

Impacts of Construction and Demolition Waste on Environment: An Overview

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Abstract

Construction and demolition (C&D) wastes are the generated materials as wastes comprising of building materials, debris and rubble resulting from construction, remodeling, repair, and deconstruction of any civil structure that is about 40% of all the solid wastes. The global C&D sector is low resource efficiency that leads to a significant waste generation area. The C&D wastes are soils, tiles, concrete, bricks, plaster, rubble, glass, wood, asphalt, plasterboard, asbestos, plumbing fixtures, metals, plastics, stone, wall paper, etc.; and these are heavy and dense, necessitating more storage space and cannot be managed easily. These must be handled properly during collection, procession, recover, recycle, and disposal. These are increasing for the construction of various new infrastructures and for the deconstruction of old or small structures due to urbanization, industrialization, economic development, and rapid population growth. Increase of C&D waste is creating harmful effects on the environment, ecological resources, and human life. The aim of this explorative study is to reduce dependence on virgin construction materials and promote resource efficiency through waste reduction, reuse, and recycling.

Keywords: C&D waste, recycle, reuse, environmental effects

1. Introduction

Construction is the process of building or assembling structures. Demolition is the science and engineering in safely and efficiently tearing down buildings and other artificial structures that convert all the materials into debris, while carefully preserving some valuable elements for reuse purposes that reduce the volume of debris. Therefore, demolition often needs some extra planning, and sometimes it is difficult to separate and recycle the waste (Suman, 2020). The amount of generation of global demolition wastes is two times more than the amount of construction waste (Gunalaan, 2015). The waste materials associated with building, such as debris and rubble are created during the construction, remodeling, renovation, repair and demolition of any civil structures, such as buildings, roads, taxiways, dams, water reservoirs, runways, bridges, pavements, and other man-made structures are considered as the construction and demolition (C&D) wastes (Zhang et al., 2022). Usually these are solid waste and are generated primarily during residential and non-residential development, redevelopment, and remodeling (Osmani, 2012).

The C&D waste is considered as huge refuse originating from construction, demolition, renovation and redevelopment projects (Mohajan, 2021c). A lot of C&D waste is generated during the construction of new buildings and deconstruction of old buildings at the end of their lives. In 2025, global annual C&D waste generation is about 2.2 billion tons (Barbir & Dabić, 2024). Sometimes natural disasters, such as floods, earthquakes, and hurricanes increase C&D waste. More than 95% of C&D waste can be easily reused or recycled (Osmani, 2012). Effective C&D waste management not only mitigates environmental degradation but also promotes resource efficiency and reduces the demand for new raw materials (Llatas & Osmani, 2016).

2. Literature Review

A literature reviews a type of academic writing that provides an overview of existing knowledge in a particular field of research. It is a summary of published work that discusses information in a particular subject area within a certain time period (Torraco, 2016). A good literature review summarizes, analyses, evaluates, and synthesizes the relevant literature within a particular field of research that tries to identify the gaps in the current knowledge (George et al., 2023). Babak Rouhi Broujeni and his coauthors have classified the C&D waste into three categories as non-dangerous waste, hazardous wastes and semi-hazardous waste. They have shown that more than 90% of these wastes can be recycled and reused (Broujeni et al., 2016). Ponnada Markandeya Raju and Pandraju Lalitha Kameswari have defined that demolition waste is waste debris from destruction of a construction. They have studied the properties of demolition waste, its hazardous effects; and suggest safe recycling/reuse/disposal methods (Raju & Kameswari, 2015).

Chunbo Zhang and his coworkers have observed that the construction sector is the biggest driver of resource consumption and waste generation in Europe. They have explored that the evolution of the waste hierarchy in Europe and how it compares with the circular economy (Zhang et al., 2022). Sukriti Suman has observed that urbanization, industrialization, modernization, and rising population are impelling the construction industry to grow at a remarkable rate. She has surveyed on the C&D waste generation, constituents, management, and its deleterious impact on the environment, and has tried to discuss the ways to generate less C&D waste and its proper handling (Suman, 2020). Ganesh Tapkire and Shashi Ranjankumar have emphasized on the importance of raising awareness and promoting the adoption of advanced sorting technologies, such as automated conveyors, mechanical separators, etc. by overcoming the challenges and implementing effective physical separation practices, significant improvements in recycling rates, resource recovery, and environmental sustainability (Tapkire & Ranjankumar, 2024).

Radka Kantová has dealt with issues concerning the modeling of the production area of a construction site from the aspect of the placement of construction machines that covers the determination of a construction site noise prognosis for planned investments (Kantová, 2017). Nurzalikha Saadi and her coworkers have tried to assess and analyze the importance of waste management plans and their impact on the generation of construction and demolition waste, and have expected to generate benefits for the construction industry in Lebanon (Saadi et al, 2016). H. C. O. Unegbu and D. S. Yawas have emphasized the need for an integrated approach to improve C&D waste management in Nigeria, advocating for enhanced regulatory measures, infrastructure development, and continuous education and training programs that offer valuable insights for policymakers and industry stakeholders, suggesting targeted strategies to overcome the identified barriers and foster more sustainable waste management practices (Unegbu & Yawas, 2024). P. X. Wong and Siti Nur Alia Roslan have wanted to estimate the amount of C&D waste at the country level through the adoption of a methodology utilizing national statistical data and the average amounts of waste generated at job sites (Wong & Roslan, 2019).

3. Research Methodology of the Study

Research is a scientific and systematic academic activity that searches for new knowledge (Silverman, 2011). Methodology is a system of principles and general ways of organizing and structuring theoretical and practical activity (Oduor, 2010). Research methodology is a set of procedures and techniques that researchers use to gather and analyze information about a research topic (Howell, 2012). In this review study we have dependent on the secondary data sources that are related to C&D waste management. We have consulted and analyzed renowned journal articles, printed and e-books of eminent authors, handbooks, conference papers, internet websites, etc. to successfully complete the study (Mohajan, 2025a).

4. Objective of the Study

The construction industry plays a vital role in meeting the needs of society that makes better quality of life (Shen & Tam, 2002). Any waste related to building materials, debris, and rubble that are produced from construction, remodeling, repair, and demolition of any civil structure is considered as C&D waste. The C&D wastes are bulky, heavy, and are mostly unsuitable for disposal by incineration and recycling or reuse is an important strategy for management of such wastes (Kumbhar et al., 2013). These wastes are the largest waste streams in the worldwide, but most of these (about 90-95%) are recyclable, working site is safer, and recycling cost is lower and makes economic sense (Lu et al., 2014). These can cause serious environmental and health risks, such as air and water pollution, soil contamination, and natural resource depletion if not managed properly (Mohajan, 2025b). Rapid urbanization, industrialization and rapid economic development have put tremendous pressure on building and infrastructure in urban areas (Suman, 2020). Main objective of this article is to study the nature of C&D waste, and to encourage in the recycling methods for the reduction of environment pollution (Mohajan, 2015, 2018, 2020). Other minor objectives of the study are as follows:

- to highlight on the types of C&D wastes,

- to focus on the impacts of C&D wastes on environment, and
- to discuss management of C&D waste.

5. Types of C&D Waste

The C&D waste could be inert and non-biodegradable materials, such as wood, concrete, cement, tiles and ceramic materials, dirt, steel, gypsum, masonry, plaster, paint and paint cans, paper, plastic, and ferrous and non-ferrous metals (Mohajan, 2025b, c). Some more C&D wastes are brush, bricks and masonry, soils and stones, cardboard, glass, rubble, fiberglass, caulking, asphalt, bituminous mixtures and tars, polystyrene foam, gypsum-based materials, packaging materials, stainless steel, aluminum, chemicals, waste electronic and electrical equipment (WEEE), hazardous substances, and other similar materials (Broujeni et al., 2016). These wastes are heavy, immense, and occupy a significant amount of space when dumped without processing. Therefore, these wastes need separate collection with the reduction of waste volumes, and also the reduction of harmful effects on the environment are necessary (Saadi et al., 2016).

6. Impacts of C&D Waste on Environment

The C&D waste can contaminate surface water of ponds and rivers that affect aquatic flora and fauna as well as animals (Mohajan, 2021a). It leads to air pollution as it may carry dust, various poisonous gases, such as carbon monoxide (CO), carbon dioxide (CO₂), hydrogen fluoride (HF), sulphur dioxide (SO₂), oxides of nitrogen (NO_x), particulate matter, such as PM₁₀, asbestos, and volatile organic compounds (Joseph et al., 2023). Much of the waste generated by the C&D is inert and non-degradable. The C&D sites generate huge noise pollution due to the sound of the concrete mixers, earthmoving machinery, pile drivers, pneumatic devices, and various other operating machineries that leads stress, irritability, sleep disturbances, high blood pressure, irregular heartbeats heart diseases, and noise induced hearing loss (Kantová, 2017). This noise pollution creates serious problems on schools, colleges, old age home, nursing homes, clinics, and hospitals. It also creates stress, irritability, high blood pressure, sleep disturbances, heart diseases, and noise induced hearing loss (Mah et al., 2018).

7. Management of C&D Waste

The C&D wastes have hazardous impacts on environment, ecological resources, animals, and human beings; and management of these is essential for sustainable development (Barbir & Dabić, 2024). Proper management of C&D waste minimizes landfills, preserves valuable landfill space, and recycled construction waste is transformed into high-value secondary raw materials that can serve other construction purposes (Mohajan, 2021b). These wastes must be categorized as whether these are recyclable, reusable, biodegradable, incinerable, and appropriate to be dumped in landfills. These can be reduced by the proper use of resources, salvaged materials, and avoiding virgin materials (Huang et al., 2002). Also, the use of standard size and quantities of materials can generate less waste. In the C&D sites, the 4R's are often known as "reduce, reuse, recycle, and recovery" wastes that are based on the idea of fully utilizing the resources before going to disposal stage (Yeheyis et al., 2013).

Reducing C&D waste we find the greatest environmental benefits, such as minimize material costs, reduce pollution from its manufacture and transportation, save energy and water, and keep material out of landfills (Sapuay, 2016). Reuse of materials helps in reducing waste and also provides economic and environmental benefits. Extra or left over materials should be safely stored for the future use in C&D sites. Reuse extends the life of existing materials and decreases the new resources needed that saves both resources and money (Huang et al., 2002).

Recycling is an effort to prevent useable and valuable materials from being dumped into the landfill (Mohajan, 2025c, d). Some common recyclable materials in the C&D waste are metals, plastics, wood, glass, cardboards, plasterboards, bricks, tiles, concrete, stones etc. (Gayakwad & Sasane, 2015). The recycling of C&D waste reduces extraction of raw materials, natural resources transportation cost, and capital investment on raw materials; and improves profits and reduces environmental impact (Thomas & Wilson, 2013). The virgin materials become scarcer and more costly; recycling materials saves energy, conserves resources, and reduces attendant GHG production. Recycling of C&D wastes started for the first time after the World War II in Germany to manage demolition waste due to the war and to reuse as raw material for reconstruction. At present C&D wastes recycling is running in the UK, France, Denmark, Germany, the USA, Japan, China, Australia, Korea, and many other countries of the world (Raju & Kameswari, 2015).

Sometimes the C&D wastes are incinerated that converts waste materials into ash, harmful gases, and heat (Joseph et al., 2023). Therefore, incineration is not very common and preferred ways that can many hazardous wastes, such as highly flammable compounds, volatile substances, toxic chemicals, etc. (Huang et al., 2018). Landfilling is the final step in C&D waste disposal of those which can no longer be used or recycled that has serious impacts on environment and human health (Gayakwad & Sasane, 2015).

8. Conclusions

The construction industry is considered as a main source of national income of a country that opens up employment and business opportunities, but it leads to the formation of waste. Demolition waste is waste debris from the destruction of a building. The C&D wastes are generally larger, heavier, and more toxic than domestic wastes. These have harmful effects on the environment, ecological resources, and human beings. These can also increase air pollution, water pollution, soil pollution, and noise pollution. Proper management of C&D waste can reduce its negative impact on the environment and human life, and can play an important role in increasing income and providing job opportunities for the global society and can conserve recycled materials that can lower waste disposal costs. The 4R's policies should be comprehensively applied in society to reduce the amount of C&D waste. Effective C&D waste management is essential to optimize resource recovery, minimize landfill use, minimize the environmental impacts, and reduce natural resource depletion.

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