World Academy of Science, Engineering and Technology
International Journal of Civil and Architectural Engineering
Vol:19, No:03, 2025

Optimizing Recycling and Reuse Strategies for Circular Construction Materials with Life Cycle Assessment

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Abstract : Rapid urbanization has led to a significant increase in construction and demolition waste (C&D waste), underscoring the need for sustainable waste management strategies in the construction industry. Aiming to enhance the sustainability of urban construction practices, this study develops an optimization model to effectively suggest the optimal recycling and reuse strategies for C&D waste, including concrete and steel. By employing Life Cycle Assessment (LCA), the model evaluates the environmental impacts of adopted construction materials throughout their lifecycle. The model optimizes the quantity of materials to recycle or reuse, the selection of specific recycling and reuse processes, and logistics decisions related to the transportation and storage of recycled materials with the objective of minimizing the overall environmental impact, quantified in terms of carbon emissions, energy consumption, and associated costs, while adhering to a range of constraints. These constraints include capacity limitations, quality standards for recycled materials, compliance with environmental regulations, budgetary limits, and temporal considerations such as project deadlines and material availability. The strategies are expected to be both cost-effective and environmentally beneficial, promoting a circular economy within the construction sector, aligning with global sustainability goals, and providing a scalable framework for managing construction waste in densely populated urban environments. The model is helpful in reducing the carbon footprint of construction projects, conserving valuable resources, and supporting the industry's transition towards a more sustainable future.

Keywords : circular construction, construction and demolition waste, material recycling, optimization modeling
Conference Title : ICCCEM 2025 : International Conference on Computing in Construction Engineering and Management
Conference Location : Tokyo, Japan
Conference Dates : March 25-26, 2025