CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT IN INDIAN CONSTRUCTION PROJECTS

ABSTRACT

Construction and demolition (C&D) waste is generated in enormous quantities during construction, demolition, and renovation of buildings and infrastructure projects. The generated C&D waste, if not managed, harms the project's financials, environmental, and social aspects. The generated C&D waste causes a considerable loss to the economy by increasing the cost of projects due to poor efficiency and low productivity. Furthermore, the generation of C&D waste has adverse environmental impacts such as land deterioration, resource depletion, greenhouse gas emissions, air, dust, and noise pollution, and the discharge of toxic waste. The social aspects include the physical working environment in waste management, the practitioner's long-term health, and the operative's safety. Therefore, there is a need to manage the generated construction and demolition waste to move towards sustainable construction. Further, to manage the waste effectively and efficiently, the accurate estimation of construction and demolition generated is essential, along with identifying the factors causing the generation of waste and developing strategies for managing the waste.

The first objective attempts to estimate the quantity of construction and demolition waste generated in a region by collecting the building permit data for the Hyderabad region, India. A random sampling technique was adopted to select the building permit to estimate the proportion of types of buildings constructed and demolished, the average area of each type of building constructed and demolished, and the overall area of building construction and demolition activity. The building construction and demolition activity is used to estimate the total quantity of construction and demolition waste generated in a region. In addition,

regression models were developed to predict the construction activity in a region based on the fee collected for issuing the permit.

Further, the management practices of the construction and demolition waste generated in a region are evaluated using environmental and economic performance. Life cycle assessment (LCA) and life cycle costing (LCC) approaches were used to assess the environmental and economic performance of the waste management practices adopted for the Hyderabad region of India. The data related to life cycle inventory were obtained from primary and secondary sources, and the environmental impacts were evaluated using Simapro software. The findings reveal that reducing the generation of C&D waste has maximum environmental and economic benefits, followed by replacing natural aggregates with recycled aggregates. Therefore, to minimize the generation of C&D waste, the study further estimates the quantity and composition of C&D waste generated in a project, identifying the factors causing the generation of C&D waste and exploring the strategies for managing the generation of C&D waste in a project.

Thus, the study identifies the highest waste-generating potential materials used in road projects to estimate the construction and demolition waste generated in a project. Further, the estimated quantity of materials, material waste percentages, demolition of buildings, and existing pavement data were collected from ongoing road construction projects in India. Quantitative analysis was used to estimate a project's construction and demolition waste. The construction and demolition waste generation rates obtained in road projects are 352.83 kg/m^2 and 129.64 kg/m^2, respectively. Moreover, the waste-generating materials were classified into high, medium, and low using k-means clustering analysis.

Subsequently, the significant factors causing construction and demolition waste were identified. The questionnaire was developed by initially determining the factors causing

material waste from the literature and subsequently finalized using the Delphi technique. The questionnaire was administered to construction professionals in road projects, and the responses were analyzed using a relative importance index and regression analysis. The regression analysis identified the significant factors causing waste generation in a project. The study results indicate that lack of on-site material control is the most common factor causing waste generation across materials, followed by unused/leftover materials and lack of supervision.

Lastly, the study explored the strategies for managing the construction and demolition waste generated in a project by collecting the data from case study projects using semi-structured interviews. The interviews were recorded, and thematic analysis was performed using NVivo 14 software. The themes identified from the study are the design phase, construction site planning and management, construction waste planning, and training and development. The results indicate that the strategies for managing construction and demolition waste vary across materials. This study will help policymakers and other stakeholders frame guidelines for managing the construction and demolition waste at the regional and project levels.

Keywords: Construction waste, demolition waste, sustainable construction, life cycle assessment, life cycle costing, waste management.