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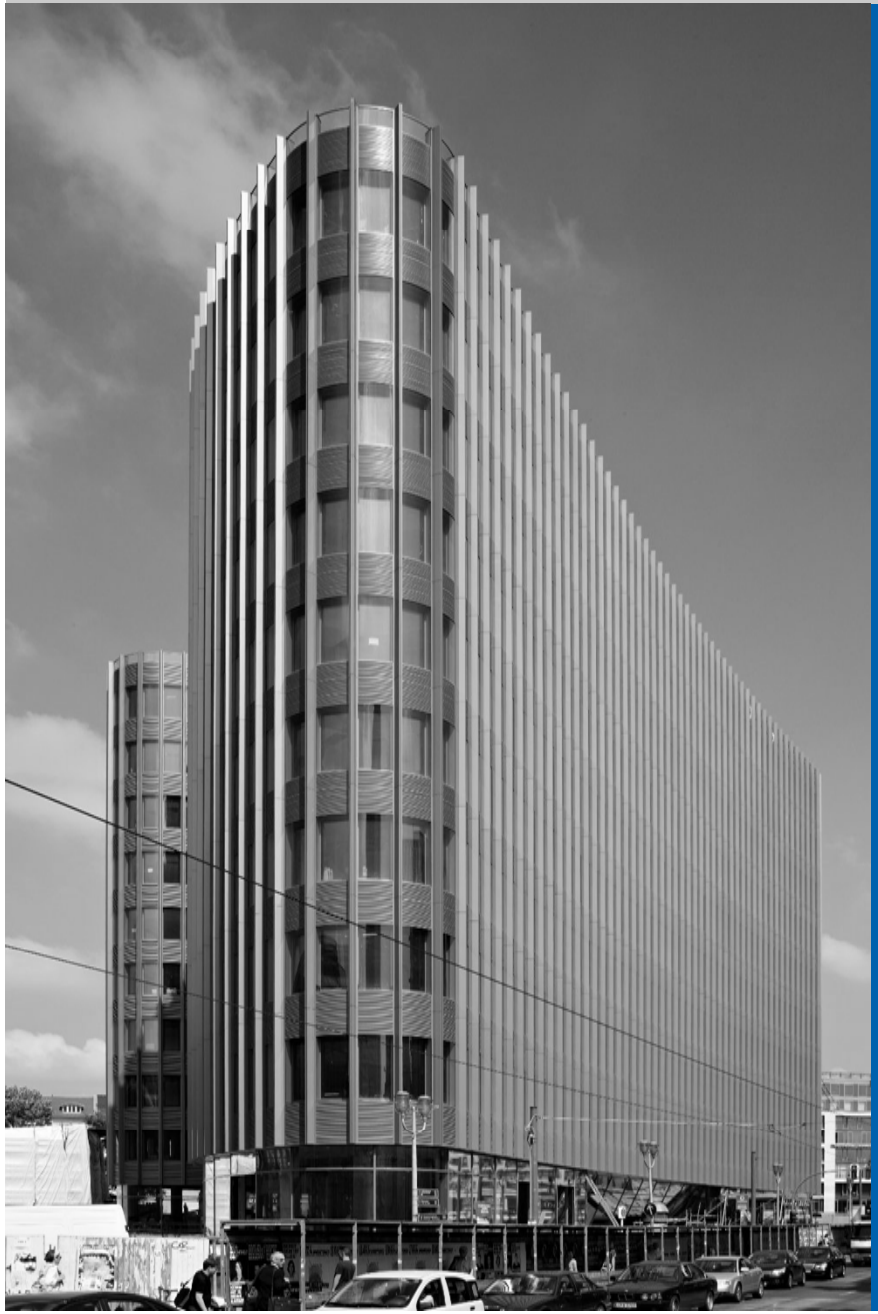

High-Rise Buildings

Integral planning - an approach for energy efficiency and functionality

Alexander Schröter

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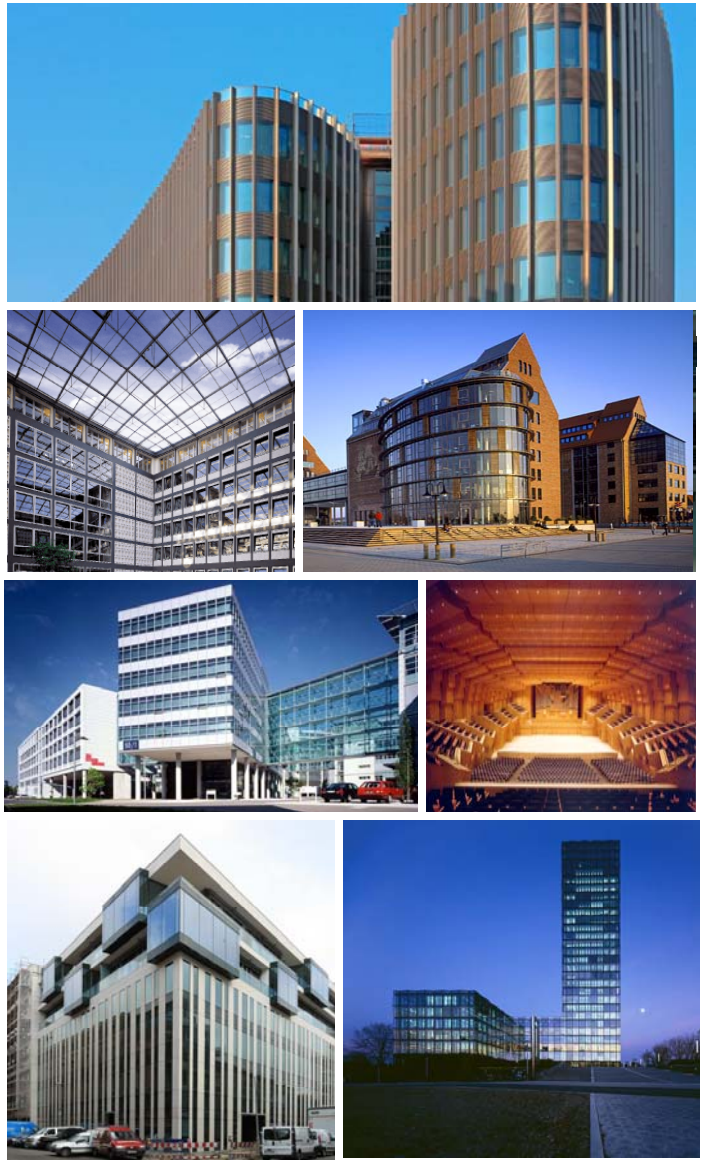
- integral planning / integrated design
- building physics
  -> approach for energy efficiency
- double skin facades
  + natural ventilation
- phenomena of high-rise buildings
- conclusion



Integral planning

Integral Planning

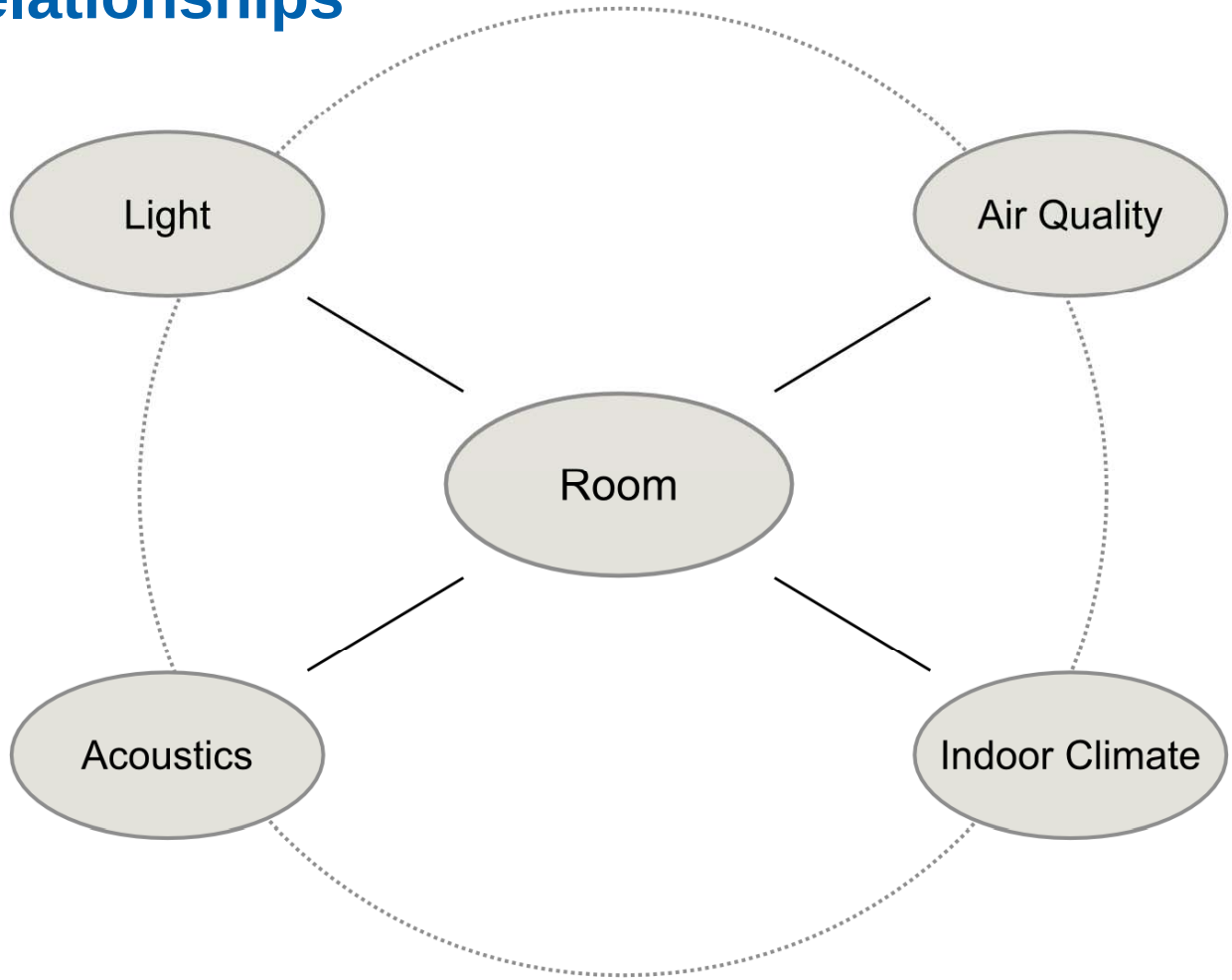
primary aims constructing a building:

- comfortable spaces for people (shelter from outdoor climate)
- with minimum effort (capital cost, technics, energy consumption)
- and minimum environmental impact

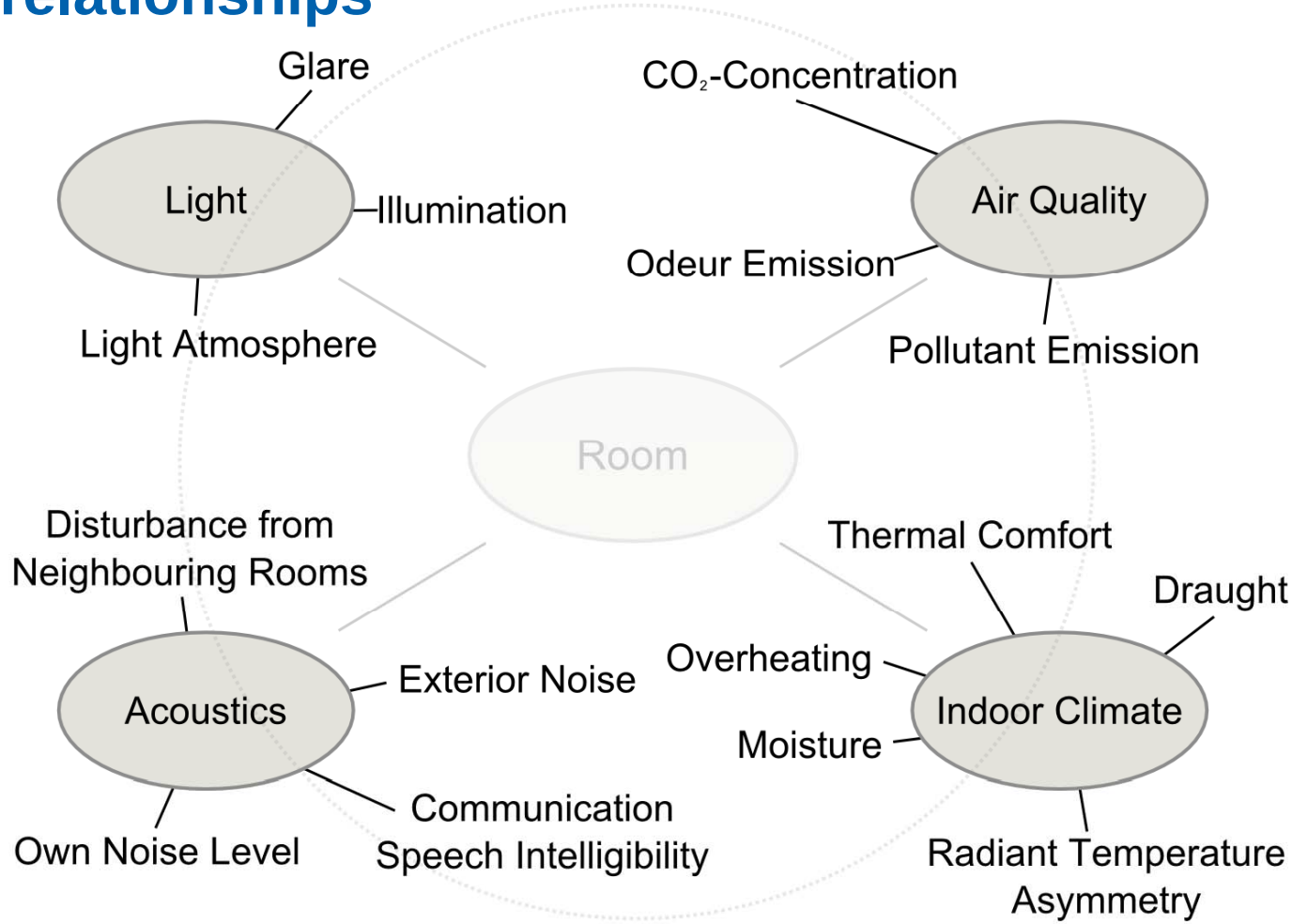
=> economic + sustainable solution

buildings are prototypes and rather complex ...

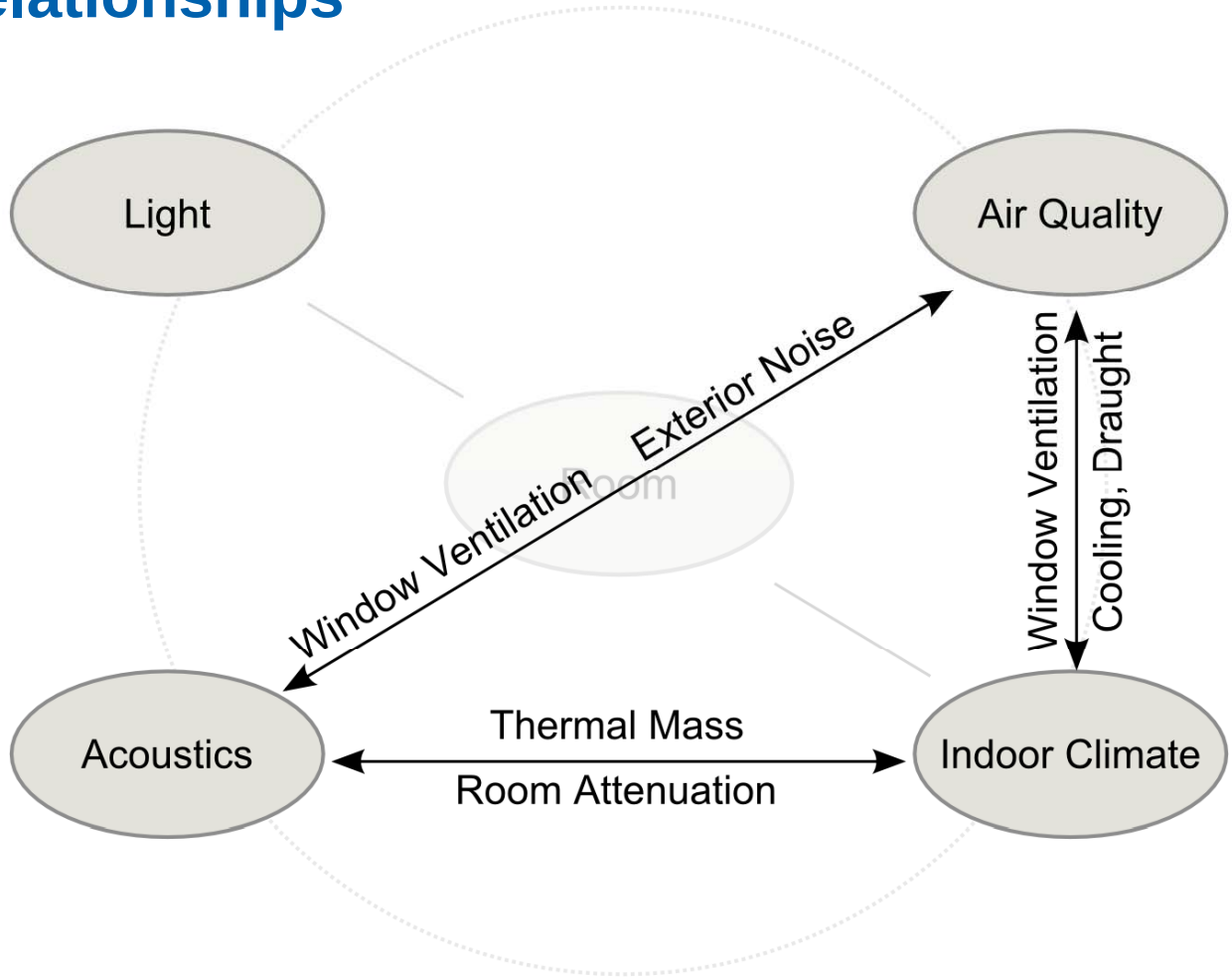
Interrelationships



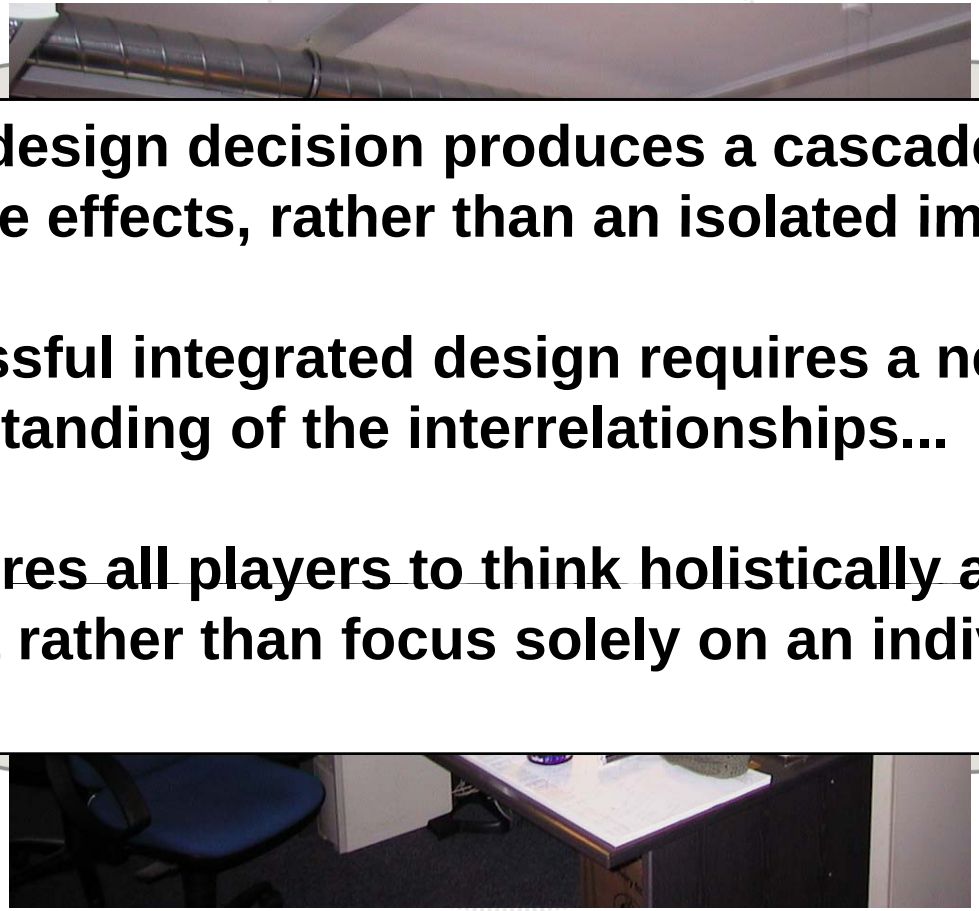
Interrelationships



Interrelationships



Interrelationships



Every design decision produces a cascade of multiple effects, rather than an isolated impact.

Successful integrated design requires a necessary understanding of the interrelationships...

It requires all players to think holistically about the project rather than focus solely on an individual part.

integral planning

requirements of integral planning:

- communication !!!
- collaboratively working team (generalists + specialists)
- consideration of the constraints (e.g. site ...)
- clear definition of the aims + control of the actual output
- special investigations / planning tools (e.g. simulations ...)

=> **possibly more time consuming planning process**
+ higher planning costs
but worth invested

building physics

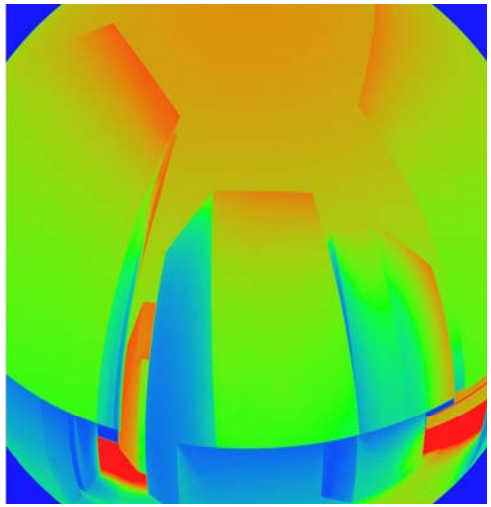
building physics approach for energy efficiency:

- let the building itself do most of the job !!
- focus on passive measures + utilisation of natural resources

  - high quality facade
  - utilisation of thermal masses
  - natural ventilation
  - nightcooling
  - daylighting

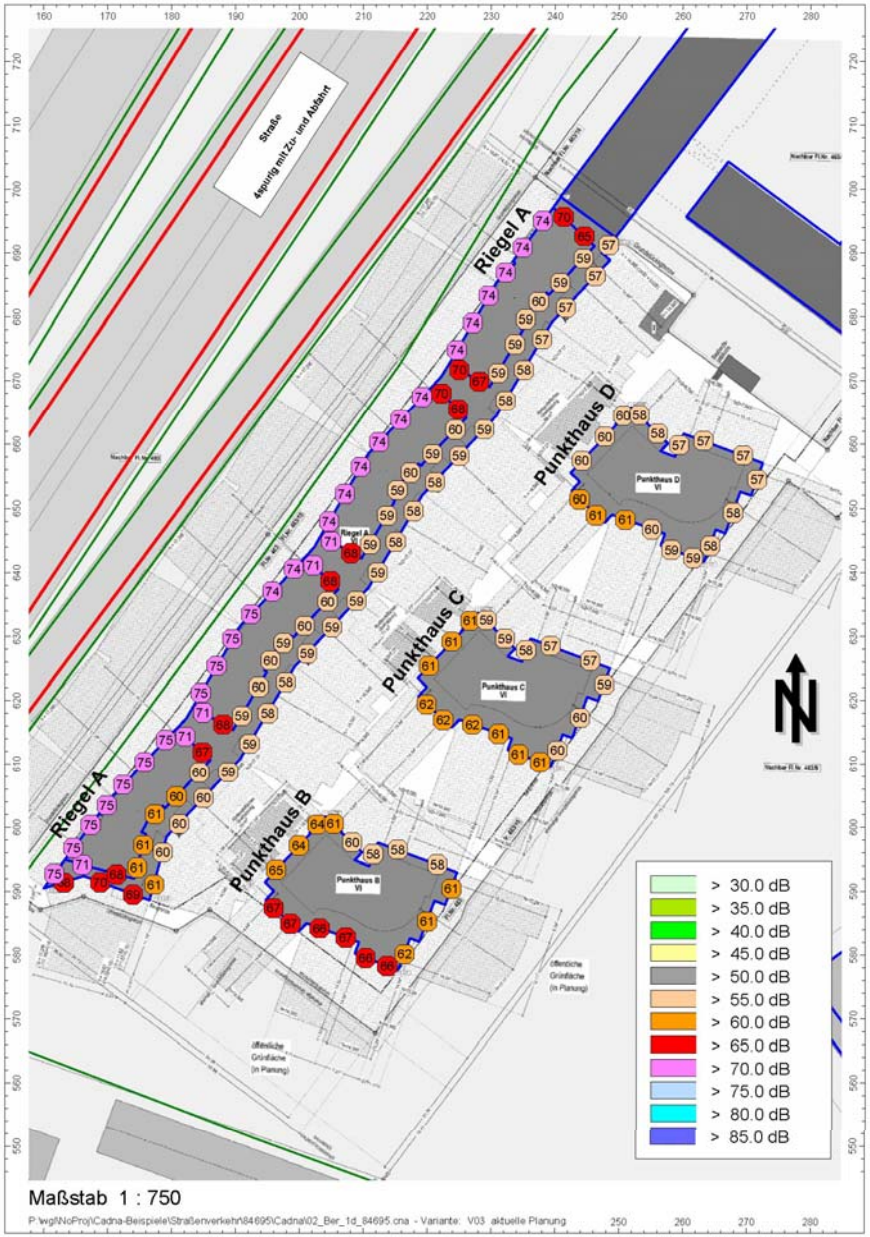
Site constraints


B1
B2
B3
B4
B5
B6
B7
V1
V2
V3
V4
V5
V6
V7
V8
V9



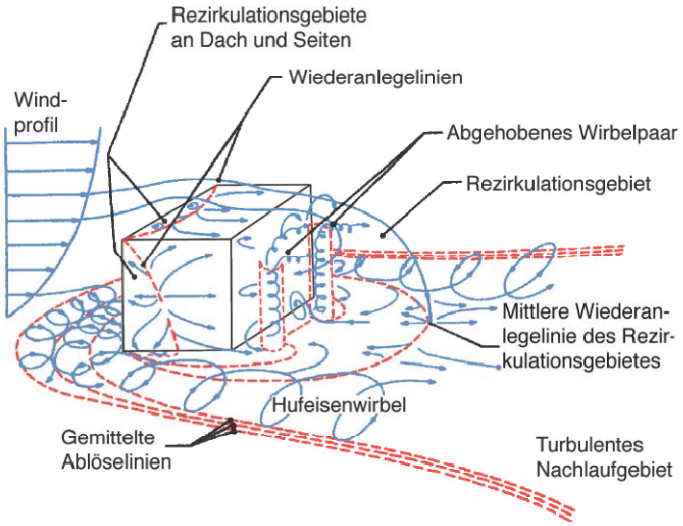
V4

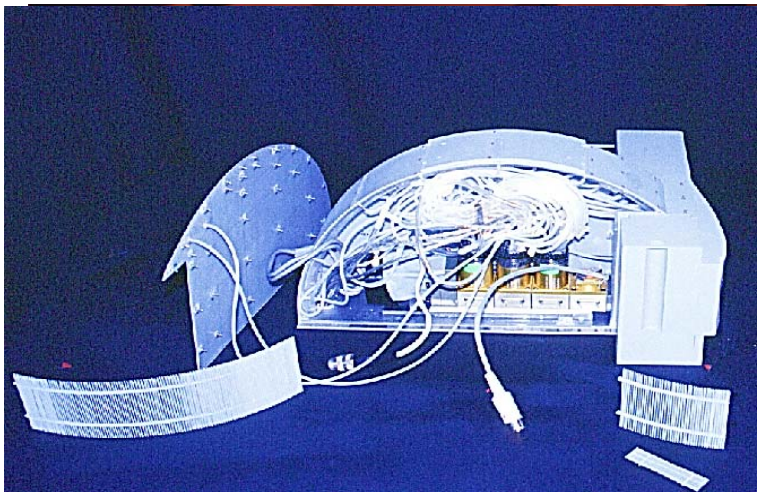
V5

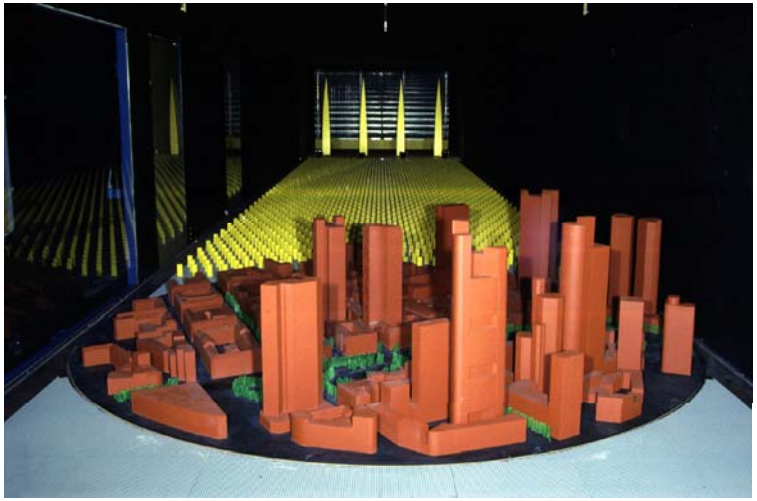

Straße
Riegel A
Punkthaus D
Punkthaus C
Punkthaus B
> 30.0 dB
> 35.0 dB
> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB
> 80.0 dB
> 85.0 dB
Maßstab 1 : 750

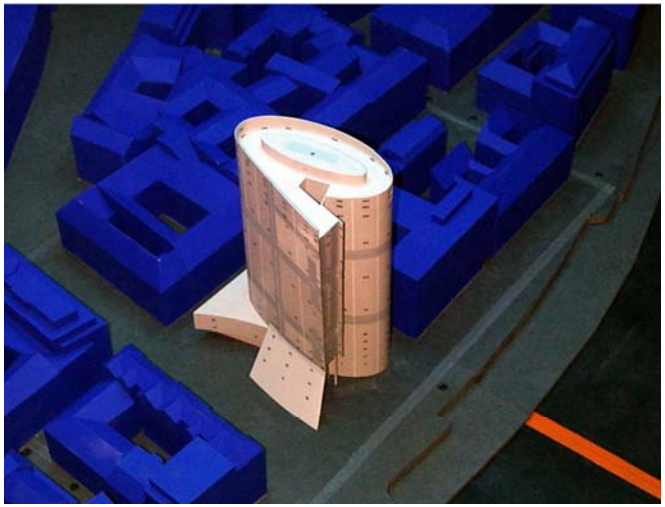
V6

Wind tunnel tests



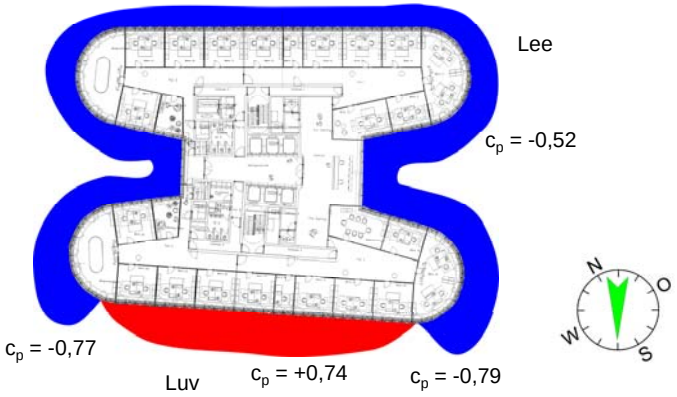




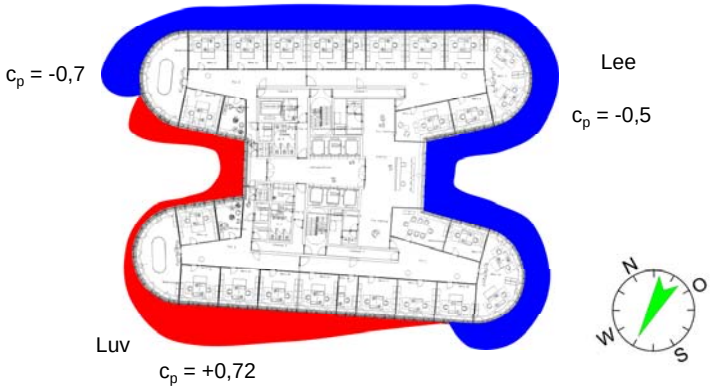


Wind tunnel tests - pressure distribution

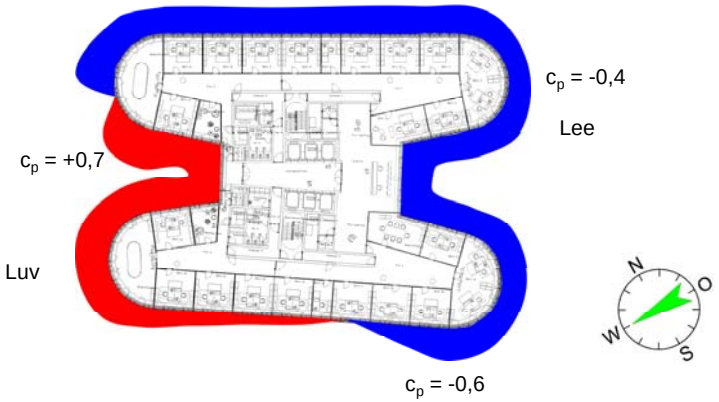
wind from SSW (210°)



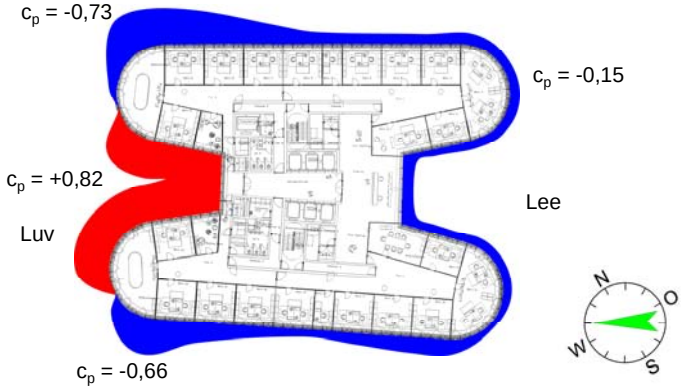
wind from WSW (240°)



wind from west (270°)



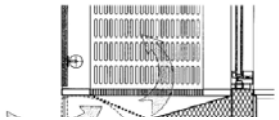
wind from WNW (300°)



pressure suction

Double skin facades

Double skin facades



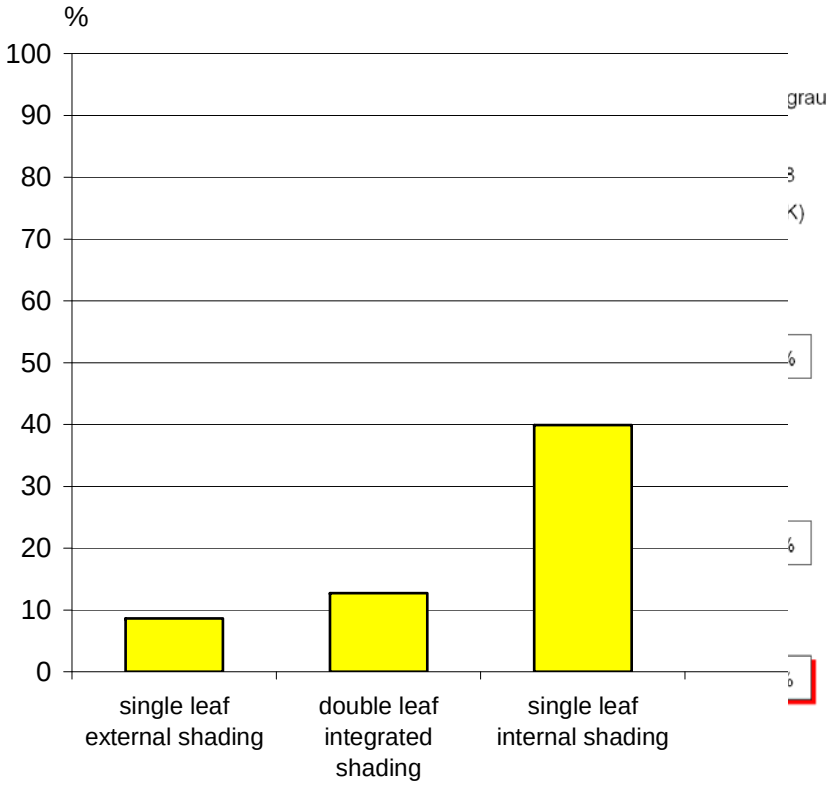
advantages / potential:

- wind protection for the sun sh
- natural ventilation of high-rise
- sound insulation (opened win

disadvantages:

- higher investment costs for th
- higher costs for cleaning !!
- reduced intensity of ventilatio
- overheating in the facade gap

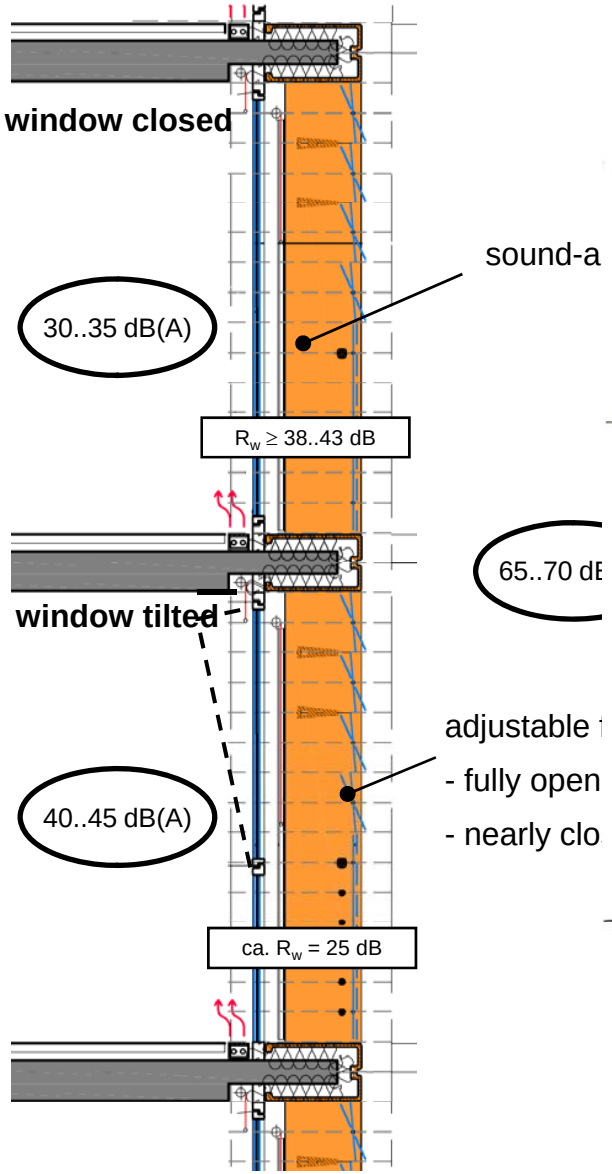
Solar factor

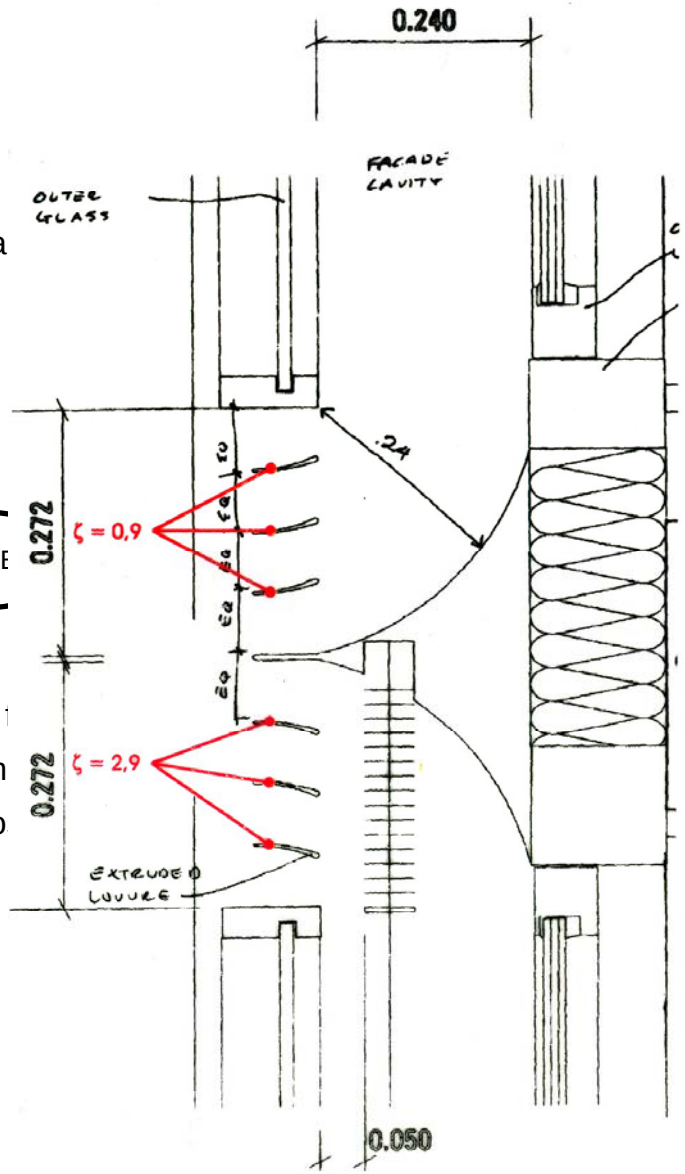


Double skin

Design par

- cellular d
- concept
- openings
- hydraulic
- depth of
- glazings
- sun shad
- surfaces





Double skin facades

When does a double skin facade make sense ?

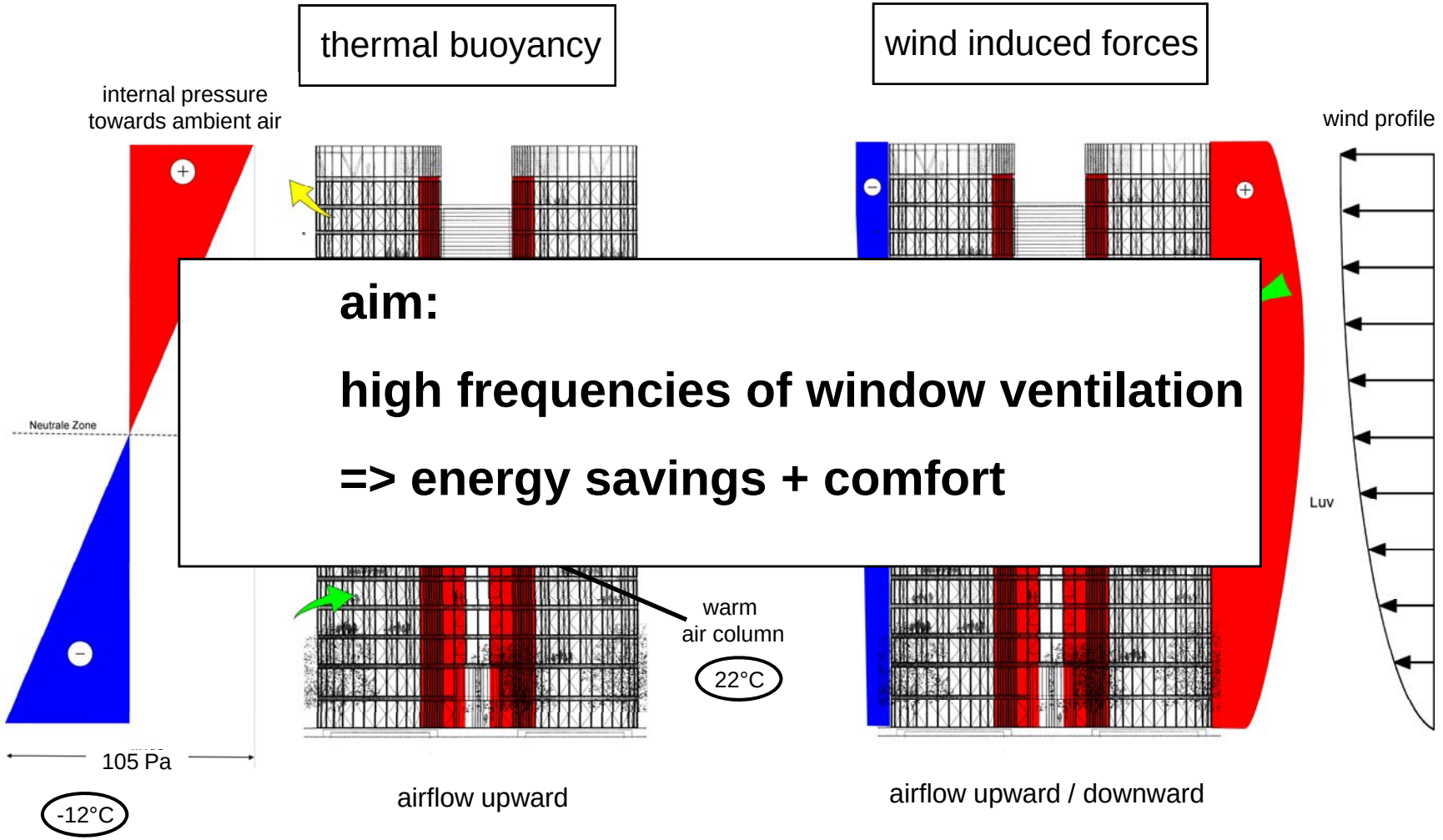
- external noise (but limited)
- high-rise buildings
  (natural ventilation, wind protection for the sun shade)

=> but well planned design of the facade
and adapted concept of climatisation necessary

=> integrated design

Natural ventilation

Naturally driven air flow through a skyscraper



aim:

high frequencies of window ventilation

=> energy savings + comfort

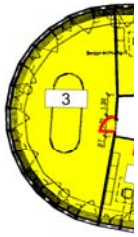
Natural ventilatio

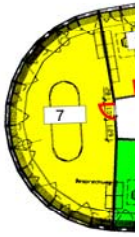
Limits:

- draught
- increased forces f
- high air temperatu

Optimisation:

- building geometry
- design of the faca
- high potential with
- separations in the

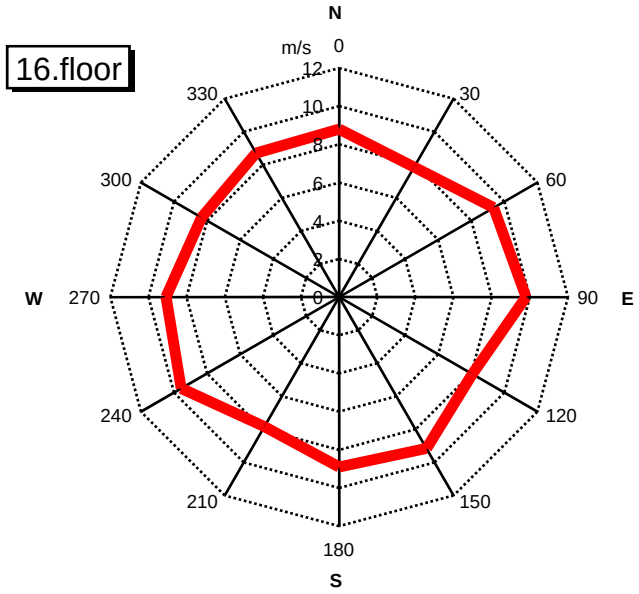




scenario:

- one windov
- doors of of
- one windov

wind



wind velocity limits for closing of the windows

double skin facades => limits are increased forces on doors

(results of an air flow simulation)

Thermal buoyancy during

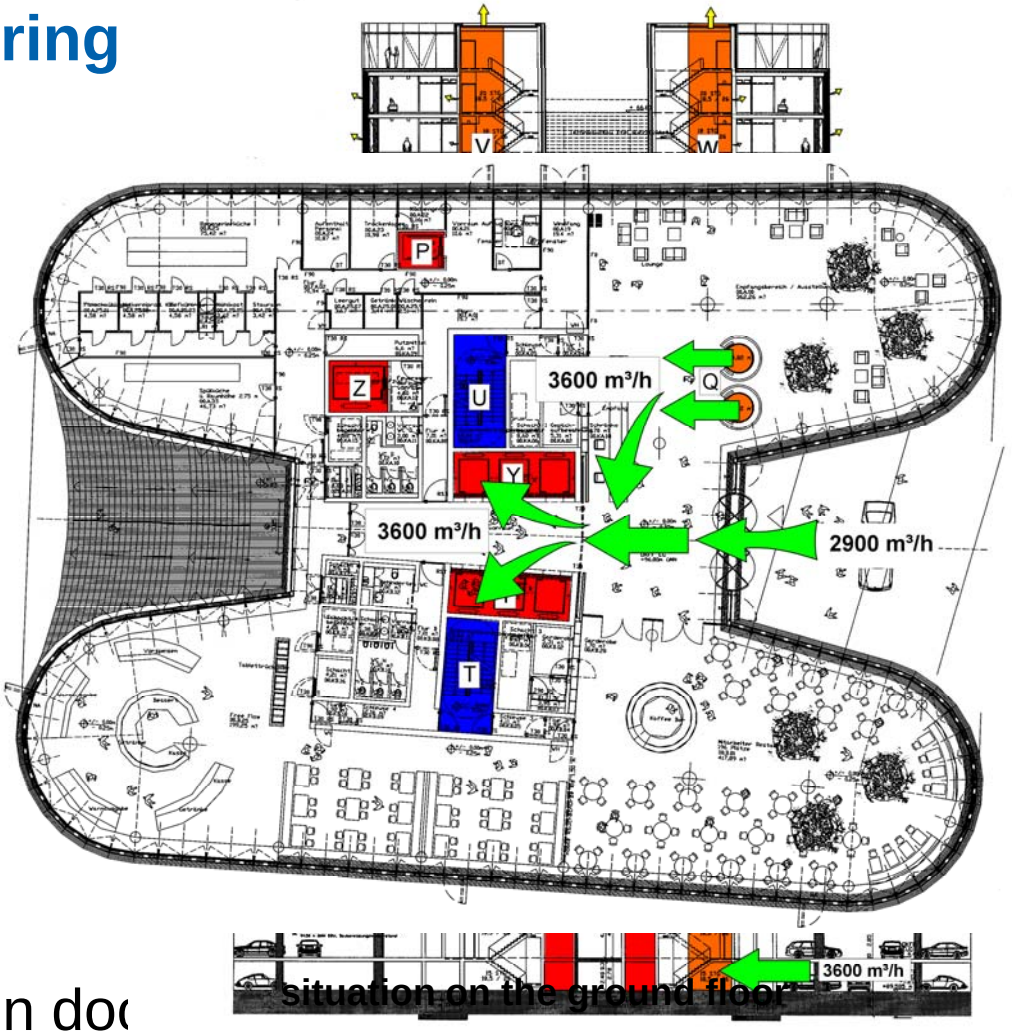
Causes:

- high temperature differ
- shafts (evators / stairc

=> stack effect

Effects:

- cold air entering foyers
- draught and sound in f
- increased forces to open do
- internal spreading of bad od



naturally driven air flow through a skyscraper in winter with low ambient temperatures

Thermal buoyancy during winter

Optimisation:

- tightness of shafts (upper ends, doors)
- tightness of doors esp. entrance doors
- separation by doors
- tightness of the facade
- seperations in the building (doors)

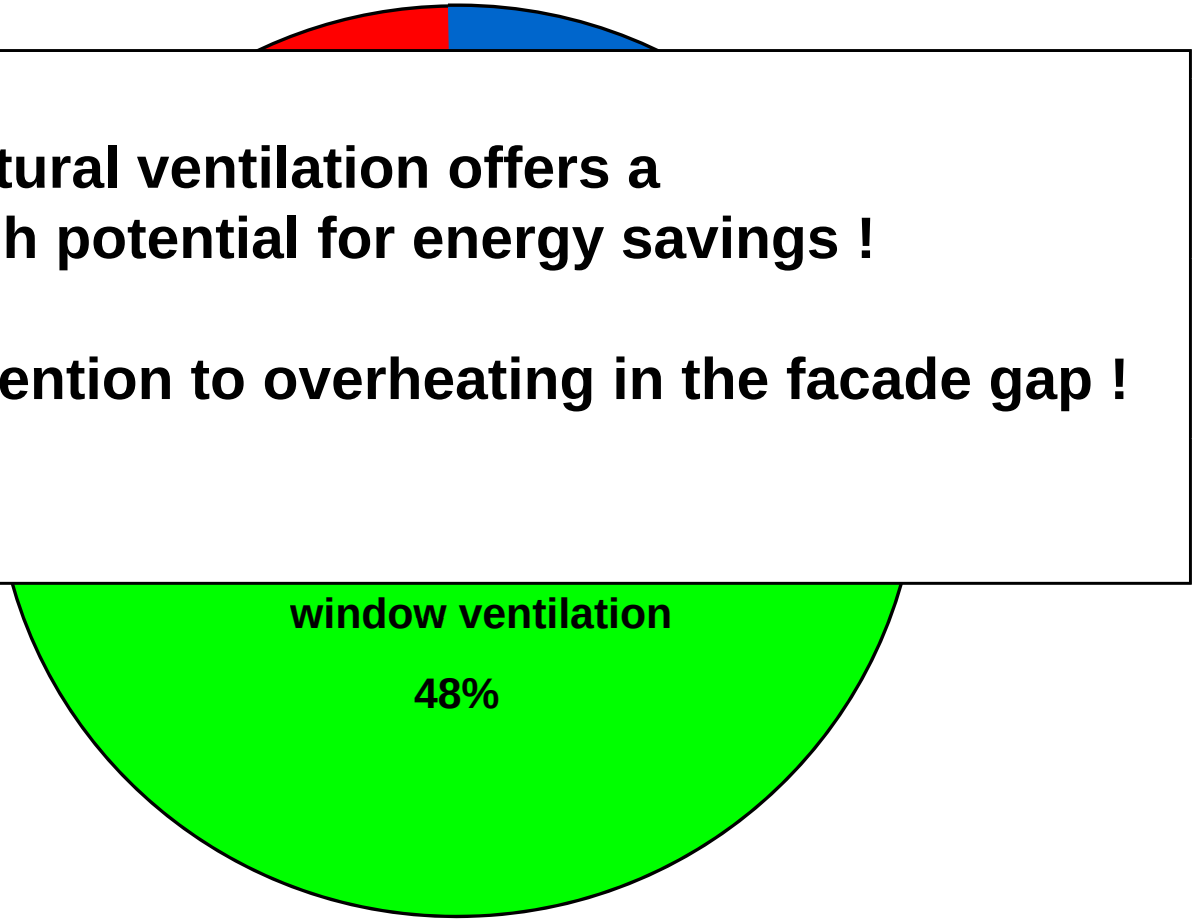
Often isolated measures have an high impact.

=> Analysis to detect the main air flow paths

=> At low ambient temperatures windows have to be closed !

Natural ventilation

How often can windows be opened ?



=> Natural ventilation offers a high potential for energy savings !

=> Attention to overheating in the facade gap !

Conclusion - Motivation for an integrated design

- comfort + functionality
- reduction of technical facilities
- sustainabilty
- planning reliability
- savings of investment + operating costs

=> solution that fits requirements of the client

Dekuji vám za pozornost - Thank you for your attention

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