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Efficiency Validation of Hybrid Cooling Application in Hot and Humid Climate Houses of KSA

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Abstract : Reducing energy consumption and CO₂ emissions are probably the greatest challenge now facing mankind. From considerations surrounding global warming and CO₂ production, it has to be recognized that oil is a finite resource and the KSA like many other oil-rich countries will have to start to consider a horizon where hydro-carbons are not the dominant energy resource. The employment of hybrid ground-cooling pipes in combination with the black body solar collection and radiant night cooling systems may have the potential to displace a significant proportion of oil currently used to run conventional air conditioning plant. This paper presents an investigation into the viability of such hybrid systems with the specific aim of reducing cooling load and carbon emissions while providing all year-round thermal comfort in a typical Saudi Arabian urban housing block. Soil temperatures were measured in the city of Jeddah. A parametric study then was carried out by computational simulation software (DesignBuilder) that utilized the field measurements and predicted the cooling energy consumption of both a base case and an ideal scenario (typical block retro-fitted with insulation, solar shading, ground pipes integrated with hypocaust floor slabs/stack ventilation and radiant cooling pipes embed in floor). Initial simulation results suggest that careful ‘ecological design’ combined with hybrid radiant and ground pipe cooling techniques can displace air conditioning systems, producing significant cost and carbon savings (both capital and running) without appreciable deprivation of amenity.

Keywords : cooling load, energy efficiency, ground pipe cooling, hybrid cooling strategy, hydronic radiant systems, low carbon emission, passive designs, thermal comfort
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