Assessment of window systems considering solar and thermal performance

Window systems play a primary role on the solar and thermal performance of the buildings. During the last few decades, the growing popularity and the major energy saving potentials of transparent constructions in office buildings, propelled a rapid and fascinating development of this type of constructions. With the increasing complexity of window constructions, the performance becomes difficult to assess resulting in noticeable divergence between results from dynamic simulations.

The study aimed to identify possible differences between software tools, as well as, relating them to possible causes. Despite the fact that a comparison to empirical data was not possible, examination of the current policies (standards, regulations and certifications) was deemed necessary, in order to correlate to the assumptions and limitations applied in real-world cases. The countries considered in terms of regulations and certifications were Sweden and the UK. The investigation of solar and thermal performance was carried out for five exemplary types of windows used in office buildings in the context of both steady-state calculations and Dynamic Thermal Simulations. The software tools used were WIS 3, IDA ICE and IES VE.

The comparison of the steady-state results indicated some minor differences between the software tools in terms of U-values and g-values. Even though the calculations were carried out according to the same standards, the limitations applied by each program in modelling the layers of the constructions (e.g. characteristics of gas used in the cavities) could possibly explain the differences noticed.

Proceeding further to Dynamic Thermal Simulations, the software tools demonstrated bigger differences. The use of shading made the divergence more evident, as its characteristics affected the overall performance of the system. The three indices examined, namely solar gains, heat transfer and inner surface temperature, proved to be adequate in describing the different approaches from the software tools. In spite of having access only to the formulas of one of the tools, the tests (including assumptions and hypothesis from the authors) resulted to a solid conclusion; the impact of solar radiation was not considered in the same way -as described in the relevant standard- in the two programs. This outcome was also reflected on the energy (heating, cooling) that the active systems (HVAC) would need to compensate for. Specifically, the deviation in energy need among the results, seemed to increase as the complexity (solar and thermal insulation) of the examined constructions increased.

Finally, the study, based on the findings, commented on the regulations and certifications being in use at the time of writing and proposed possible future work that could enhance the analysis of this intricate field.