



Low impact ventilation

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Ventilation in cultural heritage - why?



- CO₂ and thermal comfort
- Humidity protection for cultural heritage
- Well defined hygro-thermal conditions for historic surfaces
- Well defined hygro-thermal conditions for artefacts

Building envelope and natural ventilation



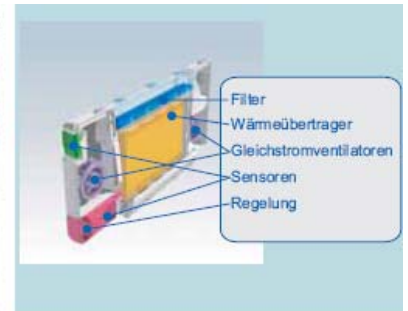
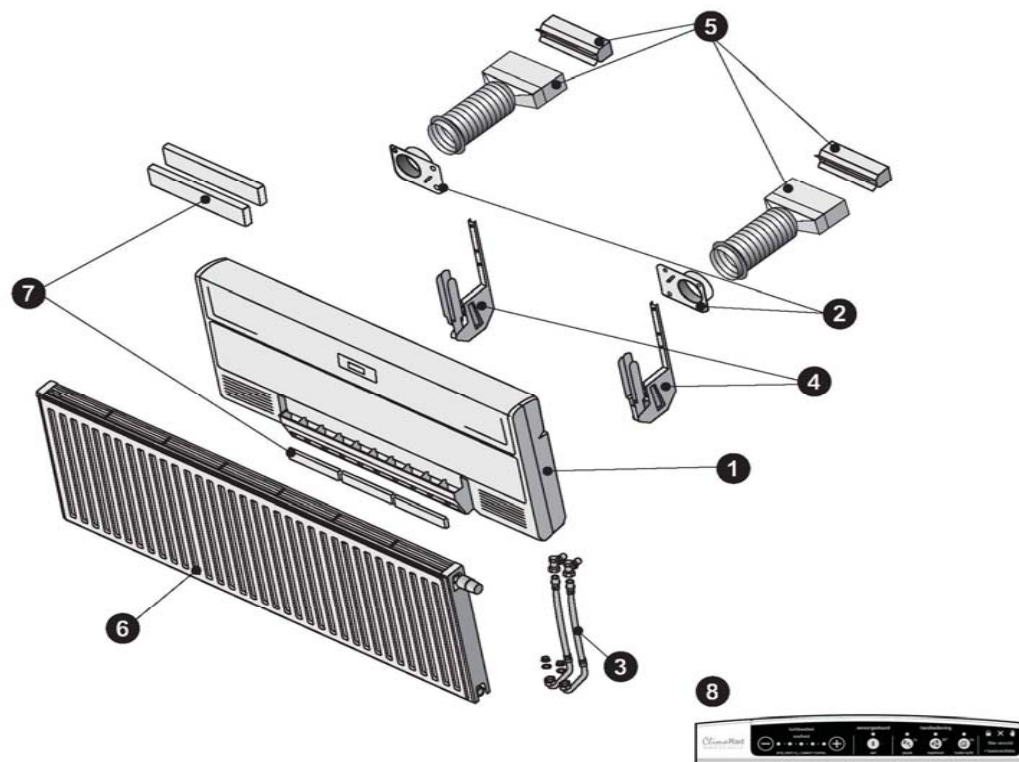
Ceiling integrated ventilation



Wall integrated ventilation



Wall integrated ventilation



Window integrated ventilation





Development for 3ENCULT

Höttinger School Innsbruck / Austria



1929-29131, Franz Baumann & Theodor Prachensky
Typical for a school of early modernism

In 3ENCULT:

Universität Innsbruck,
Architekt Gerald Gaigg



EURAC
research

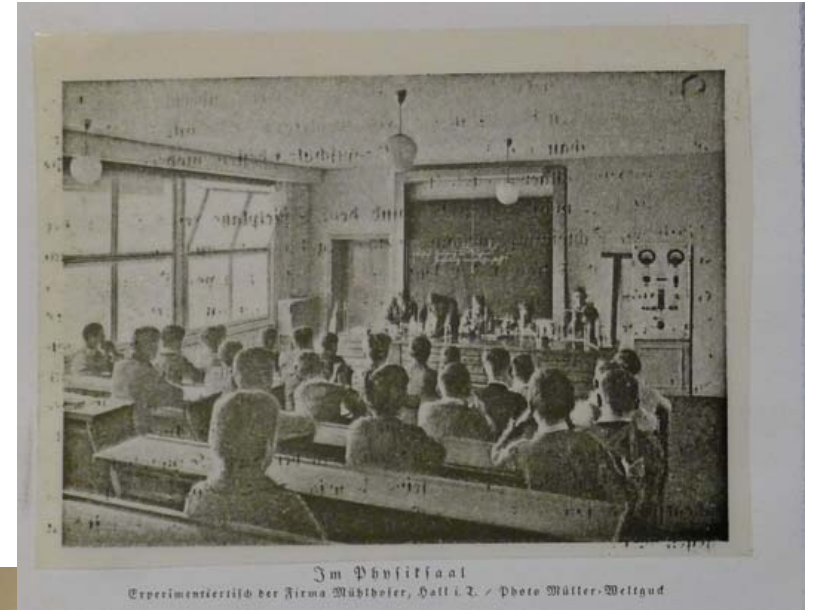
Fresh air demand ...

... can not be guaranteed with window ventilation among different lessons

→ Windows are opened also during lessons

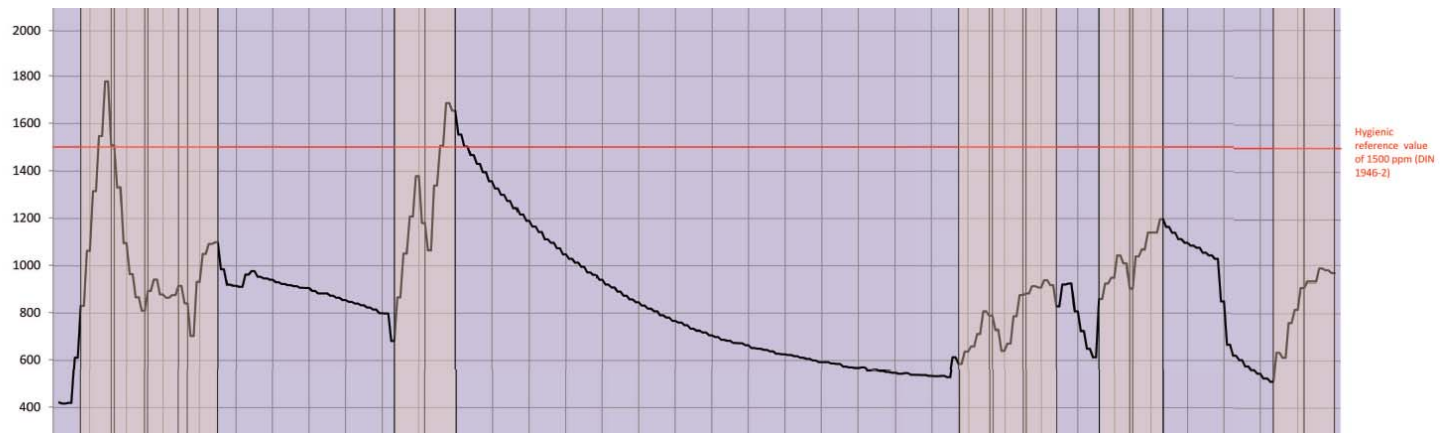
☹ heating demand

☹ comfort



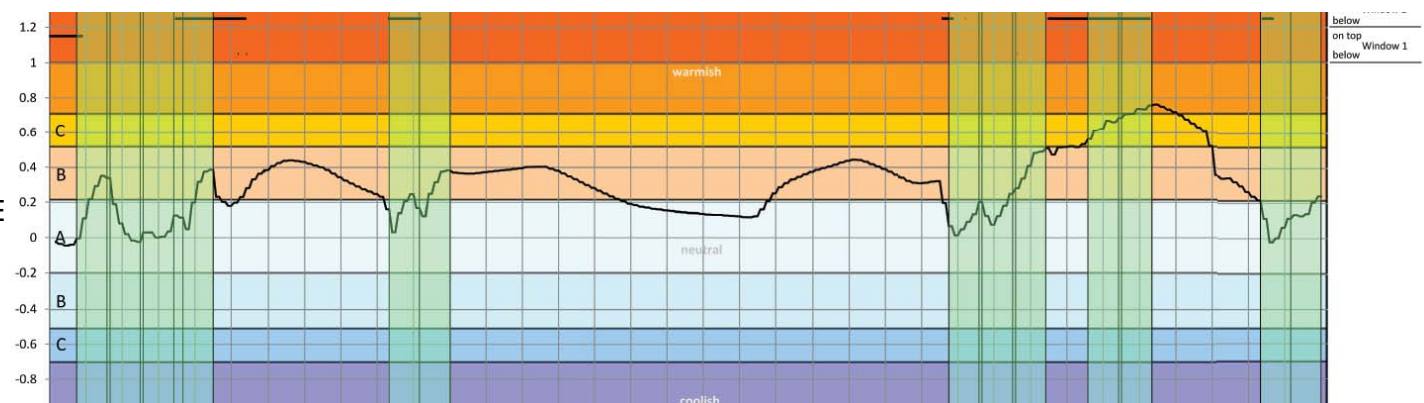
Fresh air demand...

CO₂ (ppm)



PMV

Predicted Mean Vote –
The PMV index predicts the mean response of a larger group of people according to the ASHRAE thermal sensation scale in a range between -3 cold to +3 hot



... but which system?

- Central?
 - standard with heat exchanger in cellar
 - ☹ horizontal & vertical ducting
 - ☹ holes in ceiling
 - vertical ducting
 - 😊 no horizontal ducting in the corridor
 - ☹ more holes in the ceilings
- Decentralised?
 - one ventilation system per class room
 - 😊 less ducts
 - ☹ two holes in the facade per room ...

What „offers“ the building?



- central stair case
- large corridors with access to class rooms

CASE STUDY 5, Höttinger Hauptschule,
Innsbruck, Austria

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Innsbruck, Austria

3encult

3encult
EFFICIENT ENERGY FOR EU CULTURAL HERITAGE

GROUND FLOOR, SCALE 1:200

UNDERLINE:
Armored Concrete
Rammed Concrete
Extended Brickwork
Normal Brickwork
Annex from ca. 1950
Steel Column
Balance Boundary

all dimensions are without plaster

FIRST FLOOR

UNDERLINE:
Armored Concrete
Rammed Concrete
Extended Brickwork
Normal Brickwork
Annex from ca. 1950
Steel Column
Balance Boundary

all dimensions are without plaster

SECOND FLOOR

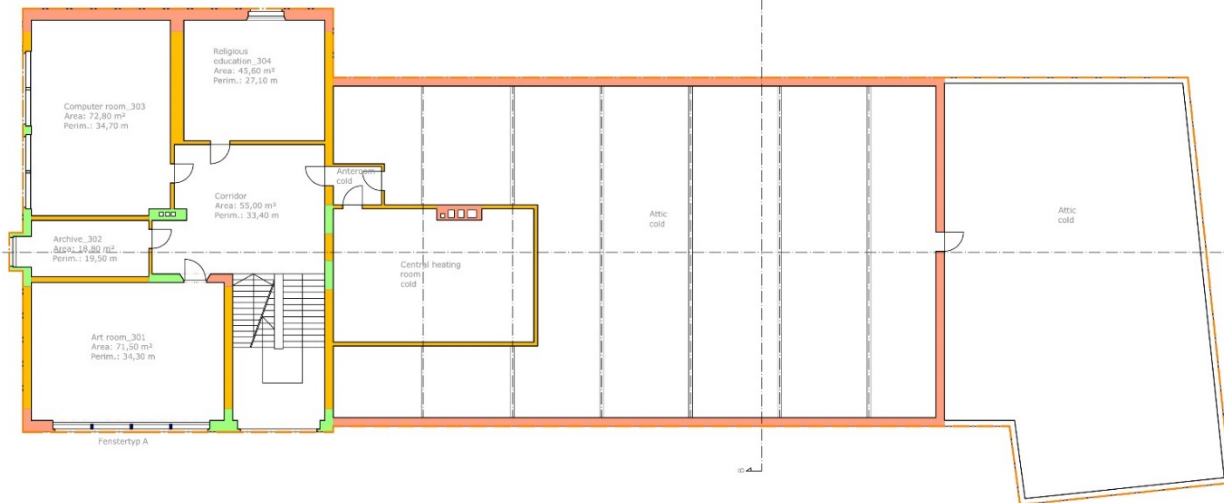
UNDERLINE:
Armored Concrete
Rammed Concrete
Extended Brickwork
Normal Brickwork
Annex from ca. 1950
Steel Column
Balance Boundary

all dimensions are without plaster

THIRD FLOOR, SCALE 1:200

UNDERLINE:
Armored Concrete
Rammed Concrete
Extended Brickwork
Normal Brickwork
Annex from ca. 1950
Steel Column
Balance Boundary

all dimensions are without plaster



What „offers“ the building?



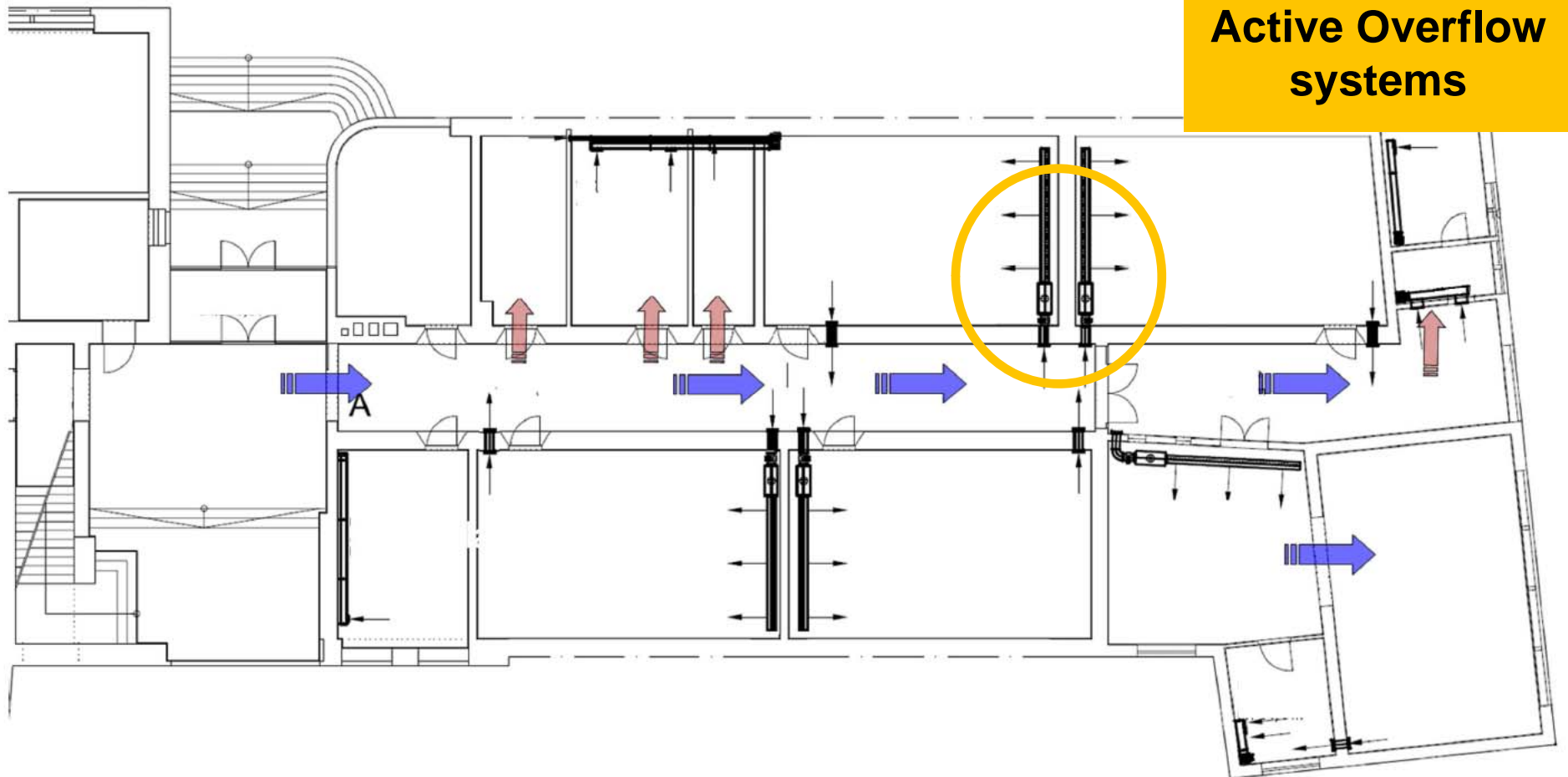
- central stair case
- large corridors with access to class rooms

→ Use this potential of the building!

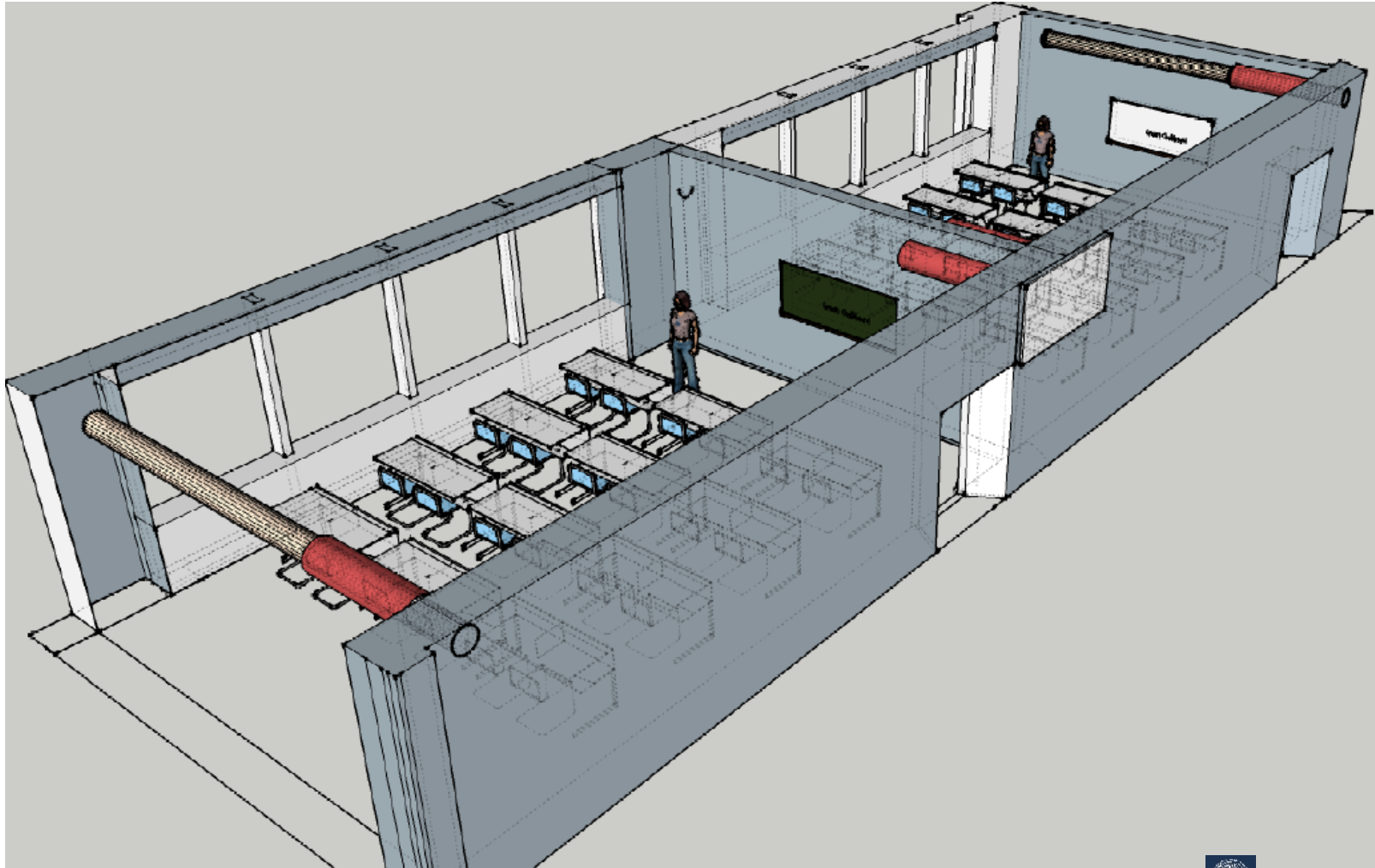
- **Fresh air reservoir** in the corridors

Corridor as fresh air reservoir

**Active Overflow
systems**



Active overflow



Active overflow



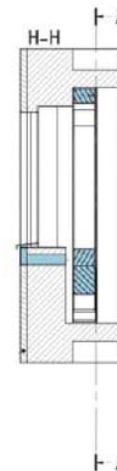
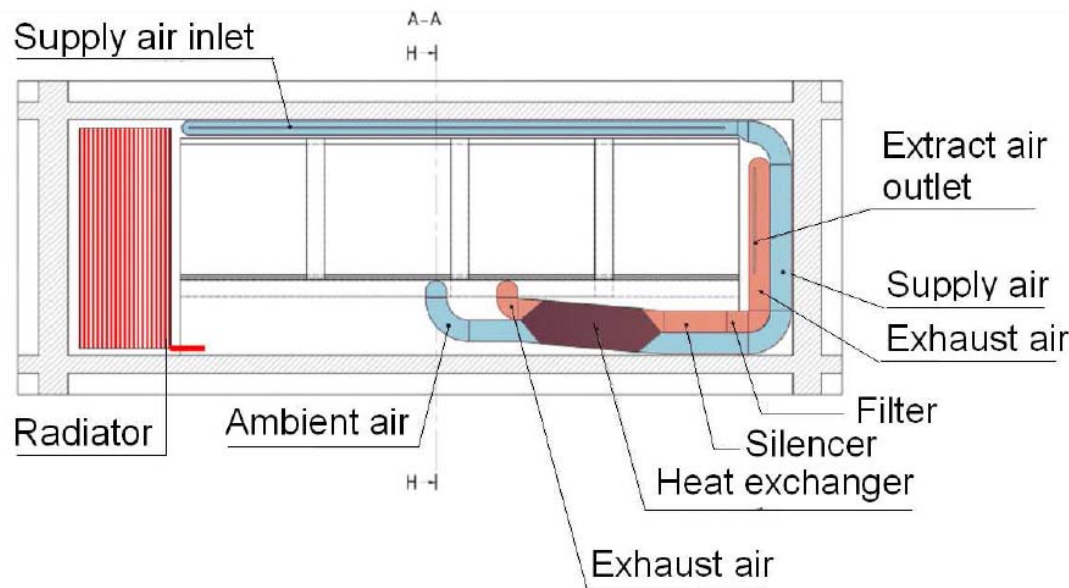
Fresh air supply in classrooms via textile hoses



Decentralised ventilation



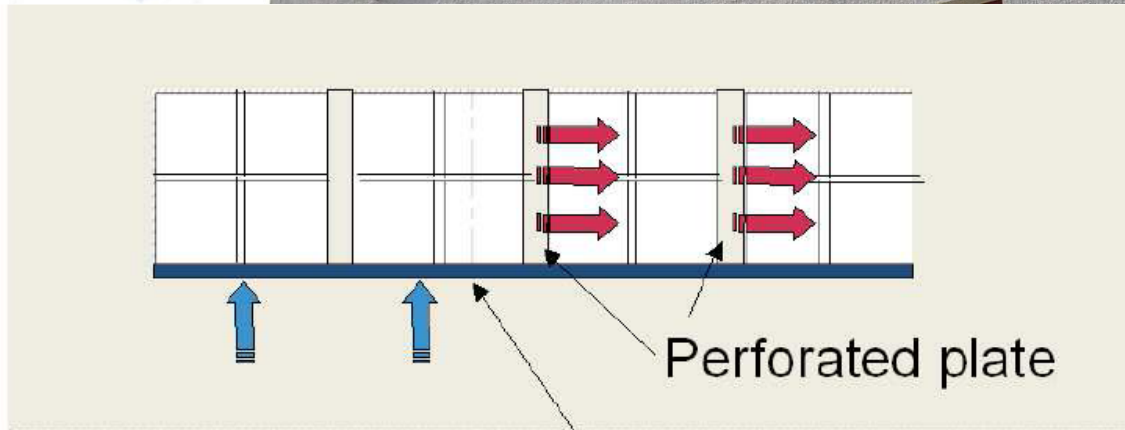
- minimal invasive and nearly invisible mounting of the counterflow heat exchanger in the parapet wall
- wall integrated solutions



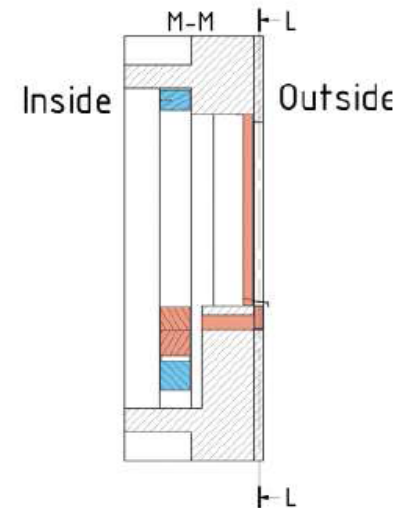
Decentralised ventilation



- fresh air through slit below window sill
- exhaust air via perforated plate in front of window post

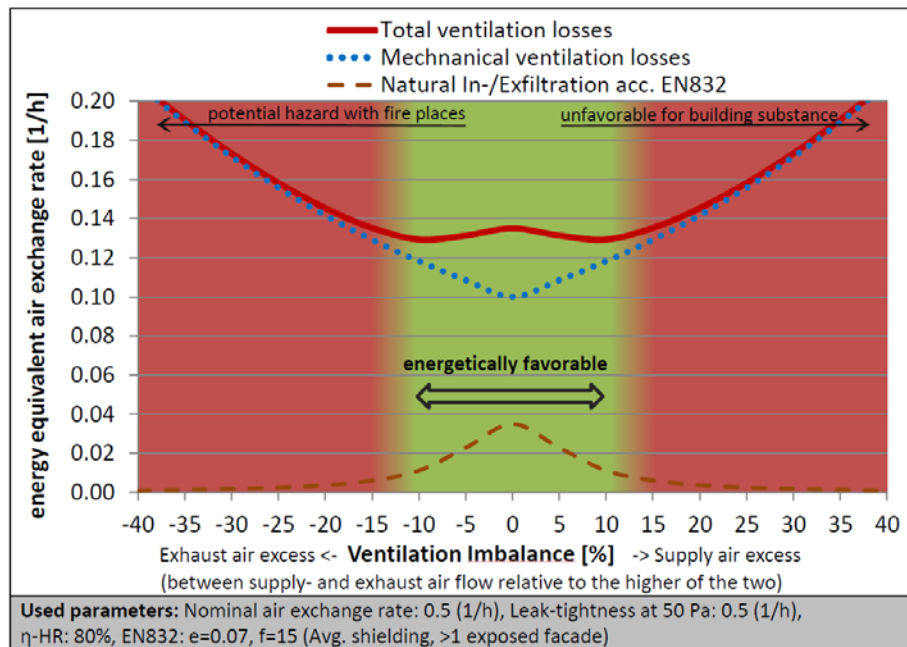


Slit below the window sill



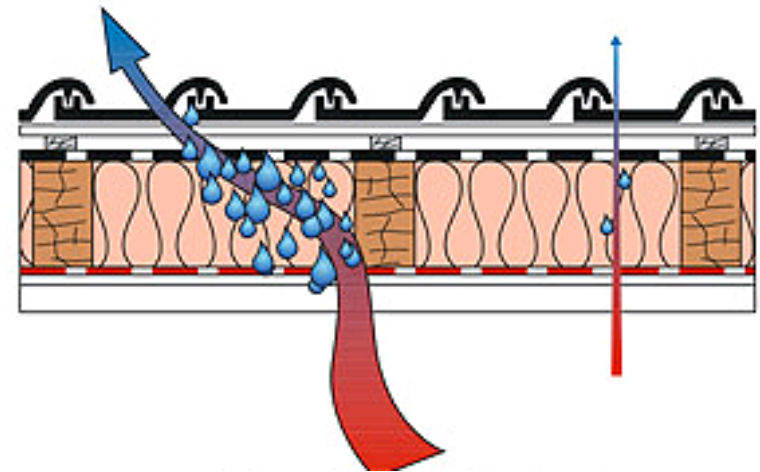
Air flow balancing

Humidity transport by convection $360 \text{ g H}_2\text{O/d m}^2$



The increased energy demand in imbalanced ventilation systems. The equivalent energy demand clearly rises when passing the threshold of $\pm 10\%$ imbalance (© Rojas-Kopeinig, UIBK)

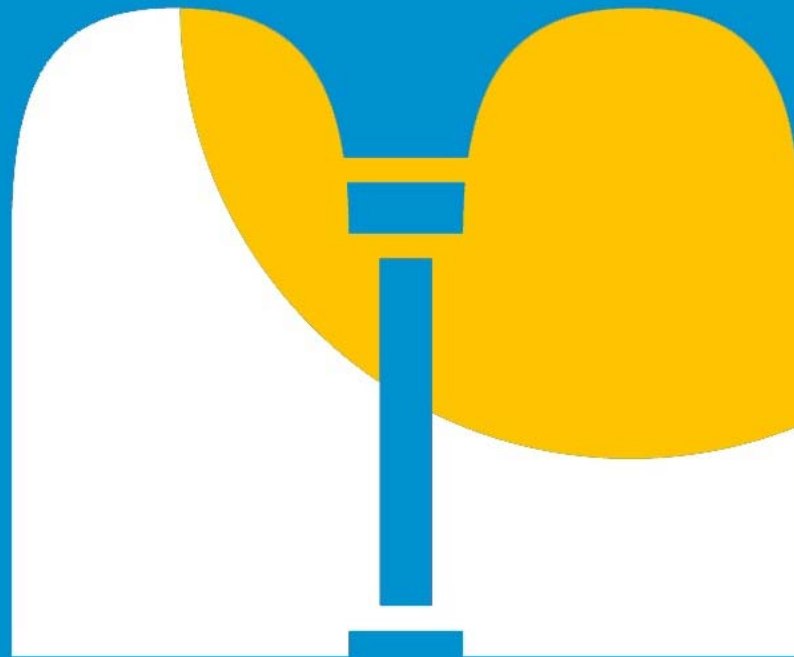
by diffusion $1 \text{ g H}_2\text{O/d m}^2$



1 mm gap, 1m length

Measurement equipment for flow measurement and control





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