13. Bioclimatic interventions for Urban Heat Island in Northern Greece

This study investigates the thermal behaviour of construction materials in the urban center of Serres, Northern Greece, and the impact of replacing conventional materials with cool alternatives on the urban microclimate. Temperature fluctuations and surface temperature differences between various materials were monitored. CFD simulations indicated that replacing traditional materials with cool ones, along with other mitigation techniques, reduced the mean surface temperature by 6.5°C. The study highlights the potential of cool materials to mitigate the urban heat island effect and improve comfort conditions in urban environments.

Tags: Construction materials, Cool materials, Urban Heat Island, Urban microclimate.

CHALLENGES ADDRESSED:

- **Urban Heat Island (UHI) effect:** due to heat retention by traditional construction materials.
- **Sustainability of construction materials:** conventional materials often contribute to environmental issues, including increased energy consumption for cooling.
- **Data-driven urban design: l**ack of empirical data to guide urban planning decisions for climate resilience.

MAIN OBJECTIVES:

- **Investigate the thermal behaviour** of typical construction materials in the urban center of Serres, North Greece, and assess their impact on urban microclimate.
- **Evaluate the benefits of replacing conventional materials** with cool materials in reducing urban heat island effects.
- **Use CFD simulations** to analyse the potential temperature reduction achieved by replacing conventional materials and applying other mitigation techniques.
- **Contribute evidence on the potential of cool materials** in mitigating urban heat islands and enhancing urban sustainability.

+ FACTS

Project type: Urban Heat Island study

Partners: Laboratory of Environmental and Energy Efficient Design of Buildings and Settlements, Department of Environmental Engineering, Democritus University of Thrace. Division of Technical Services, Serres Municipality.

Beneficiaries: Serres municipality (Greece)

Date: October 2014 (publication date)

+ PROJECT DESCRIPTION

This project investigates the impact of construction materials on urban microclimate conditions in Serres, a city in North Greece that faces significant urban heat island (UHI) effects, particularly during hot summer months. The study focuses on the thermal behaviour of conventional materials, such as asphalt and pavement tiles, in the city's dense urban areas, where surface temperatures can exceed 45°C. The project

aims to improve these conditions through the introduction of "cool" materials—those with high reflectivity and emissivity—combined with other mitigation techniques like increased green spaces.

Through field measurements and detailed CFD simulations, the project evaluates how replacing conventional materials with cool alternatives can reduce surface temperatures and improve both outdoor and indoor thermal comfort. The use of cool materials is shown to have significant cooling potential, with simulations indicating temperature reductions of up to 6.5°C in specific urban areas. This bioclimatic redevelopment approach also enhances energy efficiency in surrounding buildings by lowering the cooling load. Ultimately, the study contributes valuable evidence on the effectiveness of cool materials in mitigating UHI effects and improving urban sustainability, particularly in hot climates.

+ IMPACTS AND RESULTS

- **Reduction in surface temperatures:** the study found that replacing conventional materials with cool materials could reduce surface temperatures in urban areas by up to 6.5°C, significantly mitigating the urban heat island effect.
- **Improved thermal comfort:** the introduction of cool materials, along with other mitigation techniques, resulted in improved outdoor thermal comfort and reduced indoor cooling loads, enhancing the overall liveability of the urban environment.
- **Energy efficiency benefits:** the bioclimatic redevelopment not only cooled outdoor spaces but also contributed to lower energy consumption in nearby buildings, helping to reduce the cooling load and improve the energy performance of the city.