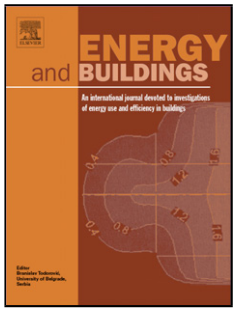

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Sustainable structural design of tall buildings based on Embodied Energy

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Abstract

This paper deals with the environmental resources consumed to construct tall building structures; the consumption is measured by the energy required to obtain tall building structures and is expressed in terms of cradle-to-gate embodied energy.

A reference structure composed of central core (made of reinforced concrete) and rigid frames (made of either reinforced concrete or steel) is considered. The reference structure is dimensioned and detailed for buildings from 20 to 70 stories; the embodied energy of each building is then estimated (total, of the components, per net rentable area).

The results show that, if some design decisions are dictated by the embodied energy, the premium for height of the embodied energy is not substantial, which proves that tall building structures can be sustainable. However, a structure with the lowest weight does not imply the lowest embodied energy. The results also prove that the embodied energy depends mainly on the flooring system, and that steel consumes more embodied energy than reinforced concrete.

Ultimately, the embodied energy is confirmed to be a viable tool to design sustainable tall buildings, and the results presented herein may address design toward minimizing the embodied energy, which means to save environmental resources.

Keywords: Embodied energy; Environmental resources; Floor types; Frame plus core; Sustainable skyscraper; Tall buildings.