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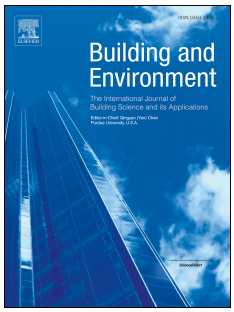

Impact of structural design solutions on the energy and thermal performance of an Australian office building

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Impact of structural design solutions on the energy and thermal performance of an Australian office building.

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Abstract

Concrete is a heavyweight construction material whose high thermal mass could increase the thermal storage capacity of a building envelope and in turn affect indoor thermal comfort. Selecting an appropriate method for concrete construction and form could also affect the total energy performance and thermal comfort of a building, a fact that is often overlooked by structural engineers. This study presents the results of energy simulations of the potential impact that concrete construction forms, in particular two slab types, and structural materials have on the energy consumption of archetypal commercial office buildings in five major Australia cities (Sydney, Melbourne, Canberra, Brisbane and Darwin). This study has three stages: 1) a structural analysis of two slab types (Flat and Waffle slab); 2) the selection of two types of structural concrete (conventional Normal weight concrete and novel Ultra-lightweight concrete); 3) a comparative analysis to quantify the magnitude of the change in predicted annual energy consumption due to changes in the form of construction and the type of structural concrete. The energy simulation results showed that the thermal energy performance of the building was influenced by structural materials and slab types. It is shown that the thermal capacity of the concrete construction forms can be utilized to shift thermal loads, reduce peak demand and reduce operational energy consumption. The selection of an appropriate concrete type was more important in terms of energy performance in the coldest (Melbourne and Canberra) and hottest (Darwin) climate zones of this study.

Keyword: Energy efficiency, Ultra-lightweight concrete, Office building, Structural design,