Mean Radiant Temperature and Outdoor thermal comfort in urban public spaces in Cardiff: A GIS-based approach

Outdoor Thermal Comfort (OTC) is an important factor in determining the health and wellbeing of people using urban spaces. Favourable OTC conditions, such as shaded areas, cool or permeable pavements and access to green spaces can help to mitigate the negative effects of extreme heat and cold and improve the quality of life in urban areas. However, many urban spaces in cities are designed with rather ambiguous climate design approaches without considering the necessary evidence-base or performance analysis. This means that climatic and comfort aspects are not considered in the design process, which can lead to unutilised spaces or spaces that have negative effects on public health and wellbeing. Hence it is crucial to evaluate the environmental performance of exiting urban spaces in cities to provide insights for climate-sensitive urban design. This is particularly essential for protecting the cities and their valuable social and urban life from rapid urban warming, urban heat island effects and frequent heat waves in relation to climate change. This study evaluates the environmental performance of three public urban spaces with different building geometry and vegetation cover in Cardiff near the Central Train Station (Central Square), Cardiff Bay (Roald Dahl Plass) and City Hall (Cardiff Winter Wonderland). Even though recently developed, the amount of vegetation, permeable surfaces, shading or protection from wind exposure in the first two areas are barely considered which poses risk to public health and thus, needs to be addressed. The study adopts a GIS-based approach to generate a Local Climate Zone (LCZ) map for urban climate classification of Cardiff and a Land Surface Temperature map to identify the hot spots in Cardiff using Landsat satellite data. Then it focuses on the case study urban spaces to determine the Mean Radiant Temperature (Tmrt), an important parameter that controls human energy balance and thermal comfort of people. Tmrt is simulated in the SOLWEIG model (Solar and Long Wave Environmental Irradiance Geometry) inside the GIS-based platform by considering the radiative (shortwave and longwave) fluxes from six directions (upward, downward and from the four cardinal points) and shadow patterns in complex urban settings. A comparison of Tmrt in the three urban spaces will aid in understanding the spatial variation, their OTC conditions and thus, help in devising strategies for improvement.