METHOD COMPARISON OF OVERHEATING EVALUATION VIA NORMATIVE CALCULATION AND NUMERIC SIMULATION

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INTRODUCTION

The avoidance or at least mitigation of summer overheating is a topic that constantly gains importance within the AEC-community (Architecture-Engineering-Construction) in recent years. This is, on the one hand, due to the climate-change-induced increase of hot periods in summer time, and, on the other hand, caused by microclimatic implications in the urban surroundings, known as the Urban Heat Island effect. Currently different methods of assessment of building designs toward summer overheating tendency are available: (i) Normative methods of different degree of complexity for instance based on the Austrian standards [1]. These methods regularly are used for certification that a certain building design or retrofit project is to a certain degree safe against severe summer overheating. Such certifications are required for different purposes, e.g. for getting a subsidy grant or receiving a building permit; (ii) sophisticated simulation-based methods that consider a wide range of input data and allow for close to any enquiry being worked upon. In comparison to the normative methods, such methods require a higher resolution of input data regarding climate data, occupant behaviour, and physical characteristics of the surround building components. Both methods are widely in use, but deliver results in different resolutions. Due to the different output data characteristics, planners often struggle to understand if certain results from simulation can be mapped onto the normative performance indicators and vice versa. Moreover, aspects that need to be considered in recent times – such as changing boundary conditions due to climate change and increased impact of the Urban Heat Island effect – cannot or only to very limited extent integrated in the normative approaches. Needless to say, this is suboptimal and needs to be addressed in close future as the normative procedure is one decision criteria for or against a granted building permit. In this contribution we illustrate our efforts pertaining to comparing and mapping results of the normative approach and the simulation-based assessment on a set of case study building designs (roof top extensions of an existing *Gründerzeit* building in Vienna). The present study is in its preliminary phase, thus we can only provide an outlook onto expected results.

METHODOLOGY

Case study buildings: For this study, a set of different designs for a rooftop extension of an existing Viennese *Gründerzeit* building have been chosen as case study. This is due to the increased summer overheating risk connected with this specific design task (large envelope area in comparison to occupied volume, often direct exposure to sunlight, limited possibility to integrate thermal mass compartments into the design). Figure 1 illustrates some of the roof top extension designs.

Figure 1: Some of the rooftop extension designs

Utilized summer overheating evaluation methods: The normative evaluation utilized in this study is based on the Austrian Standard B8110-3 [1]. In this standard both a simplified and a more detailed version are encompassed. The standard provides as results in both simplified and detailed approach operative temperatures for a virtual summer day (15th of July), which is assumed to be part of a heat period. The average operative temperature during day time and night time is then expressed in quality classes (A+ to D). The method can only be applied to single rooms, not to a set of rooms or an overall building. The numeric methodology utilizes the software EnergyPlus [2]. A wide range of output data can be generated in this tool, ranging from different temperature outputs (radiative temperatures, air temperatures, operative temperature) to heat flux through components to cooling demand calculations. Moreover, the simulation not only can be applied to single rooms, but also to a set of zones that together can form up to a whole building. Needless to say, the numeric simulation requires a more detailed set of input data encompassing hourly weather data including solar radiation data, detailed information about the physical properties of the building envelope, and – maybe most difficult to set – detailed occupancy data (including operation of windows, ventilation behaviour, presence, use of appliances and gadgets in different zones, etc.). Previous studies and works will be employed to setup the required input data in a convenient fashion [3][4].

WORKPLAN, COMPARISON CONCEPT AND EXPECTED RESULTS

In a first step, the different roof top extension designs will be evaluated, and the most critical spaces in each design will be identified. These spaces will be used for the normative procedure, and also be set as a zone in the numeric simulation. Subsequently, a comparison of the required input data and their overlap and differences will be conducted. Based on this information, a reasoning of result differences in later stages can be performed, as well as a sensitivity analysis. In a further step, all of the rooftop design variations will be subjected to both simulation and normative evaluation. Thereby, the resulting Key Performance Indicators will be analysed on potential comparison mechanisms. Besides direct mapping, alternative concepts, such as linear regression analysis or ranking-based comparison methods (compare [5]) will be evaluated as potential instruments for comparison. In subsequent steps, both the building design properties (for instance thermal mass) and the boundary conditions (e.g. integrating different climate change scenarios, or considering the urban heat island effect) will be varied, so that a sensitivity analysis can be performed. A major objective of the overall work is to find conclusions, whether and to which extent both simulation (which is considered to be “closer” to reality) and normative calculations provide sufficient planning support regarding summer overheating mitigation (or in best cases avoidance) assessment.

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