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Cost-effective Envelope Optimisation for Social Housing in Brazil's Moderate Climate Zones

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ABSTRACT

Brazil faces a housing deficit of more than 5.5 million units and nearly 11 million existing homes present inadequate living conditions. In response, the Brazilian government launched in 2009 a mass social housing programme with a target of delivering 24 million new units for low-income households by 2022. Their standardised design is relatively cheap to build but does not take into account climatic conditions, thermal comfort and energy efficiency. This could result in poor performance and uncomfortable indoor environments that could impact of the occupier's health and lead to the unnecessary use of energy-hungry space conditioning systems. Given the scale of this programme, the potential impact on Brazil's already debilitated socio-economic and environmental balance is very substantial. In this work, the authors have deployed sensitivity analysis to explore a variety of envelope combinations through dynamic building simulation for three southern Brazilian cities, Curitiba, Sao Paulo and Porto Alegre, aiming to achieve better than the typical performance. Thermal transmittance properties and air permeability rates were tested from the most common construction characteristics in Brazil to some of the highest levels of fabric energy efficiency. These combinations were also analysed in terms of their cost-effectiveness. The results suggested that optimised envelopes could improve thermal comfort by up to 97% in comparison to a typical envelope, but also cost nearly 50% more. Other envelope combinations investigated were shown to be more cost-effective with a significant increase of thermal comfort levels and were therefore considered to be a more adequate solution for the context.

Keywords: Thermal comfort, energy efficiency, envelope optimisation, social housing, insulated envelopes, air permeability.

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