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MULTI-CRITERIA SUSTAINABILITY ASSESSMENT OF STRUCTURAL SYSTEMS FOR MULTI-STOREY BUILDINGS

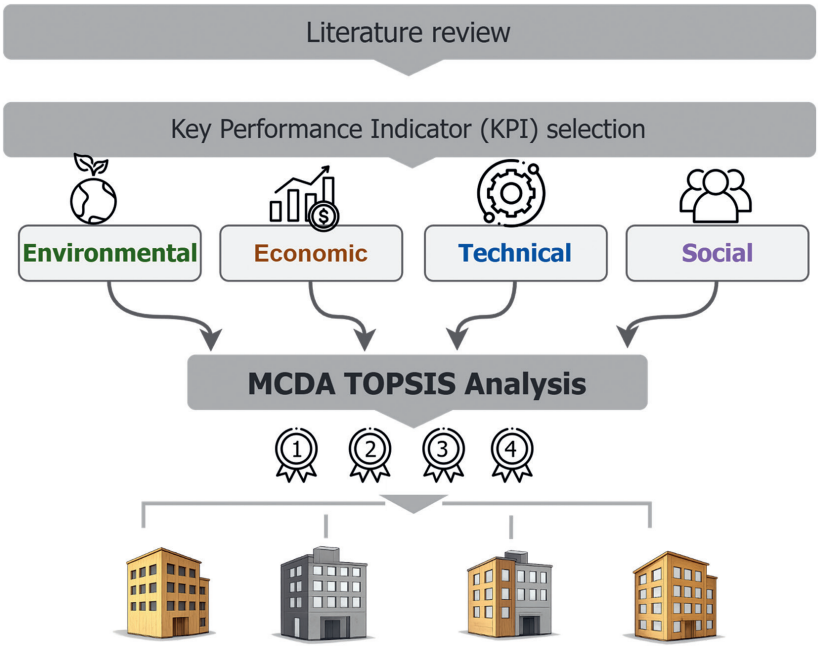
Valērija KOSTEVIČA[1*], Ilze VAMŽA[2], Megija VALTERE[3], Dagnija BLUMBERGA[4]

[1–4] *Institute of Energy Systems and Environment, Riga Technical University, Azenes iela 12/1, Riga LV-1048, Latvia*

[*] ***Corresponding author.*** *Email address: valerija.kostevica@rtu.lv*

Abstract – In Latvia, multi–story residential buildings are predominantly constructed using reinforced concrete (RC), while timber based structural systems remain underutilized. Despite the country's strong forestry sector, in the first part of 2025 multi-storey buildings constructed from timber accounted for only 8 % of newly completed buildings. This limited adoption can be explained by limited practical experience, regulatory barriers and concerns regarding cost, durability and long-term performance. This situation is notable given that Latvia ranks among worlds top ten exporters of key timber products, such as softwood sawn timber and birch plywood, highlighting a contrast between material production capacity and domestic application in multi-storey residential construction. At the same time, the building sector is responsible for a significant share of environmental impacts, prompting increased interest in alternative structural systems that can reduce carbon emissions while maintaining economic and social performance. Timber based structures such as cross-laminated timber (CLT) and glulam can substantially contribute to climate mitigation goals. However, the sustainability performance cannot be evaluated based only on environmental aspect, as economic efficiency, technical performance and social acceptance has a big impact on feasibility of residential buildings. To address this challenge this study applies a multi-criteria analysis (MCDA) approach to systematically compare timber, concrete and hybrid structural solutions. An MCDA approach based on the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was developed to rank four structural alternatives: CLT, RC, hybrid CLT-RC, and glulam building. The evaluation was conducted using comprehensive set of key performance indicators grouped into four sustainability dimensions, where indicators were selected through a systematic literature review, while social dimension indicators were defined and refined based in stakeholder interviews. The proposed framework provides a structured basis for sustainable oriented decision making and supports the evaluation of timber, concrete and hybrid based structural systems for multi-storey building designs.

Keywords – Carbon sequestration; cross-laminated timber; MCDA; reinforced concrete; sustainability assessment



MCDA based framework for comparing structural systems in multi-storey buildings