Radiative Cooling in Munich

Melih Pürnak [a], Daniel Kierdorf [b]

[a] melih.puernak@tum.de, [b] daniel.kierdorf@tum.de

The architectural design of new buildings is using more frequently large-scaled glass facades or similar transparent constructional components. Especially in office buildings, where visual connection to outdoor areas creates comfortable working spaces [1] and maximizes daylight in the room, simultaneously reducing the need for artificial lightning. However high glass surface area of the buildings' will result higher internal solar gains, causing higher cooling loads. At the same time, there is a huge interest to provide energy-efficient and sustainable energy supply for buildings, that needs multiple innovative ideas in the design and implementation of modern buildings.

Recent investigations focus on the passive cooling supply of a virtual single office room, with passive house related construction standard, located in Munich. Nocturnal radiative cooling is used by a flat plate collector to provide cooling power at night, that refrigerates water in a thermal energy storage (TES). Chilled water in the TES provides a heat sink by day. Then, it is used to cool down the investigated single office room with the ceiling cooling and the mechanical ventilation when there is a cooling demand at daytime. Figure 1 shows a simplified technical schematic diagram of the cooling supply concept. A sufficient cooling for the office room is crucial, where among other things the dependency of the collector area, the TES volume and the room area is investigated. The plant concept is simulated with the thermal building simulation tool TRNSYS 17 using Genopt to optimize the parameters of the system.

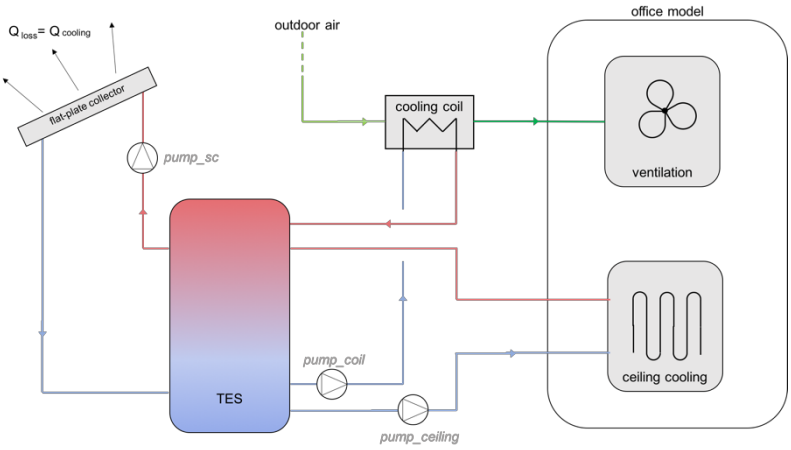

Figure 1: Simplified schematic of the cooling supply concept

First results confirm the plausibility of such designed cooling concept which makes it possible to satisfactorily temper the room in the entire cooling period. The applied passive cooling needs, in comparison to active cooling systems (e.g. conventional compression refrigeration), only a minimal amount of electrical energy. It is shown that radiative cooling can be applied in Munich's moderate climate. Possible generation of solar heating power (even electrical power using PVT-collectors) by daytime supplying the energy demand for the whole year is investigated in a parallel study. The findings of the dependency of the plant dimensions can later be used in a combined cooling and heating system. The investigation carried out are based on a virtual room, the consideration of this study can be taken into account for buildings, residential areas and future energy concepts.

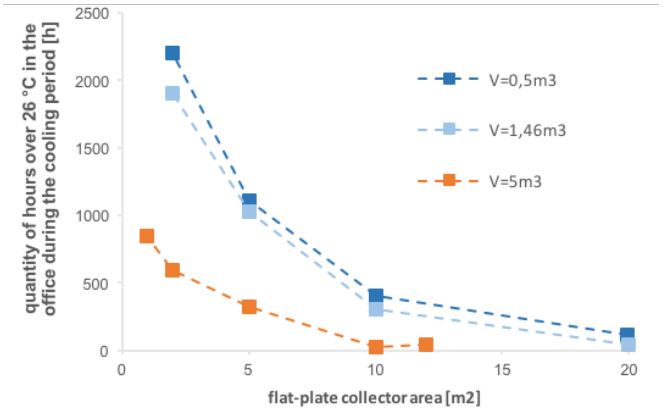

Figure 2: Dependancy of plant dimensions to provided cooling power

Reference:

[1] M. Sterner und I. Stadler: *Energiespeicher – Bedarf, Technologien, Integration*; Springer-Verlag; Berlin Heidelberg, 2014