Simple Smart Buildings

eine Zukunftsstrategie

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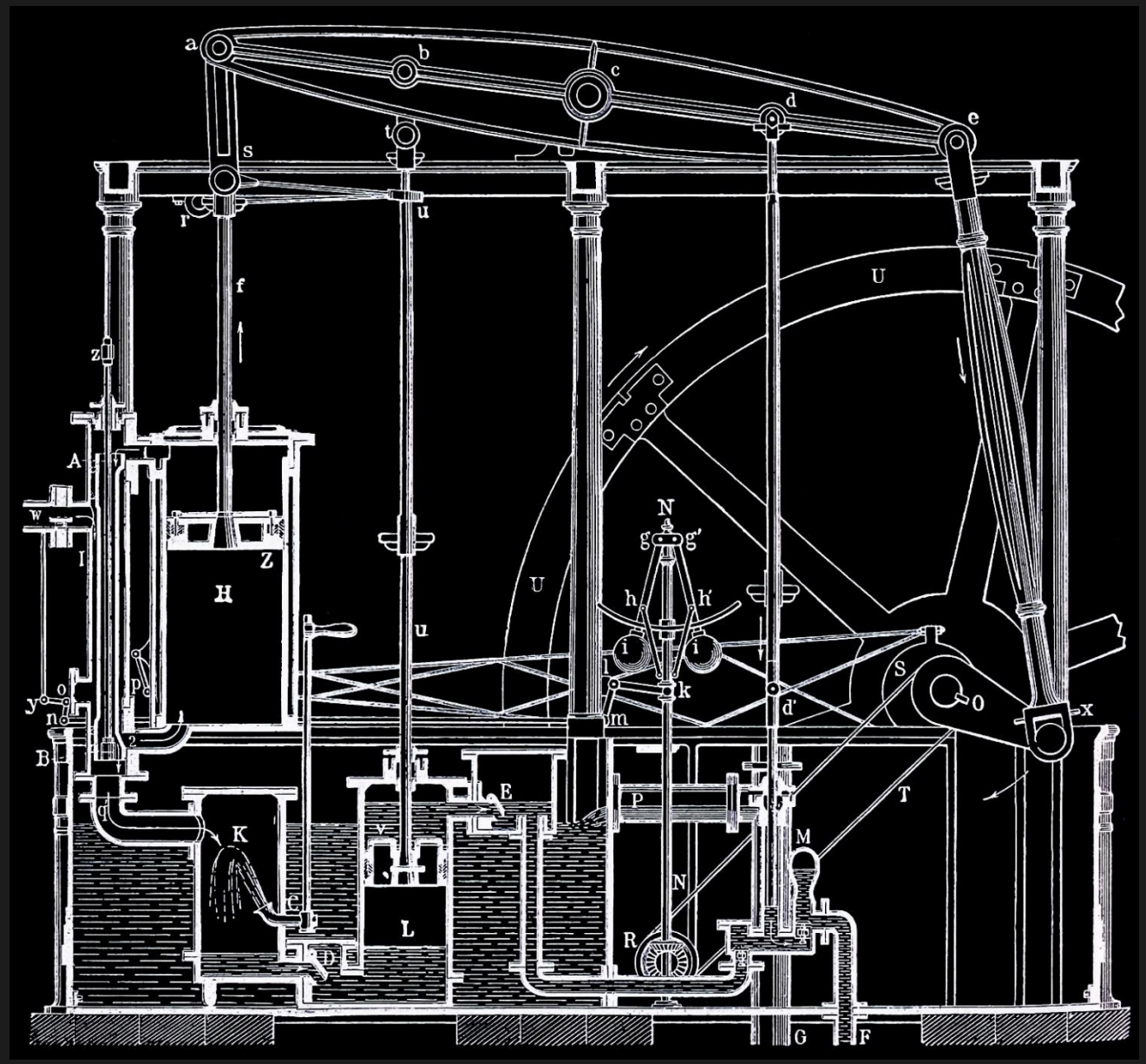
Bildquelle: Foto Idam

Smart Buildings

Bildquelle: Foto Gamsjäger

Rebound-Effekt



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Simple Smart Buildings

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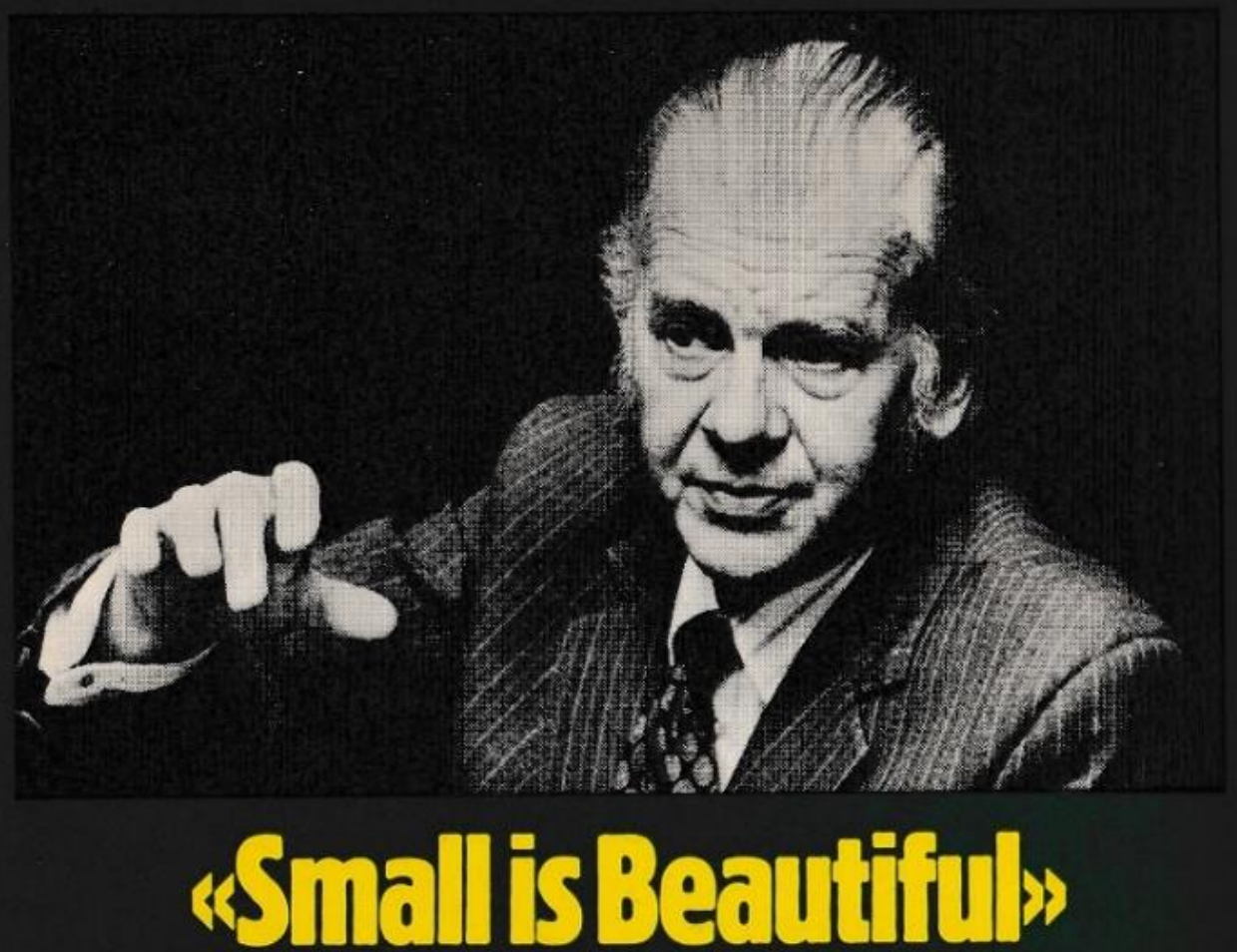
Exnovation
Intermediate Technology



Bildquelle: Foto Idam

Kastenfenster

Bildquelle: Foto Huber

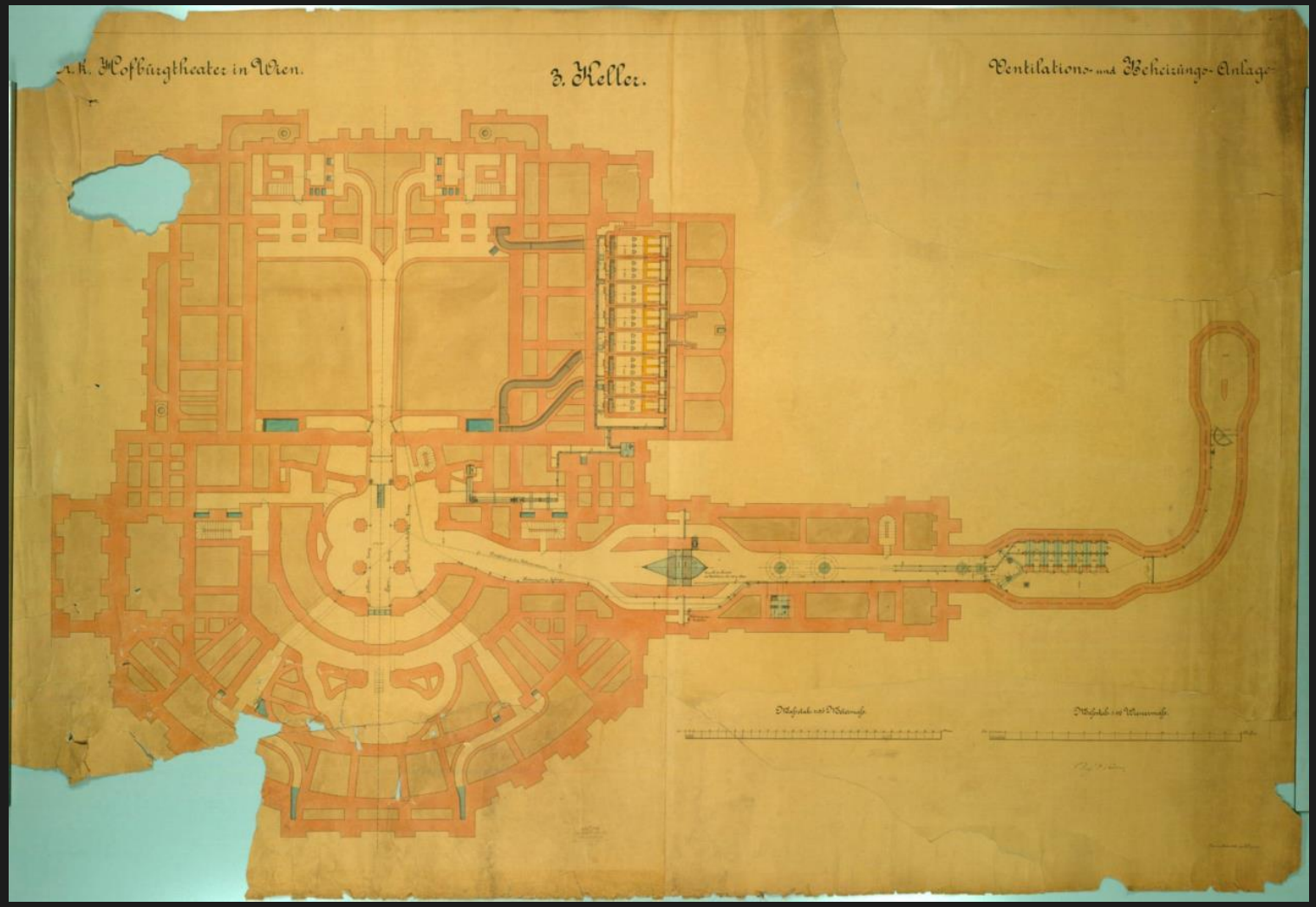
Kastenfenster - in situ Messung

Bildquelle: Foto Kain

Sonnenschutz
Hitzeschutz

Bildquelle: Foto Idam

Burgtheater Wien - Luftbrunnen



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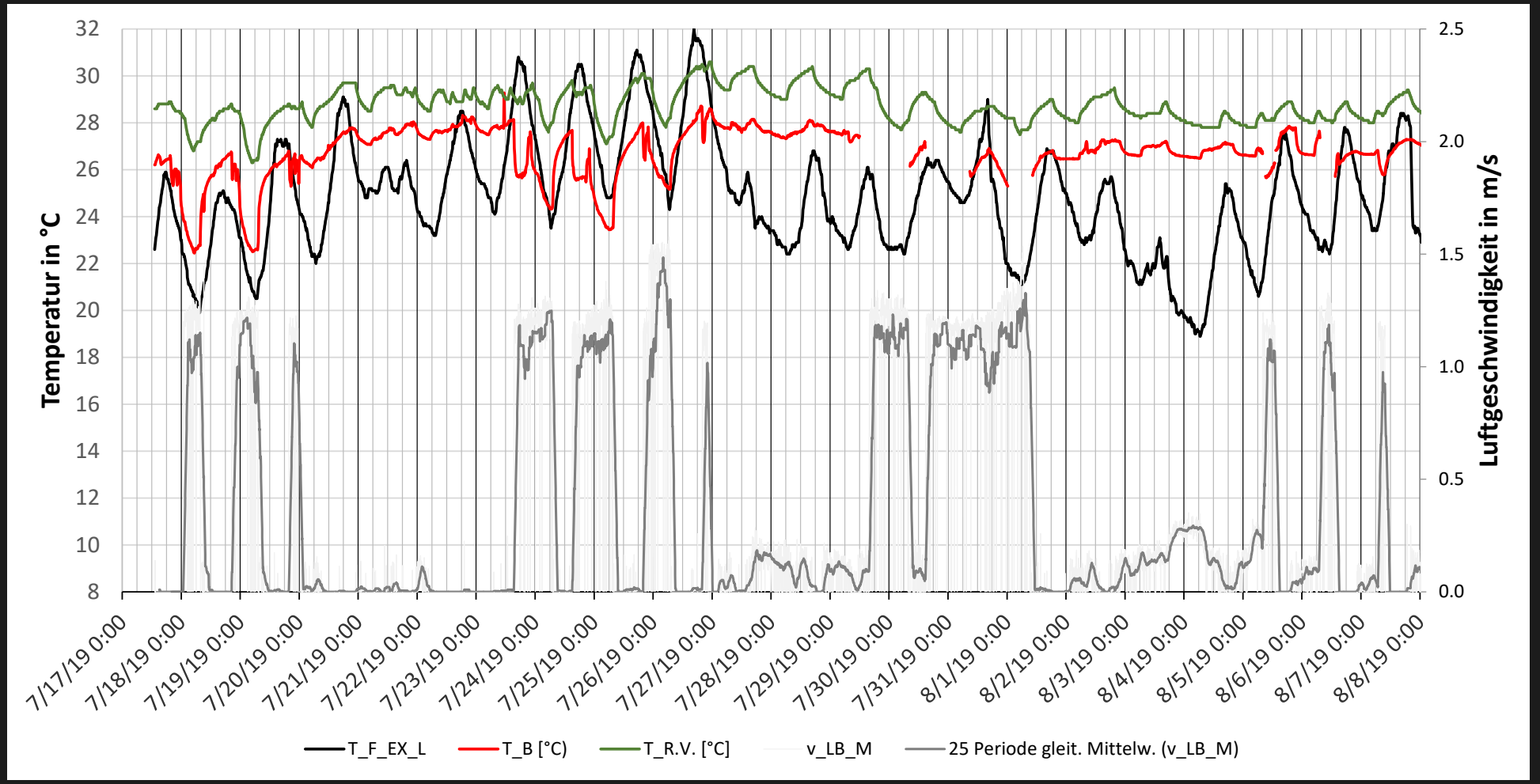
Luftbrunnenbetrieb



Bildquelle: Grafik Kain

Burgtheater Wien - Blasengel

Bildquelle: Foto Idam

Infrarotbeschattung - Burgtheater Wien

Südliches Feststiegenhaus
Burgtheater Wien

Bildquelle: Foto Karl Heindl

Bildquelle: Foto Dr. Fritze

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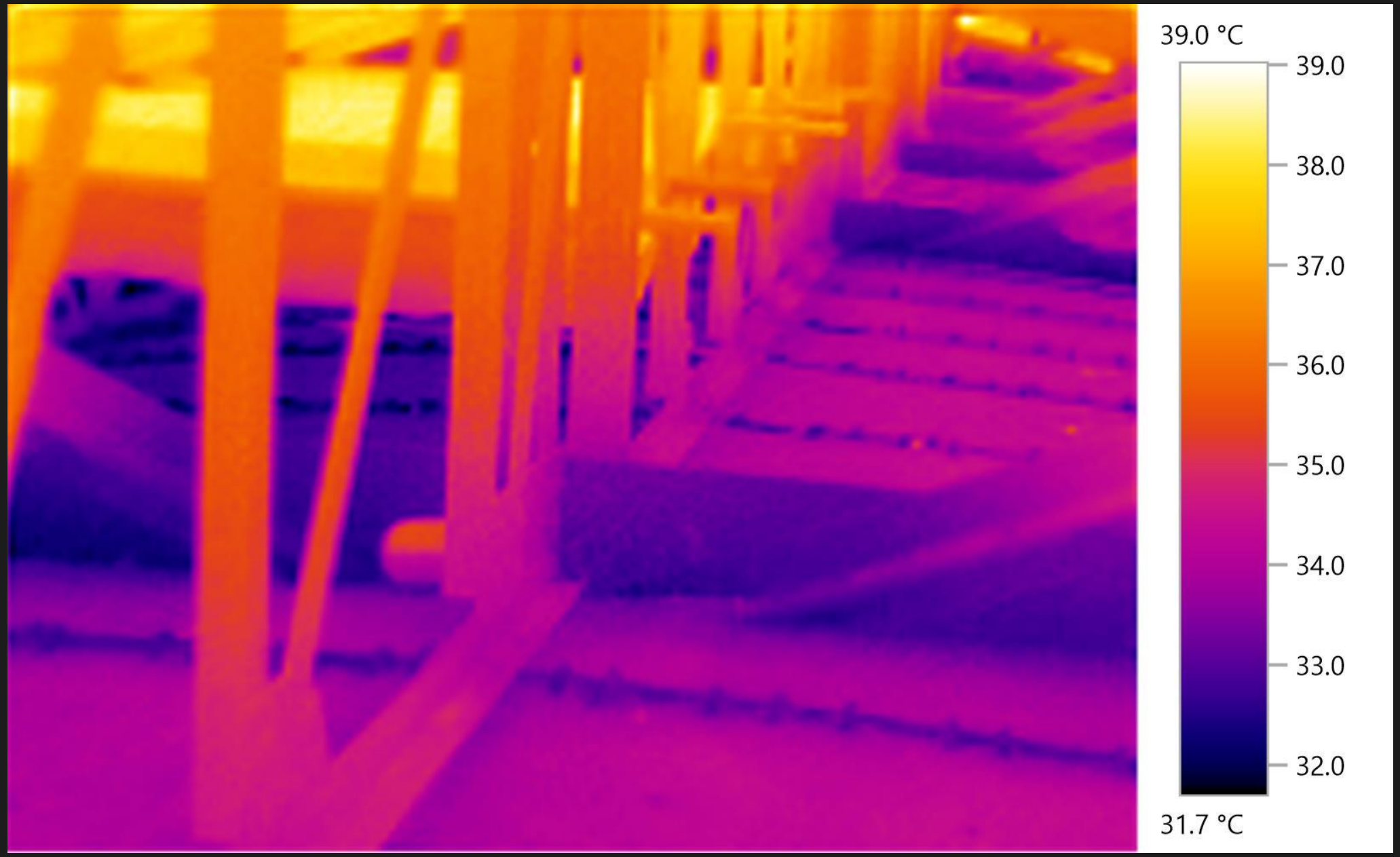

Bildquelle: Foto Kain

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Infrarotbeschattung - Zukunftsaspekte

$$q = \sigma * \varepsilon * T^4$$

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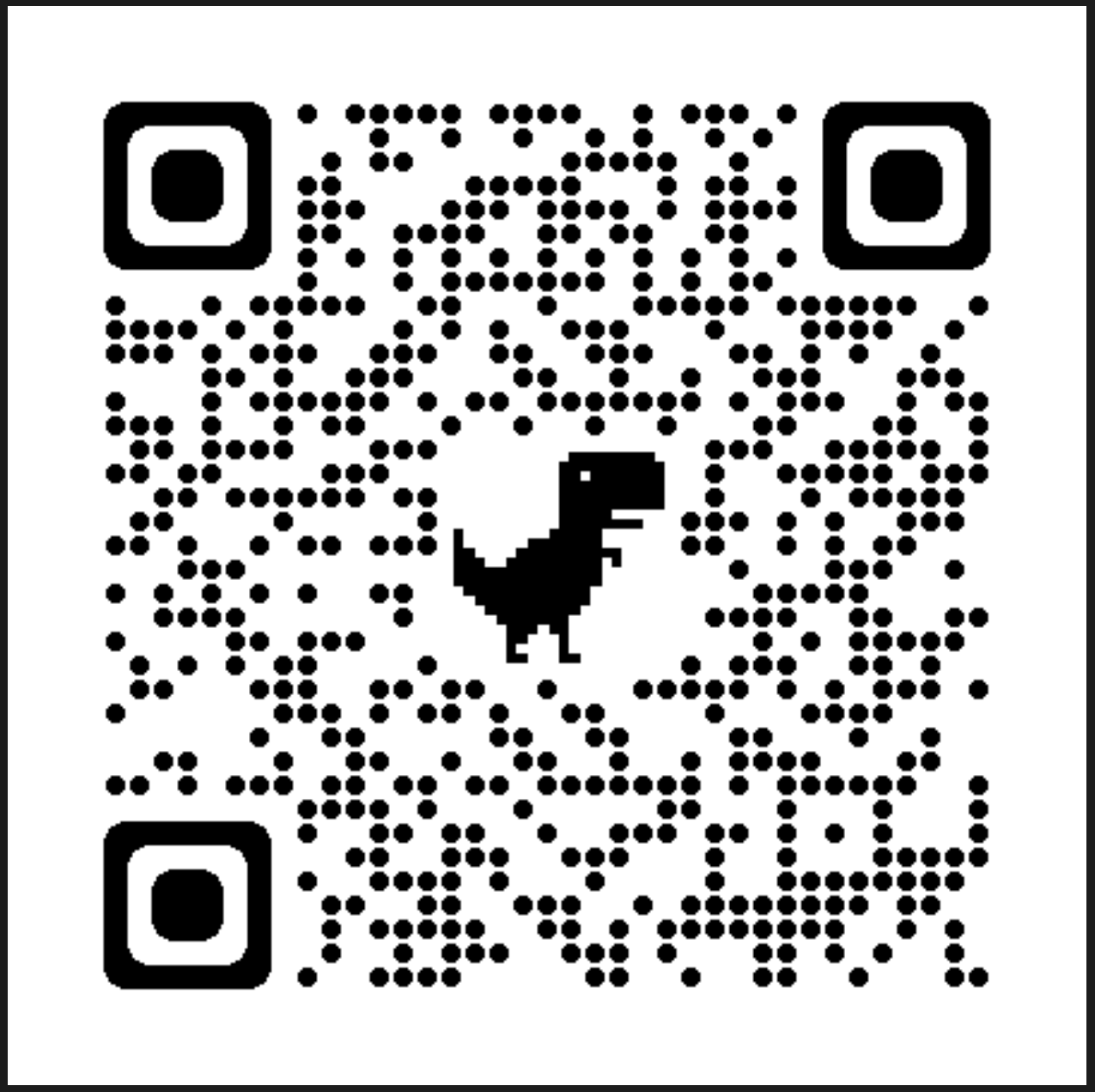

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Article

Mitigating Harmful Effects of Climate Warming on Ceiling Paintings by Ceiling Insulation: An Evaluation Using Timed IR Imaging and Numeric Modelling

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Abstract: Due to climate change, ceiling paintings in many historic buildings are subjected to increasingly high short-term temperature change, resulting in high thermal tension caused by the construction assembly. This article focuses on the combined use of timed IR imaging and numeric modelling to evaluate insulation measures on the upper side of a ceiling to reduce thermal tensions in the painting layers, overheating in summer as well as cooling down in winter. As a model room, the southern splendour stair hall in the Burgtheater Vienna was chosen. Famous ceiling paintings created from 1886 to 1888 by Gustav Klimt and his brother Ernst Klimt can be found on this ceiling. The results show that timed IR imaging is an adequate tool to study the transient thermal behaviour of ceiling paintings which are not accessible to standard sensor measurements. Moreover, it could be shown that the presented measurement technique is well suited to validate a numeric model. The latter was applied to evaluate the potential insulation on the top of the ceiling. It was shown that cooling loads and energy loss in the room underneath can be reduced and most importantly the thermal stress in painting layers is reduced. The findings are relevant as, due to global warming, the current situation in many buildings is worsening. Considering the great intangible cultural value of many ceiling paintings, the application of the presented evaluation strategy for building physical boundaries on a ceiling with paintings seems to be appropriate.

Keywords: ceiling insulation; infrared thermography; secco painting; FE modelling; thermal tensions; overheating protection; simple smart buildings

check for updates

Citation: Kain, G.; Idam, F.; Huber, A.; Mudri, M.; Petutschnigg, A.; Goldsteiner, M. Mitigating Harmful Effects of Climate Warming on Ceiling Paintings by Ceiling Insulation: An Evaluation Using Timed IR Imaging and Numeric Modelling. *Sustainability* **2022**, *14*, 308. https://doi.org/10.3390/su14010308

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1. Introduction

The average temperature in the city centre of Vienna has risen by more than 2 °C within the last 30 years and is expected to rise even more until the end of this century [1,2]. An expert interview amongst cultural heritage experts has shown that mitigation of climate change also requires measures in the cultural built heritage sector, which is a complex multivariate task [3]. They agree on the fact that cultural heritage has to be adapted in order to mitigate harmful effects of climate change on the building heritage [4] and to ensure visitor comfort [5]. Rising temperatures display a risk for the cultural heritage because of both thermal stress in construction elements and inappropriate alterations to the historic construction when introducing engineering solutions [6].

Aiming to ensure visitor comfort, in many historic buildings, cooling strategies are considered. In cultural heritage, a compromise between visitor comfort and preservation of

materials

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Article

Production and Physical–Mechanical Characterization of Peat Moss (Sphagnum) Insulation Panels

Günther Kain [1,2], Marco Morandini [1,3,*], Angela Stamminger [1], Thomas Granig [1], Eugenia Mariana Tudor [1,4], Thomas Schnabel [1,4] and Alexander Petutschnigg [1]

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Abstract: Peat moss (sphagnum) is a commonly used sealant, fill, and insulation material in the past. During the efforts to rewet drained moors due to ecological considerations, the technical use of peat moss (sphagnum farming) again became the focus of attention. In the framework of this investigation, insulation panels consisting of peat moss, bound with urea formaldehyde, were produced. Panels manufactured in a wet process and mats bound with textiles were also fabricated. The specimens' thermal conductivity, water vapor diffusion resistance, modulus of rupture, modulus of elasticity, internal bond, compression resistance, water absorption, and thickness swelling were measured. Physical–mechanical properties were adequate with the resin-bound panels, but not with wet process panels. Moss mats had good characteristics for cavity insulation purposes. The thermal conductivity of the moss panels and mats was found to be lowest with a density of 50 kg/m³, accounting for 0.04 W/m·K. The results show that peat moss is a promising resource for production insulation panels, because their thermal conductivity and mechanical stability are comparable to other insulation materials.

Keywords: peat moss; insulation materials; natural materials; renewable materials

Citation: Kain, G.; Morandini, M.; Stamminger, A.; Granig, T.; Tudor, E.M.; Schnabel, T.; Petutschnigg, A. Production and Physical-Mechanical Characterization of Peat Moss (Sphagnum) Insulation Panels. *Materials* **2021**, *14*, 6601. https://doi.org/10.3390/ma14216601

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1. Introduction

The investigation of historic building constructions not only yields information about traditional work technologies, but also brings to light materials which have been preserved over a long period. Under real-life conditions, the performance and functionality of building materials and building constructions can be evaluated. From this point of view, the building cultural heritage represents a long-term experiment with integrated experience knowledge transferred from generation to generation. Starting from the mid of the 20th century, this tradition ended, and industrial building materials are now applied areawide.

The sealing of seams in historic wood constructions seems to be of interest from this point of view, because the demand for ecologic and durable gap sealing systems is increasing in the market segment of wooden building constructions. Peat moss (sphagnum) can be found in the gaps of historic wood constructions in the UNESCO world heritage region Hallstatt-Dachstein/Salzkammergut.

Denkmalschutz = Klimaschutz - Mauerbach 2022

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