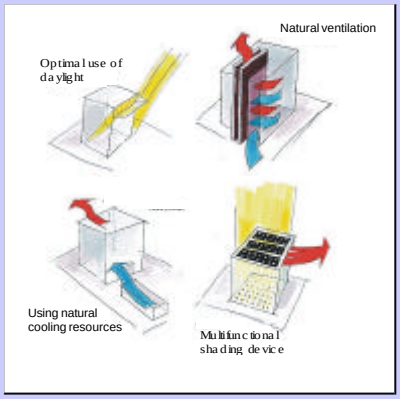

Design and evaluation of Bioclimatic Buildings

Torsten Welfonder

Transsolar Energietechnik GmbH
Stuttgart • Munich • New York
www.transsolar.com

Barcelona, June 15th 2006

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TRANSSOLAR

Project locations:

Germany	40%
other Europe	20%
Asia	10%
North America	30%

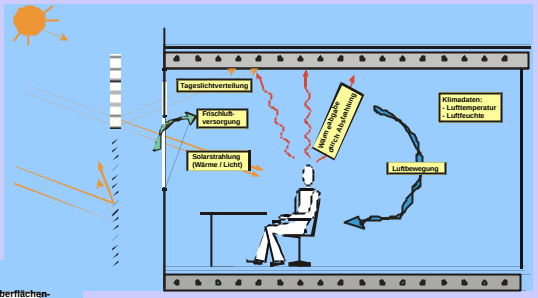
Stuttgart (28)

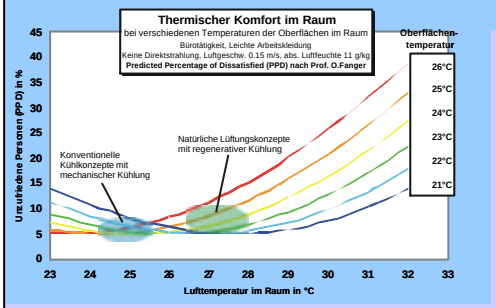
New York (1-2)

München (6)

2003 - extending from Stuttgart

- Air temperature
- Radiation temperature
- Solar radiation
- Air velocity
- Humidity
- Activity
- Clothing





Comfort evaluation DIN/ISO 7730

Thermal Comfort influences

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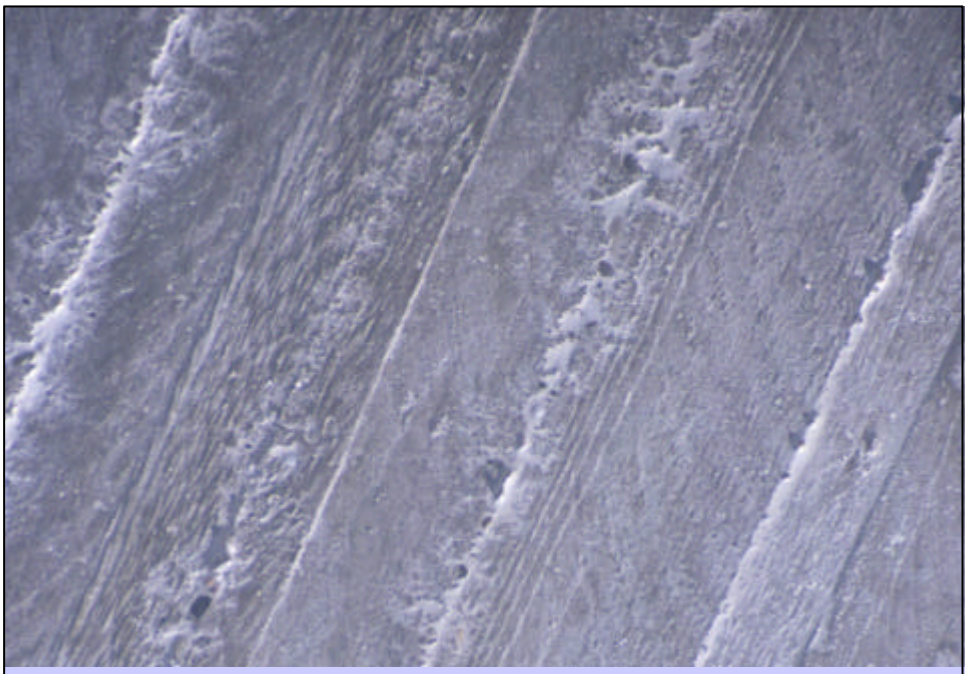
Physics



Conduction

Energy transport through a material

Depending on:

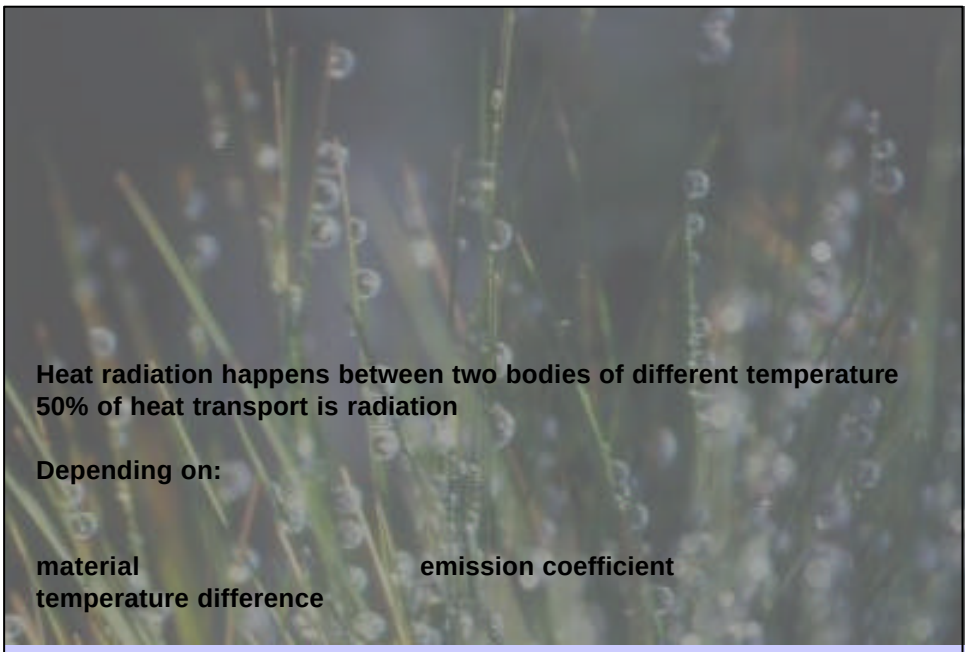
material

density
heat capacity
conductivity

temperature difference

Conduction

Heat-Radiation

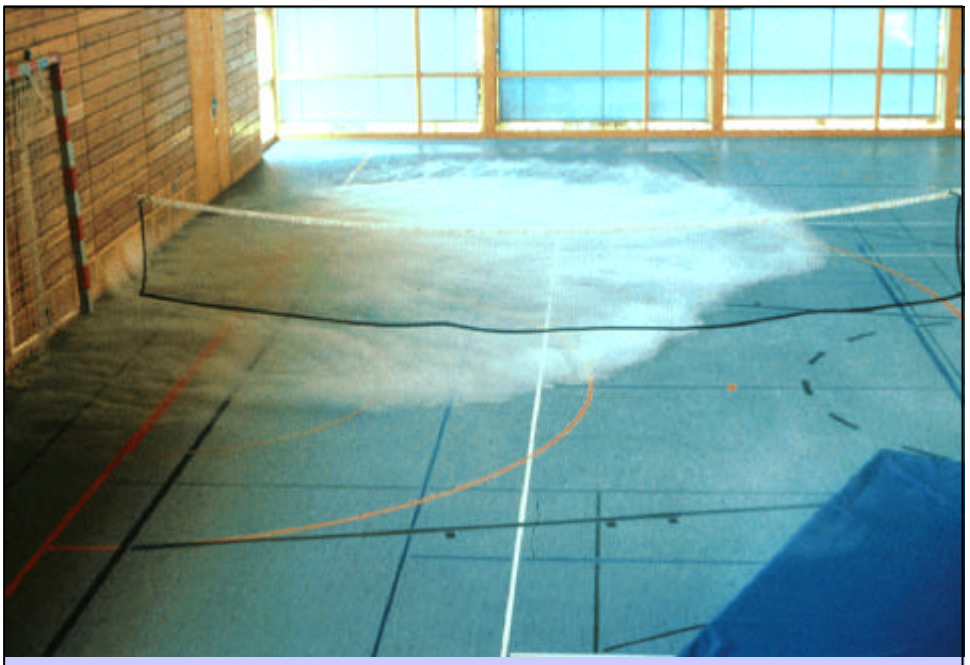


Heat radiation happens between two bodies of different temperature
50% of heat transport is radiation

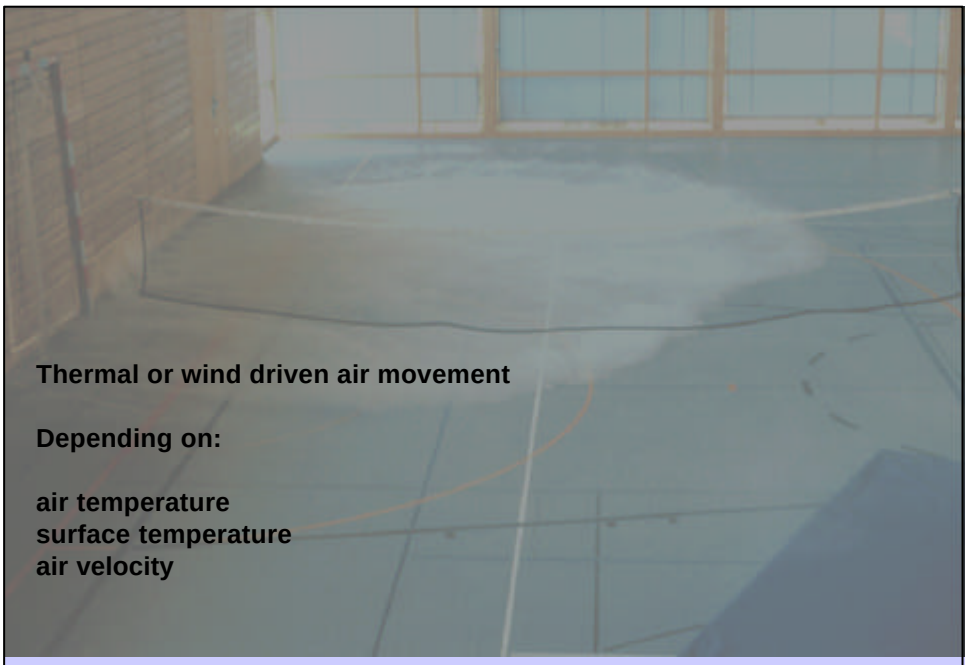
Depending on:

material **emission coefficient**
temperature difference

Heat-Radiation



Convection

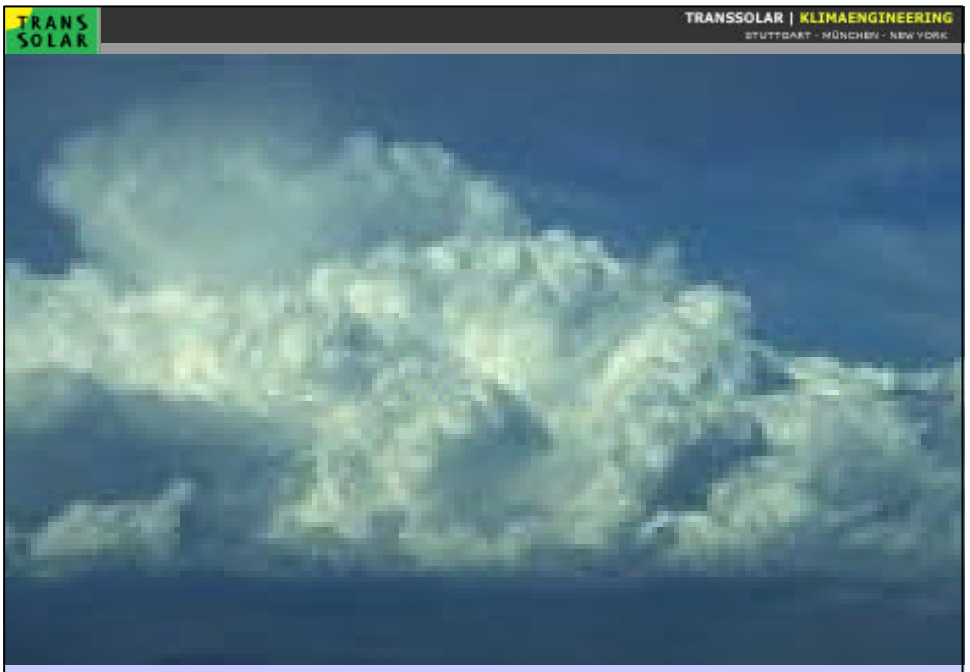


Thermal or wind driven air movement

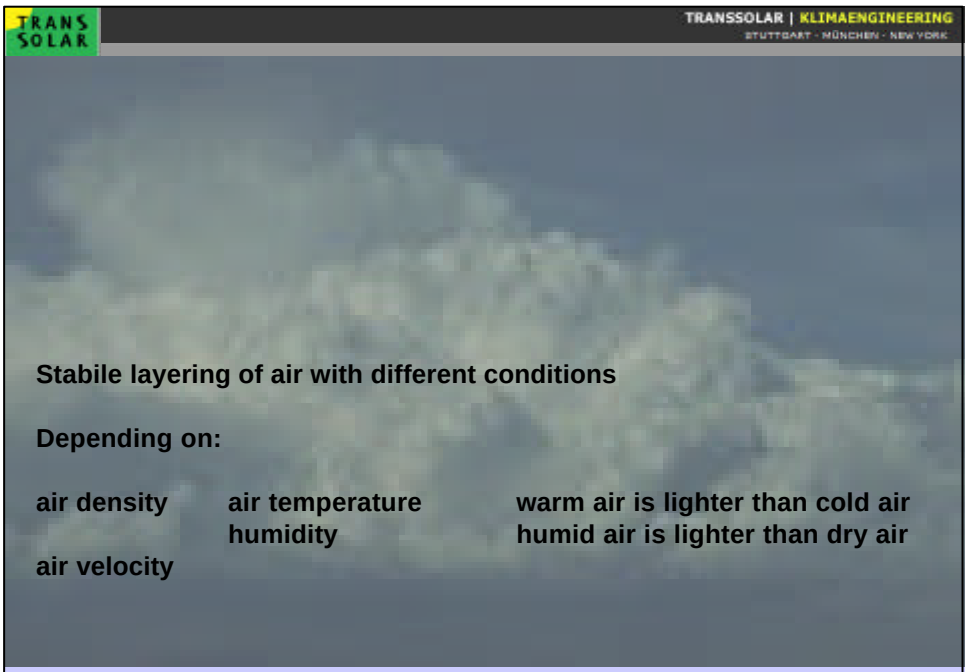
Depending on:

air temperature
surface temperature
air velocity

Convection

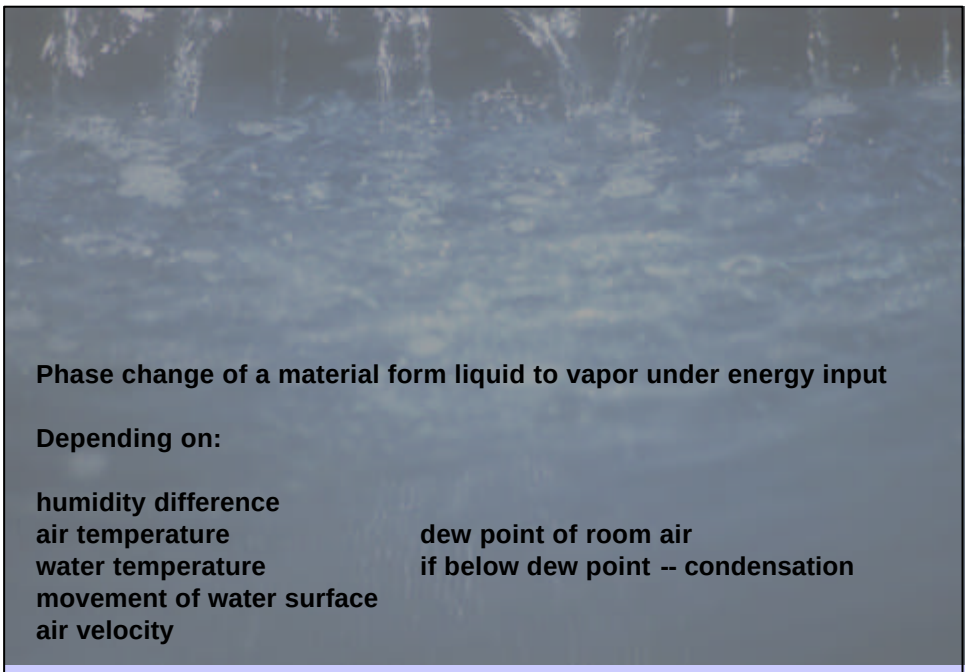


Stratification



Stratification

Evaporation



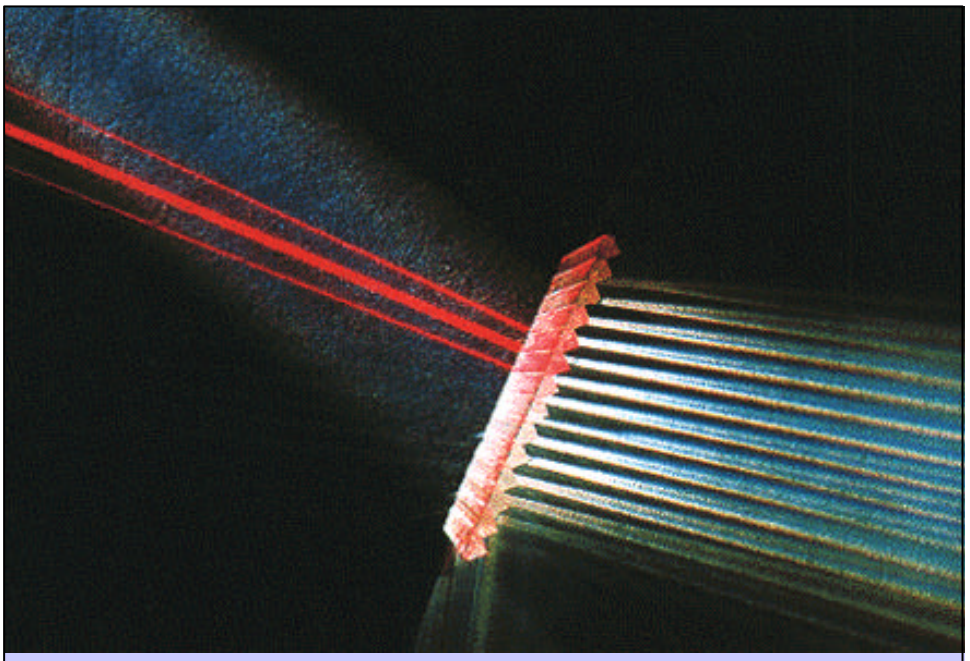
Phase change of a material form liquid to vapor under energy input

Depending on:

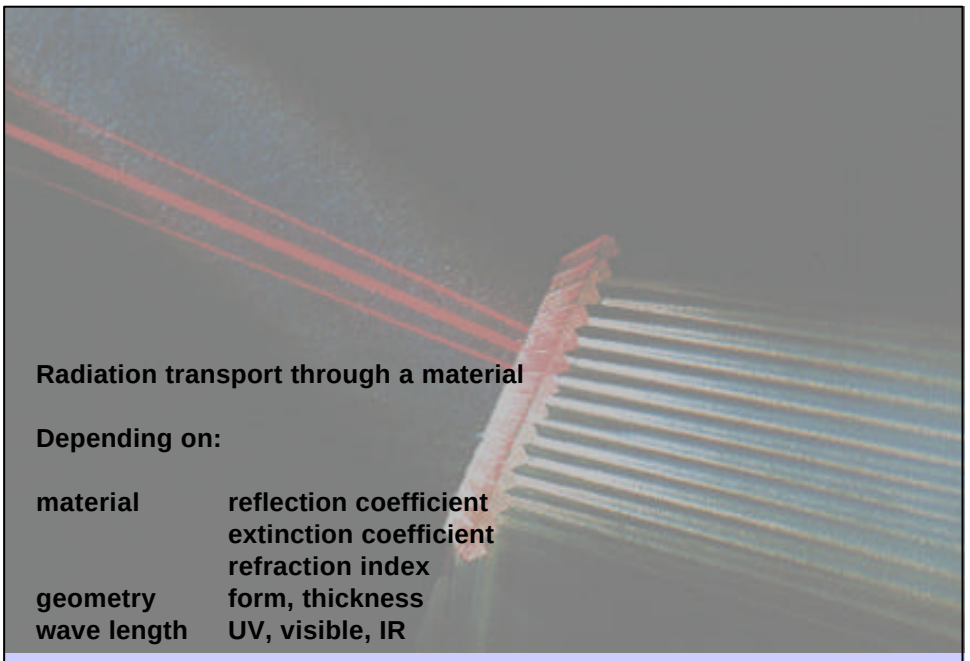
humidity difference
air temperature
water temperature
movement of water surface
air velocity

dew point of room air
if below dew point -- condensation

Evaporation



Transmission/Reflection



Radiation transport through a material

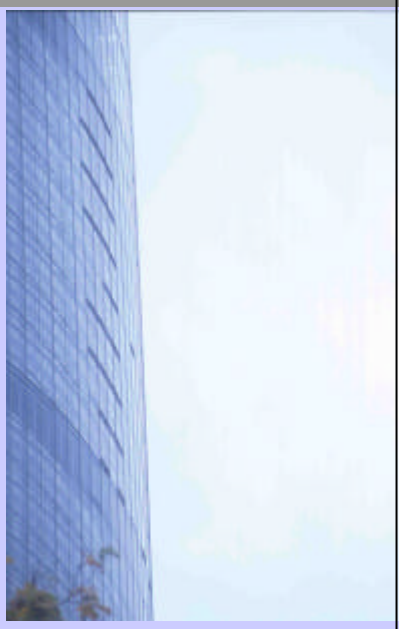
Depending on:

material	**reflection coefficient**
	extinction coefficient
	refraction index
geometry	**form, thickness**
wave length	**UV, visible, IR**

Transmission/Reflection

Deutsche Post, Bonn

Architect:
Murphy / Jahn, Chicago
Structure:
Werner Sobek Ingenieure, Stuttgart
Energy Concept:
Transsolar, Stuttgart
MEP Consultant:
Brandi Consult, Berlin



Breathing in the wind - Deutsche Post Tower, Bonn

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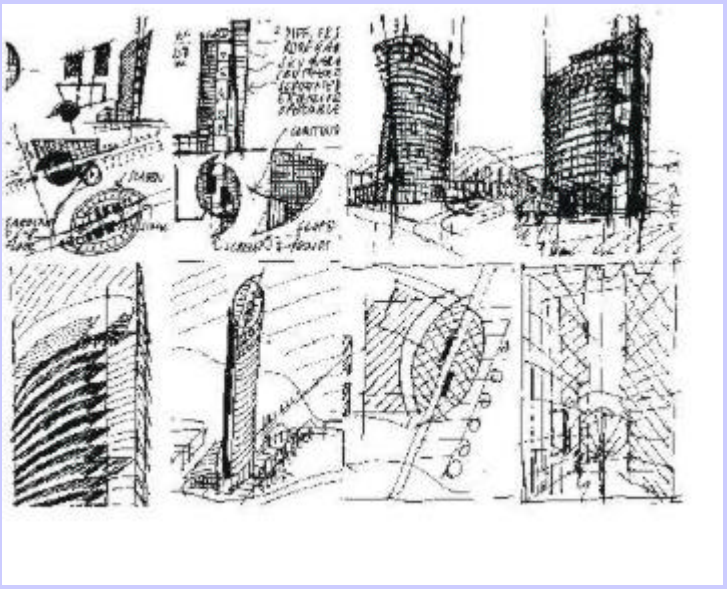
The Concept



Competition design sketches by Helmut Jahn

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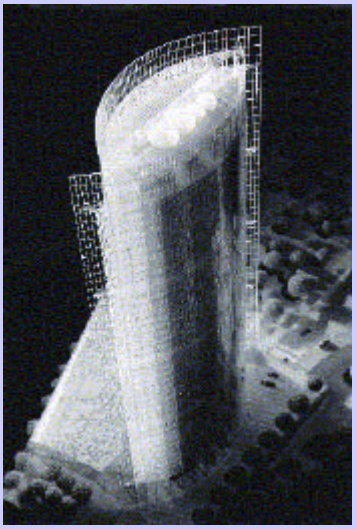
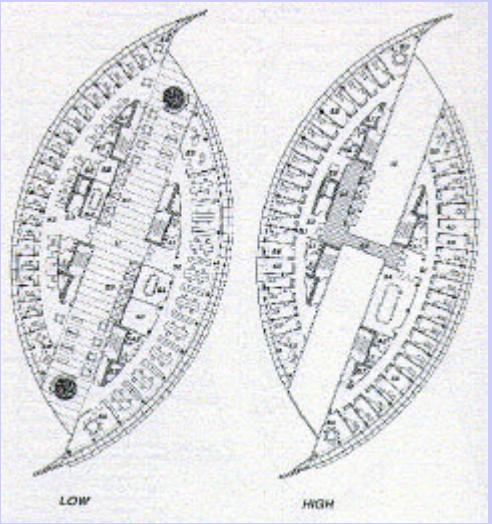
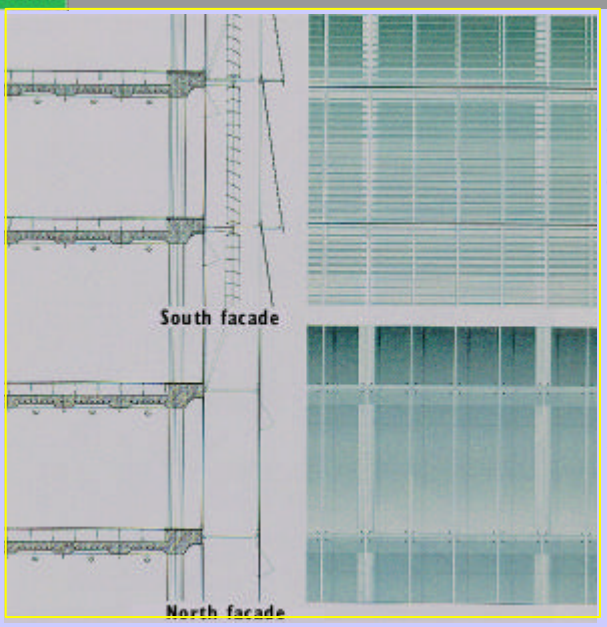




Deutsche Post AG



Facade concept

9 storey high vertical and horizontal open double skin

controlled openings
low presure differences

decentral ventilation units
air from double fassade

individual openings for natural ventilation

South side shingeled 1.35 deep

North side flat 0.85 m deep

Single low -iron glazing outside

Double glazing inside with low -e and Argon filling

Headquarter Deutsche Post AG, Bonn

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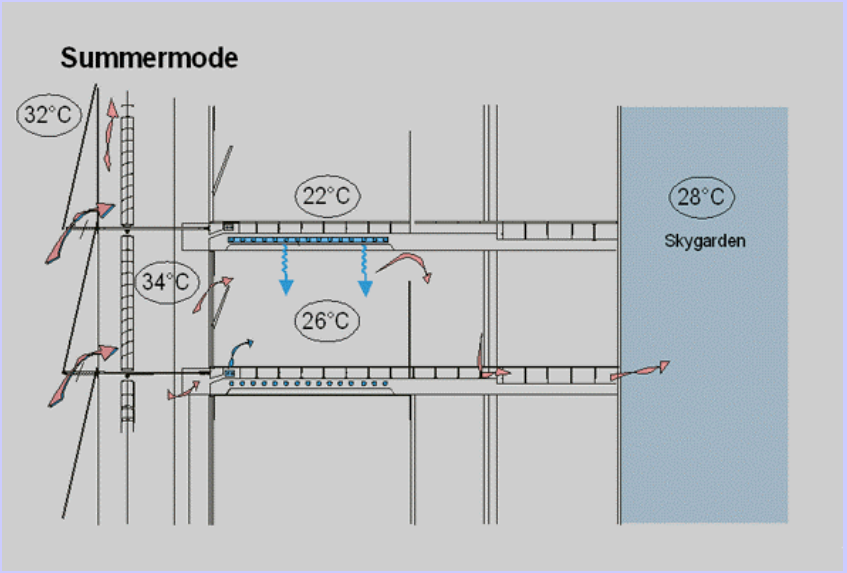
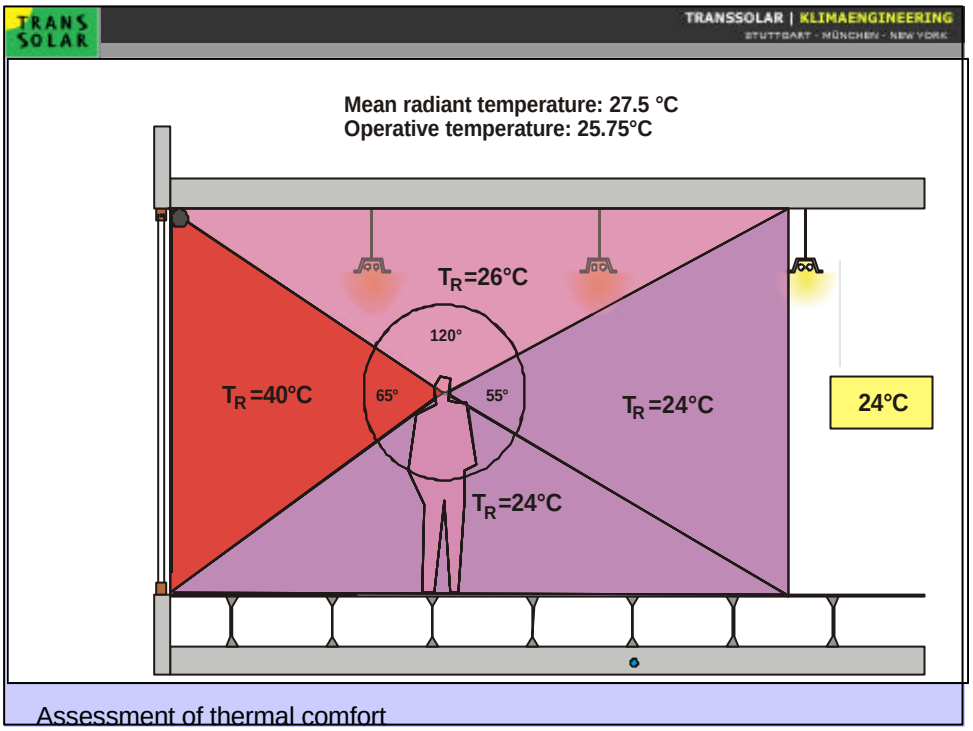
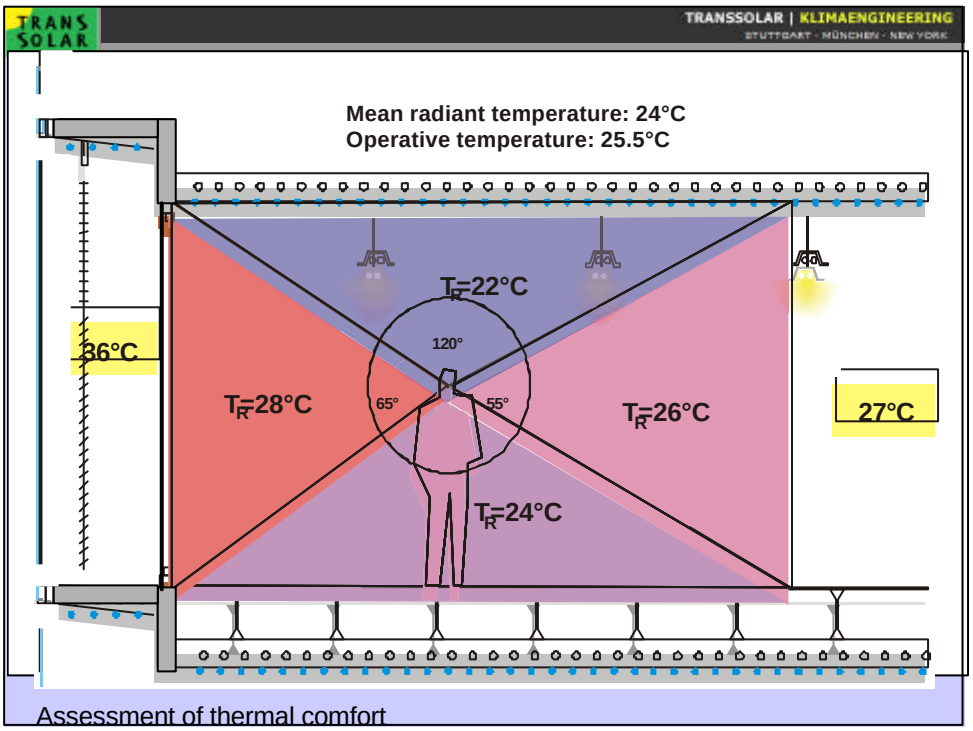
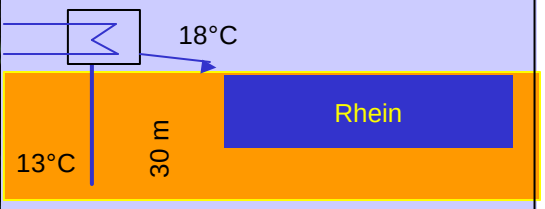


Headquarter Deutsche Post AG, Bonn


TRANSSOLAR | KLIMAENGINEERING
STUTTGART - MÜNCHEN - NEW YORK
Mean radiant temperature: 27.5 °C
Operative temperature: 25.75°C
T_R=26°C
120°
T_R =40°C
65°
55°
T_R =24°C
24°C
T_R=24°C
Assessment of thermal comfort


TRANSSOLAR | KLIMAENGINEERING
STUTTGART - MÜNCHEN - NEW YORK
Mean radiant temperature: 24°C
Operative temperature: 25.5°C
T_R=22°C
36°C
120°
T_R=28°C
65°
55°
T_R=26°C
27°C
T_R=24°C
Assessment of thermal comfort



Energy source through 2 ground water wells

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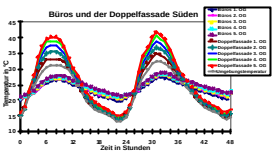
concept evaluation in the designphase - simulations and component tests

Professional Design Tools

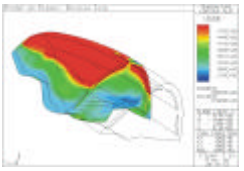
Dynamic Thermal Simulation (TRNSYS; TRNFLOW):

- dynamic thermal behaviour of a building depending on: thermal mass, weather conditions, internal and external gains, solar radiation, condensation problems
- energy consumption and power demand
- comfort evaluation
- airflow simulations



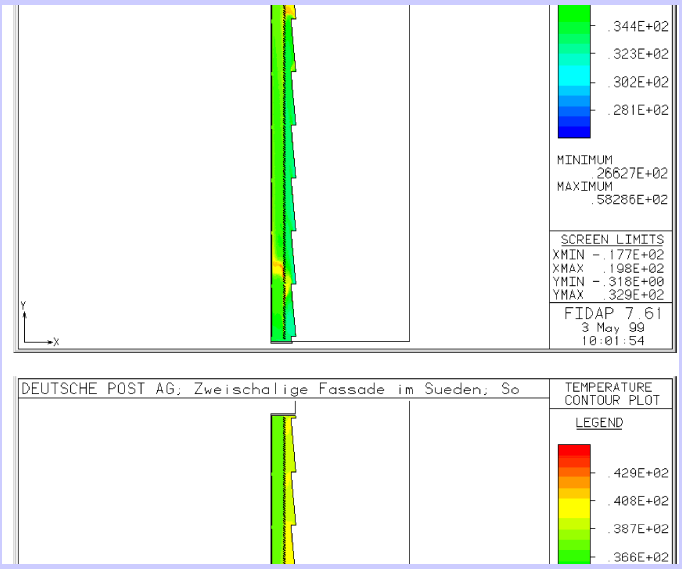
Computational Fluid Dynamics, CFD (Fluent):

- calculation and visualisation of air flows
- details of natural convection systems, stratification effects
- comfort aspects

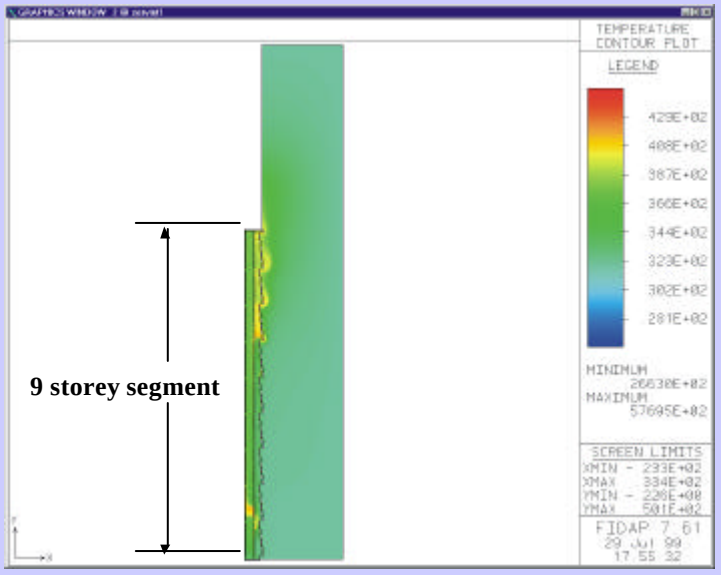


Daylighting Analysis by Simulation (Radiance) :

- calculation and visualisation of luminance and illuminace distributions
- optimisation of glazing and shading quality, shading details for complex geometry's both in spatial and temporal resolution
- analysis of contrast ratios and glare in the visual field
- visual comfort aspects



Temperature distribution in the facade cavity



Deutsche Post AG, Bonn

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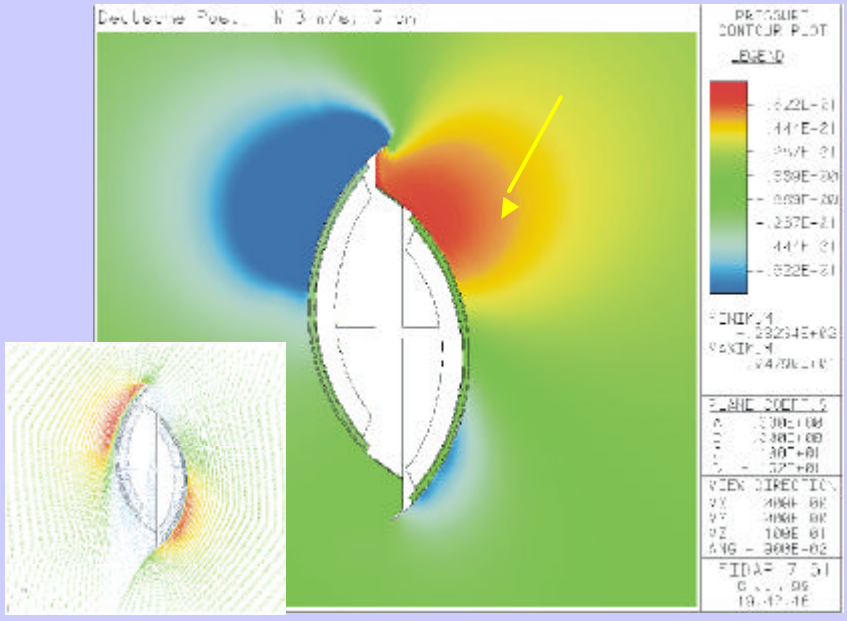
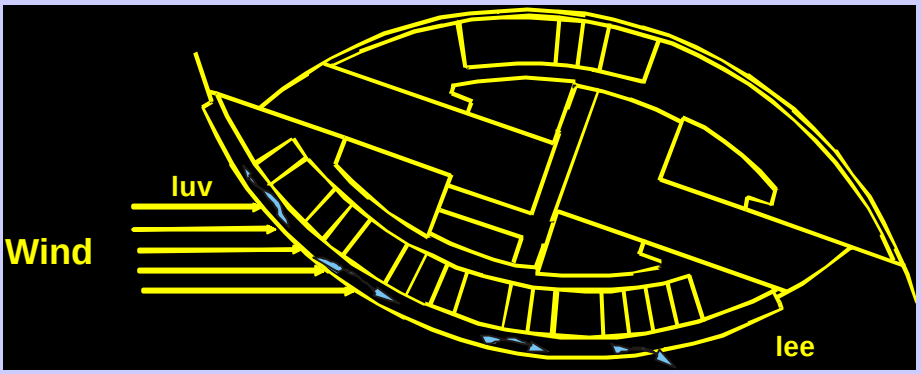
Deutsche Post AG, Bonn



Wind effected pressure distribution

Wind pressure reduction through cross flow in the double facade

TRNFLOW Simulations



Deutsche Post AG

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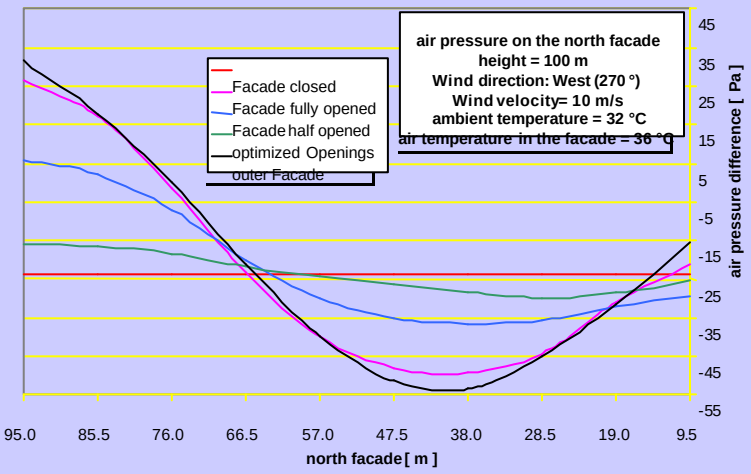

Air pressure in and in front of the facade

Decentralized air supply unit

- Air intake fan coil unit for individual heating/cooling
- sound reduction up to 42 dBa
- low pressure drop
- return air stop flap
- quite basic ventilation > 30 dBA fan noise

Component development

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1:1 component and concept tests

The building process

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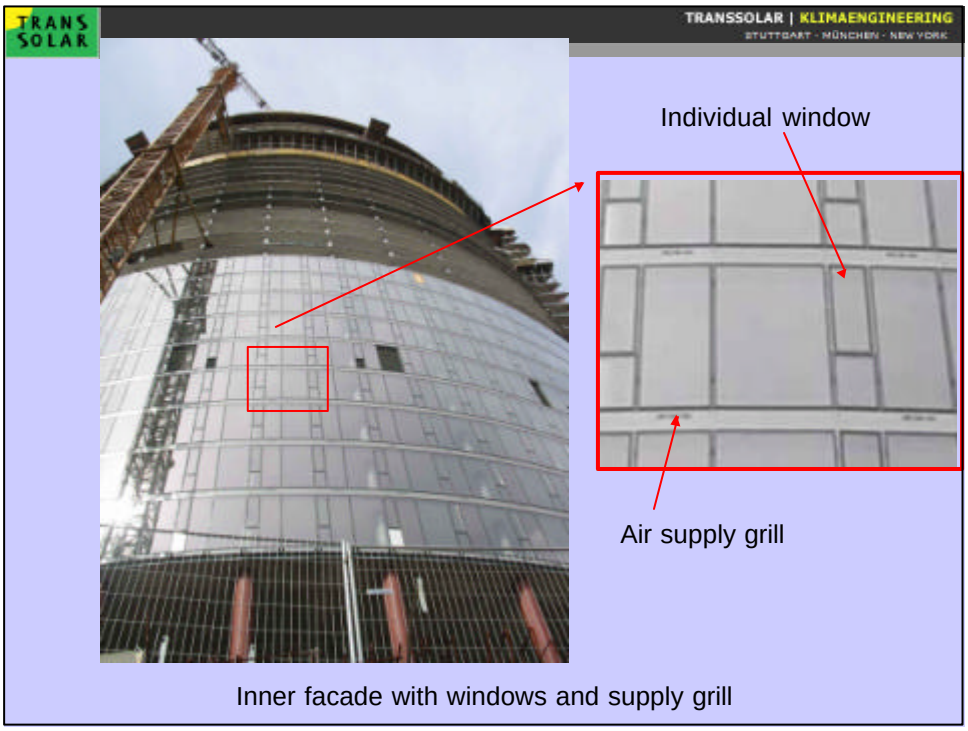
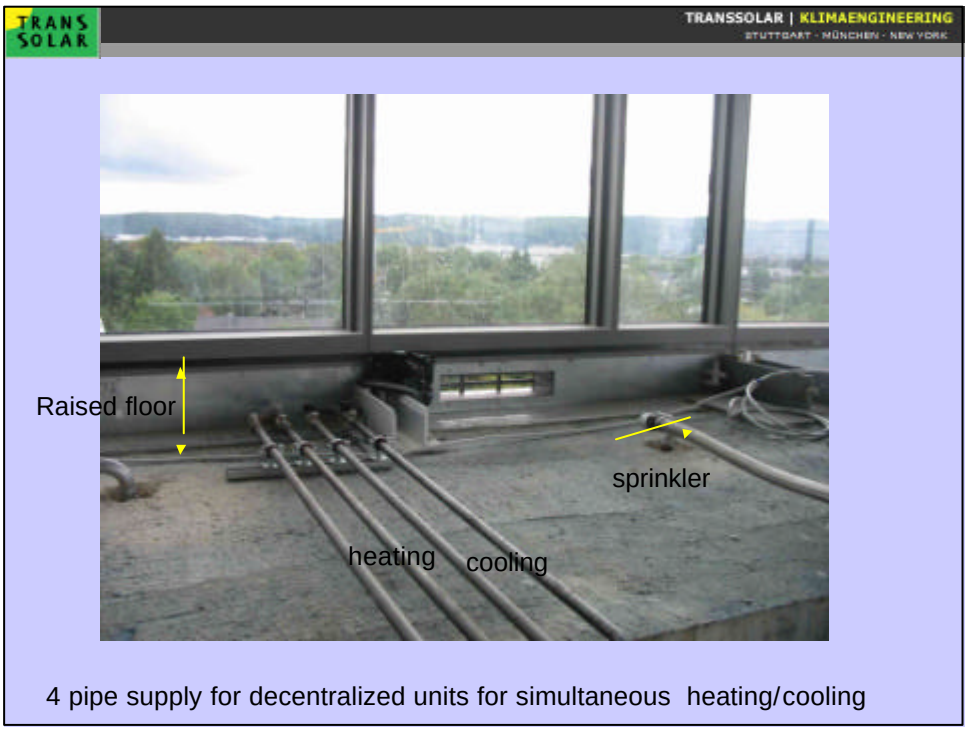
- middle position in the ceiling section
- 80% active
- for office, corridors and meeting rooms
- spiral circles
- circle length up to 120 m
- Pex-pipe 20 mm diameter

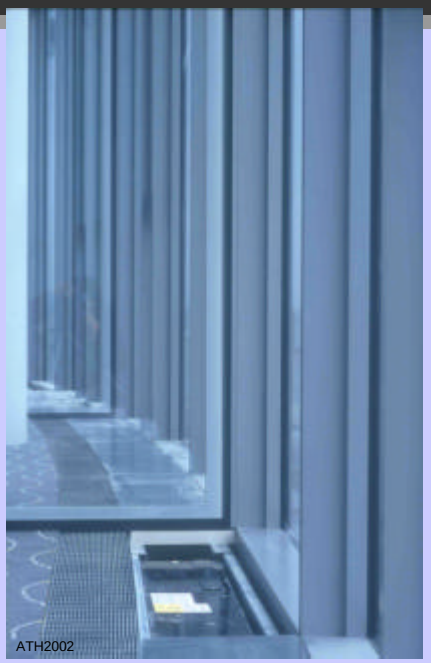
Building integrated cooling in the concrete ceilings



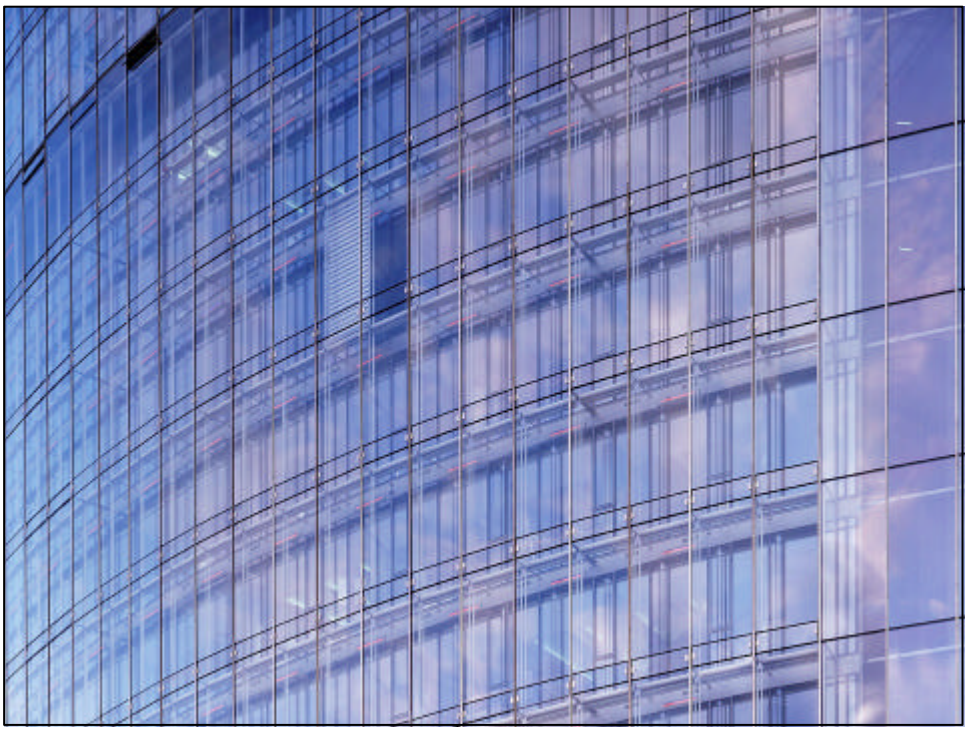
Inner facade with windows and supply grill

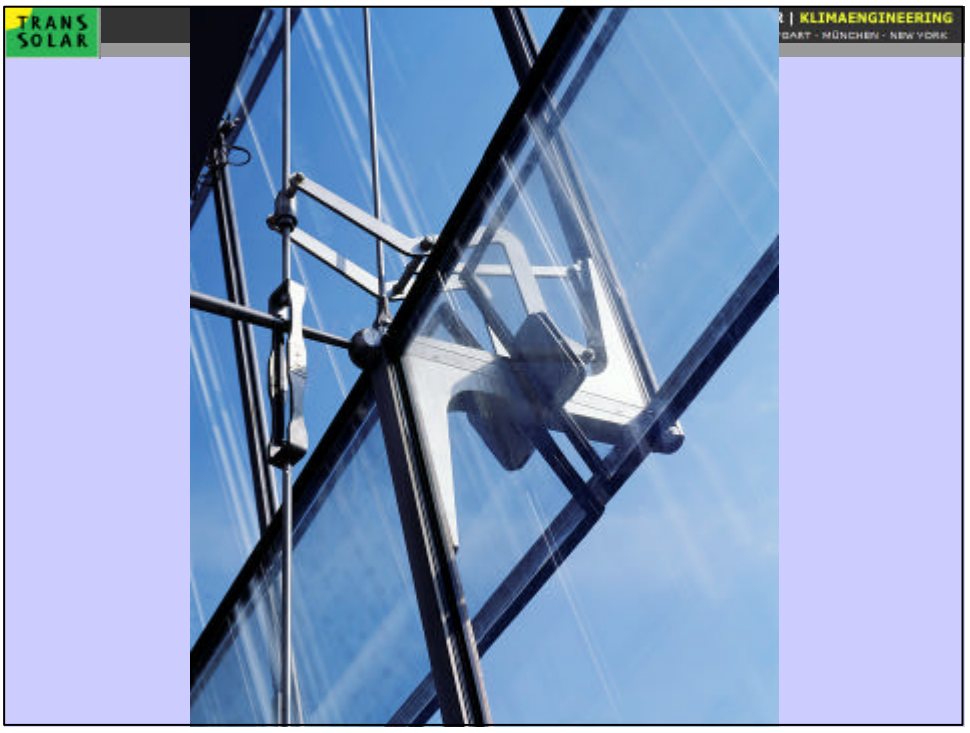


4 pipe supply for decentralized units for simultaneous heating/cooling



Decentralized air conditioning

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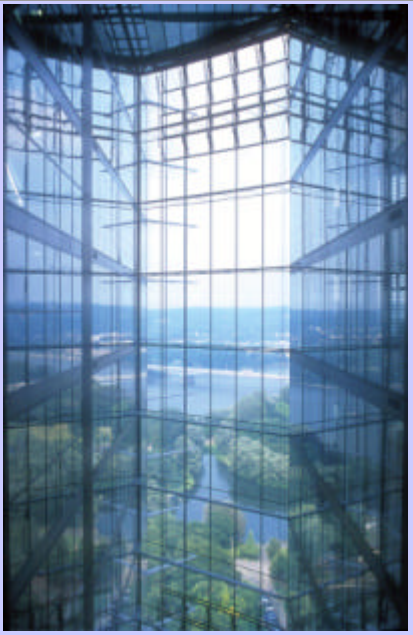
STUTTGART · MÜNCHEN · NEW YORK



Skygarden

Office floor

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evaluation by mesurements

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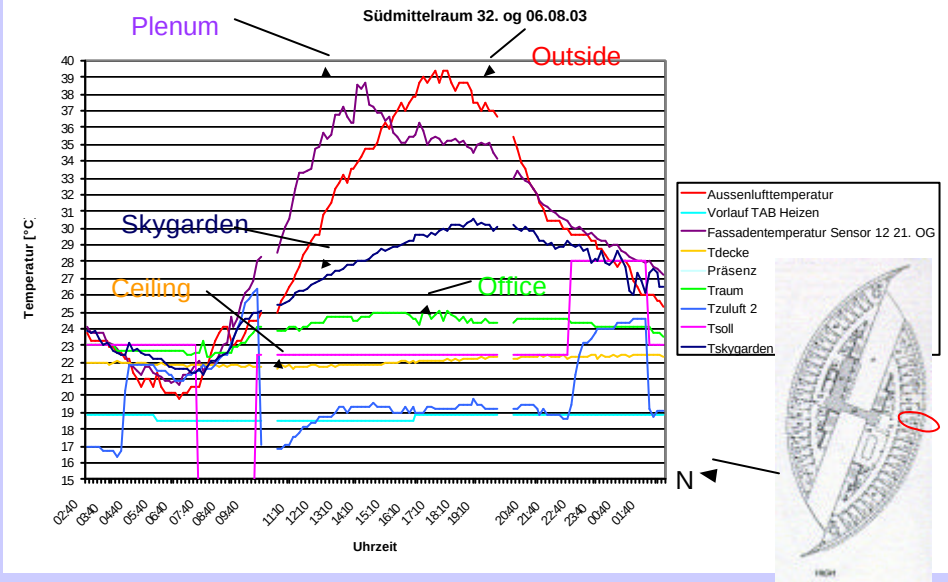
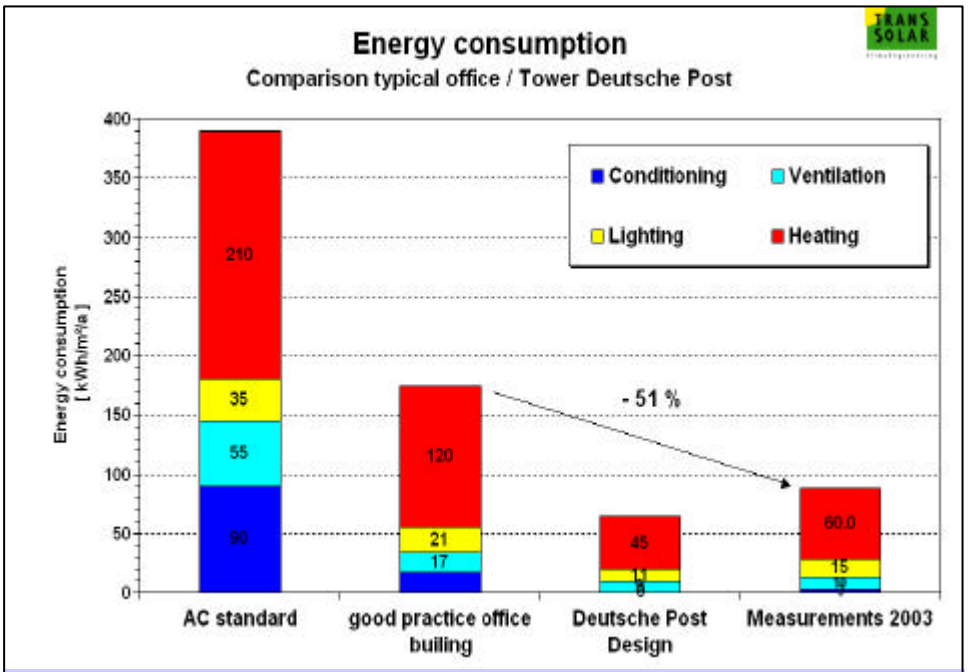


Real test under extrem conditions - July-August 2003



Design versus reality 2003

Deutsche Post from North-East

?? Applicable in Spain

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Parcela 15, Madrid, AUIA Architects

Site

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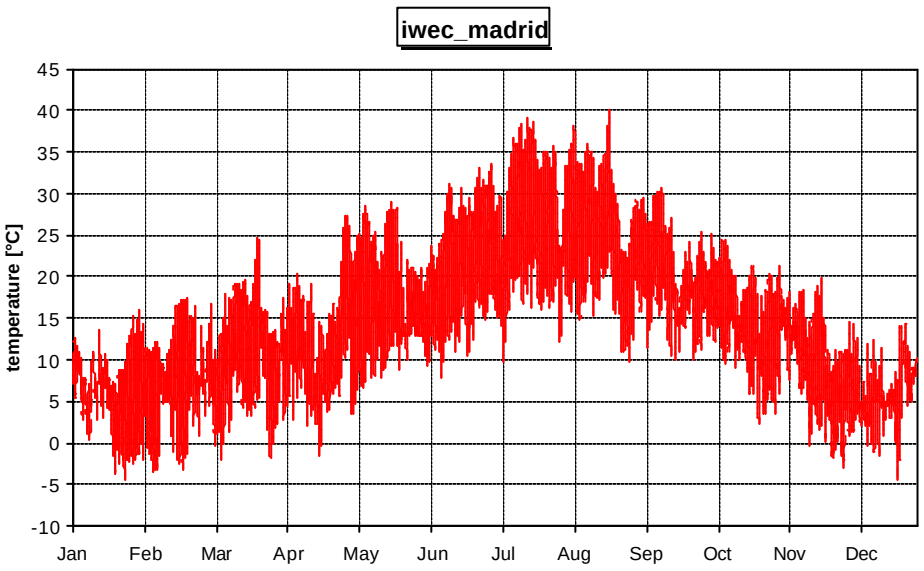
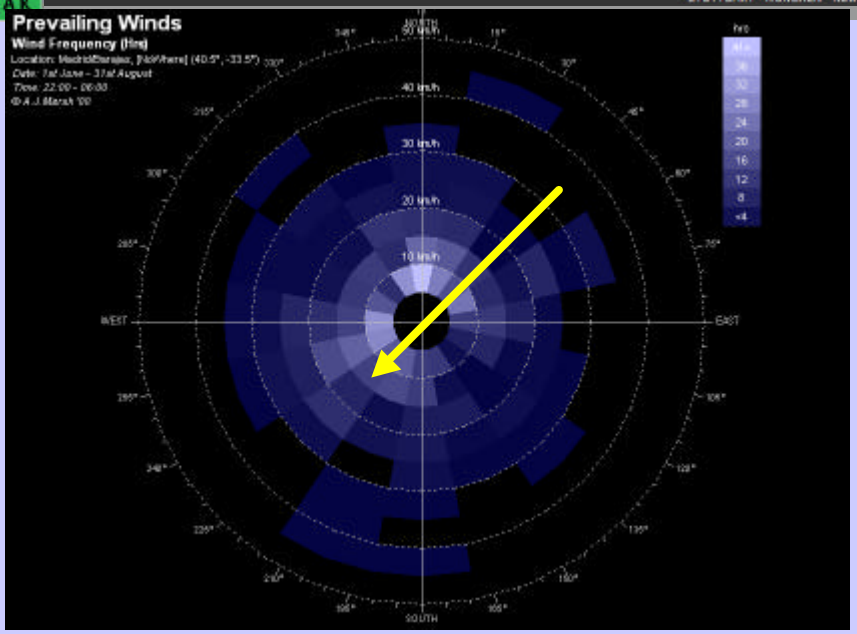
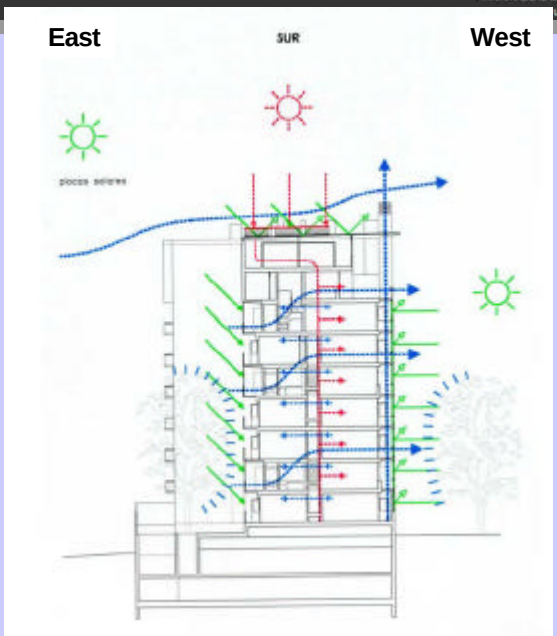


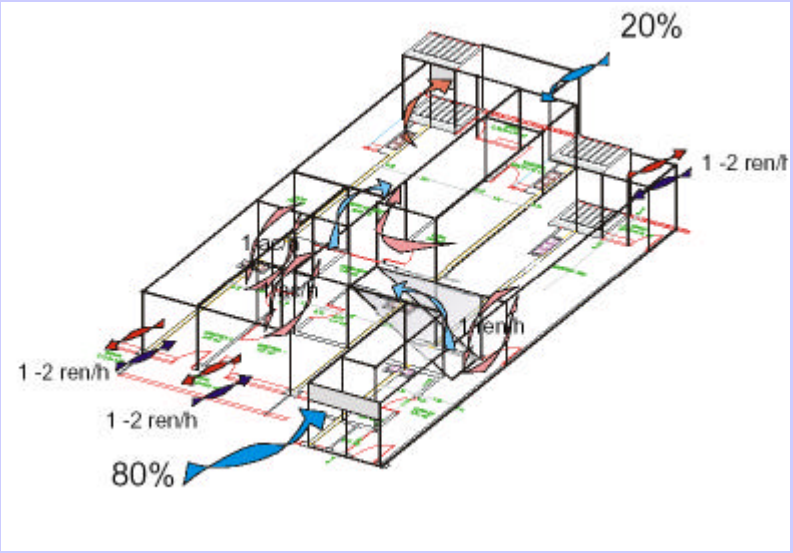
Local climate for Madrid, 800 m altitude



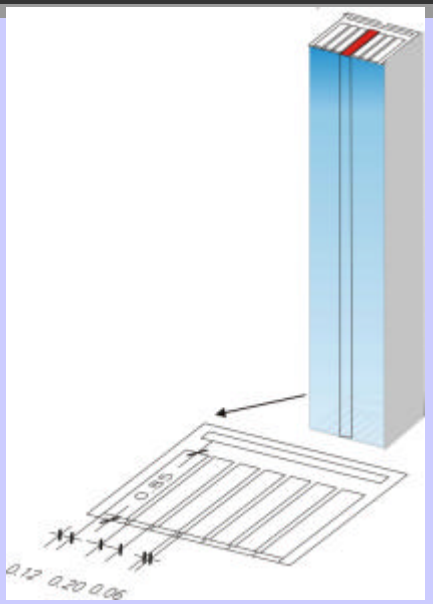
Prevailing summer night winds



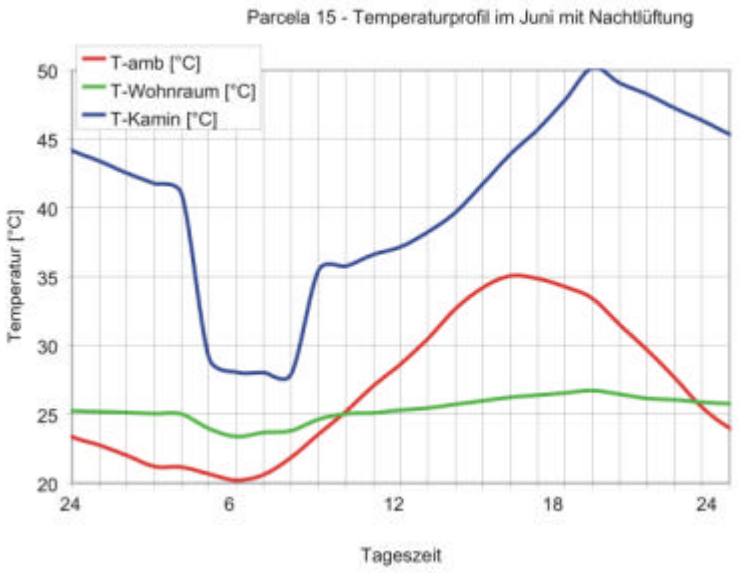
General concept



Night ventilation concept using the split level

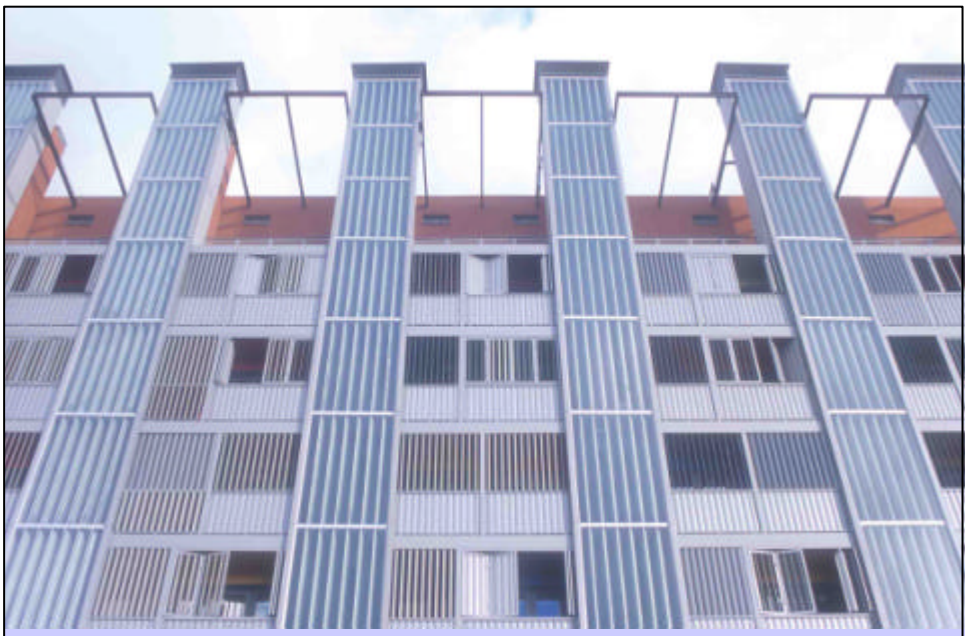


Chimney section



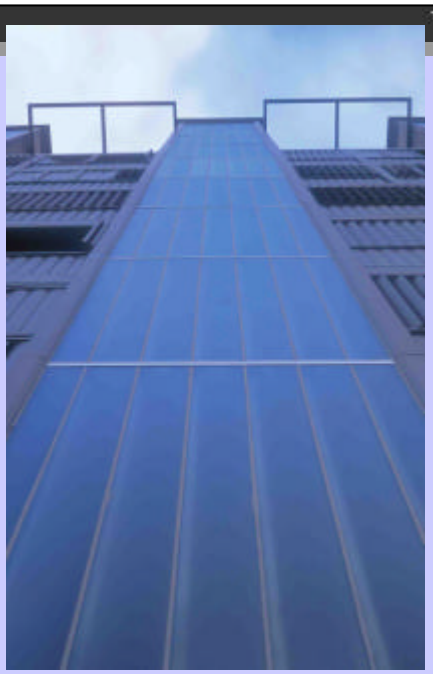
Temperature profiles

West facade of social housing project with solar exhaust chimneys



West facing facade with shaded balconies and solar chimney

Solar Chimney with individual cavities per appartment



Parcela 15, Madrid, AUIA Architects

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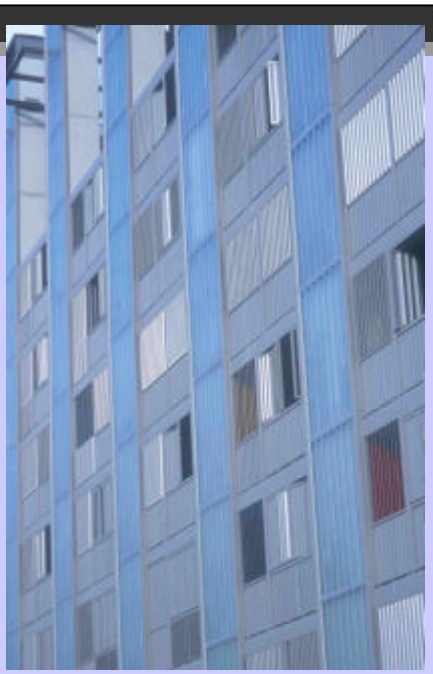
South facing facade with horizontal shading lamellas

Parcela 15, Madrid, AUIA Architects



West facade with vertical shading lamellas

Parcela 15, Madrid, AUIA Architects

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U-shaped east facade with glazed supply corridors and open balconies documenting the split level layout

Parcela 15, Madrid, AUIA Architects

Solar domestic hot water system ; Parcela 15, Madrid, AUIA Architects

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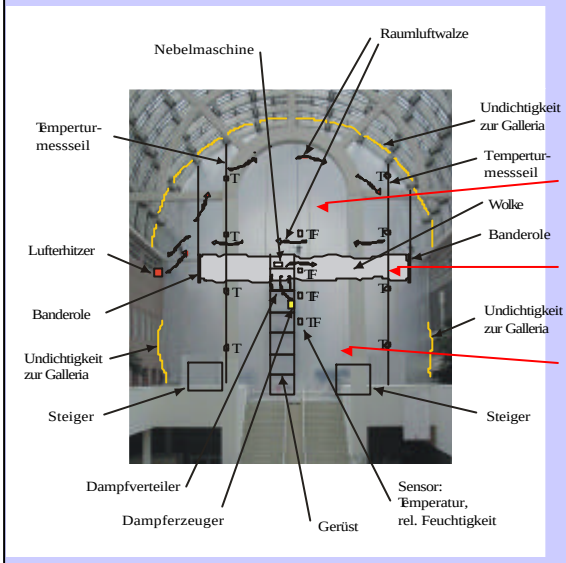
Can you make a cloud?



Cloud test

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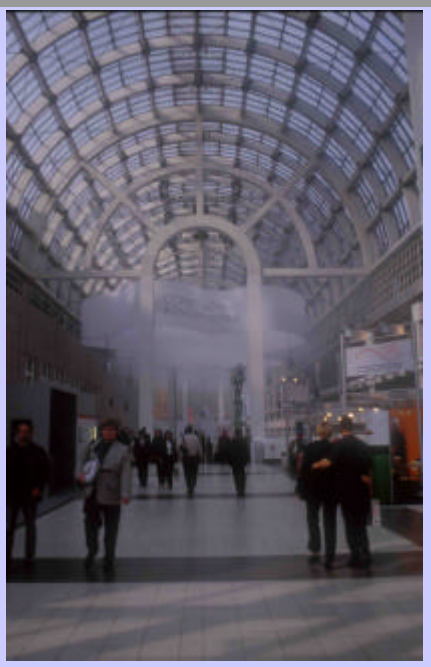

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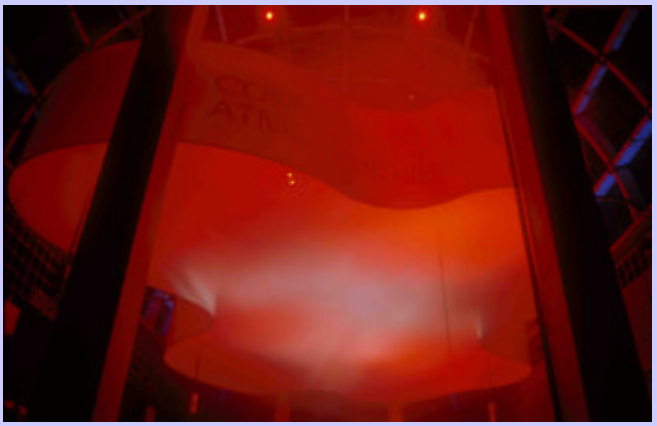

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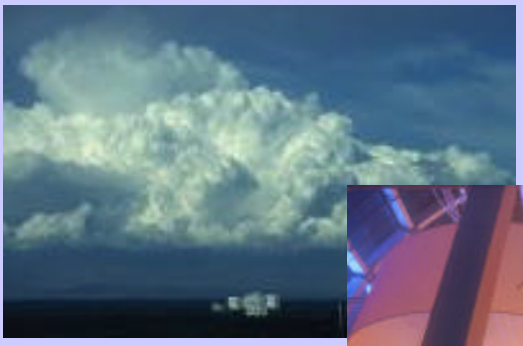

Natural clouds

Indoor cloud with
very high effort

Learning from Nature and gaining respect

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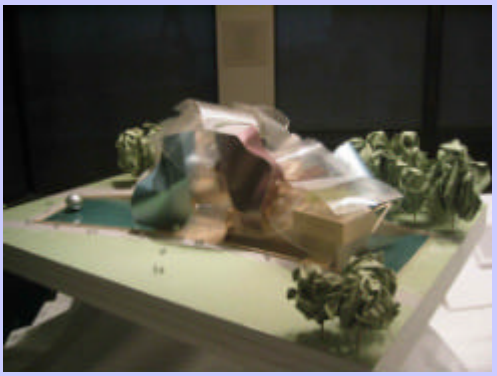
Outlook



Fondation LVMH, Gehry Partners

Doha Convention Center + Tower, Murpyh/Jahn

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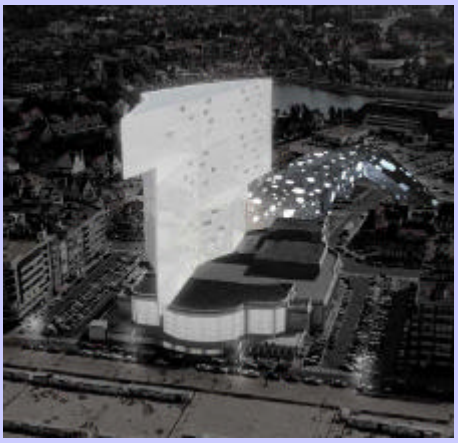
Knokke Heist, Belgium, Steven Holl Arch.



Brooklyn Bridge Park Soccer Stadium, James Carpenter Design

Elbphilharmonie Hamburg,
Herzog de Meuron

Centre de la mer, Le Havre
Atelier Jean Nouvel

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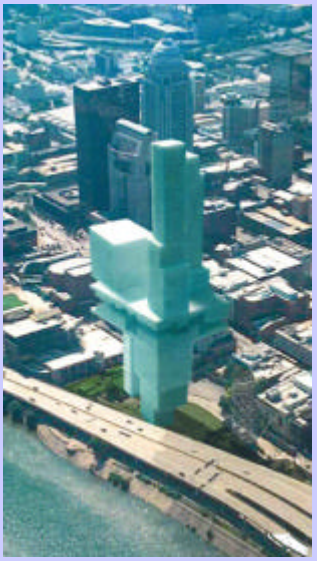
Loyola Library, Chicago
Solomon Cordwell Buenz Architects



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Thanks, if you want to read more