemically reactive and hazardous contents. Demolition of the building causes dust, noise and other nuisances which affect the air quality and health of people in the vicinity. The raw materials used for construction activities are depleting and also, a lot of energy is consumed in the manufacturing of these construction materials. The alternative to resolve the issue of scarcity of landfill sites and to reduce the extraction of raw material is to recycle the construction and demolition waste. Therefore, the emphasis is needed to reduce, reuse and recycle the construction and demolition waste to deal with issues related to depletion of natural resources, consumption of energy in the production of building material, lifecycle cost and deterioration of the environment.

1.1 Types of Waste Generated During Different Stages

There are various types of waste generated during the life cycle of a building. They can be classified into:

1. Design waste – The waste generated during the initial design phase of the project due to ineffective design techniques and alterations in design at a later stage may lead to the generation of excessive construction and demolition waste.
2. Construction waste – These types of waste are generated during the on-site execution phase of the building. It includes unused or leftover materials like concrete chunks, gravel, sand, tiles, glass, metal, wood etc.
3. Renovation waste – This type of waste is generated due to frequent renovation work, maintenance work and change in occupancy pattern of the space. Usually, the waste from the removal of tile work, old plaster, brickwork, woodwork including similar waste generated during demolition activity comes under renovation waste.
4. Demolition waste – The demolition of the building takes place usually when the life of the building is over and sometimes it happens due to change in design at a later stage of construction. The waste varies from brick, concrete, metals (steel, aluminium and copper), aggregate, glass, wood, tiles, plastic, composite panels, gypsum etc.

2. CONSTRUCTION AND DEMOLITION WASTE GENERATION IN INDIA

Increase in urbanisation and growth in the construction sector has led to the generation of construction and demolition waste in recent years, which is likely to increase

over a period of time. If effective measures are not taken in advance to curb the waste, it may lead to significant ecological impact and health hazard. The CPCB 'Guidelines on Environmental Management of C&D Waste, 2017' report states that 23.75 million tons of construction and demolition waste are generated annually in India. Major proportion of waste is generated from the demolition of buildings as per the 'Technology Information, Forecasting and Assessment Council's (TIFAC)' compared to construction and renovation waste.

Infrastructure sector (especially construction/repair of roads, bridges, flyovers etc.), Real estate (especially demolition and major renovation work), demolition of an unauthorized structure, waste generated during construction stage etc. are some of the major sources of generation of construction and demolition waste.

3. EFFECTS ON ENVIRONMENT

The accumulation of construction and demolition waste has an adverse effect on the environment. Presently, there are very few designated municipal sites for disposal of construction and demolition waste that is inadequate to handle the waste as compared to the waste generated across the cities. Segregation of waste is not a common practice at the site due to which concrete waste often gets mixed with other wastes and then disposed at the landfill site. Waste such as steel, plastic, glass, wood etc. present in construction and demolition waste, if segregated can be reused and recycled.

The inappropriate disposal of waste also poses a threat of groundwater contamination as the waste degrades with time and leaching of soil may occur due to the number of hazardous constituents that may present in residue form or as a mixture of chemicals disposal. The waste accumulated is also responsible for degrading the natural topography of the site on several occasions. Sometimes there is also the risk of collapsing of the accumulated waste under its own weight due to heavy rainfall and earth movement causing threat to human safety in the nearby area. In India, the government has taken initiative for environmental conservation and sustainable development goals. Various guidelines and policies are provided by Central Pollution Control Board, Ministry of Environment, Forest and Climate Change, Ministry of Housing and Urban Affairs and various state and central level agencies. However, they are not implemented effectively due to a lack of awareness of these guidelines.

4. METHODS TO REDUCE CONSTRUCTION AND DEMOLITION WASTE

The wastes originate from the demolition of existing structures like old dwelling units, pavements, industrial structures, new constructions, renovation and repairs. All these wastes need to be sorted out in following separate categories:

1. Materials which can be recycled in waste recycling plants such as concrete, stone, blocks, tiles.
2. Materials which can be disposed of as scraps such as metals, steel, aluminium, doors and windows, frames.
3. Materials which can be disposed by other methods such as paint, asbestos, glass, electrical etc.

Precast concrete elements and concrete blocks can be reused with little or no processing if care is taken during dismantling to segregate its parts.

4.1 Scope of work

The scope of work includes the recycling of construction and demolition waste. The sequences involved in the process are:

1. Collection: This includes collection of construction and demolition waste from the designated site location.
2. Transportation: This includes logistics to transfer construction and demolition waste from the source collection points to the processing site.
3. Processing: This includes weighment; segregation of construction and demolition waste; crushing of concrete pieces; mixing with cement and admixture to form the product.

Some products that can be made from construction and demolition waste: Paver block, kerbstone, tiles, precast compound wall, planter, drain cover etc.

4.2 Construction and demolition waste recycling plant in India

Increase in the generation of construction and demolition waste has a negative impact on public health and also pose a threat to the environment. Various construction and demolition waste recycling plant are set up in India by government and private entity to tackle the issue. Government bodies like state development authorities have also announced the establishment of upcoming construction and demolition waste recycling plant in few cities in recent years. The construction and demolition waste recycling plant in Burari, New Delhi was the first recycling plant established in 2009. There are two more recycling plant in Delhi at Shastri Park and Mundaka. Cities like Pune, Ahmedabad, and Hyderabad are among those cities to setup construction and demolition waste recycling plant. Research shows that there is a great possibility of use of fine and coarse aggregate and "Recycled Concrete Aggregate" produces from construction and demolition waste processing in road construction.

4.3 Processing and recycling of construction and demolition waste

To understand the construction and demolition wastes processing activities, the data of the waste recycling plant of East Kidwai Nagar project is collected that recycles debris into usable bricks and kerbstones. The plant was set up by NBCC to recycle 150 tonnes of construction and demolition waste per day for its redevelopment project at East Kidwai Nagar, New Delhi. The steps which are required to convert the waste into usable products (recycled brick) are:

- Collection of waste from the site that mainly comprises of concrete, bricks, block, mortar and soil.
- Transportation of waste to the brick manufacturing plant. The waste is manually segregated for any visible impurities and further stacked properly for future use.

Fig -1: Collection of waste on site

- Separation of waste through a vibrator. Large pieces (greater than 100mm diameter) separated for manual breakage. Smaller pieces sent to the crusher for further processing.

Fig -2: Segregation of waste

- Crushing of concrete pieces to a finer particle in aggregate crusher and then it passes through the sieve placed at a different level with the help of conveyer belt to filter out uncrushed material.

Fig -3: Feeding of waste to crusher

- Finally, grinding of material takes place that passes through the 4.75mm sieve. Where they are grounded to a fine granular powder of which the bricks are formed.

Fig -4: Grinding of waste

- The raw material is then transferred to a mixer to mix with cement, water and other admixture to form dough of brick.

Table-1: Composition of Materials

Raw Material	451 kg
Cement	60 kg
Admix Enzyme	60 ml
Water	35 litre
Mixing Time	5 minutes

- The bricks are cast after the dough is sent to a pressing unit with the help of conveyor belt.

Fig -5: Brick pressing machine

- Then the bricks are aerated for 28 days to achieve the desired strength. Water absorption and dimensional checks are carried out on each sample to deliver quality products.

5. WASTE CONCERN IN GREEN RATING SYSTEMS AND REGULATORY AUTHORITIES

The IGBC gives credit rating for construction waste management, resource reuse, and recycled content. GRIHA emphasizes on the various parameter for efficient utilization of resources such as efficient waste segregation, reduction in waste during construction, storage and disposal of wastes and resource recovery from waste. Likewise, "CPWD Guidelines for Sustainable Habitat" states promotion of construction and demolition waste management, reusing and recycling of construction and demolition waste. Various state and central authorities are also framing the policies and guidelines to manage the construction and demolition waste.

6. WASTE MANAGEMENT PLANNING

1. Separation of construction and demolition waste to be promoted and facilitated at the source.
2. Separation of waste into categories and also some amount of use, reuse and reprocessing from crushed construction debris are to be encouraged.
3. Provision to be made to levy charges on construction and demolition waste generators who dumped their waste illegally which may have an adverse impact on the environment.
4. Environment-friendly technologies (such as segregation of waste through wet processing) to be adopted for construction and demolition waste processing in the recycling plant.
5. Standards and guidelines, especially for construction and demolition waste need to be formulated for the effective utilization of waste.
6. Construction and demolition waste recycling facility can be set up in close proximity of several sites where construction, demolition and renovation work is to be carried out. The size of the recycling facility may vary from small to medium capacity.
7. Life cycle assessment of construction and demolition waste is to be carried out.
8. Innovative technology to exchange construction and demolition waste through a digital platform to be promoted to raise awareness among public and different stakeholder to communicate directly for the trade of waste and product made from waste.

7. CONCLUSION

It has been observed that a considerable proportion of construction and demolition waste material goes unused and ends up at landfill sites, which has recycling and reusability potential. This disposal of potential waste is mainly due to the lack of material management and quantity estimation of the type of waste generated on-site. Insufficient data and inadequate regulatory framework of construction and demolition waste pose significant challenges for its efficient utilization such as concern for disposal of waste and impact on environmental which also includes an increase in particulate matter during demolition activities and leaching from contaminated soil due to presence of chemical mix in dumping waste. Construction and demolition wastes are bulky in size and require excessive manpower and dumping area if disposed of at the landfill site. In India concrete is the most commonly found construction and demolition waste among all other categories along with sand and silt. It can be easily seen that the use of "Recycled Concrete Aggregate" and recycled product from construction and demolition waste not only result in a significant reduction in the extraction of natural resources but also helps to reduce the burden on the landfill site as well as the adverse impact on the environment.

Opportunities for recycled construction and demolition product are likely to grow as environmental consciousness grows to meet the increased demand for building material in the future. This helps to encourage digital platform to exchange waste among public and various stakeholder. Innovative and recycled material from construction and demolition wastes will help to tackle the challenges due to abundant waste generation and lack of disposal alternatives. It is therefore important to implement construction and demolition waste management planning to achieve the envisaged target to reduce the environmental impact of construction and demolition waste. The effort of recycling construction and demolition waste helps to achieve eco-friendly, cost-effective construction and sustainable future.

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