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Thermal Comfort and Outdoor Urban Spaces in the Hot Dry City of Damascus, Syria

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Abstract : Recently, there is a broad recognition that micro-climate conditions contribute to the quality of life in urban spaces outdoors, both from economical and social viewpoints. The consideration of urban micro-climate and outdoor thermal comfort in urban design and planning processes has become one of the important aspects in current related studies. However, these aspects are so far not considered in urban planning regulations in practice and these regulations are often poorly adapted to the local climate and culture. Therefore, there is a huge need to adapt the existing planning regulations to the local climate especially in cities that have extremely hot weather conditions. The overall aim of this study is to point out the complexity of the relationship between urban planning regulations, urban design, micro-climate and outdoor thermal comfort in the hot dry city of Damascus, Syria. The main aim is to investigate the temporal and spatial effects of micro-climate on urban surface temperatures and outdoor thermal comfort in different urban design patterns as a result of urban planning regulations during the extreme summer conditions. In addition, studying different alternatives of how to mitigate the surface temperature and thermal stress is also a part of the aim. The novelty of this study is to highlight the combined effect of urban surface materials and vegetation to develop the thermal environment. This study is based on micro-climate simulations using ENVI-met 3.1. The input data is calibrated according to a micro-climate fieldwork that has been conducted in different urban zones in Damascus. Different urban forms and geometries including the old and the modern parts of Damascus are thermally evaluated. The Physiological Equivalent Temperature (PET) index is used as an indicator for outdoor thermal comfort analysis. The study highlights the shortcomings of existing planning regulations in terms of solar protection especially at street levels. The results show that the surface temperatures in Old Damascus are lower than in the modern part. This is basically due to the difference in urban geometries that prevent the solar radiation in Old Damascus to reach the ground and heat up the surface whereas in modern Damascus, the streets are prescribed as wide spaces with high values of Sky View Factor (SVF is about 0.7). Moreover, the canyons in the old part are paved in cobblestones whereas the asphalt is the main material used in the streets of modern Damascus. Furthermore, Old Damascus is less stressful than the modern part (the difference in PET index is about 10 °C). The thermal situation is enhanced when different vegetation are considered (an improvement of 13 °C in the surface temperature is recorded in modern Damascus). The study recommends considering a detailed landscape code at street levels to be integrated in urban regulations of Damascus in order to achieve a better urban development in harmony with micro-climate and comfort. Such strategy will be very useful to decrease the urban warming in the city.

Keywords : micro-climate, outdoor thermal comfort, urban planning regulations, urban spaces
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