

## Concepts in the Design of Lateral-Load Systems in High Rise Buildings to Reduce Operational Energy Consumption

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**Abstract :** The location of the main lateral-load resisting system in high-rise buildings may have positive impacts on sustainability through a reduction in operational energy consumption, and this paper describes an assessment of the accompanying effects on structural performance. It is found that there is a strong influence of design for environmental performance on the structural performance the building, and that systems selected primarily with an eye towards energy use reduction may require substantial additional structural stiffening to meet safety and serviceability limits under lateral load cases. We present a framework for incorporating the environmental costs of meeting structural design requirements through the embodied energy of the core structural materials and also address the issue of economic cost brought on by incorporation of environmental concerns into the selection of the structural system. We address these issues through four case study high-rise buildings with differing structural morphologies (floor plan and core arrangement) and assess each of these building models for cost and embodied energy when the base structural system, which has been suggested by architect Kenneth Yeang based on environmental concerns, is augmented to meet lateral drift requirements under the wind loads prescribed by ASCE 7-10.

**Keywords :** sustainable, embodied, Outrigger, skyscraper, morphology, efficiency

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