A GIS application tool for solar radiation control in urban built up areas

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Abstract

A key question for sustainable urban and energy planning concerns the form and patterns of the urban built up areas and the rational use of energy. The configuration of urban form and the use of open spaces, the building form and used materials together with their energy performance, the microclimate conditions, can influence the "urban heat island" formation. Building form and obstructions shade views from façades to the sky and sun, are strictly connected with radiant exchanges that influence the microclimate (temperature, air velocity and air pressure distribution), energy use and natural light availability. Lower density urban patterns are related to a higher energy consumption, while energy performance of buildings is strictly linked to its architectural form and the urban context. Ensuring solar access into urban texture can provide quality of the built environment. Furthermore, daylighting is an important issue for urban energy planning affecting the configuration of urban space, occupant comfort (visual and thermal) and energy use inside building. The reflected natural light from the ground (streets, open spaces and urban texture in general) to the surrounding buildings is an important source of interior lighting. Natural light coming from the sky and the sun is considered as the best lighting source for optimal colour rendering and visual perception. Its quality is the essential light source mostly closed to human visual response. Moreover, natural light use can reduce electricity demand and the related cooling load due to artificial lighting. Consequently urban form plays a significant role in daylighting design. This paper investigates the energy consumptions due to different building configurations and daylighting performance and shading effect due to nearby obstructions through good grid pattern and building passive solar design. Then a software tool, based on Geographical Information Systems (GIS) technologies, for the calculation of the shadows distribution in different built up urban areas, is provided. This tool takes into account different climate conditions and the hourly variation of the sun position with respect to different oriented and inclined building façades for the evaluation of the shadows distribution and form due to different building configurations.