

The history of TABS and its worldwide applications

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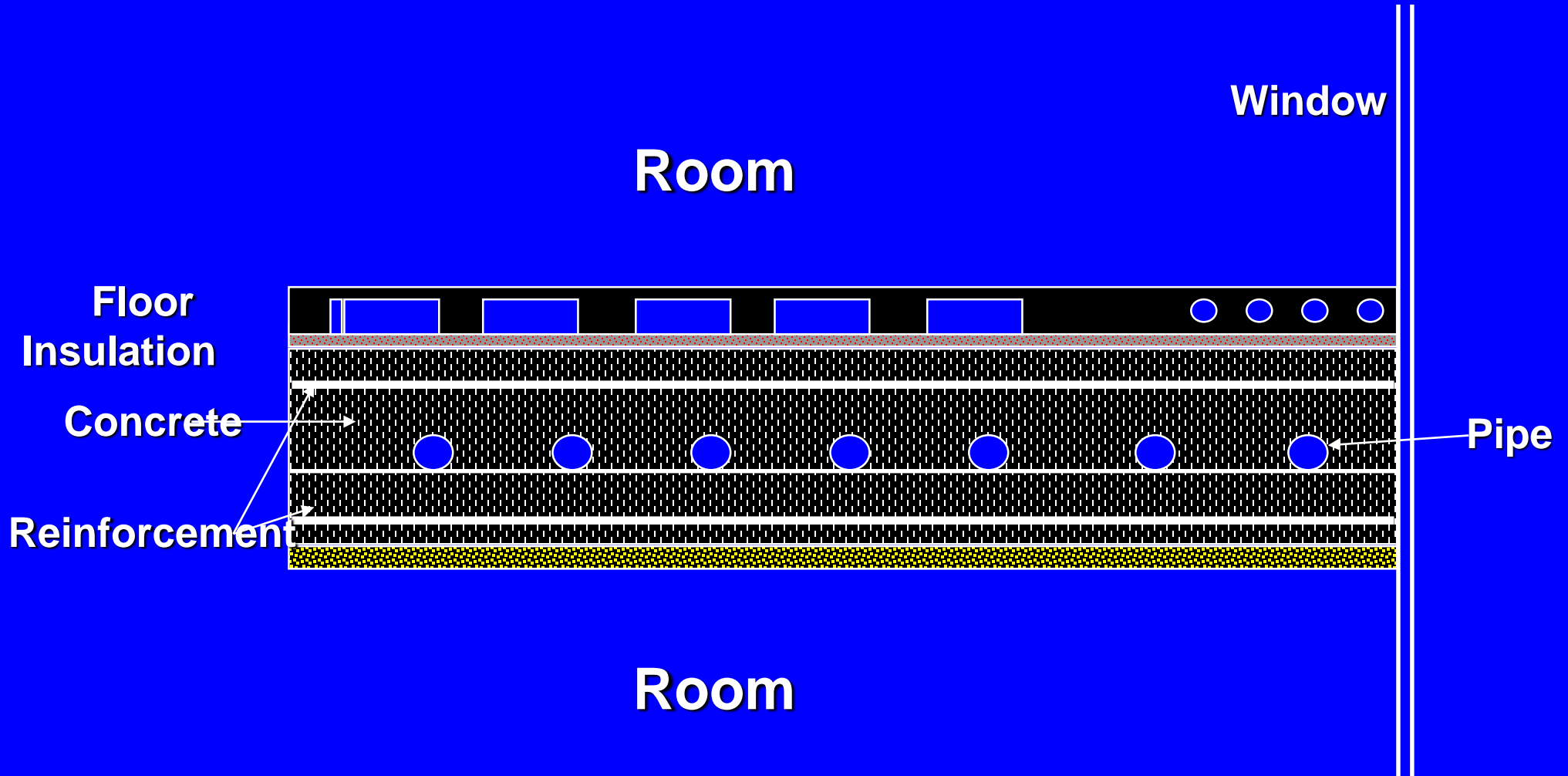
International Centre for Indoor Environment and Energy

Department of Civil Engineering

Technical University of Denmark

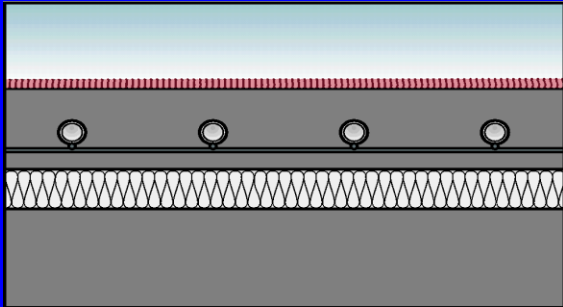
TABS

Thermo Active Building Systems

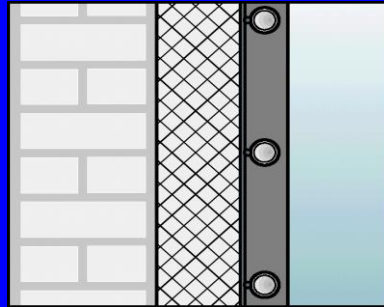


Radiant surface heating and cooling systems

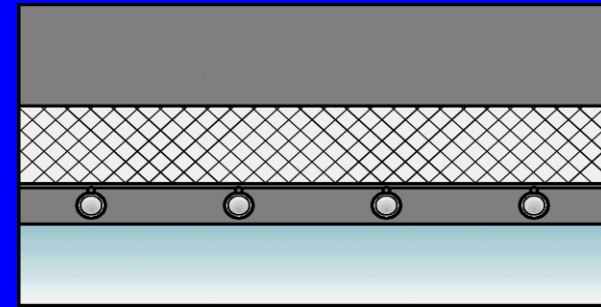
Floor



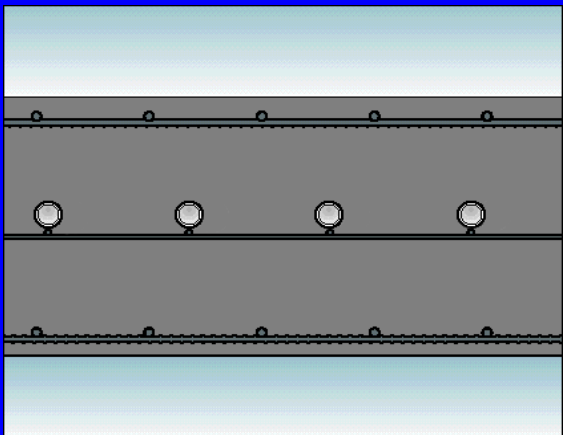
Wall



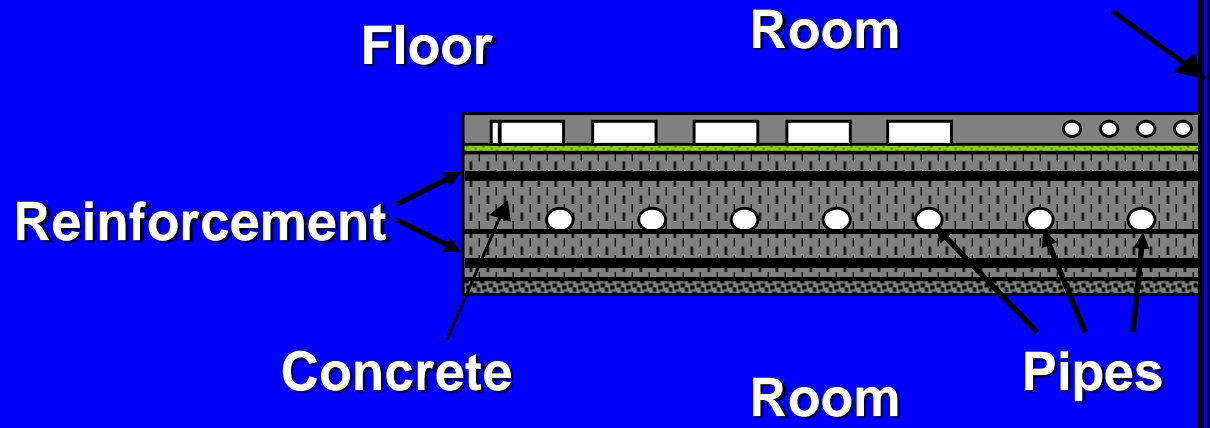
Ceiling



Thermo Active Building Systems



Window



HISTORY

ONDOL Korea

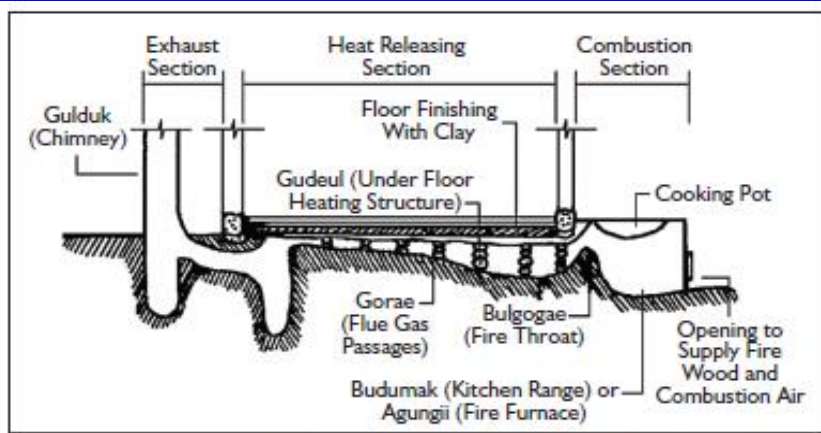


Figure 2: Structure of entirely ondol floored room.⁹

c. 10,000 B.C., China



c. 10,000 B.C., China, the word “kang,” can be traced back to the 11th century B.C. and originally meant, “to dry” before it became known as a heated bed.

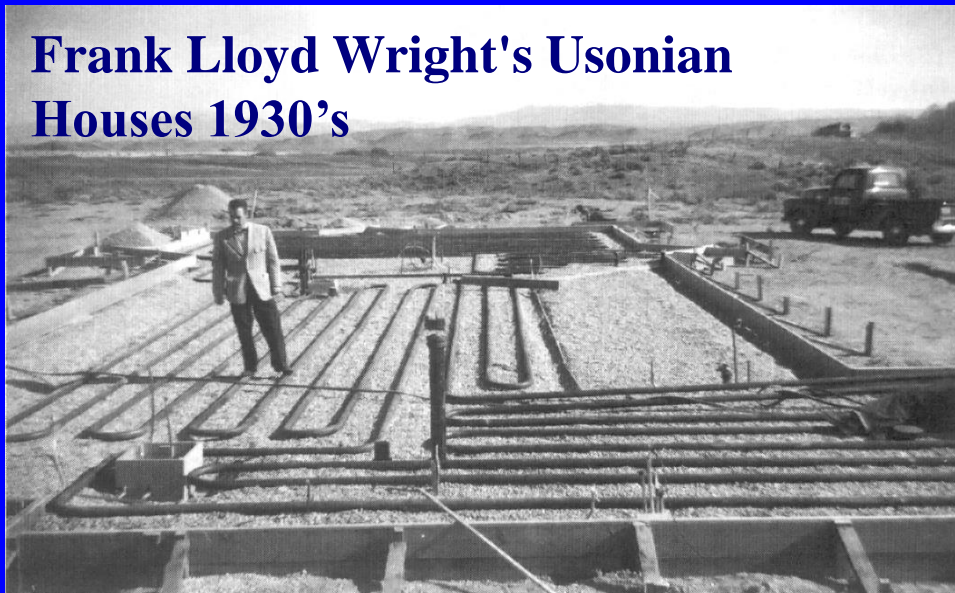
c. 5,000 B.C., evidence of baked floors are found foreshadowing early forms of “kang” and “dikang” (heated floor) later “ondol” (warm stone) in China and Korea, respectively.

HISTORY

A lightweight floor slab was used and the traditional basement was dispensed with. By using steam or hot water piping, it became possible to heat the floor, therefore eliminating the need for radiators. The overall result was heat without a draft or temperature variation of the most comfort - cool head and warm feet.



Hypocausts were used from the third century B.C. in ancient Europe.



Frank Lloyd Wright's Usonian Houses 1930's

**Strahlungsheizung, Lüftung und Kühlung
eines großen Warenkauses**

von Max Hottlinger, beratender
Ingenieur und Dozent für Heizung und
Lüftung an der Eidgen. Techn.
Hochschule in Zürich

Für die Ausführung von Deckenheizung im Erweiterungsbau 1936/1937 lag mir eine Planung nach der Bauweise CRYTTALL vor und führte zu einem lebhaften Meinungswechsel. Andererseits besaß man damals in der Schweiz mit dieser Heizung noch keine Erfahrungen. Als besonderen Vorteil hob die planende Firma hervor, daß die Wasserzirkulation im Sommer mit der Deckenheizung auch gekühlt werden können.



Aufsatz in
der Fachzeit-
schrift
Gesundheits-
Ingenieur
(1938)

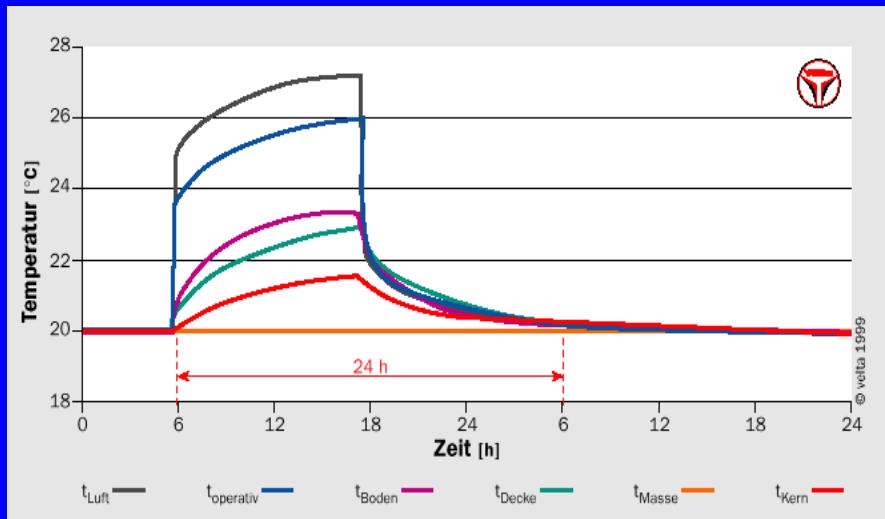
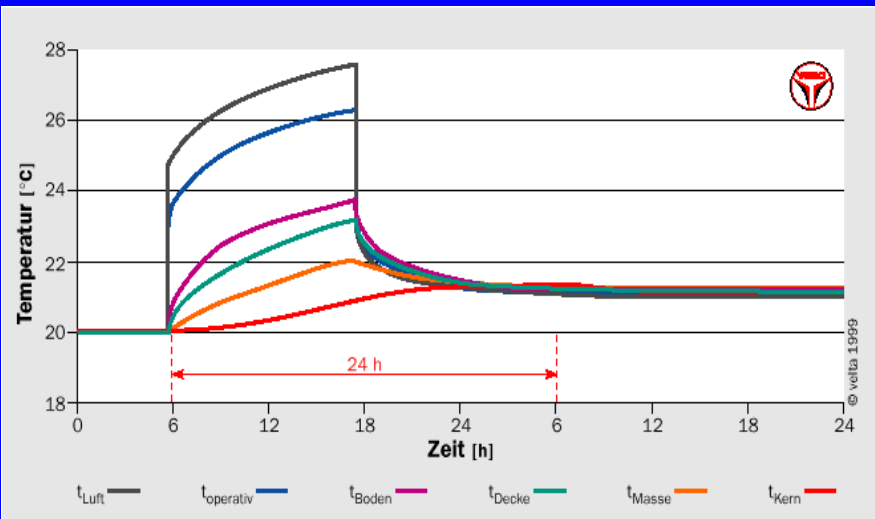
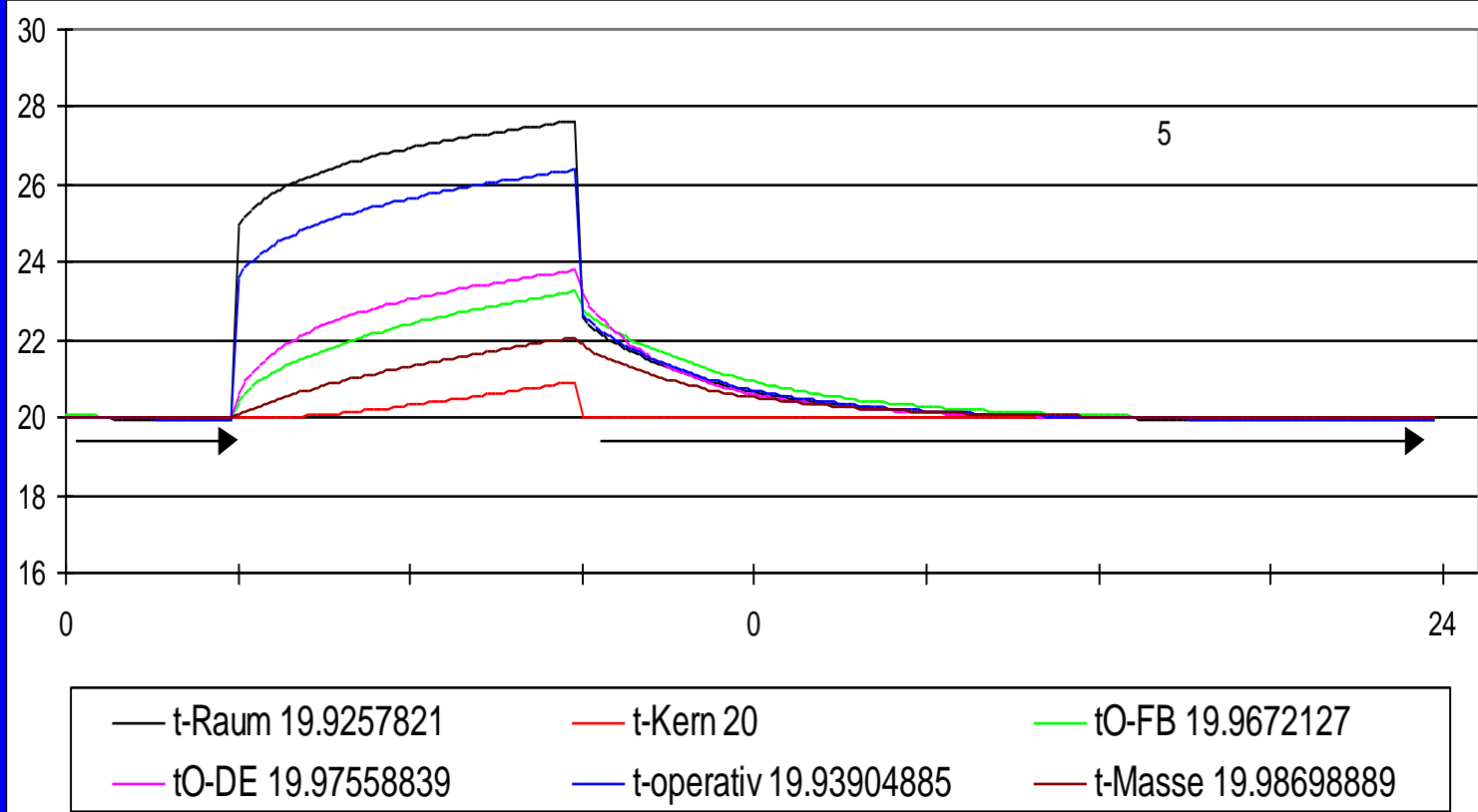


Zusammenschweißen
der Rohre vor
dem Verlegen
(1937)



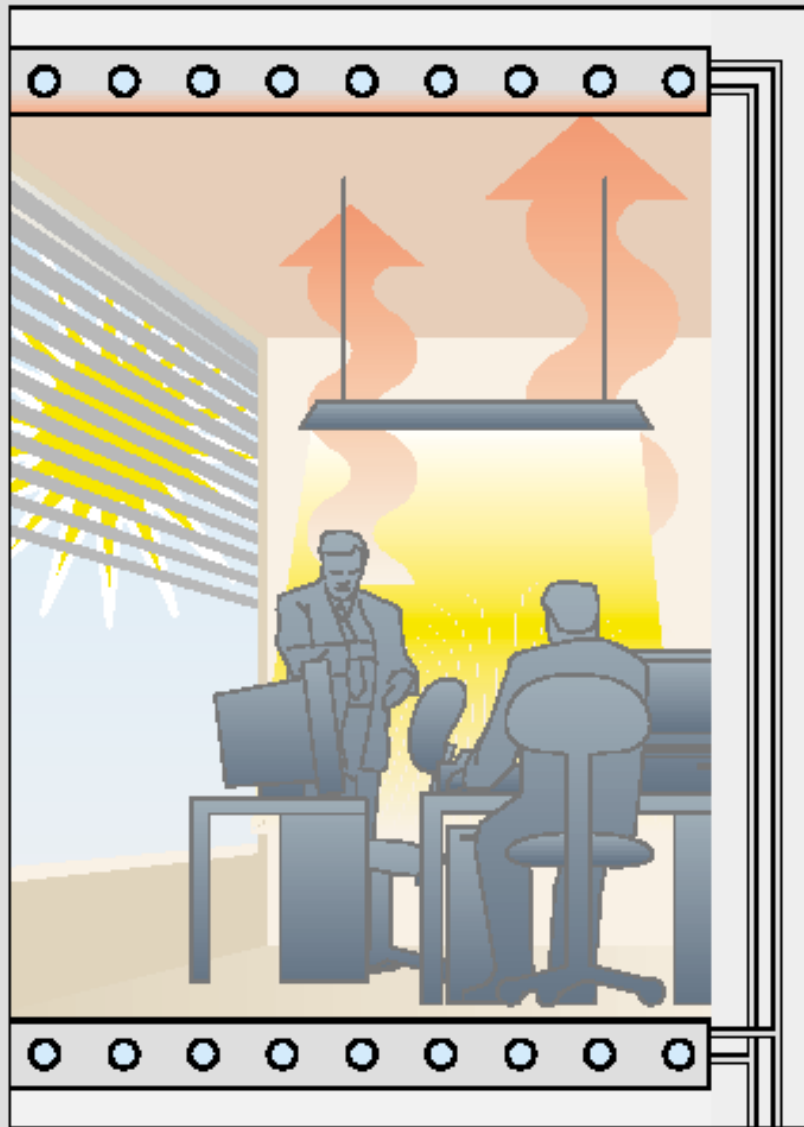
Deckenheizung
mit eingezogenen
Ammianglasrohren.

- Activated thermal slab
- Old concept (1938)
- Steel pipes
- Bends
- Welding
- DOW Chemical (1993)
- Meierhans re-invent
TABS

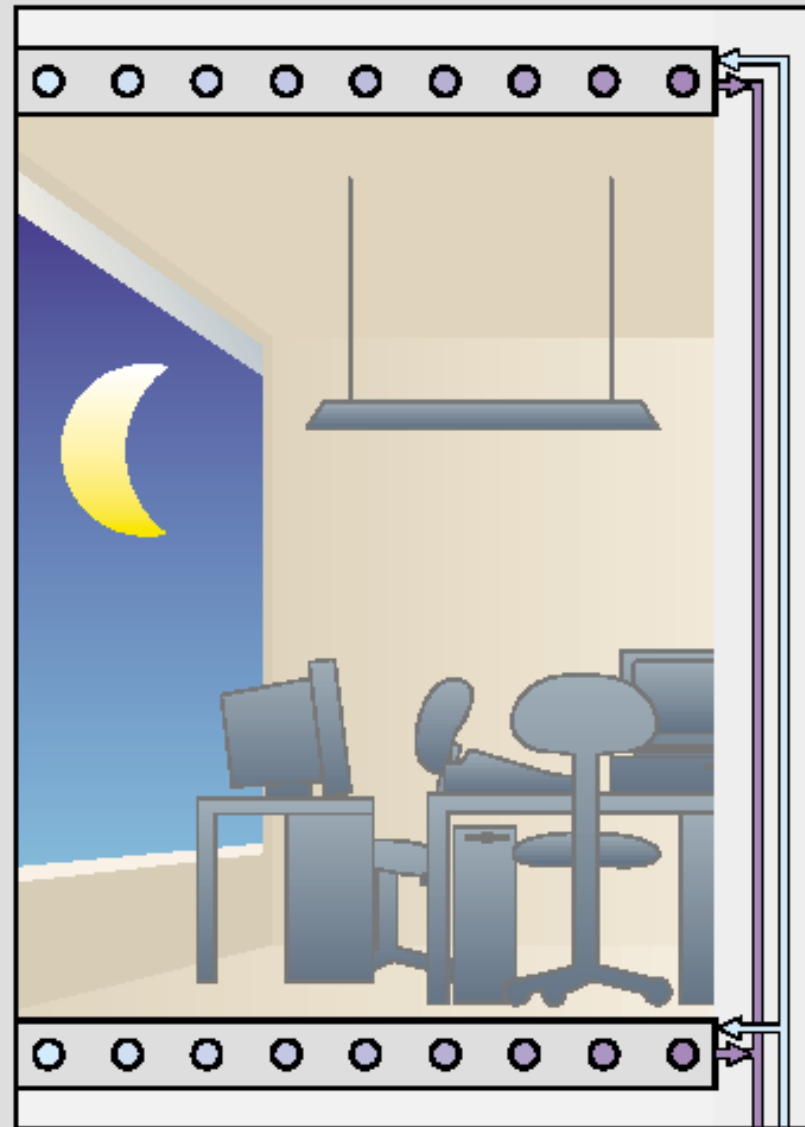


Activated Thermal Slab System

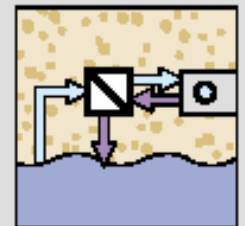
Day



Night



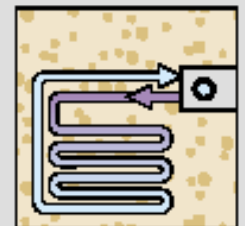
Cooling methods



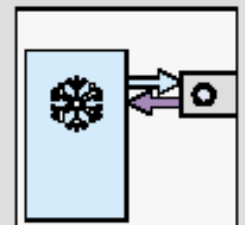
Groundwater



Night-air



Ground collector



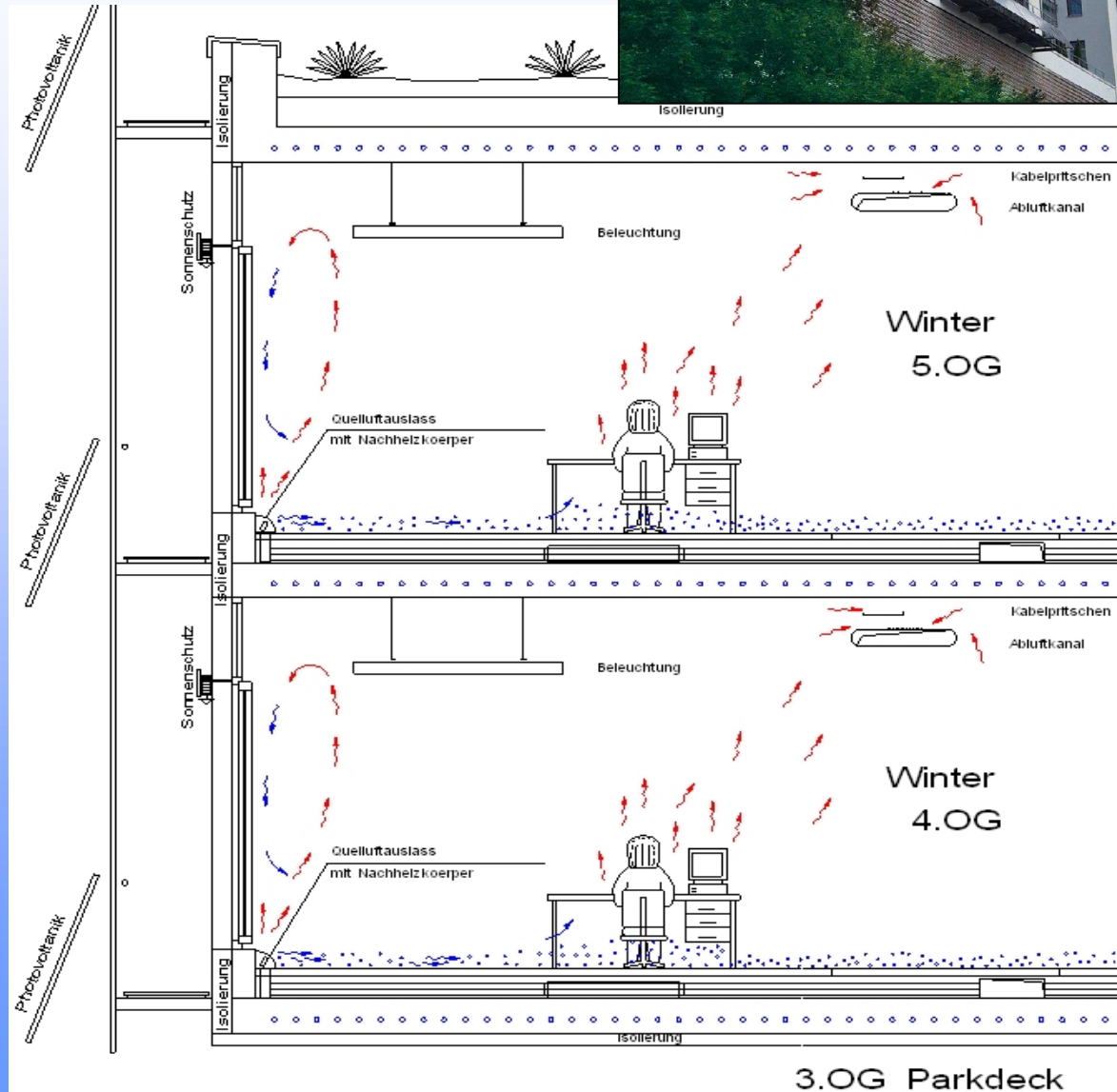
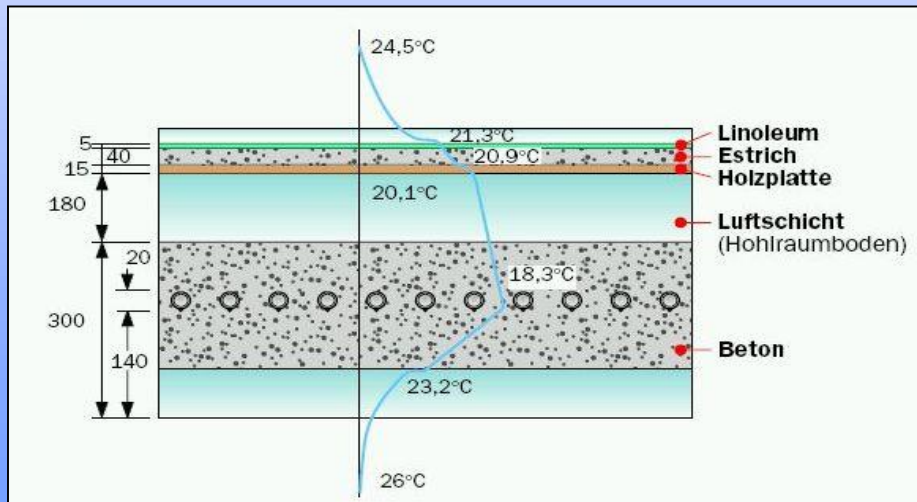
Chiller

- **MW-Zander (1998)**
- **First Velta system** *Offices*

Stuttgart, Germany

- TABS -

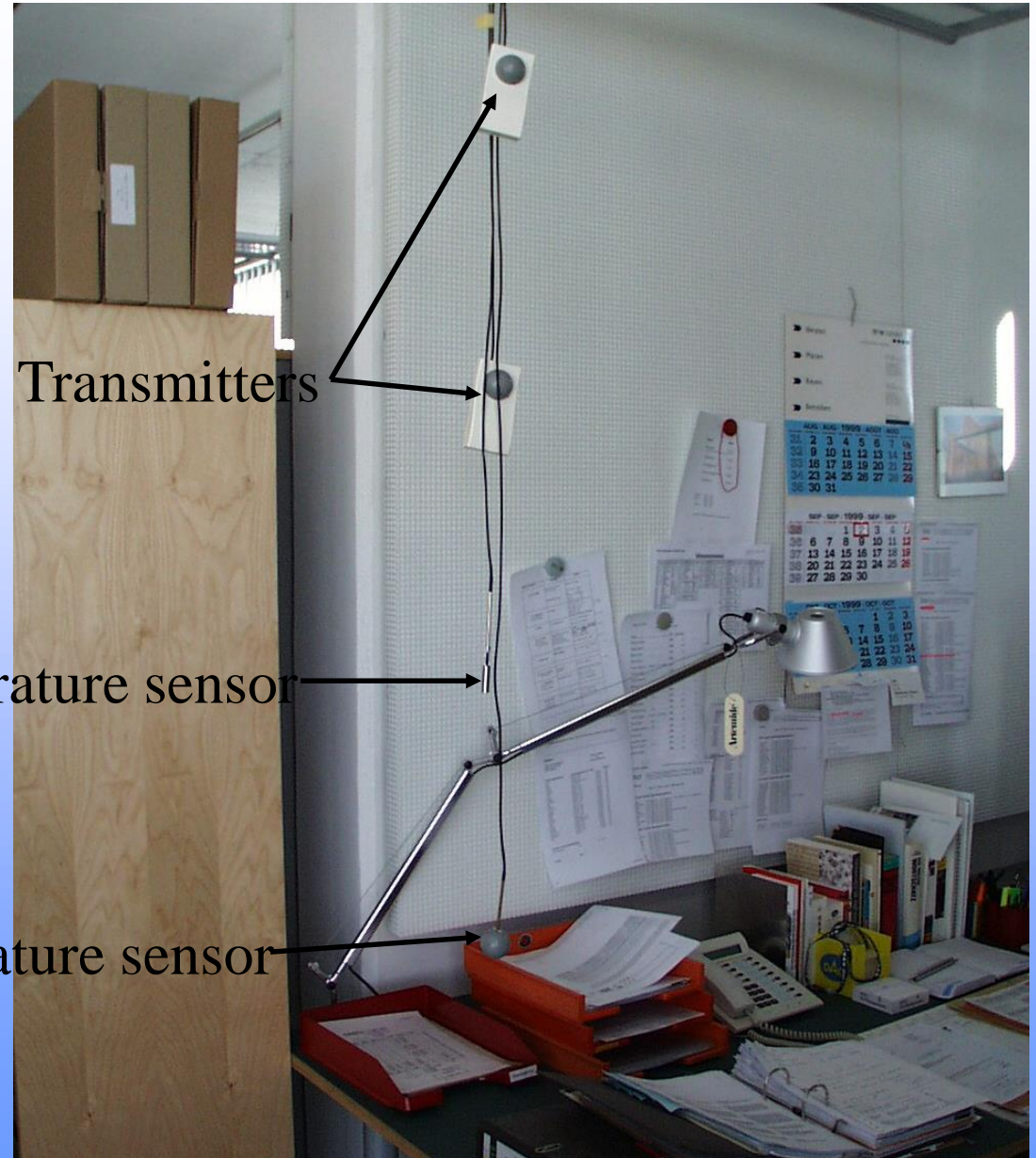
- in 6.500 m²



MW-Zander



Measurements during normal operation



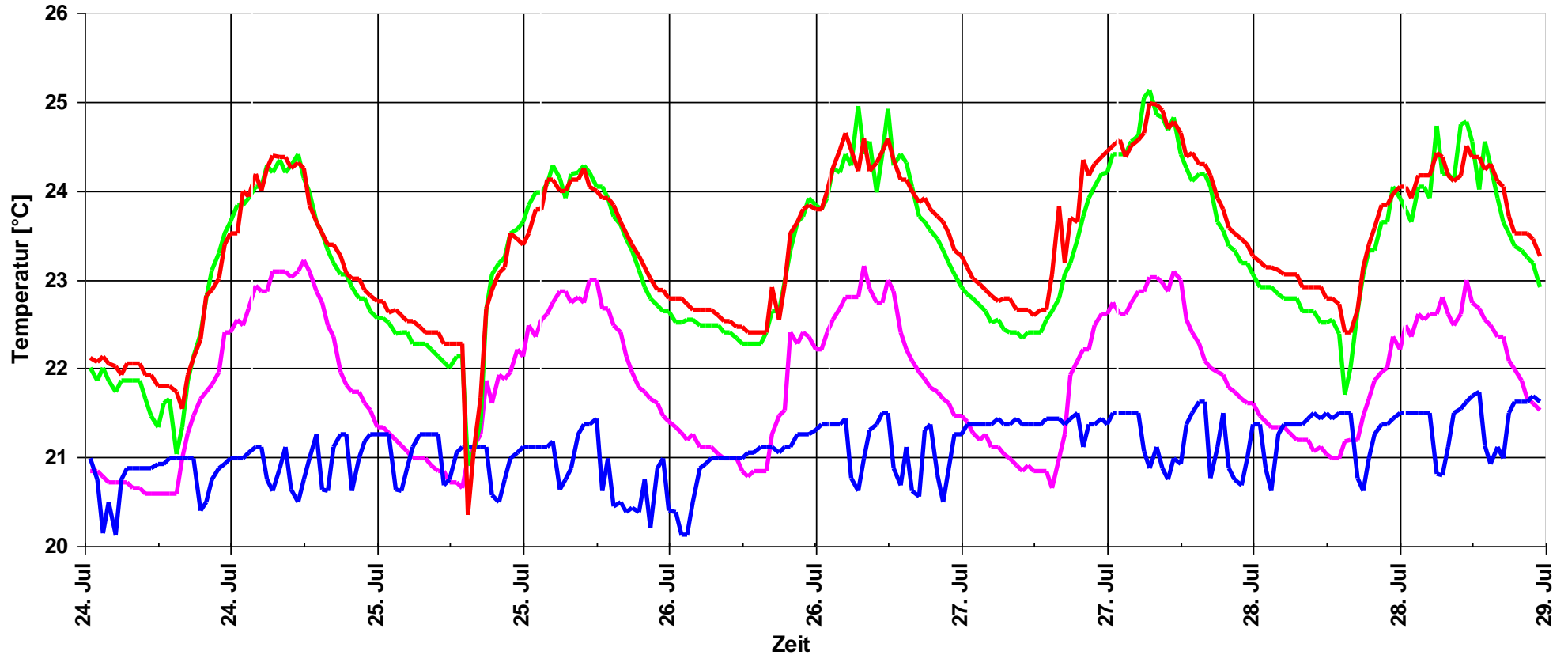
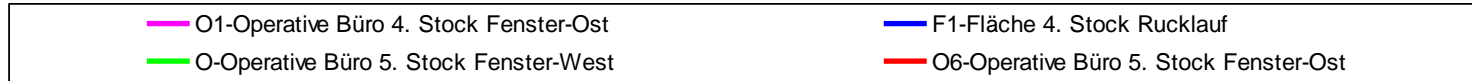
Transmitters

Air temperature sensor

Operative temperature sensor

Stuttgart

Stuttgart 24.07. - 28.07, 2000

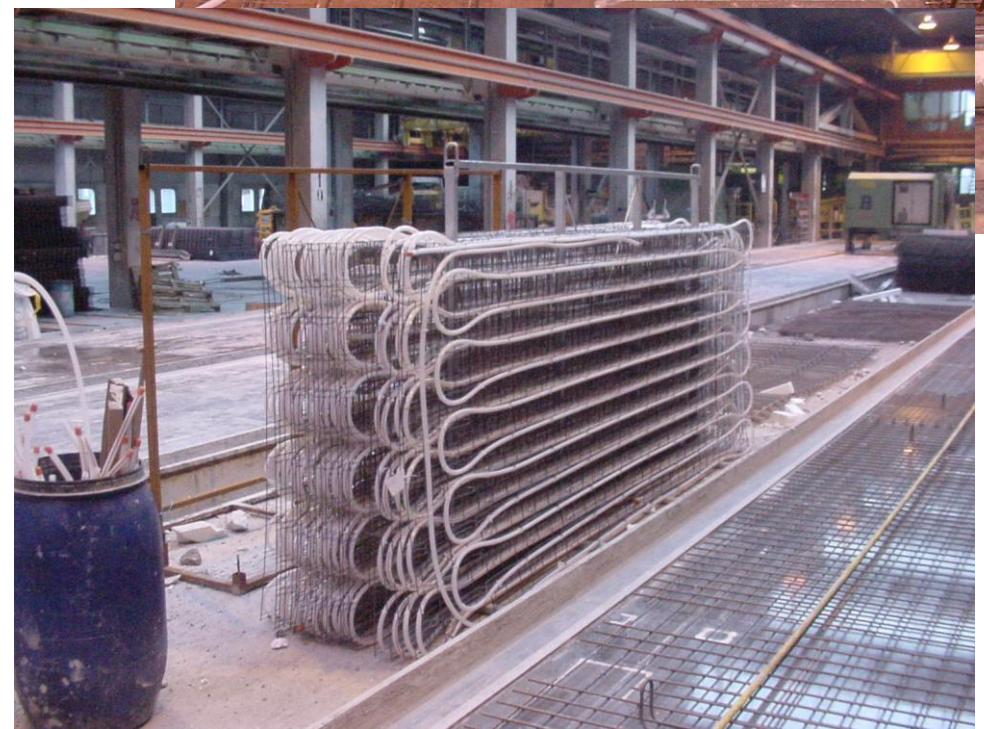
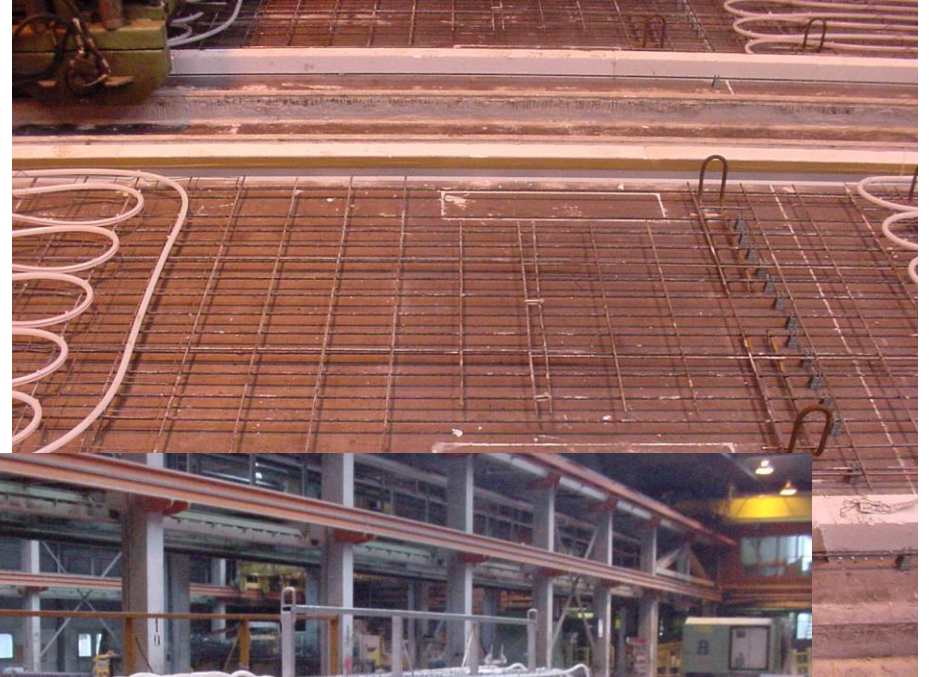




Installation – pressure test



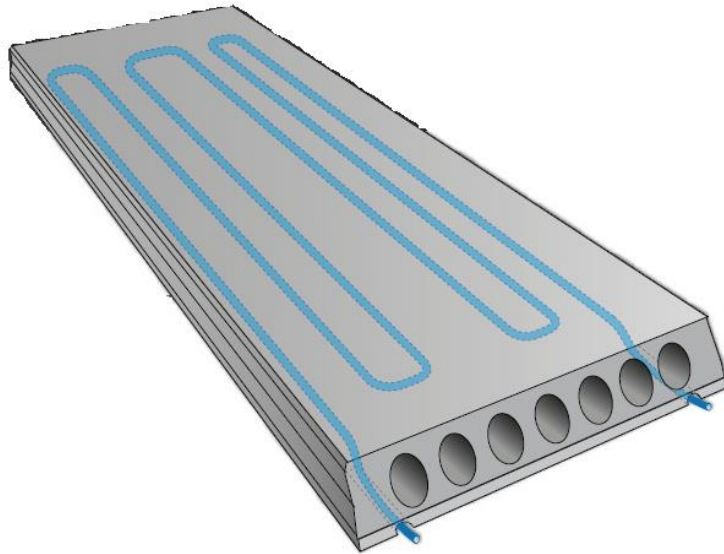
Prefabrication



Thermo active hollow-core slab

ThermoMax

- Produced in Denmark by Spæncom
- 1.2 m wide, thickness 220, 270, 320 and 400 mm
- 20 mm PEX-pipes



Concept of Thermo Active Building Systems

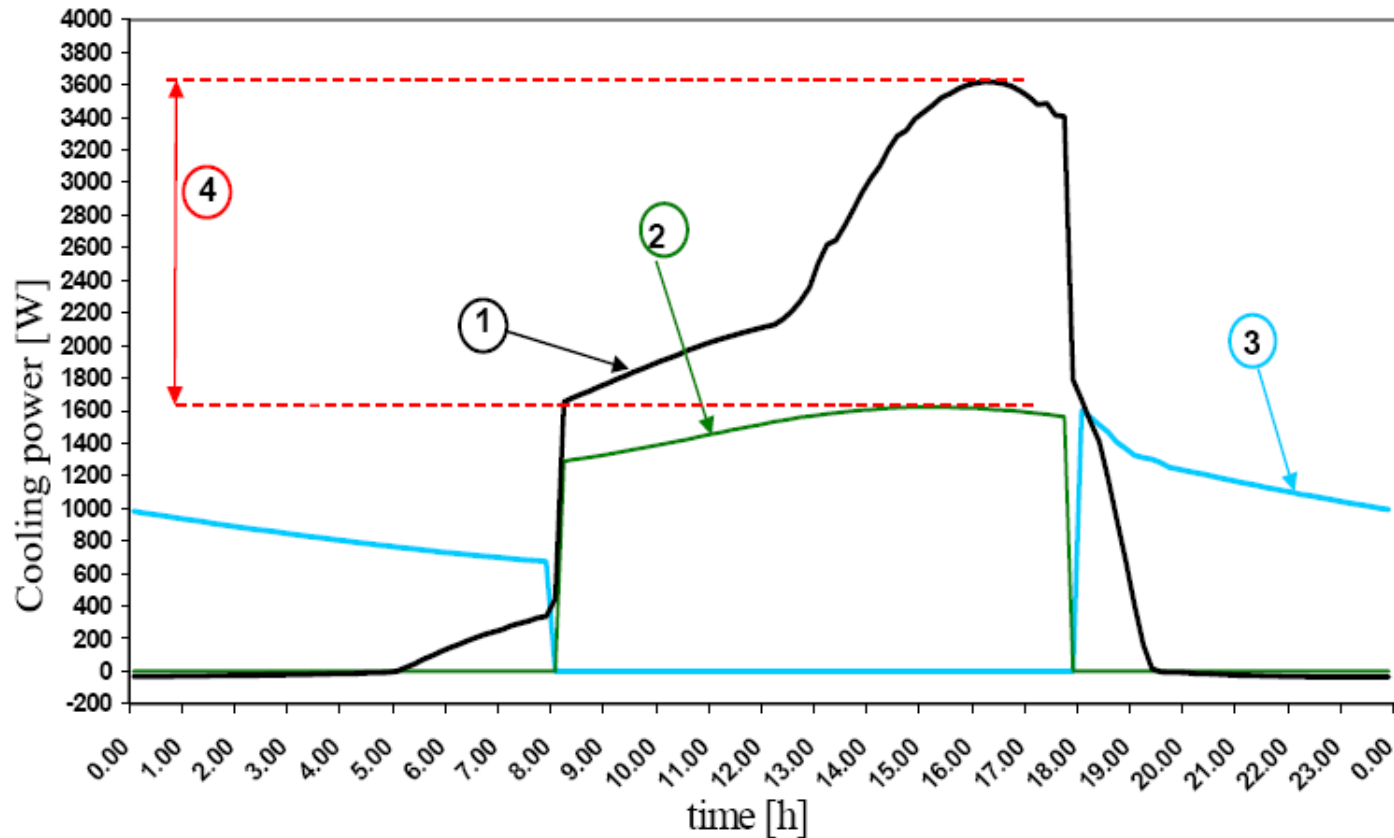
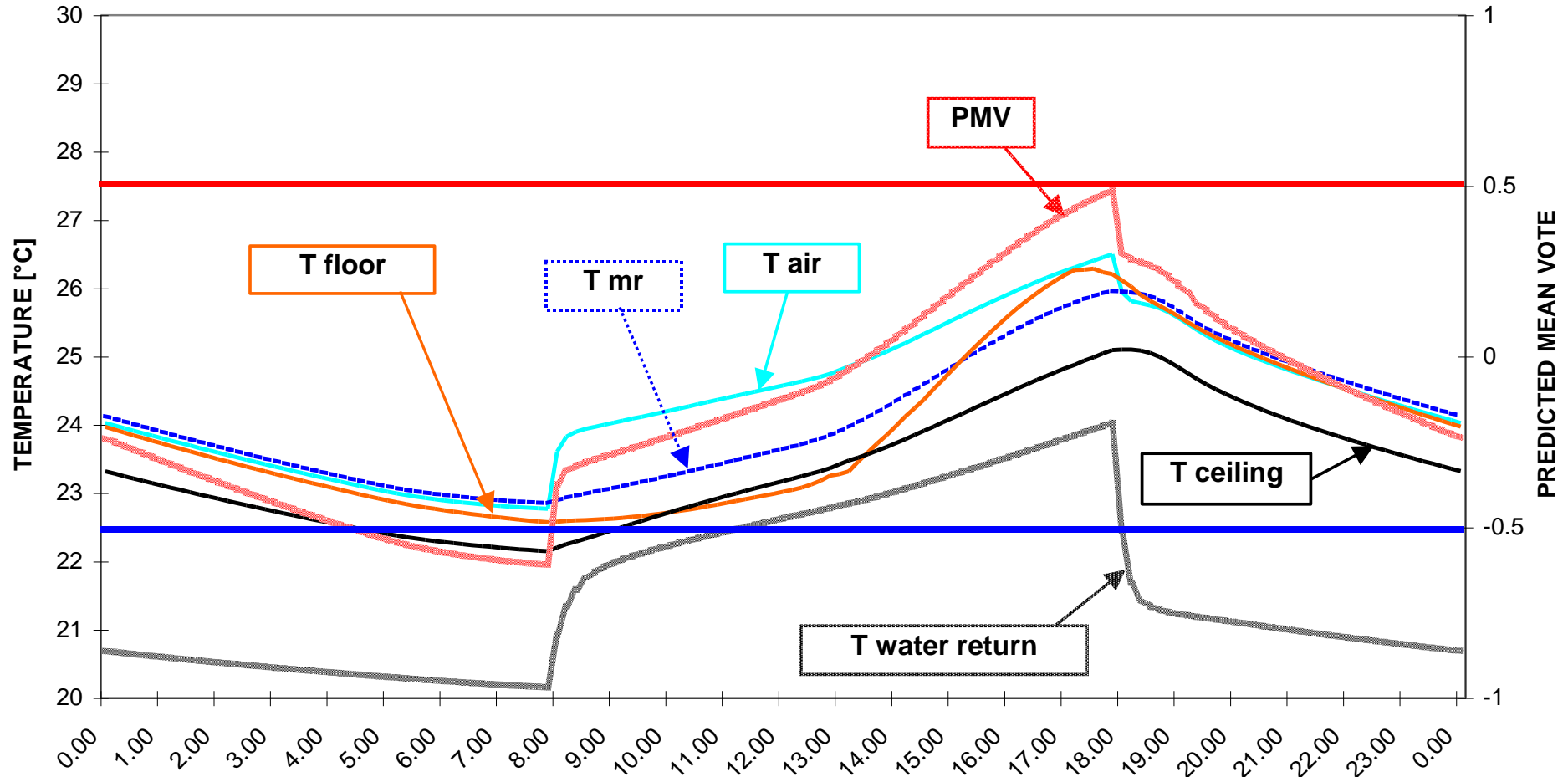


Figure 2 – Example of peak-shaving (reducing the peak load) effect (time vs. cooling power [W],)

Where: 1) heat gain, 2) Power needed for conditioning the ventilation air, 3) Power needed on the water side, 4) Peak heat gain reduction.

Concept of Thermo Active Building Systems (TABS)

EXAMPLE OF INTERNAL CONDITIONS WITH THERMAL SLAB



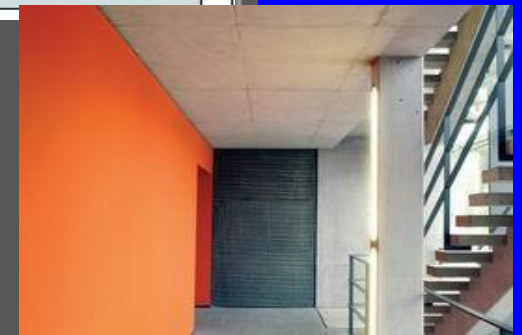
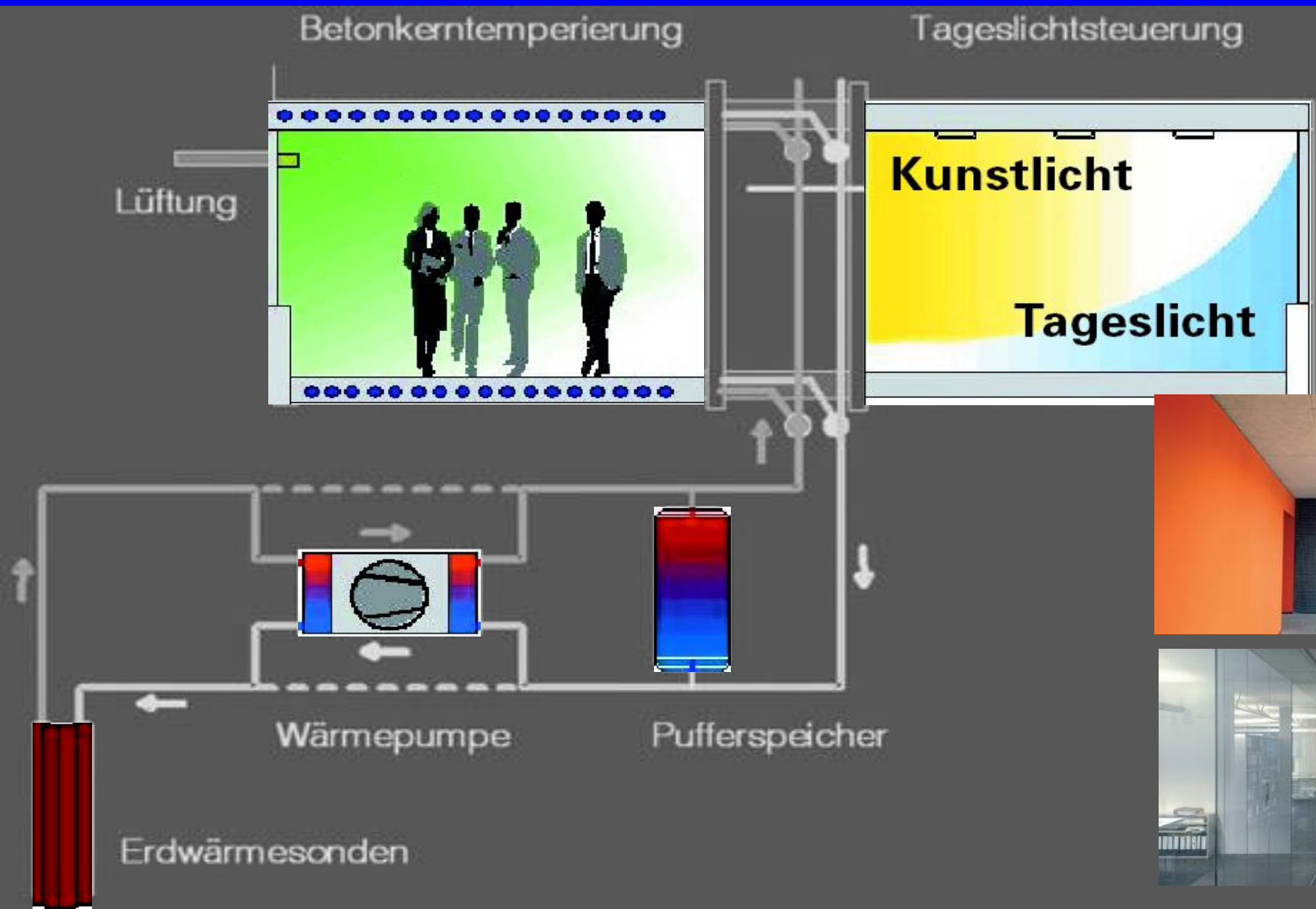


ART MUSEUM BREGENZ

bob.1

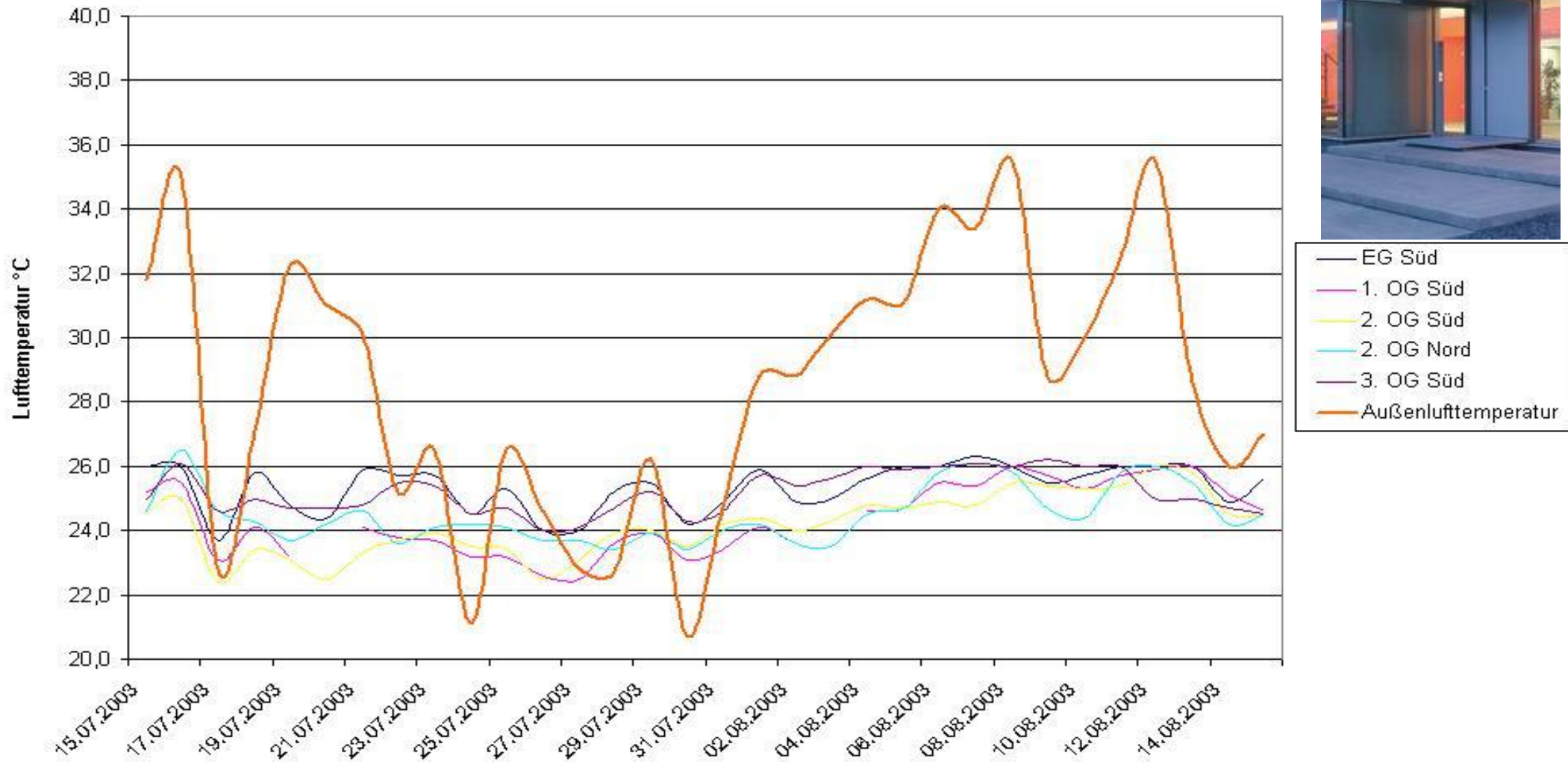


Energy concept in BOB.1



cooling period in BOB.1

Sommer 2003



- EG Süd
- 1. OG Süd
- 2. OG Süd
- 2. OG Nord
- 3. OG Süd
- Außenlufttemperatur

American University, Beirut, Lebanon

Coping with difficult climate conditions



Requirements from customer side:

- Location close to the Mediterranean sea with high air humidity
- Intelligent solution for reduction of operational costs
- Cooling in summer, heating in winter needed

Solution:

- TABS for heating in winter season and cooling in summer season for main loads
- Chillers for the peak loads and for reduction of air humidity



TABS heating/cooling: American University, Beirut, Lebanon



- Charles Hostler Students Center with cafeteria, offices and sport facilities (2007)
- ca. 4.500 m² embedded pipes for **invisible cooling and heating**
- Reduced energy consumption during operation
- Combination of chillers and TABS leading to reduced operational costs
- Cooling/Heating tower using Mediterranean seawater (temperature 20-26°C)



Pipe installation: American University in Beirut, Lebanon
Fixing of Uponor MLCP to steel-mesh which will then be covered by concrete

PALADS



El Ágora



OFFICE



HOSPITAL



OFFICE



TRAIN STATION



THE WORLD'S LARGEST SIDE BY SIDE COMPARISON OF VAV AND RADIANT COOLING



Figure 1 - Infosys SDB-1 Hyderabad - 125,000 sf of radiant cooling and 125,000 sf of VAV cooling

Sun shading and daylight penetration

RADIANT

VAV

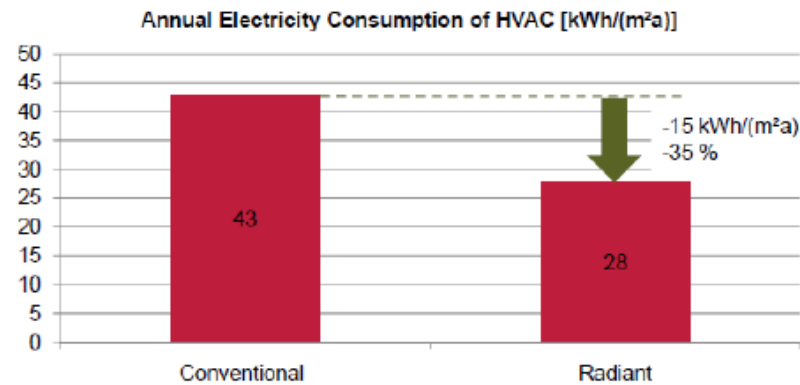


Energy

Radiant Cooling – Third Party Evaluation

Evaluation Infosys – Hyderabad, India 2. Analysis of Energy Consumption

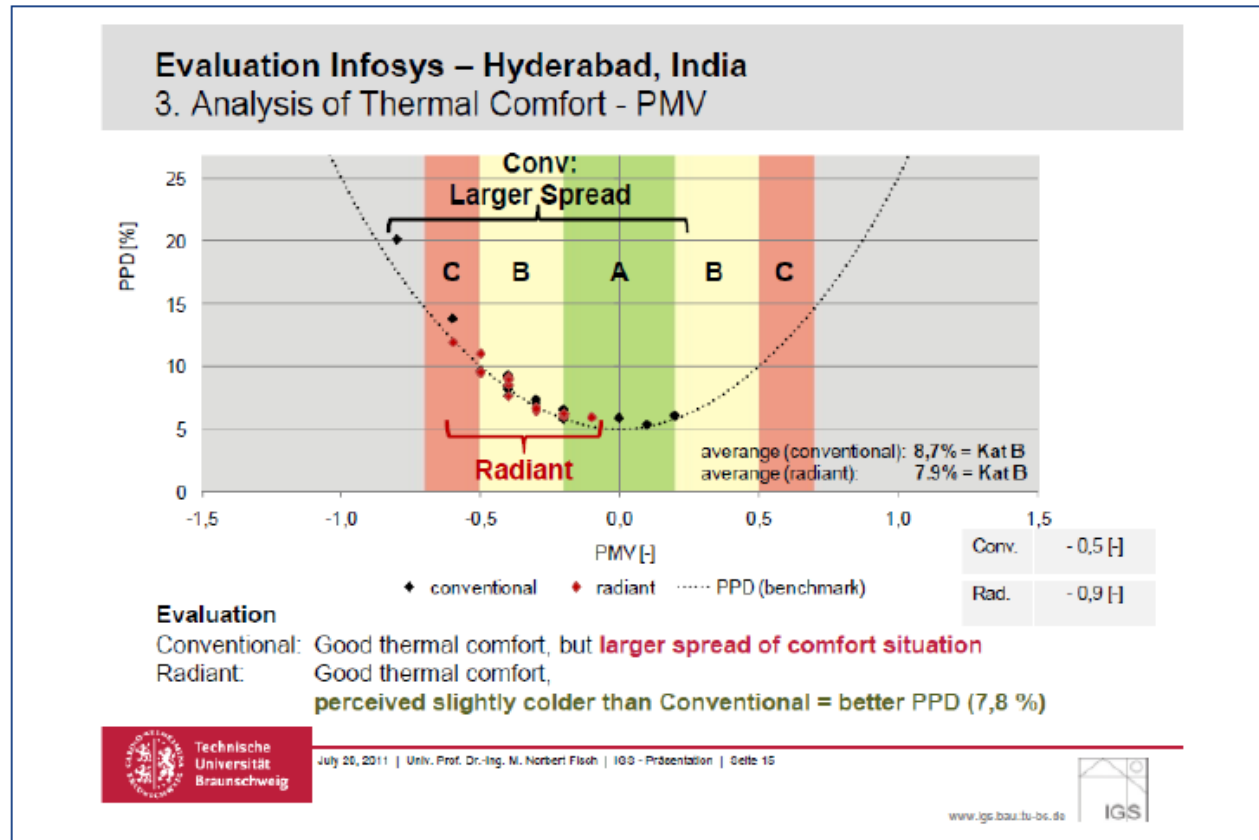
SDB1: HVAC



Evaluation Conventional: HVAC consumption 16 kWh/(m²a) respectively 50 % higher compared to Radiant.

Thermal Comfort

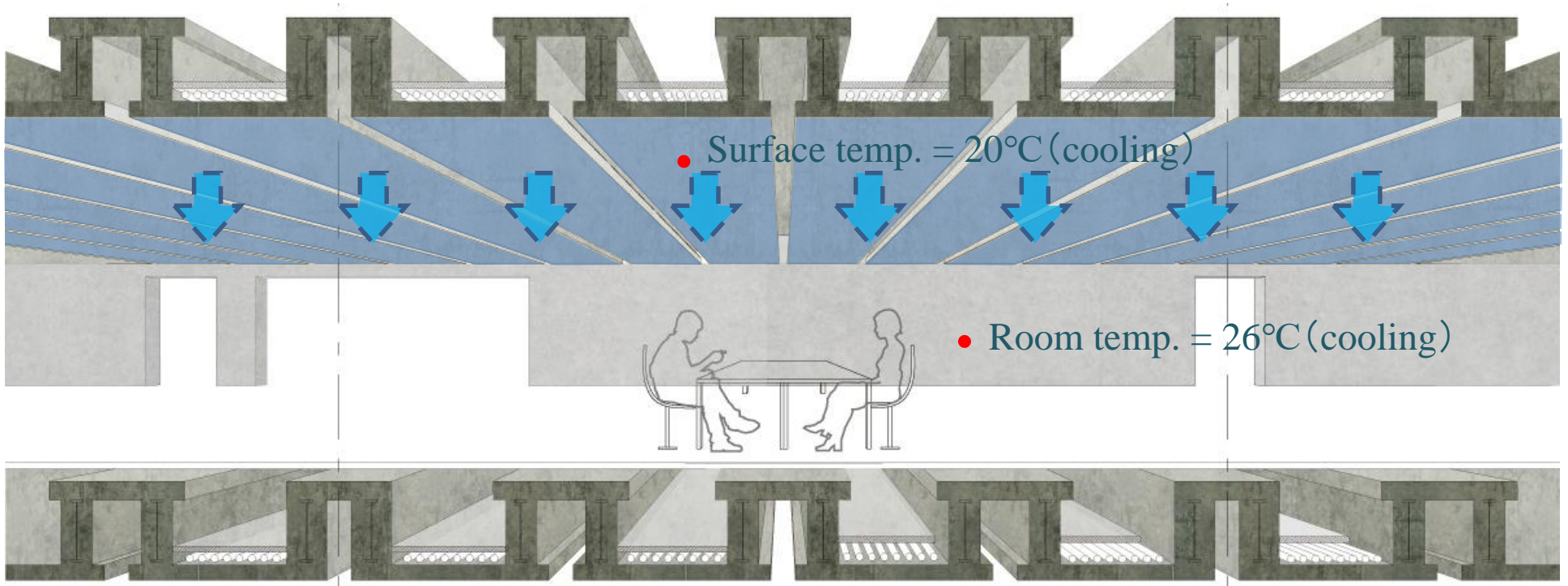
Radiant Cooling – Third Party Evaluation



A photograph of the Shogakukan Building at dusk. The building is a large, modern structure with a light-colored facade and a grid of windows. Two large, dark, perforated metal panels are mounted on the roof. The building is illuminated from within, and the sky is a deep blue. The text "Shogakukan Building" is overlaid in the center of the image.

Shogakukan Building

Radiation Cooling and Heating



Healthy and comfortable

- Improvement in quality of room air by increasing supply rate of fresh air.

Energy Conservation

- Reduction in heat transfer energy by converting heating medium (air→water).
- Improvement in heat pump COP by raising temperature of supply chilled water.