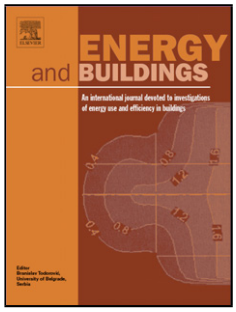


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# Quantitative study of free convective heat losses from thermodynamic partitions using Thermal Imaging

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## Highlights

- Considerations of heat losses from the surfaces were carried out.
- TIC method of determining heat losses has been presented.
- Quantitative studies of the heat flux determination have been indicated.
- Researches proved that TIC method can be used for thermodynamic partitions walls.

## Abstract

The following paper presents a simple method of determining the presence, distribution and values of heat losses from external building walls as thermodynamic partitions using a Thermal Imaging Camera (TIC).

According to Fourier's equation, the value of heat loss is proportional to the temperature gradient $\partial t/\partial y|_{y=0}$ in air in the *y* direction perpendicular to the heated surface. Unfortunately, air temperature cannot be measured with a TIC, as gases do not emit thermal radiation. It is therefore suggested that a grid placed vertically in the air and perpendicularly to the heated surface should be used as a detector of temperature field. Warmed by convective air flows, such a grid becomes a source of infrared radiation. The temperature distribution reproduced on the grid constructed from thin strands of a low thermal conductivity material is sufficiently distinct and sharp to be recorded with a TIC.

The correctness of the TIC method has been tested in laboratory conditions on the example of a vertical heating plate, as well as in real-life conditions – on a single pane of glass serving as a building partition. When compared to the works of other authors, the result obtained as $Nu = 0.571 \cdot Ra^{0.25}$ relation reveals a satisfactory correlation for the heating plate, while estimated temperature distributions and heat fluxes from the room to the surface of thermodynamic partition wall $\boldsymbol{Q}_{\text{loss,conv,in}}$ and on the outside of the building $\boldsymbol{Q}_{\text{loss,conv,ext}}$ successfully and quite precisely correlate (5−7% for both internal and external sides) with theoretical calculations.

Therefore, the TIC method proposed in this paper can significantly extend the range of application of TICs in energy audits, especially for buildings.

Nomenclature

### Symbols

***a*** - coefficient of thermal diffusivity, $m^2/s$
***A*** - heat exchange surface, $m^2$
***b*** - width of the plate, m
***C*** - coefficient in equation (5)
***D*** - diameter, m
***g*** - acceleration due to gravity, $m/s^2$
***h*** - height of the plate, m