Abstract

To understand insulation properties of buildings, radiative energy fluxes indoors, outdoors and between these two environments are to be understood as well. Radiative fluxes are important in case of windows especially. The largest improvements are achievable just there. Such improvements are important for further development and proliferation of the passive house standard (demanding 10 W/m^2 at most for heating, relative to the area of habitable floor) and for living comfort in general, as well as for climate protection, i.e., for phasing out the use of fossil fuels.

Windows are weak points of modern buildings; because of that, traditional houses had small windows to be sustainable. Technologies to improve the poor properties of windows exist just some twenty years. Deposition of "low-e" thin layers onto polyester foils came into existence in the 80's, what resulted in almost eliminating the radiative transport between glass panes. Such layers are applied to glass surfaces now commonly. The other improvement consists in using noble gas fills in hermetic-sealed glass cavities (argon or krypton instead of air), to suppress heat conduction across the cavity. In the third millenium, the market with well insulating double or triple glazings is flourishing already, even in the Czech Republic. However, from the viewpoint of physic, their development seems to be finished, no large improvements can be expected. The only exception is development of evacuated glazings with very thin cavities, whose market penetration may start after 2010.

There is, however another pathway to improve windows: by including movable, just a bit transparent foils into windows. Such foils act similarly as the highly transparent "low-e" layers, but bring another advantages as well. Their primary goal is suppressing heat loss at night, but they offer a very effective tool to control solar heat gains and light as well.

Such layers are commercially available as very thin plastic foils with an aluminium layer deposited in vacuum chamber, and they are cheap. Applying them in a sophisticated way (using two roller shades and creating three air cavities which are airtight enough) enables achieving the passive house limit of composite thermal transmissivity $U \leq 0{,}8$ $W/(m^2K)$ even for old double windows, reducing the heat loss through them to one fourth. Their application is the only available way how to get roof windows with favourable physical properties (and obeying the passive house limit). I have proposed (and explained from the viewpoint of physics) such use of aluminised foils inside windows cavities in 1998 already. In this thesis I describe their function in detail and show real examples of their application. In addition, I discuss radiometric methods (thermography) by which heat fluxes can be measured in common civil engineering practice.

Keywords

heat protection of buildings, windows, radiative fluxes, infrared radiometry, thermography, movable blinds, emittance, emissivity, luminance temperature, measurement of heat fluxes, heat demand reduction, passive houses