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International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

An Effective Implementation of Reduce, Reuse and Recycling Triad in a Construction and Demolition Waste Management

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ABSTRACT

The construction and demolition waste generated by the Indian construction industry has grown significantly in recent years. Excavation, building construction, site clearance, demolition, road work, and building renovation all produce construction and demolition waste. Construction and demolition waste disposal in landfills has raised serious environmental issues, necessitating the implementation of a more effective waste management strategy. It is common for C&DWM approaches to adhere to the 3R (Reduce, Reuse, and Recycle) principle when dealing with construction site waste. The handling of waste on construction sites is no longer a serious concern. The problem, however, is that with the development of towns and rural areas, it is likely to increase from time to time. The implementation of the 3R triad for waste management methods in the Indian construction industry is discussed in this study. It also focuses on initiatives that can improve waste management in the construction industry at various stages of a project. For this final recommendation on an Indian project, maintain the quality of secondary resources and improve environmental sustainability is proposed for reuse, recycle, and reduce.

Keywords: -, construction, demolition, waste management, benefits, techniques, Reuse, recycling, Reduce, construction project

1.Introduction:

"Waste from construction, remodeling, maintenance, and demolition of any civil structure designated by the Ministry of Environment, Forest, and Climate Change (2016)".Hazardous and non-hazardous waste are all included in construction and demolition waste (Menegaki &Damigos, 2018). These are heavy and take up a lot of space on the walkway or in the waste bin. Individual household C&D waste is dumped into a neighboring municipal waste container, which allows for the disposal of waste that would otherwise be too large or difficult to be treated in natural ways like incineration, composting, landfilling, or energy regeneration. Some local construction firms retain waste on the site because of the imbalance it causes in the environment, such as increased vegetation and low infiltration. Poor waste disposal practices, such as overusing materials and dumping waste, are common in the workplace. If these processes continue, the building sector's development will be hindered by a lack of resources. In comparison to advanced countries, developing countries fall far behind in terms of C&D waste management (Lu & Yuan, 2010). Reusing and recycling construction and demolition waste is an effective method of limiting the degradation of natural resources. Throughout the last few decades, great progress has been made in the use of recycled construction waste in many countries.

Reuse, reduction, and recycling of waste in the construction industry are examined in this study. Journals and recommendations on the use of reprocessed waste materials are good places to look for this information. This project is broken down into a number of distinct sections, as outlined below. Section 2 provides an overview of the research. Section 3 deals with sustainability. In section 4 of the sustainable waste management hierarchy.sustainableC&D waste management is the subject of Section 5. Section 6 focuses on India's recycling and reuse facilities. Section 7: Benefits of reuse and recycling of construction and demolition waste materials. Ultimately, the rating system provisions in section 8and conclusion in section 9.

2.Research background

In any field of study, it is essential to conduct a literature review (Xiao & Watson, 2017). A literature review is a methodical approach to gathering and summarising prior research (Snyder, 2019). Reuse, recycling and reduce are at the core of construction and demolition waste management concepts (Job & Wilson, 2013). The "3R" principle was proposed to carry out some construction industry operations with reference to waste reduction, reuse, and recycling. A green economy must adhere to "3R" values in the construction sites since all of the different building project procedures included in the design, production, and manufacture of the construction sites are linked to waste generation. Activities, society, people, and sources are all

connected to the "3R" concepts. Studies based on the 3R concept are increasing in number as a result of its widespread use in the management of waste generating sites (Vidyasekar&Selvan, 2019).Karrar&Pandey (2013) studied the 4R waste management strategies utilized on-site (reduction, reuse, recycling and recovery). A resource-efficient approach to the use of raw materials extends from the procurement of raw materials all the way through transportation, usage, and disposal. Immature recycling processes have been identified by Beijia et al., (2018). This includes an inadequate management structure and a time of immature recycling as well as a lack of market development for recovered CD materials. Recommendations to improve the current state of affairs, principally in light of concepts such as the "3Rs," "circular economy," "source control," "new technology," and "targeted incentives," The methods proposed by Ponnada and Kameswari(2015) for recycling, reusing, and disposing of waste are safe. The first step is to clean up the contamination that comes from C&D waste. India's C&D waste reuse and recycling innovation is being assessed at a higher level for sustainable conversion, according to Gupta & Malik (2018). The Bureau of Indian Standards will create and monitor standards for recycled and reused materials. Thus, the use of the 3R principle (Vidyasekar&Selvan, 2019) in waste management strategies increased the system's performance, resulting in a reduction in construction and demolition waste.

3.Sustainability

Ecologically responsible use of natural resources is an important part of sustainable development. Recycling C&D waste, which may be used to substitute virgin coarse or fine aggregate, is needed to limit the usage of these non-renewable resources. This alternative uses fewer natural resources and minimizes the amount of waste sent to landfills (Ganiron, 2015). Materials used in construction must take into account a variety of factors, such as natural resources, energy sources, and the intended use of the building (Ruuska&Häkkinen, 2014). There must be a thorough understanding of sustainable materials' features and characteristics (Koltun, 2010). in order to ensure that they are not used as a direct replacement for conventional materials. Standardizing the use of recycled materials in a flexible manner will allow engineers to make practical use of these resources in the future. It is critical to design more sustainable building materials that contain RA. When it comes to structural concrete, this is especially important for fine and low-quality coarse aggregates. The concrete industry can lessen its negative social and economic effects, waste, and pollution by switching to more environmentally friendly materials and products.

4.Sustainable waste management hierarchy

The Indian government has implemented waste control policies in the public and commercial sectors. Based on a hierarchical model (Peng et al., 1997), the various phases necessary to manage waste were outlined. Reducing, reusing, and recycling C&D waste is the authors' preferred method of waste management. There are other methods of reducing waste outside recycling, such as avoiding or minimising consumption, which are regarded beneficial in addition to recycling.Figure 2 depicts the structure's top-to-bottom flow (reduce, reuse, recycle, and dispose). Reducing building and demolition waste; reusing as much as possible; recycling C&DW; and disposing of it in a safe and secure manner are the most recommended options. According to Hwang et al., (2011), proper waste management in the building site provides a range of benefits from its generation to its final disposal across its entire life cycle. The economic and environmental benefits of properly managing building waste are widely acknowledged.

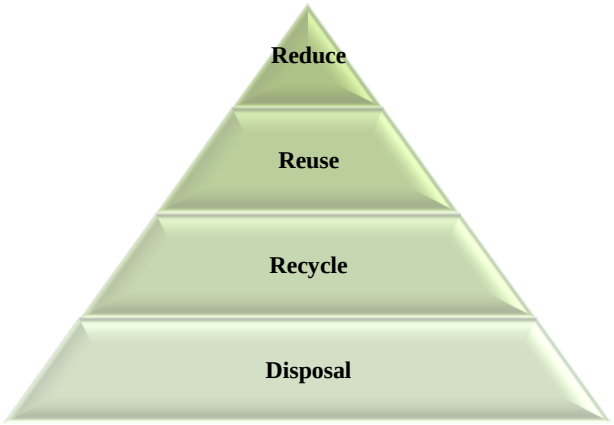


Fig. 2 waste management Hierarchy

5.Sustainable C&D waste management

Recycling systems should be established and funded on a national scale, rather than in local communities. Encouragement should be given to the use of recycled and/or salvaged materials. In order to stimulate the usage of recycled and salvaged materials, tax reductions should be implemented. Classified

waste should be priced lower than unclassified waste, and reasonable pricing procedures should be created for C&D waste (Arslan et al., 2012). For better waste management, services for classifying and dismantling C&D waste should be developed. It's important to think of open mines and quarries as sites for excavated waste because they're often unappealing and unsuitable for quick utilization. Illegal dumping of waste from construction and demolition projects decided to change.In addition market for recovered materials, as well as incentives for C&DW reuse and recycling, were also shown to be essential (Shooshtarian et al., 2020).

6.Reuse/recycling facilities(C&DW) in India

The first construction and demolition waste recycling facility in India, located in Burari, New Delhi, handled 2000 tonnes of C&D garbage per day in 2010. The first unit is operational, and the East Delhi Municipal Corporation wishes to expand the second and third units (500 TPD and 150 TPD). There is a demand for more C&D waste recycling plants due to the success of the first three units. So more recycling plants are planned (2017-2018). The capacity of India's second building and demolition recycling plant in Ahmadabad expanded from 300TPD in 2014 to 600TPD in 2016 and 1000TPD in 2018. Both recycling operations are run by public-private partnerships. The factories produce recycled aggregates, manufactured sand, flagstone, kerbs, tiles, and precast constructions. So, in order to make a shift practicable in India, more awareness of reuse and recycling is required. Reprocessed products must meet the Indian Requirements.

7.Benefits of reuse and Recycling C&D waste materials

Waste material recycling that reduces waste output and preserves the environment from a variety of issues, including pollution. Waste materials can be turned into secondary resources and disposal costs can be reduced through continuous recycling procedures. According to Kageishienyet al., (2018) two techniques (on-site and off-site) have been reported. In order to encourage the collection of mixed building waste, the following measures should be used. There are "relationships" between the amount of reusable and recyclable materials and construction waste, according to Tam (2011). According to Chini, and Bruening (2005) around 18.4 million metric tonnes of garbage could be salvaged, which translates to about 50% of the total. The following is a list of materials that can be reused or recycled:

Recycled concrete can be utilized in building projects by grinding it into rubble. A concrete mix, filler, or lane paving can all benefit from the inclusion of recycled concrete. Site base layer for lane construction can be made from smaller pieces of concrete. Poon etal., (2002) found that recycled aggregates were used to supplement fine and coarse materials in construction projects (25-50 percent). It's strong enough to meet Indian norms. A less expensive alternative to coarse aggregate was presented by Cavalline&Weggel (2013) who collected broken bricks from a construction site. Initially, the crushing properties of recycled masonry aggregate were determined. Blends of concrete have been developed that are both workable and have the desired characteristics. Studies were out to ascertain the qualities of the materials and the hardness of concrete. RBMAC (recycled brick masonry aggregate concrete) may offer advantageous material qualities, as evidenced by testing. However, the hardened concrete has a limited lifespan.

It's possible to recycle or reuse timber. For example, it can be utilized as a covering, shuttering, passage or bedding for animals. The contact with concrete moisture, which is employed as a fuel, smooth it out. You may create a variety of different types of wood-chip concrete flooring, beams, and decks by placing cement grout into mold cavities. Building materials other than scrap metal have the best recoverability stage, according to Chini, and Bruening (2005). It's because of the massive amount of salvageable lumber on the job site that this is possible. Reuse, recycle, or up cycle wood products in the same containers they were originally packaged in.

Sand is used to prepare mortar/concrete. According to Behera et al.,(2019), using C&D waste derived RFA(recycled fine aggregate as a sand resource for SCC activities within the company would not solve the waste management issues. The resting section serves no purpose, and as a result, waste is generated. As a sub-base for road construction, or as a decorative element in a garden, Recovering recovered materials is a major industry emphasis for the steel industry. According to the American Iron and Steel Institute, steel is the world's most recycled commodity (AISI). People are motivated to recycle scrap steels without losing their properties and buy them on the market because of their high cost. Every year, the globe recycles over 400 million tonnes of steel.

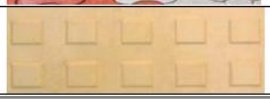
Building projects may be able to employ recycled brick that has been ground into rubble. Recycled brick can be utilized in the concrete mixture, lining, and road foundation. During the loading and unloading process, waste is broken down into bats and other small pieces that can be used as non-structural elements. As far as Chini and Bruening (2005) is concerned, the most current way for repurposing old bricks is cleaning the mortar from the old bricks, curing concrete and using it as a sub base road sheet, etc. Recent studies have shown that the insulative qualities of recycled glass aggregates give concrete made from them the necessary hardness and insulation. When a glass isn't handled properly, it breaks. As a building material, it can be utilized in the construction of bricks, decorative sanitary ware, stainless steel insulation, and as a diffusion agent. The government was in charge of waste disposal and recycling for the junkyard's residents.

Gypsum is the primary ingredient in drywall. It's possible, according to Chini and Bruening (2005) because gypsum aids soil and plant growth. Fertilizer made from recycled materials is applied to farmland and mushroom beds as soil amendments. For example, it can be utilized as a bulking

agent in compost, a raw material in Portland cement and even recycled into new drywall. As Chini and Bruening (2005) explained, the plasterboard's purpose was to handle landfill-site processing of hydrogen sulphide (H2S). Smells like rotten eggs can be found in landfills across the United States and Canada due to a variety of factors. Due to the fact that drywall is not accepted in landfills in Canada and the United States, they are considering limiting the amount of drywall that can be disposed of on property.

It's possible to use recycled asphalt from roofing shingles or asphalt concrete as a base for new pavement. In the course of excavating, a variety of useful filler materials such as topsoil, sand, and clay are liberated. Roads in rural areas often employ crushed asphalt shingles as a base layer for concrete work like driveways and walkways. Recycled asphalt can be utilized in low-traffic road construction, when bitumen levels are slim and required to be extremely adaptive and malleable, according to Adrian et al. (2018). More durable modules were obtained employing recycled asphalt pavement (RAP 75 percent) as new sample materials, according to Arshad& Ahmed (2017). Remaining strains increased only when RAP quality was between 0% and 50%. At 25 ° C, 35 ° C, and 45 ° C, RAP mixes have greater stable modulus values than mixes without RAP. Table 1 shows some of the C&D recycled products and their applications.

Table: 1C&D waste recycled products and its application (Vani, 2020)

Sr. No	Product Name	Image Specimen	Uses
1	Ready Mix Concrete		•Most versatile construction material. •Used in all kind of construction activities
2	Hollow Bricks		•Used in construction of buildings and houses, especially compound walls. •Provides heat insulation.
3	Pavement blocks		•Parking Pavements. •Pedestrian Pathways •Passageway
4	Chequered Tile		•Pedestrian subways

8.Rating system:

The GRIHA (Green Rating for Integrated Habitat Assessment) rating system was established by TERI (The Energy and Resources Institute). GRIHA used to measure building reliability using nationally approved conditions or benchmarks. For this, the 5Rs waste control strategies are as follows.

1. Refuse: Do not accept or adopt inadvertently anything from outside the country. Especially in the case where one needs to find local substitutes.
2. Reduce: Depend on specific products, technology, methods, etc
3. Reuse: Buildings and their services can be reduced in cost by reusing resources, items, and new ideas.
4. Recycle: the site's prospective materials can be recycled.
5. Reinvent: Technology, layouts, and practice all need to be changed.

There are three points available in the GRIHA green grading system under criteria 22, 23 and 24, with each point worth one point. In order to maximize raw material recovery and secure movement of material during the course of construction, Criteria 22 recommends reducing waste throughout the restoration (1point). A criterion 23 mandates the use of different coloured containers for the collection of different types of garbage at the site in order to ensure efficient waste segregation (1point). A criterion 24 mandates that garbage be stored and disposed of in a separate location prior to transporting it to recycling/disposal stations (1point).

9.Conclusion:

The construction industry primary goal is to increase productivity without dealing with any waste. Reduce waste production by minimizing, reusing and recycling C&DW on construction sites; while ensuring the quality of secondary materials is maintained and environmental sustainability is improved by retaining the quality of recycled materials. The problem of construction and demolition waste is getting worse right now and will only get worse in the future, thus it must be effectively utilized in order to be organized and minimized. Indeed, the 3 R's triad is effective in both the recovery and the production of completed items. If professionally used, recycling would be both profitable and affordable, while also meeting environmental, health, and safety criteria.

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