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Τίτλος Σπουδαστικής Εργασίας:

« Mitigation of the urban heat island effect: cool materials, energy-efficient design, and radiative cooling»

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MITIGATION OF THE URBAN HEAT ISLAND EFFECT: COOL MATERIALS, ENERGY-EFFICIENT DESIGN, AND RADIATIVE COOLING

Abstract

Over the last few decades, the rise in global temperature and the intensification of the Urban Heat Island (UHI) phenomenon have necessitated the search for sustainable cooling solutions. The increased use of active air conditioning systems strains energy consumption and exacerbates the problem, making the application of passive cooling techniques particularly promising.

This paper focuses on the Theoretical Framework for tackling the UHI (Chapter 1), analyzing the factors contributing to the phenomenon and the methods for its mitigation. The main mitigation strategies examined include increasing urban greenery, the use of cool materials (such as cool roofs and coatings), and energy-efficient building design. Within the scope of Energy-Efficient Building Design (Chapter 2), the core pillars of passive design were presented, with an emphasis on envelope interventions (such as insulation and cool materials) and passive cooling techniques. Techniques such as shading, natural ventilation, and natural cooling via the ground (Underground Construction, Earth to Air Heat Exchangers) and evaporative cooling were examined. The work focuses extensively on the Radiative Cooling technique (Nocturnal and Diurnal), analyzing the physical process, its thermodynamic basis (such as the Energy Balance), and critical design parameters. The theoretical analysis concludes that radiative cooling, as a passive cooling technique, constitutes a highly efficient solution for reducing the thermal load on buildings, with its efficiency directly depending on the material's emissivity and local climatic conditions.

Key words

Urban Heat Island (UHI), Energy-Efficient Building Design, Cool Materials, Passive Cooling, Radiative Cooling