REHVA

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Ventilation Effectiveness

REHVA Guidebook no 2

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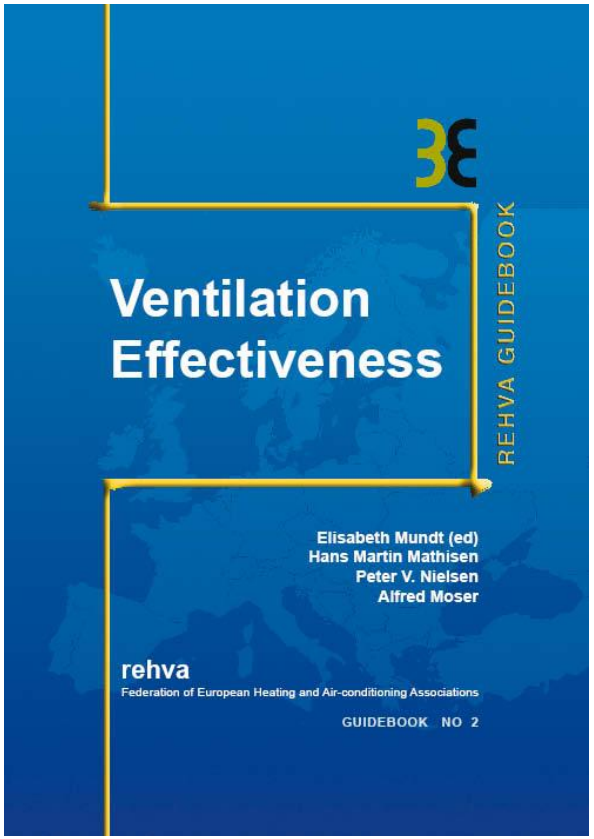

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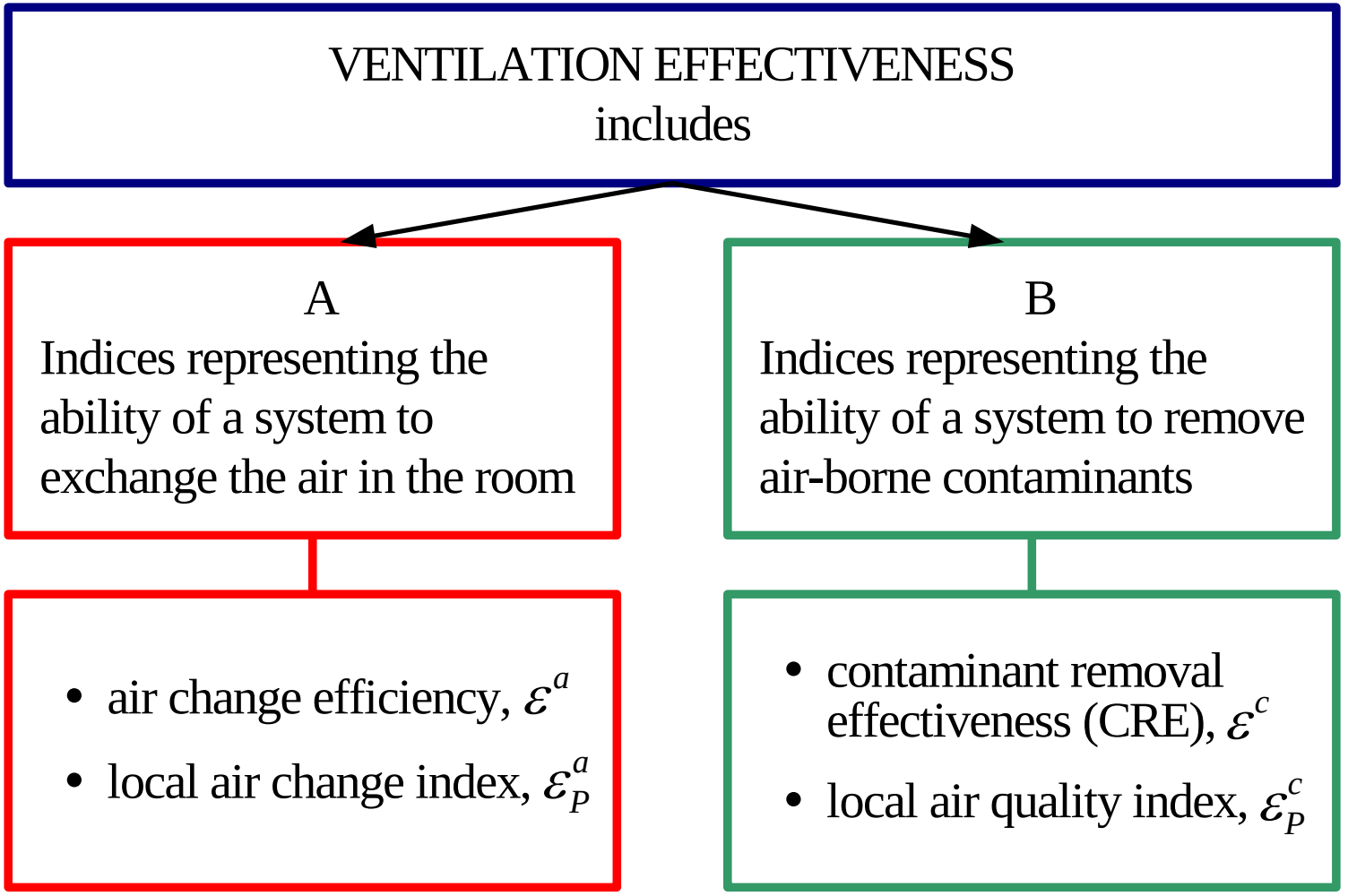
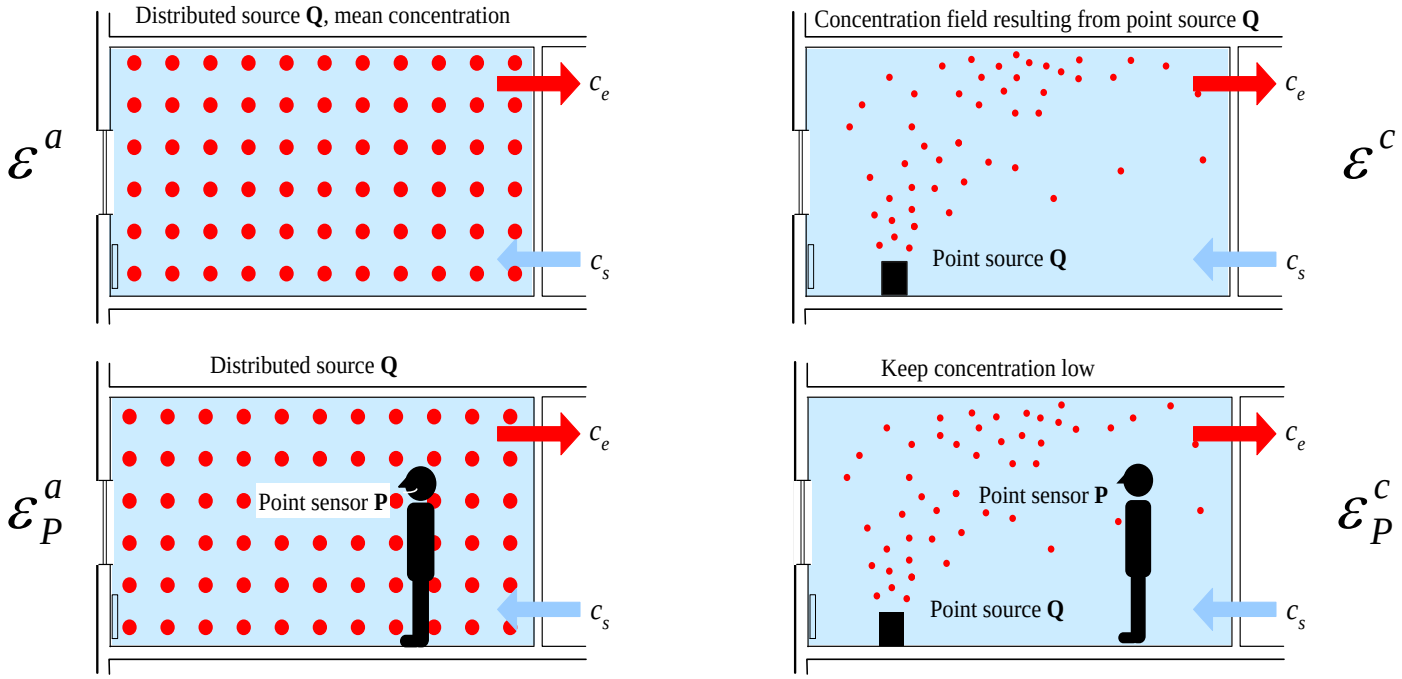
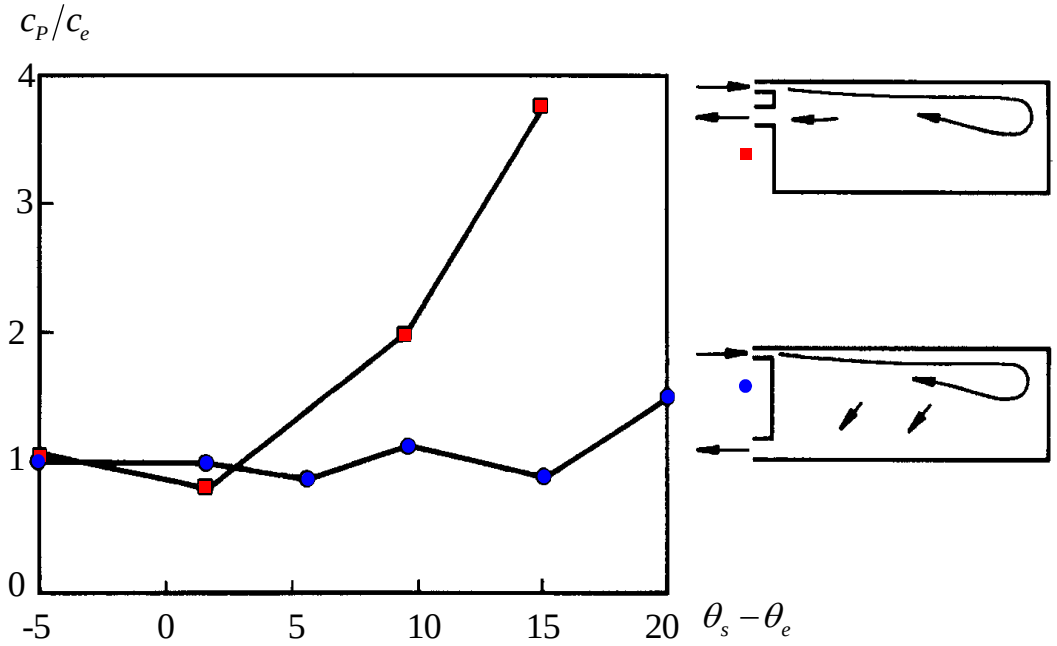

VENTILATION EFFECTIVENESS
includes
A
Indices representing the ability of a system to exchange the air in the room
B
Indices representing the ability of a system to remove air-borne contaminants
• air change efficiency, ε^a
• local air change index, ε_P^a
• contaminant removal effectiveness (CRE), ε^c
• local air quality index, ε_P^c

INTRODUCTORY CHAPTERS

1. VENTILATION EFFECTIVENESS IN A NUTSHELL
2. SYMBOLS AND TERMINOLOGY
3. WHY VENTILATION EFFECTIVENESS



4 TYPICAL CONTAMINANTS AND CONTAMINANTS DISTRIBUTION IN VENTILATED ROOMS



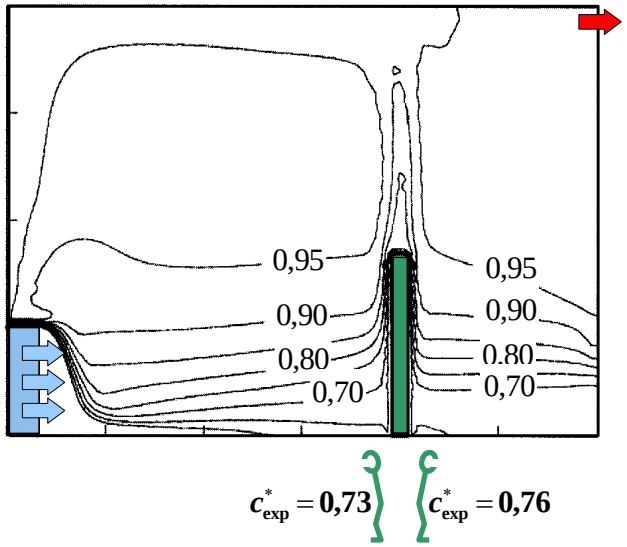
Return opening

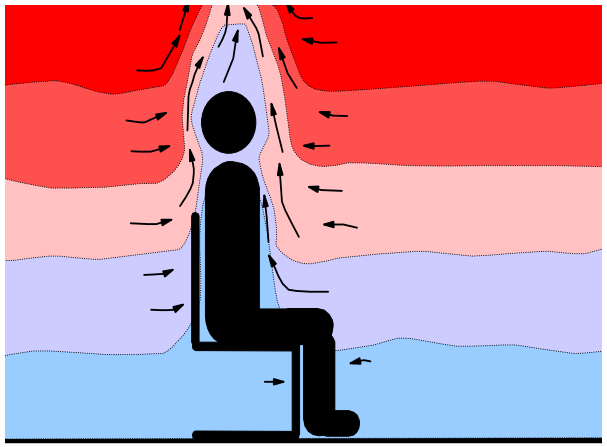
The location of a return opening may have a very large influence on the concentration distribution, although it only has a small influence on the velocity distribution.

4 TYPICAL CONTAMINANTS AND CONTAMINANTS DISTRIBUTION IN VENTILATED ROOMS

Displacement ventilation and vertical concentration gradient

The idea behind displacement ventilation is to accept a variation in the concentration distribution with a high value below the ceiling and a low value in the occupied zone.

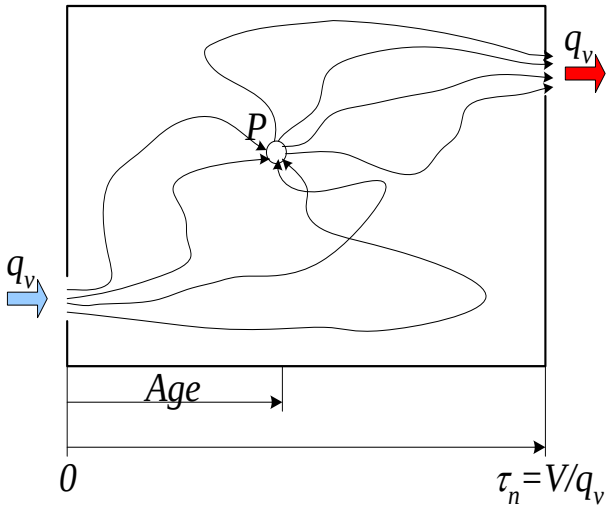




5 THEORY AND DEFINITIONS

Air Change Efficiency ε^a

$$\varepsilon^a = \frac{\text{Mean age of air in the exhaust}}{\text{2 x Room mean age of air}} = \frac{\tau_n}{2 \cdot \langle \bar{\tau} \rangle}$$



The mean age of air in the exhaust
is always equal to the nominal time constant τ_n

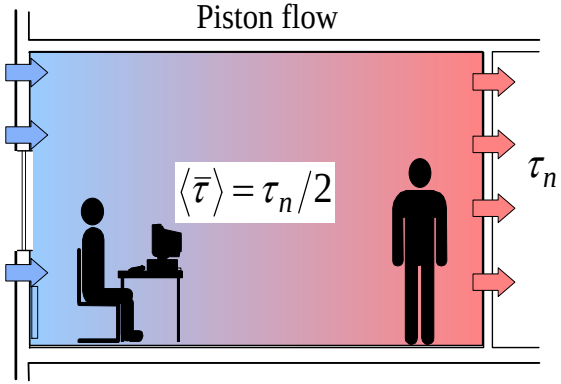
What is the mean age of the air in the room?

The room mean age of air can not be less than half the nominal time constant!

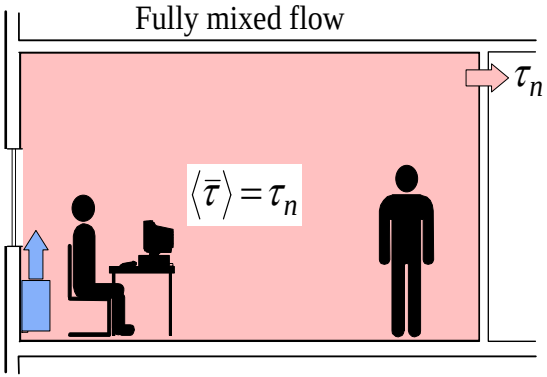
Thus the air change efficiency < 100 %

5 THEORY AND DEFINITIONS

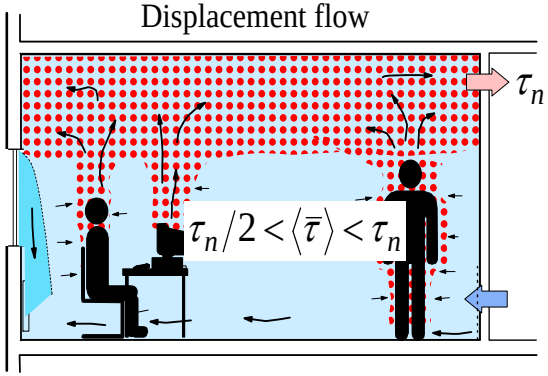
Air Change Efficiency



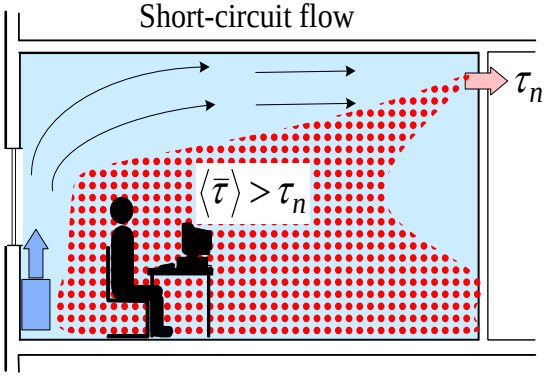
$\varepsilon^a = 100\,\%$



$\varepsilon^a = 50\,\%$



$50\,\% \le \varepsilon^a \le 100\,\%$

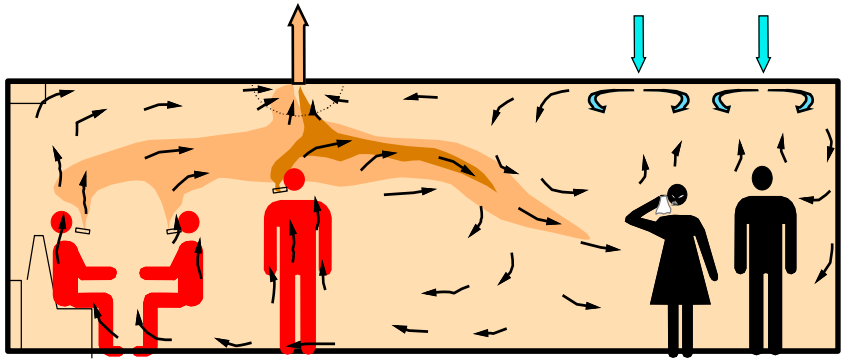


$\varepsilon^a \le 50\,\%$

5 THEORY AND DEFINITIONS

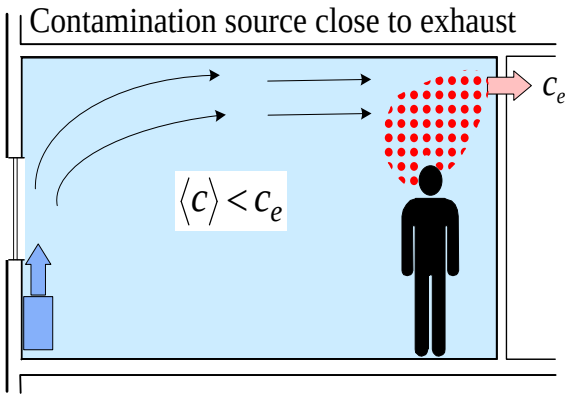
Contaminant Removal effectiveness, CRE

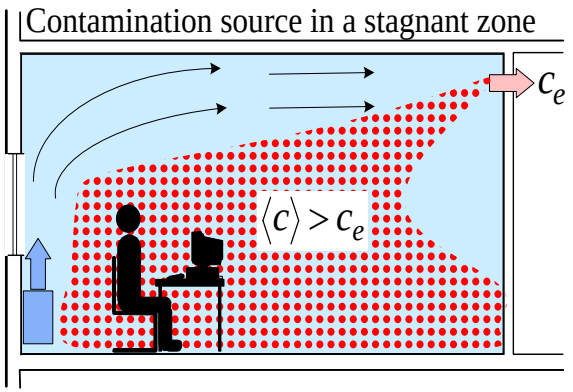
$$CRE = \frac{\text{Concentration in the exhaust}}{\text{Mean concentration in the room}} = \frac{c_e}{\langle c \rangle}$$

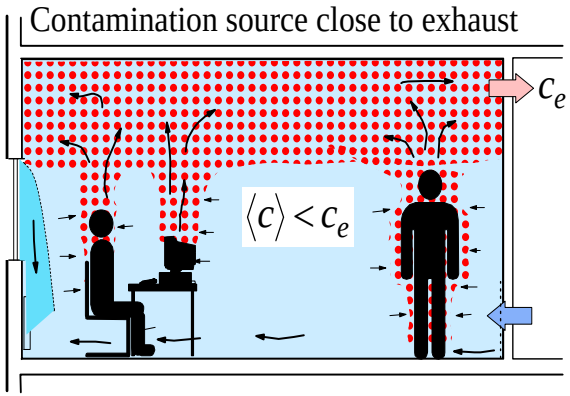


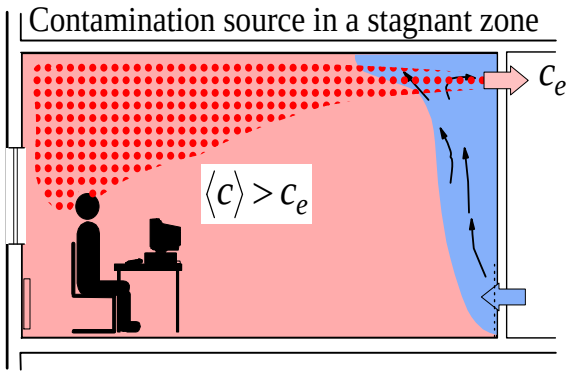
5 THEORY AND DEFINITIONS

Contaminant Removal effectiveness, CRE

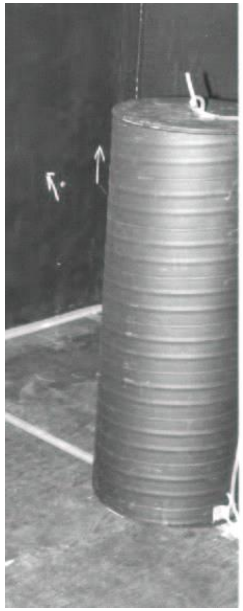


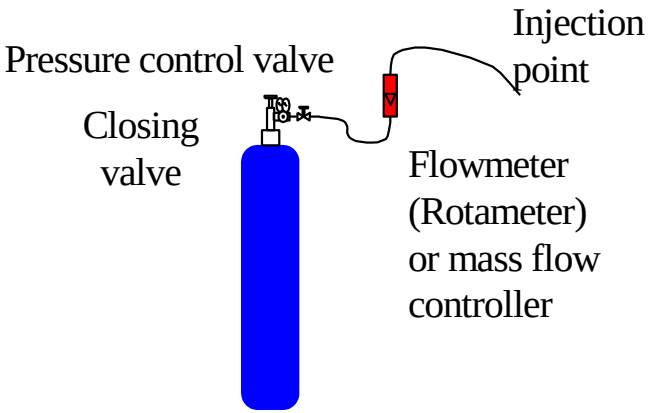






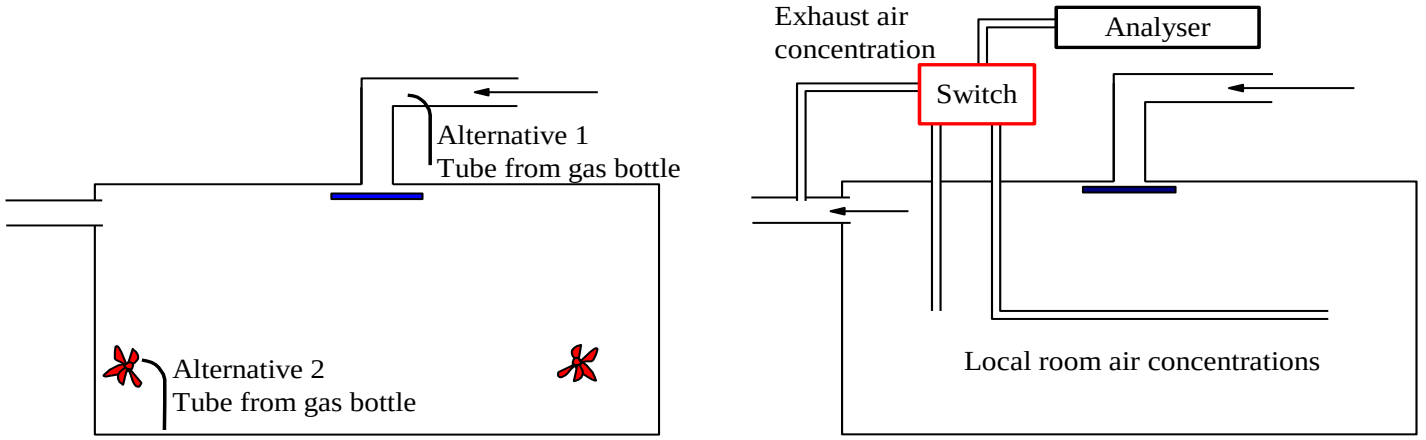
6 MEASUREMENTS



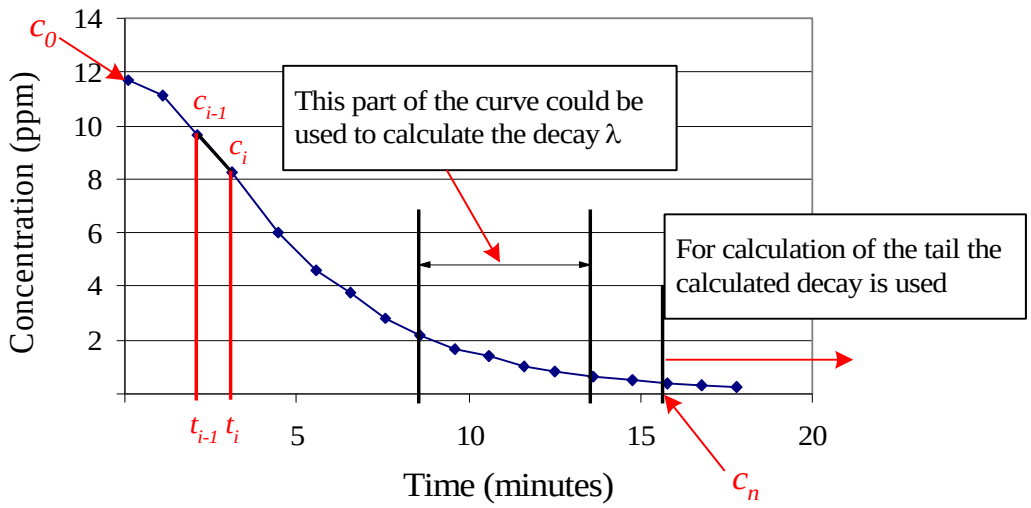


Injection of tracer gas

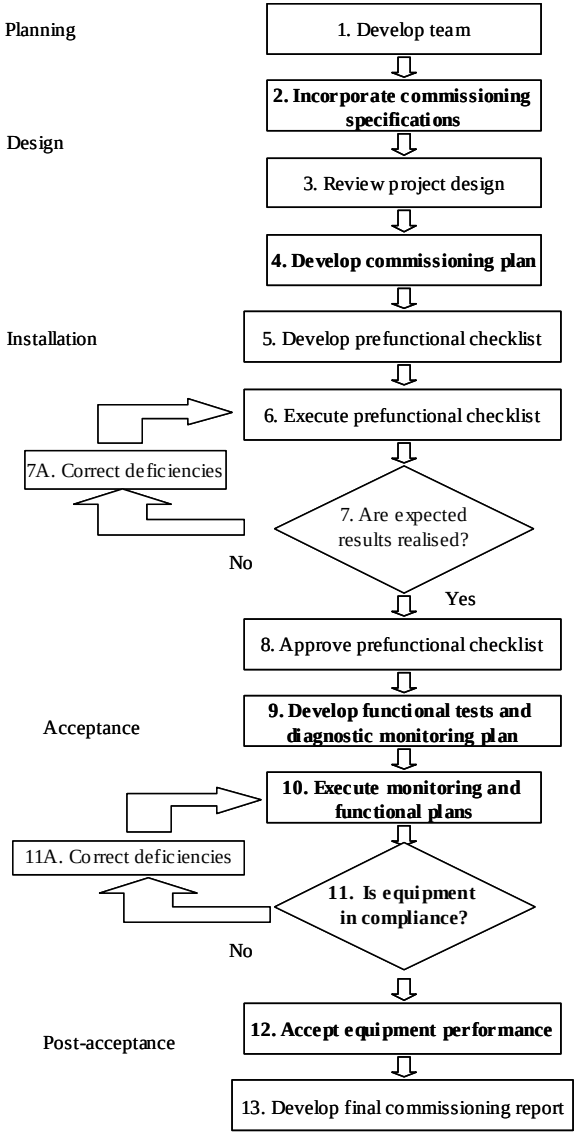
6 MEASUREMENTS



Routines for how to measure and calculate the ventilation effectiveness

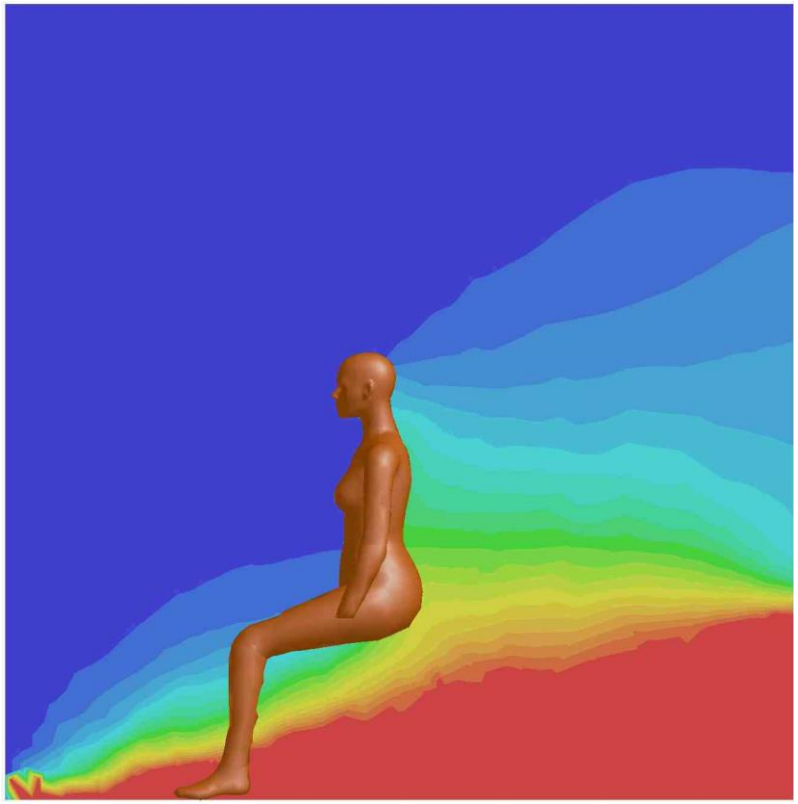


6 MEASUREMENTS



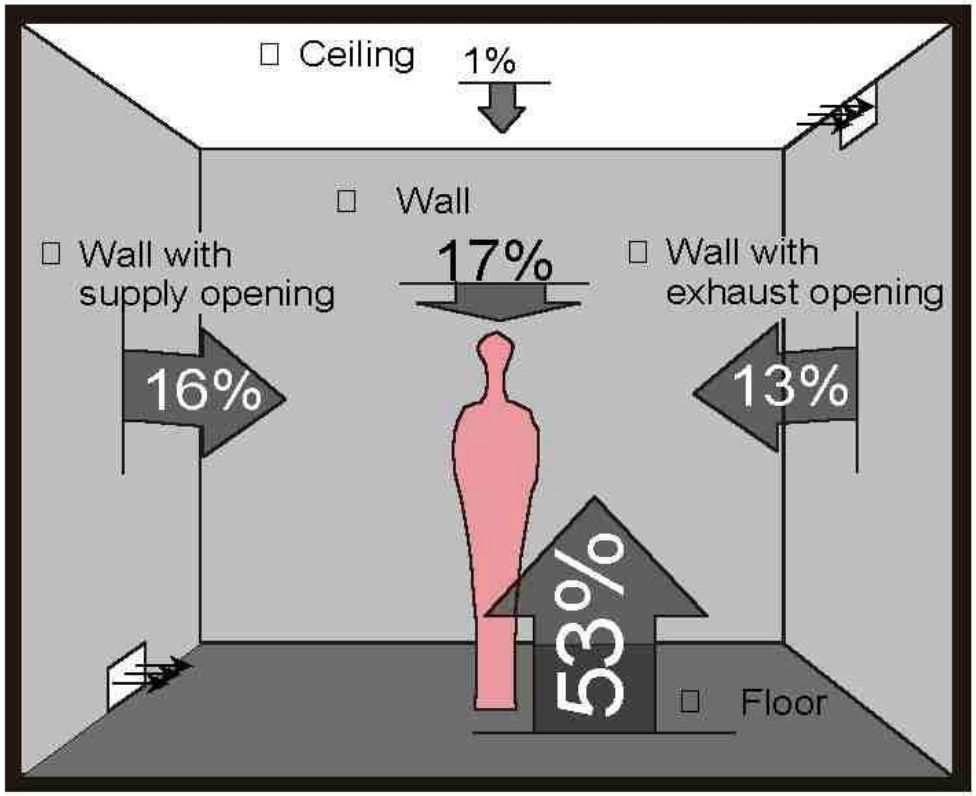
Commissioning

7 PREDICTION OF AIR QUALITY BY COMPUTATIONAL FLUID DYNAMICS



Contaminant distribution around a sedentary person, contaminant source at the floor

7 PREDICTION OF AIR QUALITY BY COMPUTATIONAL FLUID DYNAMICS

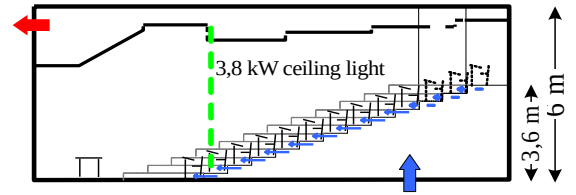


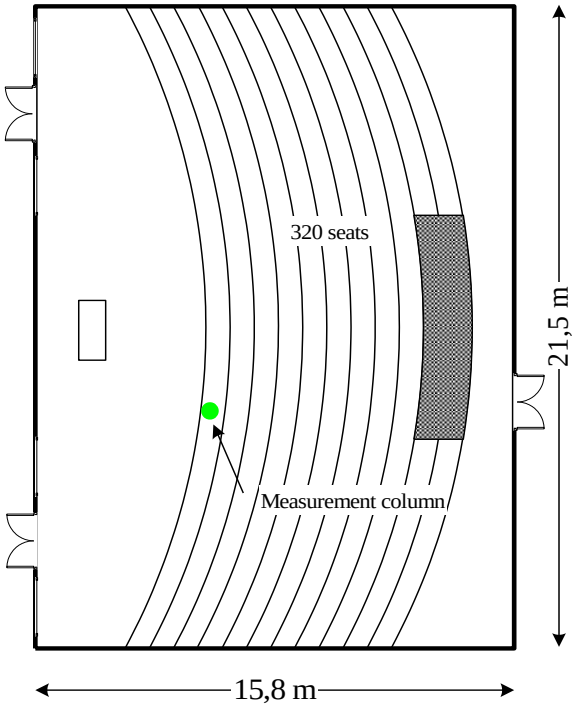
The exposure of a standing person from different surfaces with the same emission

8 CASE STUDIES

Description and Design Values, Measured Results, Discussion of Results

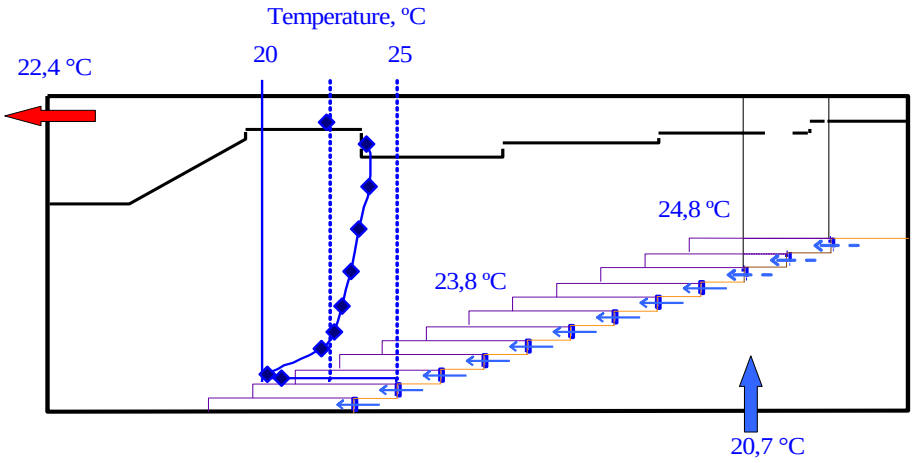
Auditorium

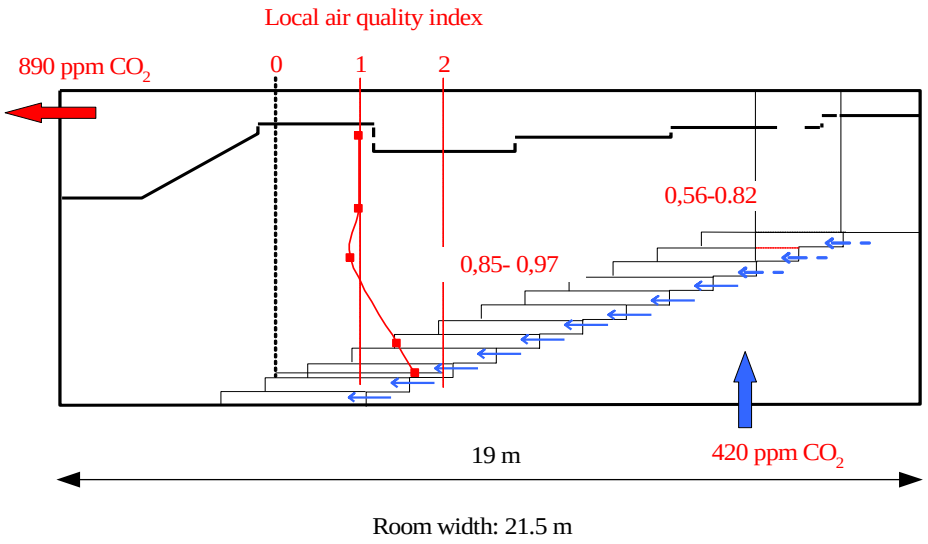




8 CASE STUDIES

Auditorium





Room width: 21.5 m

8 CASE STUDIES

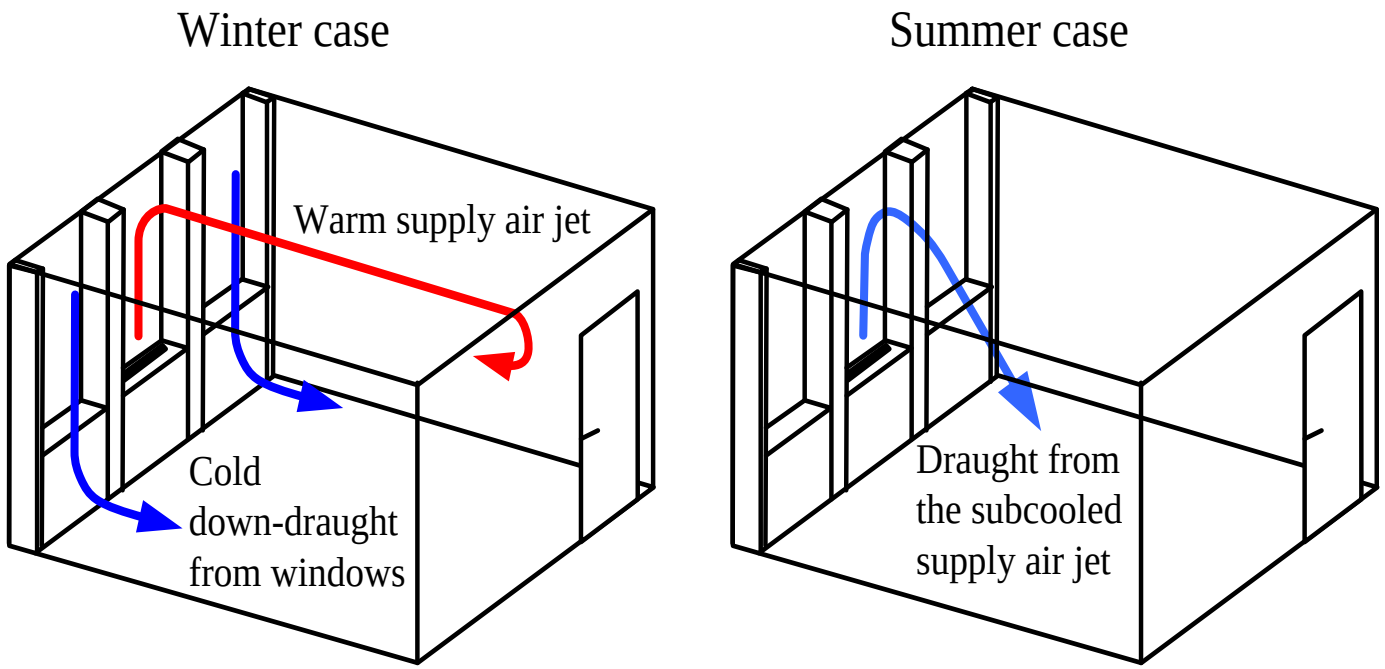
Office in town hall

Office in town hall

Full scale experiments

8 CASE STUDIES

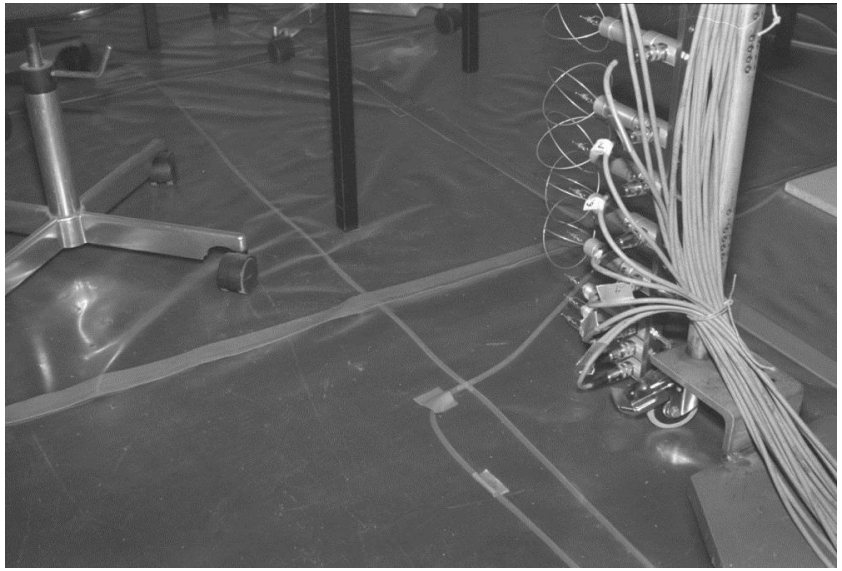
Office in town hall



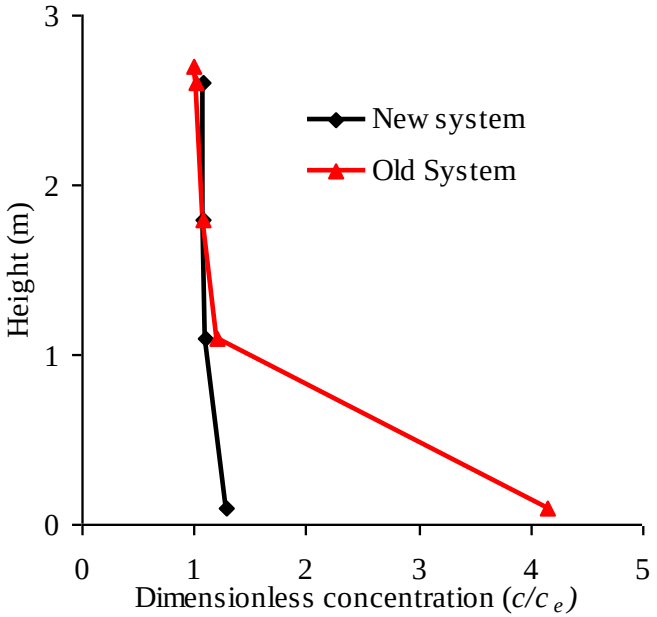
Flow pattern before reconstruction of the ventilation system

8 CASE STUDIES

Office in town hall



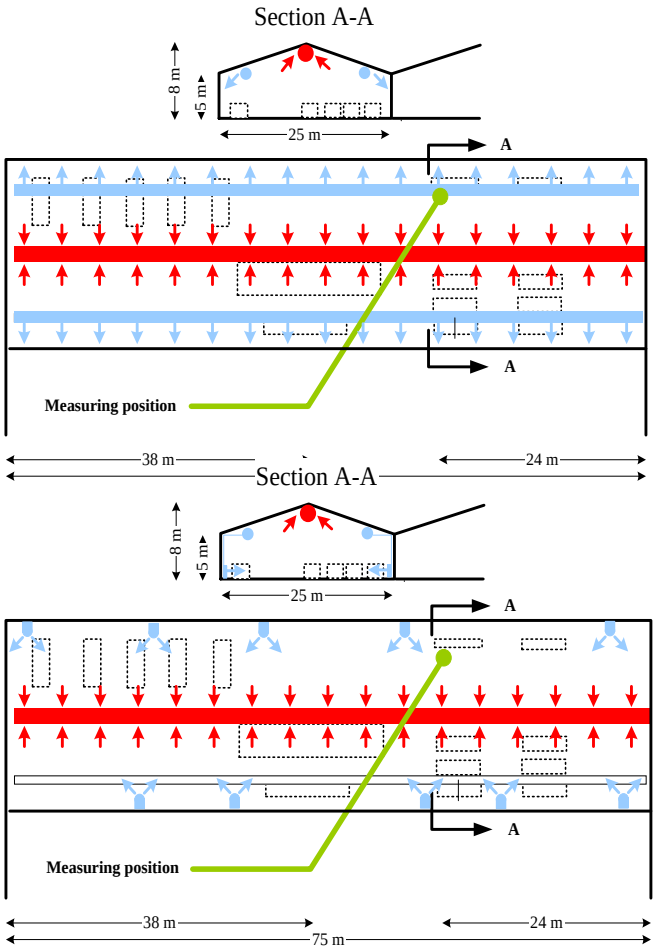
Carpet as contaminant source



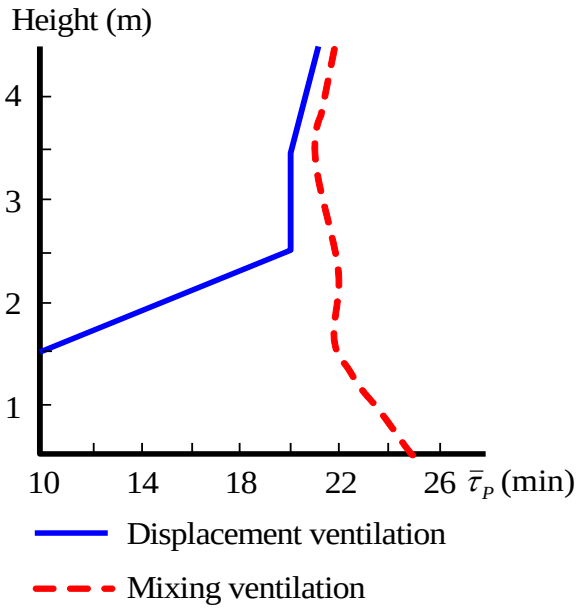
Concentration profiles

8 CASE STUDIES

Industrial building



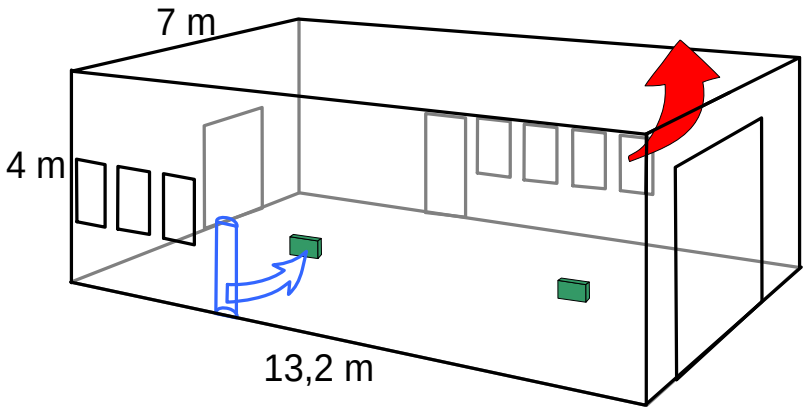
Mixing ventilation



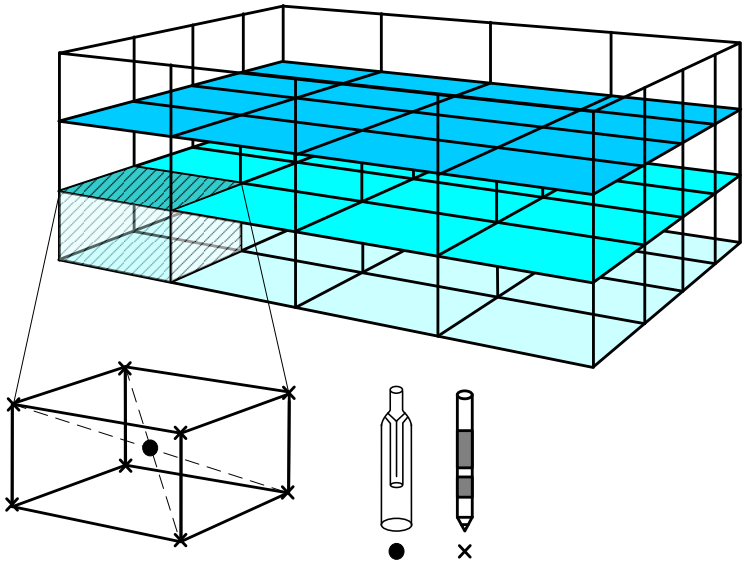
Displacement ventilation

8 CASE STUDIES

Homogeneous emission techniques



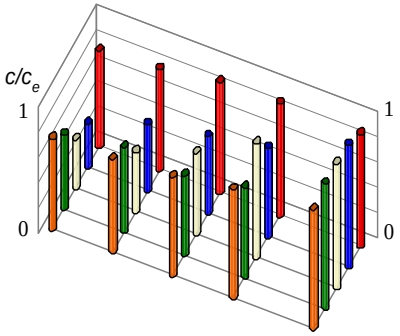
Laboratory hall

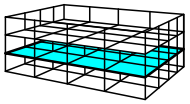


Subdivision of the room

8 CASE STUDIES

Homogeneous emission techniques

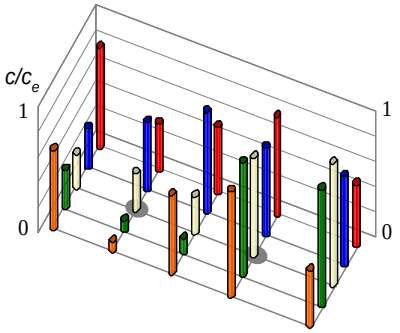


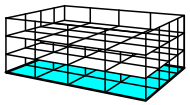


1,33 m above the floor

0,35	0,42	0,50	0,54
0,28	0,35	0,45	0,60
0,27	0,28	0,43	0,63
0,33	0,33	0,48	0,57

Computed local mean age of air in the sub-volumes between the two layers

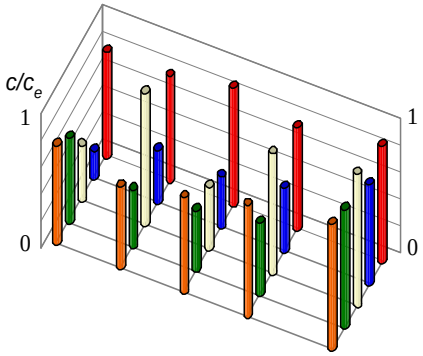


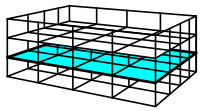


Floor level

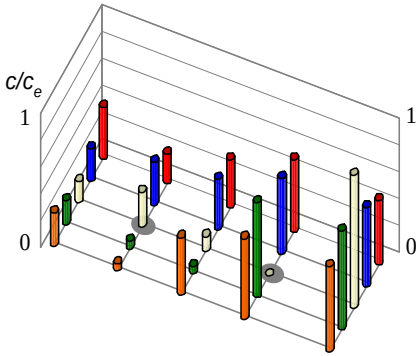
The shadowed ellipses show the positions of the two 750 W air convectors at the floor level

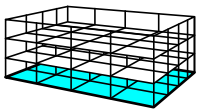
Local mean age of air





1,33 m above the floor





Floor level

The shadowed ellipses show the positions of the two 750 W air convectors at the floor level

Local concentrations with point sources

Thank you for your attention

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