



48 (2021) NEW RESEARCH RESULTS IN BRIEF

Stefan Bichlmair, Martin Krus,
Ralf Kilian

Fraunhofer Institute for Building Physics IBP

Nobelstrasse 12, 70569 Stuttgart, Germany
Phone +49 711 970-00
info@ibp.fraunhofer.de

Holzkirchen Branch

Fraunhoferstr. 10, 83626 Valley, Germany
Phone +49 8024 643-0
info@hoki.ibp.fraunhofer.de

www.ibp.fraunhofer.de

Literature

[1] Kilian, R. et al: *ENOB – Innovative Wandheizungen*. IBP-Bericht RK 013/2014/294. Fraunhofer IBP Holzkirchen, 2015.

[2] Krus, M.; Kilian, R.; Bichlmair, S.: *Vergleichende Untersuchungen zu Wandheizungssystemen im historischen Bestand*. In: DIN (ed.): *EnEV aktuell*, Jg. 9, No. 4: Beuth, S. 12–15, 2015.

[3] Kilian, R.; Bichlmair, S.; Krus, M.: *Evaluation of different wall heating systems in historic monuments – aspects of energy and conservation*. In: *Journal of Architectural Conservation* 2018, Vol. 24, No. 1, p. 19-26. Taylor & Francis Group 2018.

[4] Bichlmair, S.: *Die Temperierung und die Erhaltung von Gebäuden in traditioneller Bauweise – Wirkung auf Raumklima und Baukonstruktion*. Dissertation, TU München, 2020.

© Fraunhofer-Institute for Building Physics IBP –
Any reproduction or use of text and graphics (in full or in part) requires prior written permission of Fraunhofer IBP.

TEMPERIERUNG WALL HEATING RE-EVALUATION OF HEAT DISSIPATION FROM THE TEMPERIERUNG COMPARED TO WALL HEATING SYSTEMS

BACKGROUND

At the Fraunhofer Center Benediktbeuern, the Fraunhofer Institute for Building Physics IBP conducted a comparative study of the heat emitted by various wall heating systems in rooms of the "Alte Schäferei". The results have been published [1] and briefly summarized [2] and [3].

In four almost identically furnished measuring rooms (Fig. 1), a team of researchers studied heat dissipation from the Temperierung wall heating as well as from three other heating systems. The Temperierung mentioned above was installed in Measuring Room 3. In Measuring Room 1, a special heating system fed by hot water with optimized convective heat dissipation (hydronic radiator) was used. In Measuring Rooms 2 and 4, different wall heating systems were installed.

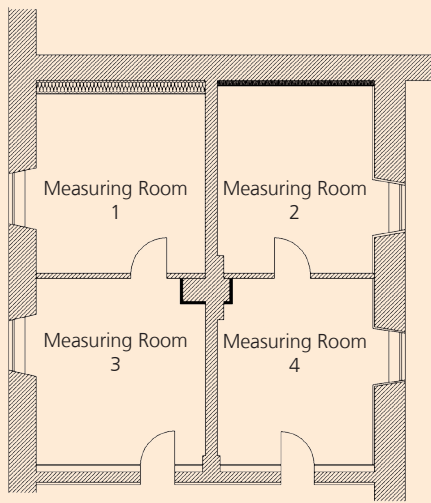
To compare the various systems, zero measurements were carried out over a longer period of time in these rooms with identical electric radiators with a winter outdoor climate and a room temperature of 20 °Celsius. The results were then analyzed to evaluate energy efficiency. This clearly showed that a direct comparison of the measuring rooms was impossible due to significant differences between the rooms. Consequently, the zero measurement was taken as a reference measurement to enable a room-by-room comparison of heat dissipation.

In a next step, heat dissipation from the water-heated systems (Temperierung wall heating, hydronic radiator and wall heaters) was measured over a longer period with a similar winter outdoor climate and a room temperature of 20 degrees Celsius. The heat emitted by the water-heated systems was compared with that emitted by the electric radiator (reference measurement), taking the outdoor climate in the respective measurement periods into account.

This gives a heat dissipation ratio or energy efficiency value of the respective heating system in relation to the heat dissipated by the electric radiator in the same room. For the heating element concealed under plaster (Temperierung wall heating), this initial evaluation of the measurement performed showed an energy consumption of 166 percent compared to the reference with the electric radiator (100 percent) under similar standardized conditions.

RENEWED EVALUATION OF HEAT DISSIPATION

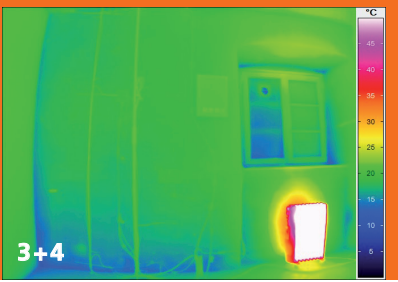
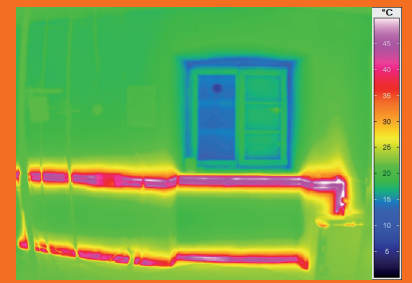
In new, in-depth experiments on the development of a model for characterizing the heat dissipated by the Temperierung in real operation and derivation of a simplified calculation method [4], the published results were reviewed and subsequently re-evaluated.



1



2



3+4

Due to incorrectly programmed averaging in the recording of the volume flow measurement data (flow rate), elevated heat emissions were calculated in the original evaluation.

Re-evaluation of heat dissipation

It is too late to correct the original heat dissipation measurement. In [4], extensive heat dissipation measurements (with correct flow data) were carried out in several case studies as well as in Measuring Room 3 of the Alte Schäferei, and a new method was developed and validated for calculating the heat dissipated by the Temperierung wall heating correctly.

These tests show a markedly improved heat dissipation ratio of around 129 percent

compared to the reference measurement with the electric radiator. Diagram 1 shows the corrected comparison of heat dissipation from the wall heating systems.

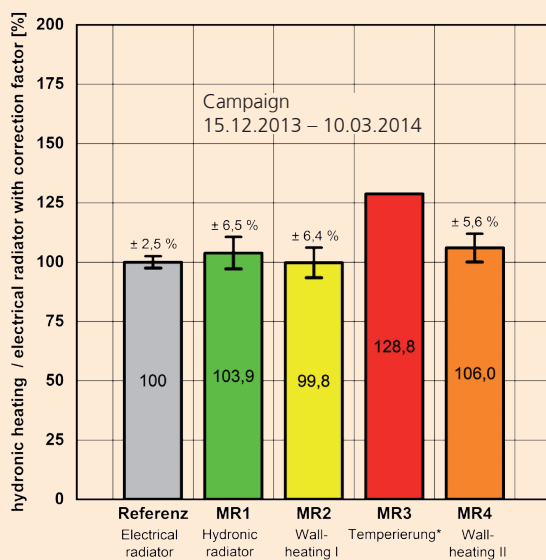
In addition to the overall heat dissipation ratio, the heat dissipation ratios - referred to as heat dissipation factors - were determined for the different installation situations at the base and in the wall as well as at different wall cross-sections (standard wall cross-section and window recess), see Diagram 2. Depending on the wall thickness, the heat dissipation factors range from 122 percent in the standard cross-section (wall thickness 63 cm) to around 160 percent in the most unfavorable installation situation in the wall niche (wall thickness 40 cm) in Measuring Room 3.

SUMMARY

The heat dissipation ratio or heat dissipation factor of the Temperierung wall heating is mainly determined by the thermal resistance R of the wall. Using a simplified, newly developed calculation method [4], this can now be easily determined for standard wall cross-sections, provided the thermal resistance is known. This allows the energy efficiency of the Temperierung wall heating to be correctly calculated for a wide range of applications.

- 1 Floor plan of the measuring rooms with different heating systems.
- 2 Interior view of the outer wall in Measuring Room 3.
- 3+4 Thermographic images of the outer wall in Measuring Room 3, top: with Temperierung switched on, below: with electric radiator during reference measurement.

Diagram 1: Comparison of heat dissipation from wall heating systems with reference system.



*) corrected values, see [Bichlmair 2020]

Diagram 2: Comparison of heat dissipation, simulation of Temperierung wall heating.

