Solid Waste Management in the Construction Sector: A Prerequisite for Achieving Sustainable Development Goals
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Abstract
The Indian construction industry contributes nearly 5% - 6% to the Nation's GDP and is one of the largest in the world economy. The building and construction sector is one of the essential industries contributing highly towards environmental impacts. Balancing development at all stages with environmental protection is the prime aim of the United Nations Sustainable Development Goals (SDGs). The construction sector paves the way for greater economic development in a country and thus has an obligation to protect the environment against degradation. A few of the notable SDG's relating to the construction and building sectors concerning the environment and climate change issues are SDG 11- Sustainable Cities and Communities, SDG 6 - Clean Water and Sanitation, SDG7- Affordable and Clean Energy. Solid waste management is very crucial as the solid waste from construction sites highly degrade the environment. Using of green resources of constructing buildings may reduce the energy efficiency and after construction can reduce the carbon emission. But the construction materials which are not disposed properly have become a moot question on the effectiveness of the existing regulations and the legislations. The solid wastes which are disposed in unregulated dumps or when openly burned may lead to serious health issues, effect the safety and results in environmental degradation. This solid waste, when disposed of, emits gases like methane, carbon and contributes to global climate change. India has an obligation to achieve the United Nations Sustainable Development Goals, by balancing development and environmental protection. This paper will analyse the existing legislation relating to solid waste management, its effectiveness in regulating the construction sector and how far they comply with the international standard or requirement in protecting the environment. This research is conducted by analysing existing judgments, legislations, national reports as primary data. United Nations and its specialised agencies reports are utilised as secondary data.

Keywords: Construction Industry, Solid Wastes, Environment, Sustainable Development Goals, Development

1. Introduction
Solid waste management (SMW) has increased in numerous ways as a result of urbanisation and industrialisation. SWM is a critical challenge for local bodies due to increasing population densities in cities. In developing countries like India, achieving sustainable development within the country is difficult because of the rapid population and advances in housing standards. Although tremendous progress in the context of human, social, financial, and environmental development, India's SWM systems have maintained substantially unmodified. Solid Waste Management is the collection, processing, and disposal of wasted solid material that has served its purpose or is no longer useful. Unhygienic circumstances come from inefficient solid waste disposal, which leads to environmental pollution [1]. Humans, flora, and fauna all suffer as a result of the gaps. We're all aware of the dangers of polluting our waterways and breathing polluted air. There are far too many sources of solid waste, and each type necessitates a unique collection of varieties, treatment for purification, and removal strategy. The following are part of the sources. Culinary trash, leatherette, glassware, iron and steel, plastic, wasted oil, expired bulbs, batteries, chargers, phones, and many other electronic devices are all examples of household garbage. Household garbage, container wastes, building material and trash, toxic chemicals, and other industrial wastes are dangerous. Educational institute and office waste, agricultural and biomedical wastes from hospitals and laboratories, etc.,

1.1 Construction Industries and Solid Wastes
Urbanisation is the prime factor for the growth and development of many industries. One of the basic needs of the urban population is residential buildings. These buildings are
now styled with the concept of gated communities, which includes all basic amenities such as swimming pools, recreation parks and clubs, shops, departmental stores, health centres, schools, daycare centres, etc. The construction industries with these luxurious features have boomed while fulfilling both urban and city population requirements. The international communities began to realise that industrialisation, globalisation, urbanisation, and modernisation have challenged the environment and paved the way for its degradation. The concept of green buildings and technologies were found to be a solution to avoid future environmental degradation. The other solution is, utilising renewable energy in the developmental process. Construction and Demolition waste is defined under Construction and Demolition Waste Management Rules, 2016, Section 3(c) as “Waste comprising of building material, debris and rubble resulting from construction, remodelling, repair or demolition of any civil structure”[2].

1.2 United Nations Sustainable Development Goals (SDGs) and Solid Waste Management

The United Nations Sustainable Development Goals are the outcome of the 2030 Agenda for Sustainable Development and are an urgent call for action by all the world nations to end poverty, reduce inequality, protect environment and spur economic growth [3]. The 2030 Agenda for Sustainable Development, which all UN Member States approved in 2015, presents a shared strategy for peace and prosperity for people and the planet now and in the future. The 17 Sustainable Development Goals (SDGs) are at the core of it, and they represent an urgent call to action by all nations - developed and developing - in a global partnership. They realise that eradicating poverty and other deprivations must be accompanied by policies that enhance health and education, decrease inequality, and stimulate economic growth – all while combating climate change and working to protect our oceans and forests. SDG 11- make cities inclusive, safe, resilient and sustainable. Target 11.6 states that by 2030 there must be a reduction of cities' adverse per capita environmental impact, including paying special attention to air quality and municipal and other waste management. Indicator 11.6.1 provides the proportion of municipal solid waste collected and managed in controlled facilities out of total municipal solid waste generated by cities. But the definition of solid wastes excludes construction and demolition wastes

1.3 SDG and Construction Industry

Transform the world where no one is left behind in every aspect of development is the prime aim of Sustainable Development Goals. While all the major sectors are contributing towards the economy and is largely depending upon the technology, it widely has the obligation to protect the environment. As one of the major sectors in the world, the construction industry also is urging upon its research capabilities to find eco-friendly technology solutions in protecting the environment while the industry is highly dependent on such modern technologies. Achieving the SDG is like a marathon, where success can be won by evidence-based planning, implementation, monitoring and continuous improvement. According to the World Economic Forum, by 2022, the green building industry will double, leading to rising awareness and legislative measures. The Nationally Determined Contributions (NDCs) of India to the Paris Climate Agreement seek a 33-35 per cent reduction in annual greenhouse gas (GHG) emissions by 2030, highlighting the need for green buildings. With these driving factors, the SDGs also mandates the world nations to balance with environmental protection in all aspects of development. SDG 3 – ensures healthy lives and promote well-being of all at all ages , SDG 6 - Clean Water and Sanitation, SDG7-Affordable and Clean Energy SDG 11- Sustainable Cities and Communities. For Instance, in India, the Real Estate (Regulation and Development) Act, 2016 under Sections 4(e) and 32(e) provide for the utilisation of renewable resources in the
construction sector. Thus, countries like India has come out with effective legal obligations in protecting the environment.

1.4 Construction Industry and Solid Waste Management in India

The development of the construction industry in India is generating massive amounts of C&D debris, and this trend is expected to continue in the following decades. Significant destruction frequently precedes development, particularly in older cities, when older structures are removed to make room for newer ones, generally high-rises. Even though a complete estimate of C&D waste generation in India is unknown, a study conducted by Technology Information, Forecasting and Assessment Council (TIFAC) in 2001 states that 12-15 million tonnes per annum is generated. The following Table 1 shows that the 2015 survey of 10 cities across India also reinforces that the TIFAC 2001 estimate is probably a significant underestimate [4].

| Name of the City | Population as per 2011 Census | Daily CDW generation-tonnes per day | Annual CDW generation* -million tonnes per annum |
|------------------|-------------------------------|------------------------------------|-----------------------------------------------|
| Mumbai           | 12,442,373                    | 2,500                              | 0.75                                          |
| Delhi            | 16,787,941                    | 4,600                              | 1.38                                          |
| Bengaluru        | 8,443,675                     | 875                                | 0.26                                          |
| Chennai          | 6,500,000                     | 2,500                              | 0.75                                          |
| Kolkata          | 4,496,694                     | 1,600                              | 0.48                                          |
| Jaipur           | 3,471,847                     | 200                                | 0.06                                          |
| Patna            | 2,514,590                     | 250                                | 0.08                                          |
| Ahmedabad        | 6,063,047                     | 700                                | 0.21                                          |
| Bhopal           | 1,917,051                     | 50                                 | 0.02                                          |
| Coimbatore       | 2,618,940                     | 92                                 | 0.03                                          |

* Daily generation multiplied by 300 to calculate annual generation since CDW generation is not constant throughout the year, almost disappearing during the rainy monsoon season.

During the mega-construction of its Kempegowda International Airport, Bengaluru paid a high price for improper disposal. During first phase of the project, the contractor took advantage of the vast project site and dumped generated C&D trash on the allocated area for the second phase. Now, the second phase's contractors are trying to clear up the debris, which has increased the project's cost and duration. The 2016 Rules state that big projects should preferably use considerable *in-situ* C&D waste in their projects wherever possible.

The Swachh Bharat Mission has gradually recognised the importance of C&D waste management. Swachh Survekshan is an annual pan-India competition that encourages cities to improve the condition of urban sanitation. Its primary goal is to "ensure the sustainability of initiatives taken toward garbage free and open defecation free cities, provide credible outcomes that would be validated by third party certification, institutionalize existing systems through online processes, and create awareness [5]. In Swachh Survekshan 2021, the ranking points for C&D waste management have been raised to 100 points, which are equally divided between management infrastructure and waste processing efficiency. Cities will need a construction and demolition waste collection infrastructure, as well as notification pricing for C&D services and debris categorization into five streams: concrete, soil, steel, wood and plastics, and bricks for better environmental management.
1.5 Construction and Demolition Waste Management Rules, 2016[6]

Construction and Demolition Trash Management Regulations 2016 are one of the complete legislation particularly handles C&D waste. This whole legislation covers the duties of different parties, including generators, municipalities, government pollution management councils and departments for urban development. Accordingly, waste-generating duties, service providers' duties, contractors' duties and local authorities' duties should be given the following responsibility:

i. Duties of Waste generators:
Collection, segregation and storage, as informed or required by the local government, of C&D waste produced on their premises according to the C&D Rules.

a. Ensure that C&D waste is not associated with additional solid trash.

b. In order to minimise any impediments to mobility, public or sewerage, C&D trash should be maintained in place to prevent littering or waste buildup.

c. Waste producers producing more than 20 tonnes daily or 300 tonnes per project during a month must comply:
   - Divide trash in five categories: cement, soil, metal, wood and plastic, bricks and stemming.
   - Pay the appropriate fees for collection, transportation, processing, and disposal stipulated by local authorities. It is required to submitting to the local authority an approved plan before the start of construction, demolition or restoration works.

ii. The Service Providers and Contractors Duties
Service providers shall establish an integral waste management plan within six months after the publication of the rules of procedure (in April 2016) covering the segregation, stockpiling, recovery, reuse, recycling, transportation and disposal of C&D waste produced in their jurisdiction. Further, the C&D waste should be removed in a reasonable period, preferably within one day, in cooperation with the local authorities. Another important duty is, the company must subcontract for removal of C&D wastes to licensed organisation in the absence of logistic support and pay the relevant fees, as directed by the local authorities.

iii. Local Authorities and their Duties
- Provide thorough C&D waste management instructions as required by the regulation and seek a complete generator plan or project.
- Outline the stages, technique, and equipment utilised and the materials used in the entire activity and the final clean up once building and demolition are completed.
- In consultation with the appropriate authorities, dispose of C&D waste polluted by harmful trash, poisonous material, or nuclear waste safely.
- Arrange for the collection of C&D trash and ensure that it is cleaned up on a regular basis.
- Transportation of trash through internal resources or private organisations to the treatment facilities.
- Provide sufficient incentives for generators, particularly in situ, to rescue, process and/or recycle.
Waste management plans of scrutiny and sanction generators within 1 month of the date of approval, or in 1 month from the date of approval.

Checking and updating C&D waste data produced once a year within your jurisdiction.

Educate and disseminate C&D waste management information via their websites or through consultations with professionals and civil society groups.

Encourage the use of C&D materials, especially non-structural materials.

iv. Duties of State Pollution Control Board or Pollution Control Committee

- Monitor local government actions to enforce the regulations.
- C&D waste management plants are authorised after the examination of applications in the forms needed.
- Prepare and submit an annual report to the CPCB by 31 July each year, concentrating on the compliance with C&D legislation within local governments.

v. Duties of State Government or Union Territory administration

- Within one year of receiving notified of the rules, prepare a policy document addressing C&D waste management provisions.
- The state government/union territory shall provide adequate C&D waste storage, processing, and recycling facilities.
- TCAP shall include the location in an authorised land-use plan to avoid future disruption to the facility.
- Mandatory use of materials derived from C&D waste (10–20%) in municipal and governmental contracts.

vi. Central Pollution Control Board’s Responsibilities and Duties

- Develop standards for environmentally sustainable C&D waste management.
- SPCB/PCC (Pollution Control Committees in Union Territories) analyze and collect information to assess the regulations regularly.
- Coordinate with SPCB or PCC on any environmental standards-related issues.
- Submit to the Central government, on the basis of the SPCB/PCC data, an annual compliance report, by 30 August of each year.

vii. Bureau of Indian Standards and Indian Roads Congress and its Obligations

- Develop code of methods and norms for use in infrastructure design and highway construction of recycled materials and C&D waste products.

viii. Central Government’s Duties

- Local agencies are helping in the compliance of the Ministry for Urban Development (MoUD), the Ministry of Farmers’ Development (MoRD), and the Panchayati Raj (MoPR).
- The Central Government must evaluate the implementation of the Rules whenever required by the Ministry of Environment, Forestry and Climate Change.

Most of the necessary changes to specifications and pricing schedules to implement the C&D Waste Management Rules were done nationally ever since. As a result, the handling of C&D waste in cities should have also been harmonized by now. The failure of *Swachh Survekshan* to reach cities based on the same percentage of trash handled criteria used for municipal solid waste, on the other hand, shows the lack of implementation. Furthermore, despite multiple High Court judgments that go above and beyond the Rules’ mandates, one of the wealthiest Urban Local Bodies in the country—Mumbai—has failed to operationalize a single C&D waste recycling facilities for the city.
India’s focus on Circular Economics to manage the issues in handling C&D wastes. Circular Economics is an investment and distribution paradigm that enhances the value and the inherent energy of existing materials, goods and components. In fact, this implies that waste may be eliminated as far as possible. While a product has reached its destination, its materials and contained energy are utilized in the economy to the maximum. These can be put to better use over and over again, resulting in increased value. Sharing, leasing, reusing, repairing, refurbishing, and recycling are just a few of the ways to put CE principles into practice [7]. The circular economy always remained a challenge in India. If the 2016 Rules and circular economy is maintained, India would have a better model in managing the C&D waste.

2. Methodology
Legislation and Case law analysis - The doctrinal and non-empirical research method is utilised by analysing both primary and secondary sources to systematise, correct, and explain the issues on any particular topic connected to legislation. The most widely acknowledged research paradigm is library-based research, which focuses on reading and analysing source material such as legislation and case law. In addition, secondary data such as legal glossaries, textbooks, journals, articles, and case digests are utilised in the present research.
3. Results and Discussions

Construction and demolition (C&D) waste poses a serious environmental risk. Massive quantities of concrete, bricks, and metal waste from building development and infrastructure choke our rivers, green areas, and public spaces both inside and outside cities. Massive amounts of hazardous dust particles released by the debris contaminate the air. The guidelines for controlling this garbage were established in 2016, but their execution has been difficult. Recent major legal changes are now expected to have a considerable effect on citywide C&D waste management. The judiciary in India, in many situations, has established its effectiveness in protecting the environment. M/S Bahubali Stone Crusher vs Raj State Pollution Control [8] stated that "While the State is required to encourage sustainable development of the State, it is equally essential to ensure pollution-free environment for the people". In Hanuman Laxman Aroskar vs Union of India [9] insisted that the as per the norms established under Construction and Demolition Waste Management Rules, 2016, Section 4- Duties of the waste generator, the solid inert waste found in the sites of constructions such as building rubble, demolition material, concrete; brick, timber, plastic, glass, metals, etc shall be recycled. In M.C.Mehta (Stubble Burning &Air Quality) vs Union of India[10], the Court directed the governments of NCT, Delhi, Rajasthan, Haryana and Uttar Pradesh to present a status report regarding compliance with the Construction and Demolition Waste Management Rules, 2016 and ordered to take penal actions against the developers who have flouted the norms. Further in this case, the Court emphasized the duty of citizens in protecting the environment by stating Article 51A(g) of the Constitution of India, 1950, which confers "to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures"[11]. Therefore, it is high time to realize that not only the stakeholders mentioned in 2016 Rules are responsible for the C&D waste, but the citizens must come forward in safely disposing the C&D debris, especially small parts of their house or changes in already existing constructions such as building cupboards, extending rooms, building structures and compound walls or any other small constructions. They also contribute towards the degradation of the environment where the government and citizens are responsible in managing the C&D debris.

4. Conclusions

The C&D Waste Rules 2016 detailed the particular role and obligations of a wide range of stakeholders, including waste generators, ULBs, and federal and state governments and organisations. It also includes documentation samples for each management step, making the deployment simpler. Despite the existence of suggestions and warnings, these Rules have not been completely implemented. C&D waste management and utilisation have not progressed as planned under the 2016 Rules due to a variety of reasons. According to a recent research done by the Centre for Science and Environment, India barely recycles 1% of C&D waste. Construction and demolition debris may be a significant source of construction materials. Indeed, the current sand mining issue in India has highlighted the need of recycling, reusing, and substituting naturally sourced construction materials. Due to a lack of support for business models that lead to better implementation, compliance of construction and demolition (C&D) waste, plastic trash, and e-waste has been restricted. There is a need to mobilise waste treatment funds or costs through Extended Producer Responsibility (EPR), and the Polluter Pays Principle. According to the 2020 report of the Centre for Science and Environment, "Another Brick off the Wall," noted that the 2019 C&D waste strategy report Resource Efficiency & Circular Economy by NITI Aayog finds a severe lack of knowledge of the Rules in the construction sector across the
country. There is some sensitivity toward waste disposal in major projects when C&D waste management is integrated into the environmental clearance requirement, although rarely in compliance with the Rules. But the issues are the constructions in the rural and urban areas that are unnoticed. These constructions are not even big projects but generate larger C&D wastes where there is a lack of knowledge of either reusing the materials or disposal. The major obstacle in the construction sector is a lack of awareness regarding waste management techniques and approaches among local contractors, construction personnel, and architects. The majority of the debris generated throughout the construction process is usually the consequence of improper management and techniques. There are hardly any contractor federations or professional organisations in the nation, which may considerably increase knowledge among clients and contractors about the potential economic advantages and social implications. Another major cause of ignorance in the sector is a lack of priority placed by clients on incorporating waste reduction and management methods into projects. Clients/consumers do not support efforts that do not provide them with concrete benefits. Significant cost savings are not yet being deliberately incorporated in projects, and timeframe is given first priority. Issues obstructing effective and comprehensive C&D waste management, which would allow for the implementation of a circular economy, have remained. Despite legislative and regulatory reforms implemented over the previous decade to permit C&D waste collection and recycling, on-the-ground implementation has remained a non-starter in the majority of the country. Only a few major cities have begun to take action. Moreover, given the country's limited scientific research and fragmented pilots, solutions to India's C&D waste challenge require a broad and nimble approach.

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