Solar shadings – sustainable architectural responses to the Swedish climate

Buildings use enormous amounts of energy for cooling without guaranteeing a comfortable indoor climate. Effective yet sustainable solutions introduce solar shadings and free cooling strategies. New climate-based tools to predict the benefit of such solutions were developed through the study of shadings on a southern facade.

Modern buildings in Sweden experience overheating. There are three main reasons for this burning issue. One of them is undoubtedly climate change. The other two – highly glazed facades and extensive insulation, have turned buildings into heat traps. Interviews[1] with architects in Scandinavia revealed their unawareness about solar shadings' enormous benefit. Because this attitude is common among architects, it is oftentimes the engineer that ends in charge of designing a shading device, for otherwise they would have to dimension a huge cooling system. The study on fixed external shadings in Sweden found that such device can reduce even 85 % of solar heat gain through a window at a given hour. Their immense benefit towards sustainability in modern buildings is evident.

Simulations are widely used in a design process, but they are based on numerous building specific inputs. Regardless of our often limited level of understanding of the underlying algorithms, we tend to trust the annual simulated predictions, but if the input assumptions are wrong – can we really use them? The study found that occupants' interactions with built systems such as electric lights or internal blinds strongly affect building performance and are expected to increase the energy use by from 10 % up to 50 %. Therefore, it is crucial to include schedules of operation for those systems based on expected behavioural patterns. And those are not easy to predict thus are increasingly studied, as people's perception of brightness is dependent on each individual and even cultural inclinations. The study found that façade design decisions should not be made solely based on energy and daylight analysis, as it is often practiced, but also on visual comfort assessments (i.e. glare). It is due to a risk that such selected design option can be in fact less sustainable when occupant comfort driven system interactions are considered.

New climate-based equations were developed to address the above problems. External shading benefit index (ESBI) can help to quickly assess the need for an external shading device from very early design stages, and potentially in the future will support selection of suitable fenestration solutions. It can also determine when free cooling with outdoor air could be utilised. Similarly, internal shading benefit index (ISBI) was created to serve as a quick recognition of hours with direct sunlight – potentially inducing glare, for which an internal shading device would be required. In the future this tool can be used to prepare schedules of blinds operation, which could then be plugged in to energy simulations, without having to run a glare analysis. The main advantage is the time saved on tedious simulations when using only weather data. Furthermore, the results which include blinds operation would more closely reflect the actual performance. The novel prediction methods, albeit evident potential, need further development and validation to verify their usability in the architectural design process.

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[1] Kanters et. al., 2013.