

Thermal Simulation for Urban Planning in Early Design Phases

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Abstract : Thermal simulations are used to evaluate comfort and energy consumption of buildings. However, the performance of different urban forms cannot be assessed precisely if an environmental control system and user schedules are considered. The outcome of such analysis would lead to conclusions that combine the building use, operation, services, envelope, orientation and density of the urban fabric. The influence of these factors varies during the life cycle of a building. The orientation, as well as the surroundings, can be considered a constant during the lifetime of a building. The structure impacts the thermal inertia and has the largest lifespan of all the building components. On the other hand, the building envelope is the most frequent renovated component of a building since it has a great impact on energy performance and comfort. Building services have a shorter lifespan and are replaced regularly. With the purpose of addressing the performance, an urban form, a specific orientation, and density, a thermal simulation method were developed. The solar irradiation is taken into consideration depending on the outdoor temperature. Incoming irradiation at low temperatures has a positive impact increasing the indoor temperature. Consequently, overheating would be the combination of high outdoor temperature and high irradiation at the façade. On this basis, the indoor temperature is simulated for a specific orientation of the evaluated urban form. Thermal inertia and building envelope performance are considered additionally as the materiality of the building. The results of different thermal zones are summarized using the 'Degree day method' for cooling and heating. During the early phase of a design process for a project, such as Masterplan, conclusions regarding urban form, density and materiality can be drawn by means of this analysis.

Keywords : building envelope, density, masterplanning, urban form

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