

stba Contemporary City

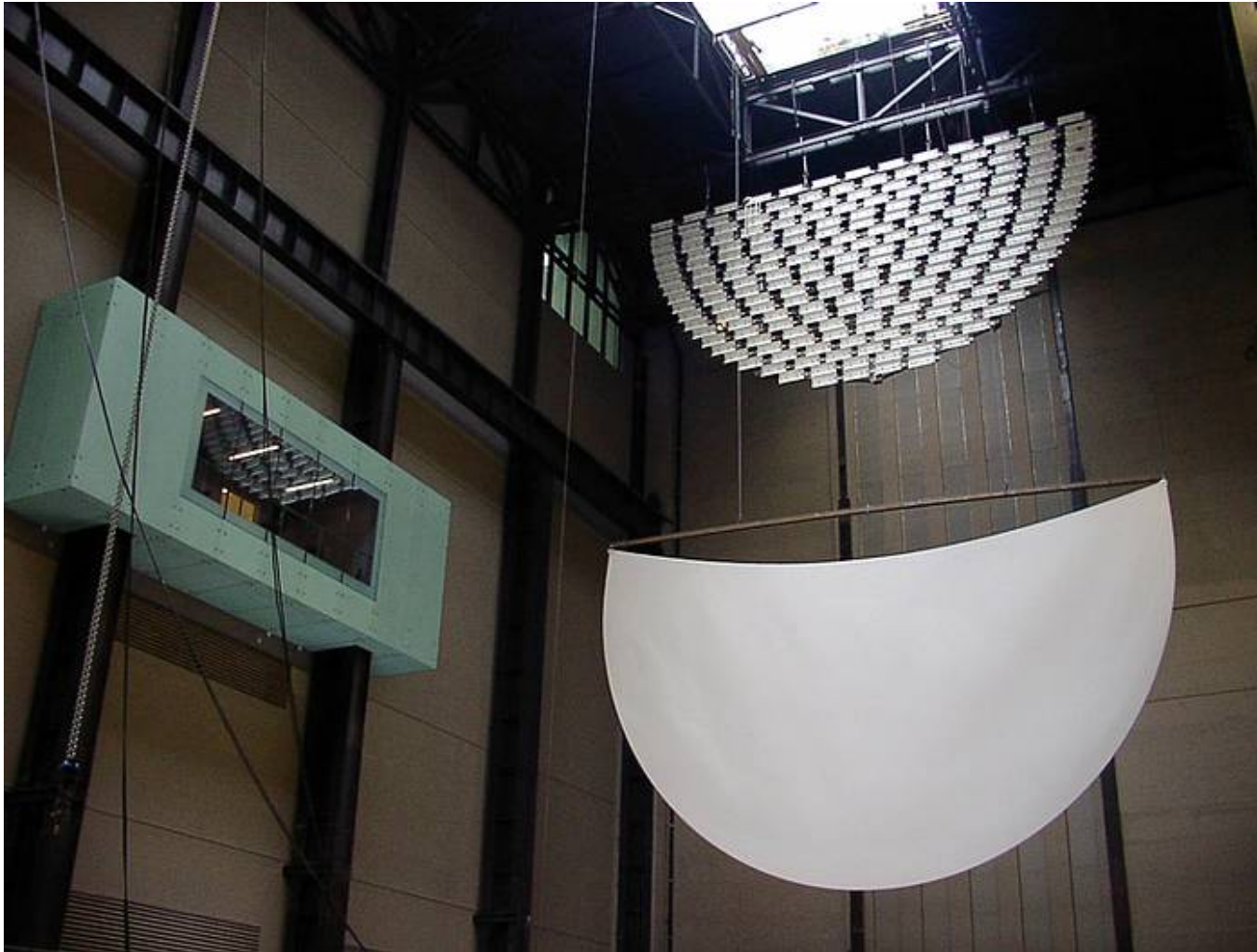
WEATHER

Urban Climate and Urban Place Form

Weather Project, Tate Modern, London. Olafur Eliasson, 2003-4



Weather Project, Tate Modern, London. Olafur Eliasson, 2003-4



Weather Project, Tate Modern, London. Olafur Eliasson, 2003-4



WEATHER – Urban Climate and Urban Place Form - a contemporary vernacular

Weather

- 98% of all energy derives from sun
- energy flows on earth
- thermodynamics: Wind

Urban Climate

- albedo
- evaporation (+ heat island)
- rain
- smog
- heat island
- wind and urban place form
- cold night air flows

Urban Climatology

Difference to rural areas

- Albedo, geometry
- evaporation + heat gain (drying out)
- small water cycle
- Versiegelung v Versickerung (sealed v porous)

Effects

- changing rain patterns
- smog and inversion
- heat island
- wind and urban place form
- cool night air flows

Mitigation

- green roofs
- street trees,
- urban parks, urban gardens
- urban forest, renatured rivers

Weather

The city is a weather changer; it alters the regional metabolism. Dark colored surfaces, air conditioning waste heat and vehicular traffic raise temperatures. Inefficient and wasteful water consumption practices stress local water table.

Weather considers the reciprocal performance between three entities:

- local climate and weather
- building ensembles,
- the green biomass in the city

Assumption

Performance of urban place form can initiate a metabolism correction.
Extraction, construction and operations of buildings, spaces and landscape:
from extractive and linear to productive and cyclical metabolisms.

Importance for performance of green space, urban forest and water in cities.

Physics of plants: how they shade, cool, clean the urban microclimate and modify wind.

Climate describes the overall long-term weather pattern in a particular area.
Weather is the instantaneous state of the atmosphere, its current conditions and behavior, and can be said to be the enactment of the climate system.

Relevance of continental, regional and urban weather cycles for urban climate.
Divergence of urban and rural weather: temperature, air movement, humidity.

Urbanisms – Urban Place Form

Temperate zone, Tropics (hot-humid), deserts (hot-dry) and arctic regions (sun in, wind out)

What are the attributes of the traditional architecture of these regions?
How do they mediate climate and weather conditions to achieve human comfort?

Mechanically air-conditioned cities are a socially, economically and ecologically unsustainable (energy use and waste heat into urban space).

How can form, materials and planting restore human comfort to external urban spaces?

How can urban place form adapt to and shape the environmental conditions of the place: airflow, air temperature, air humidity, and radiation from the sun?

Science - Understanding urban climate and weather

I The solar energy cycle

II The science behind urban gardens, parks and forests.

Physics of shade, transpiration and evaporation

Plants as the basis of food chains and the creation of habitats.

Albedo (reflectivity of a surface)

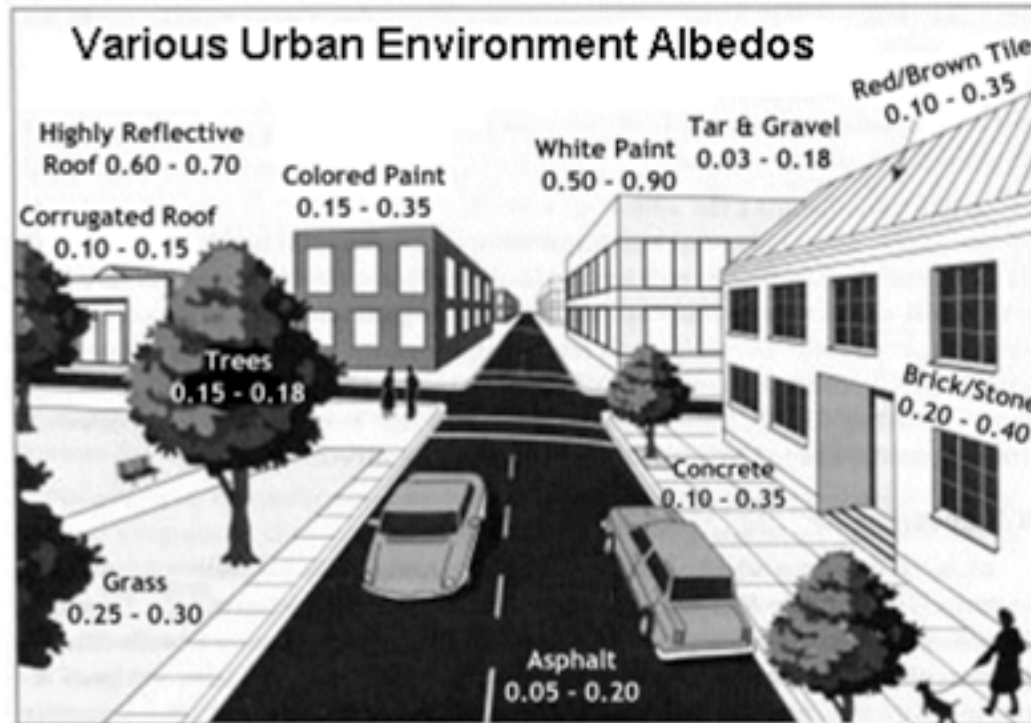
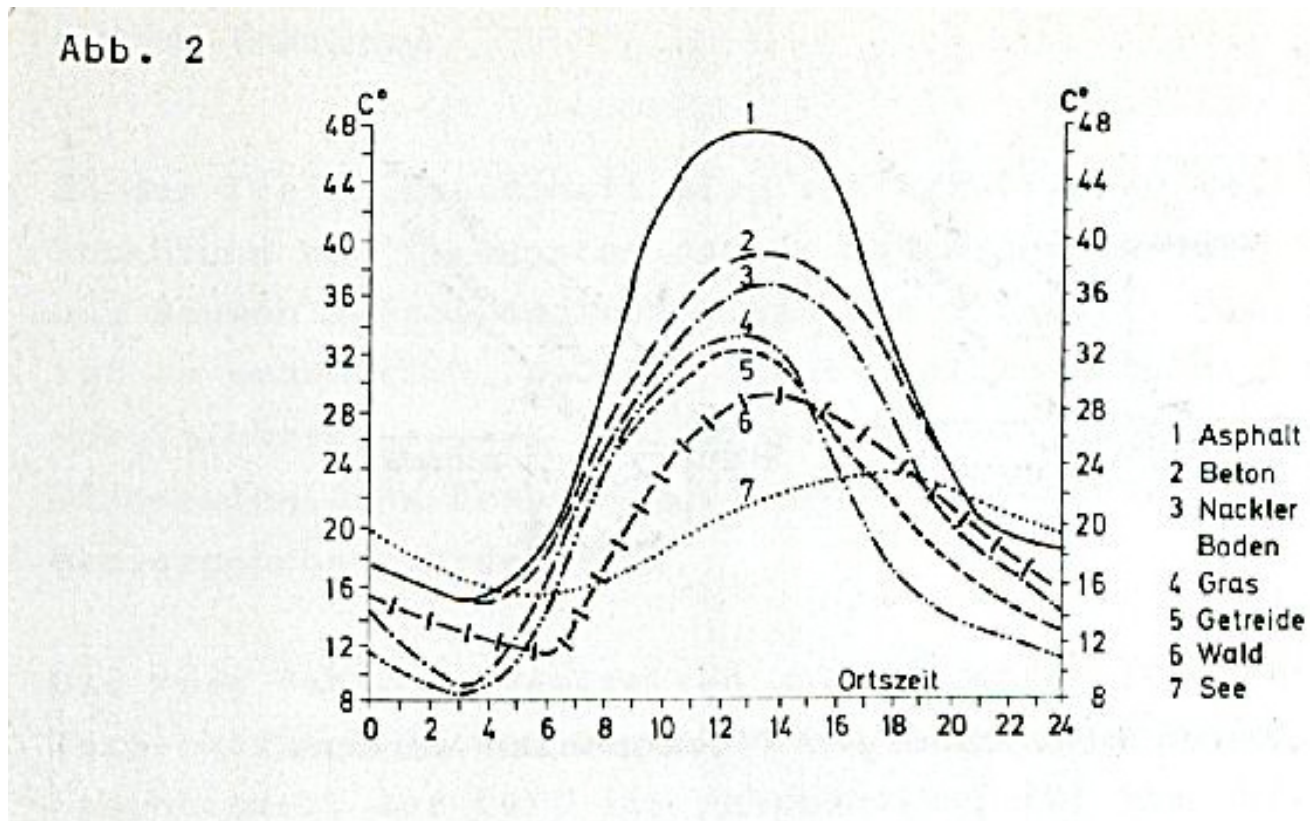
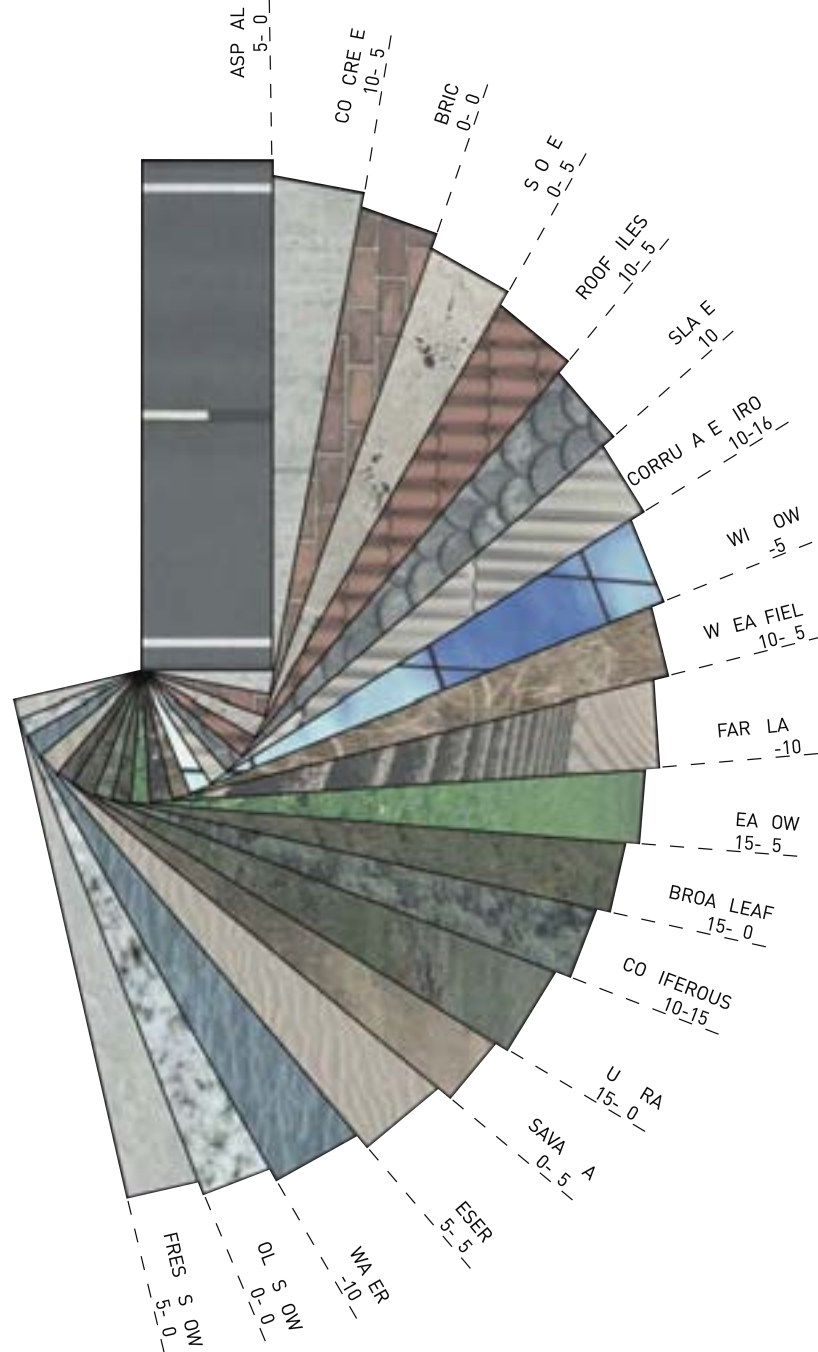


Abbildung 1: Charakteristische Albedo-Werte in der Stadt. (MILLER 1999)

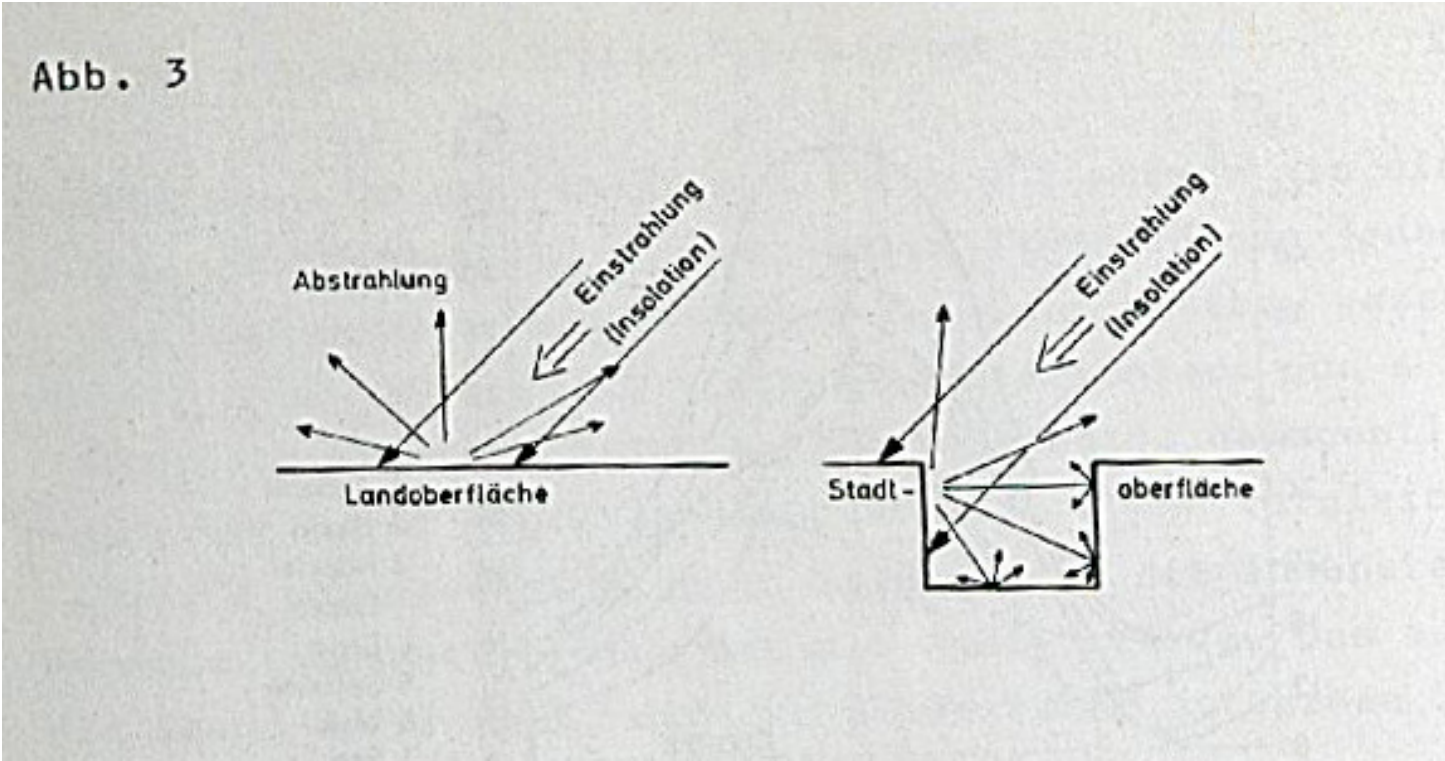
Albedo (reflectivity of a surface)



Albedofan



Geometry of city Buildings



Evaporation

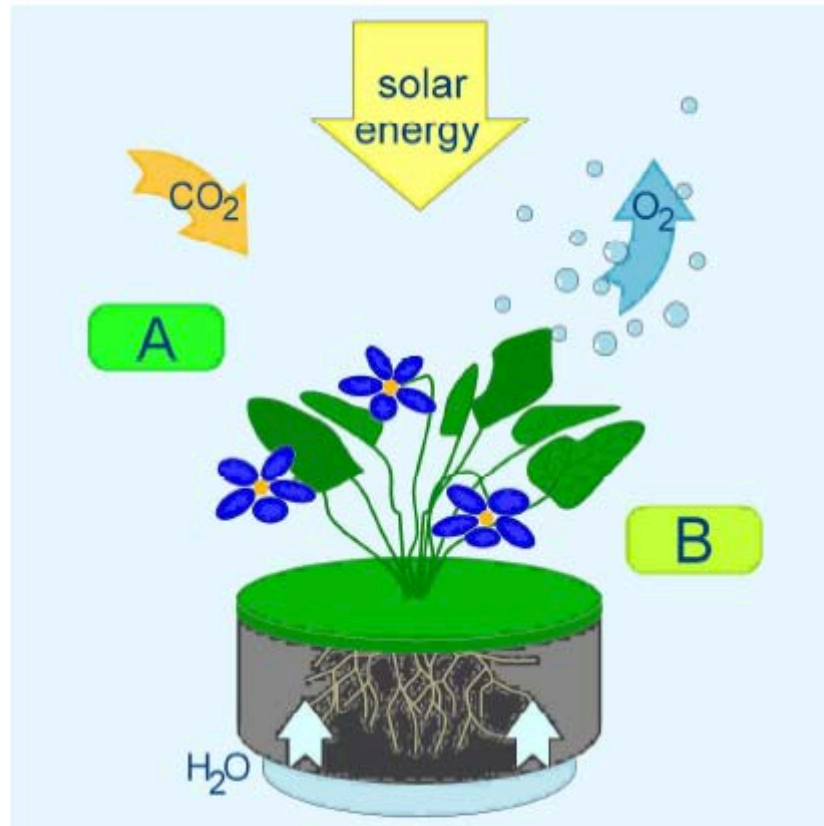


Fig. 6 An example of the daily energy balance of CO₂ and H₂O fluxes per 1 m² of vegetation stand: A: For the creation of 10g of dry matter, 48Wh (170kJ) are consumed for the fixing of 14g CO₂ (0.32 mol). B: Evapotranspiration (3 l) requires 2.1 kWh (7.5 MJ).

Evaporation

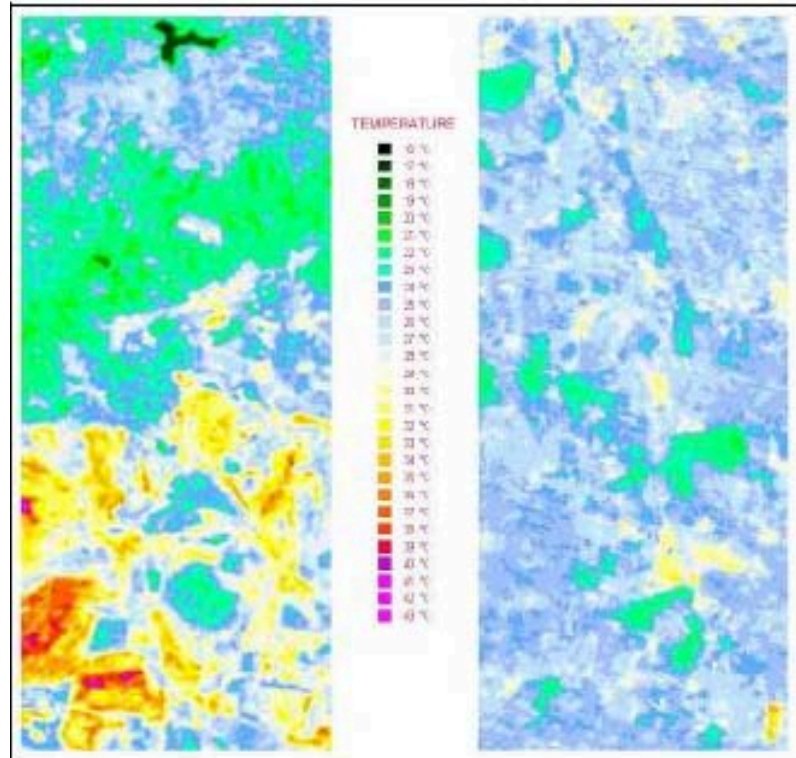


Fig. 9 Comparison of the distribution of sensible heat in two different types of land (Mostecko and Třeboňsko)

The pond-covered Třeboňsko with wetlands shows a lower regional temperature difference (right) than the drier land of Mostecka (a strip coal mining area), which has insufficient vegetation (left).

Evaporation

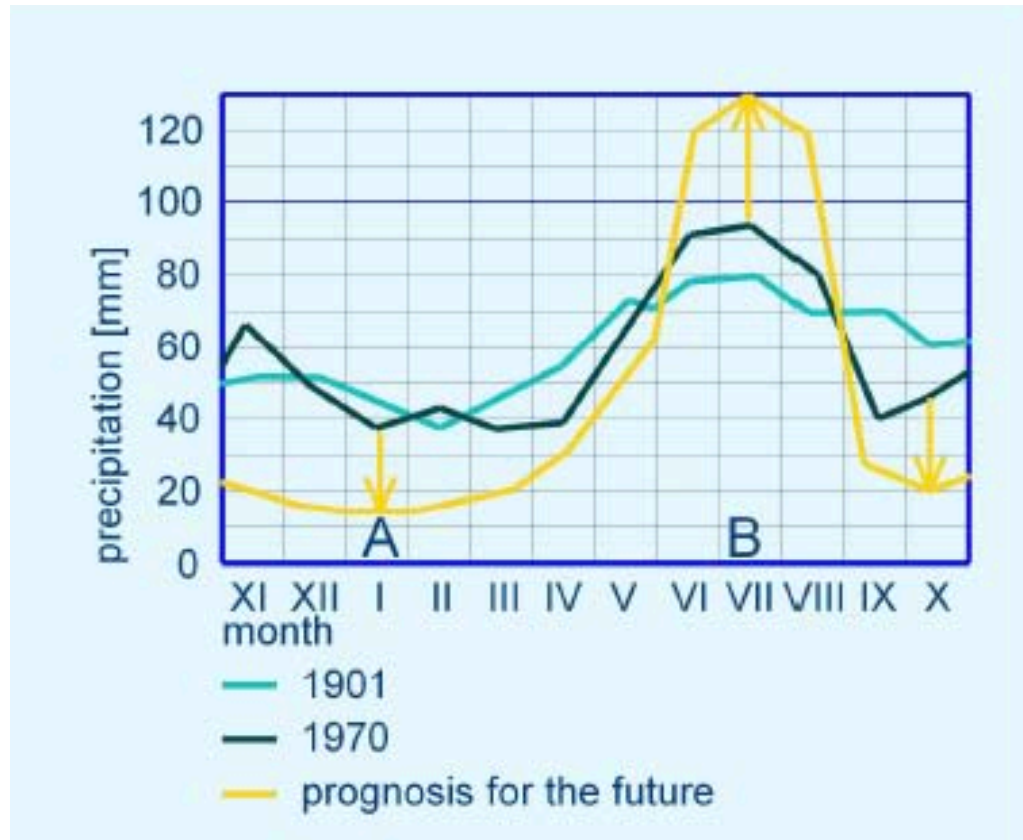


Fig. 22 Precipitation trends in Slovakia

Periods of "drought" are lengthening (A) and the time period in which most precipitation falls is getting shorter (B).

Evaporation

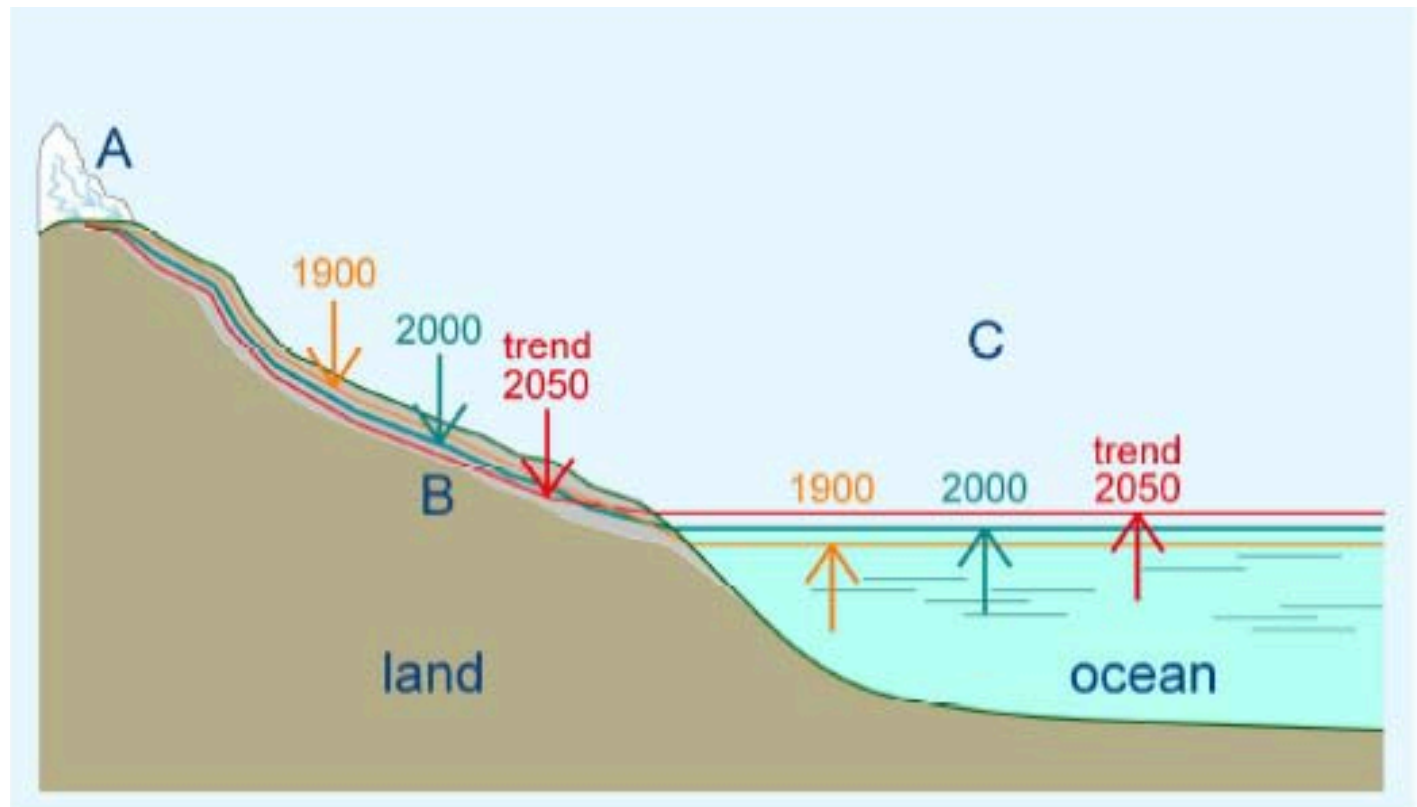


Fig. 26 The impact of glaciers melting (A) and the decline in the reserves of water on the continents (B) on rising ocean levels (C)

Evaporation:

breakdown of small water cycle leads to desertification

Waterholding measures restore cycle

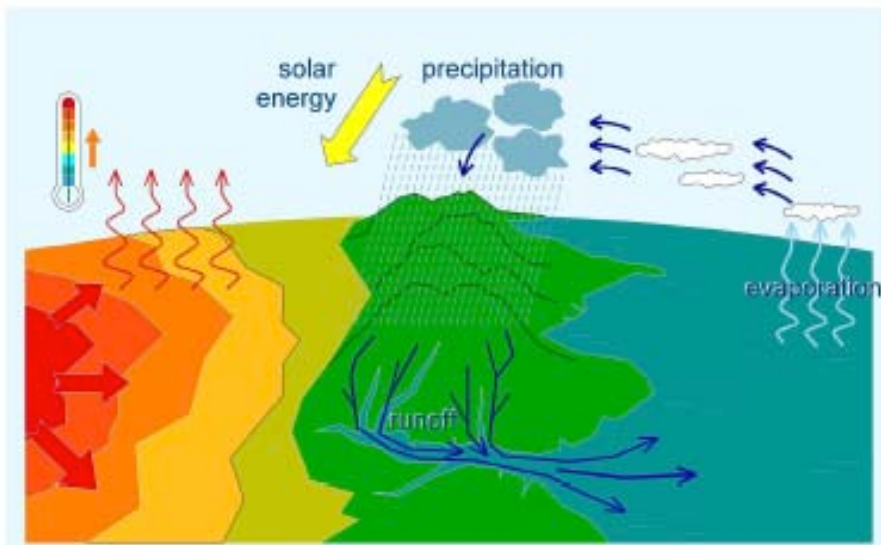


Fig. 28 Diagram of the expansion of deserts or semideserts with the breakdown of the small water cycle

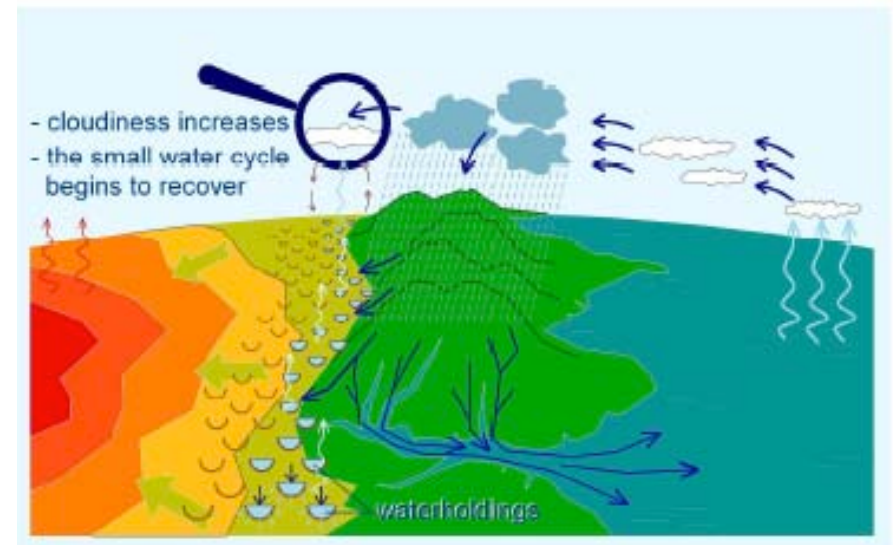


Fig. 29 Waterholding measures on the edge of critical areas
Their role is to harvest and hold water from the small water cycle from adjacent lands, or water from the large water cycle (even in deserts it rains occasionally). The period in which the water cycle is renewed depends on circumstances (the hydrological and pedological conditions, success of the growth of protective vegetation, etc.).

Evaporation

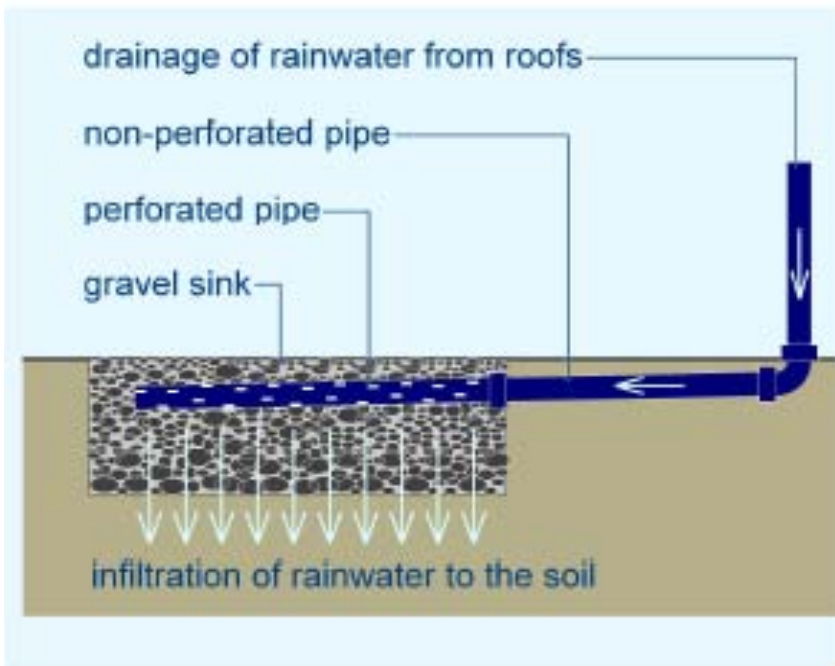


Fig. 34 Detail of a pipe for taking rainwater to a gravel spill drain⁶⁵
Utilized for the infiltration of rainwater from the roofs of houses to the soil and subsoil.

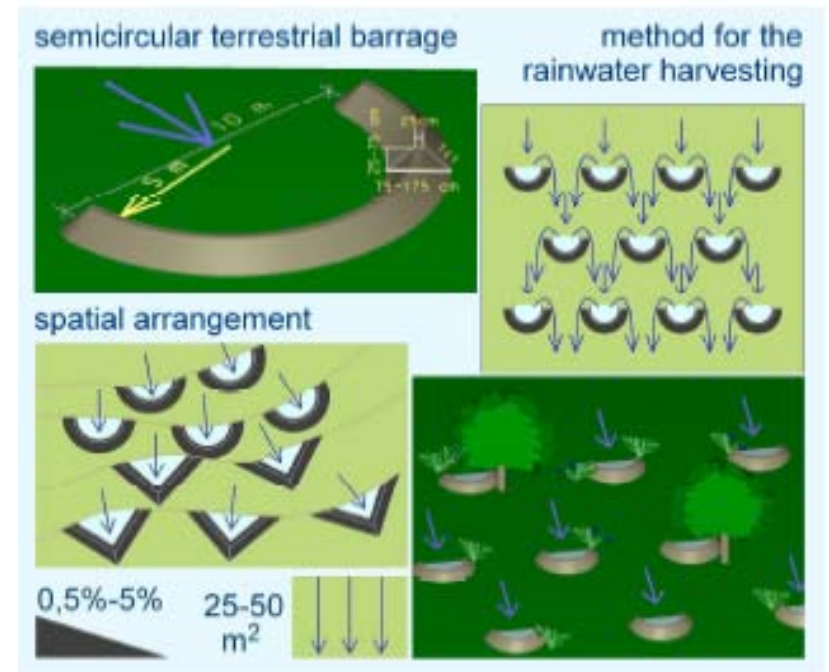
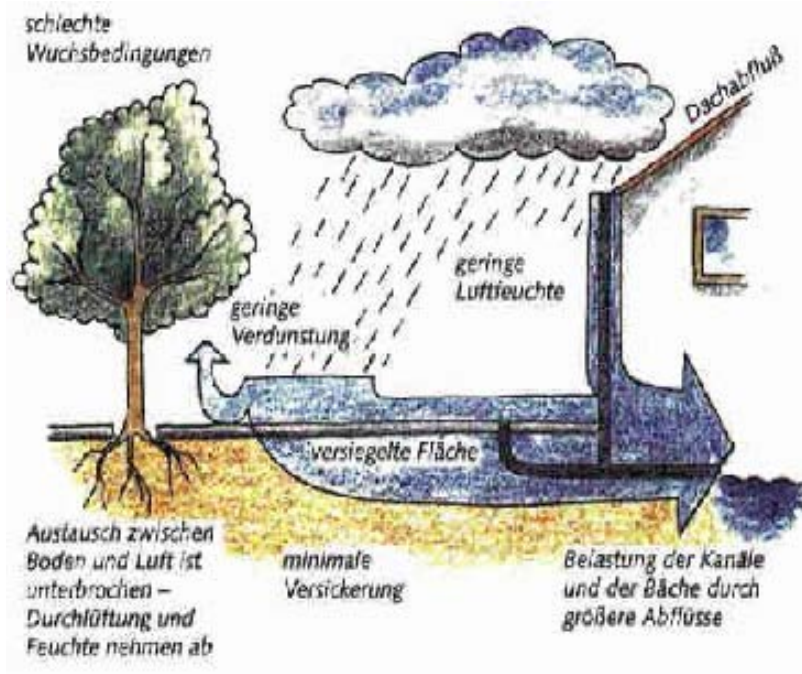


Fig. 32 An example of cascade ground tanks for rainwater harvesting on slopes

Decrease in Humidity

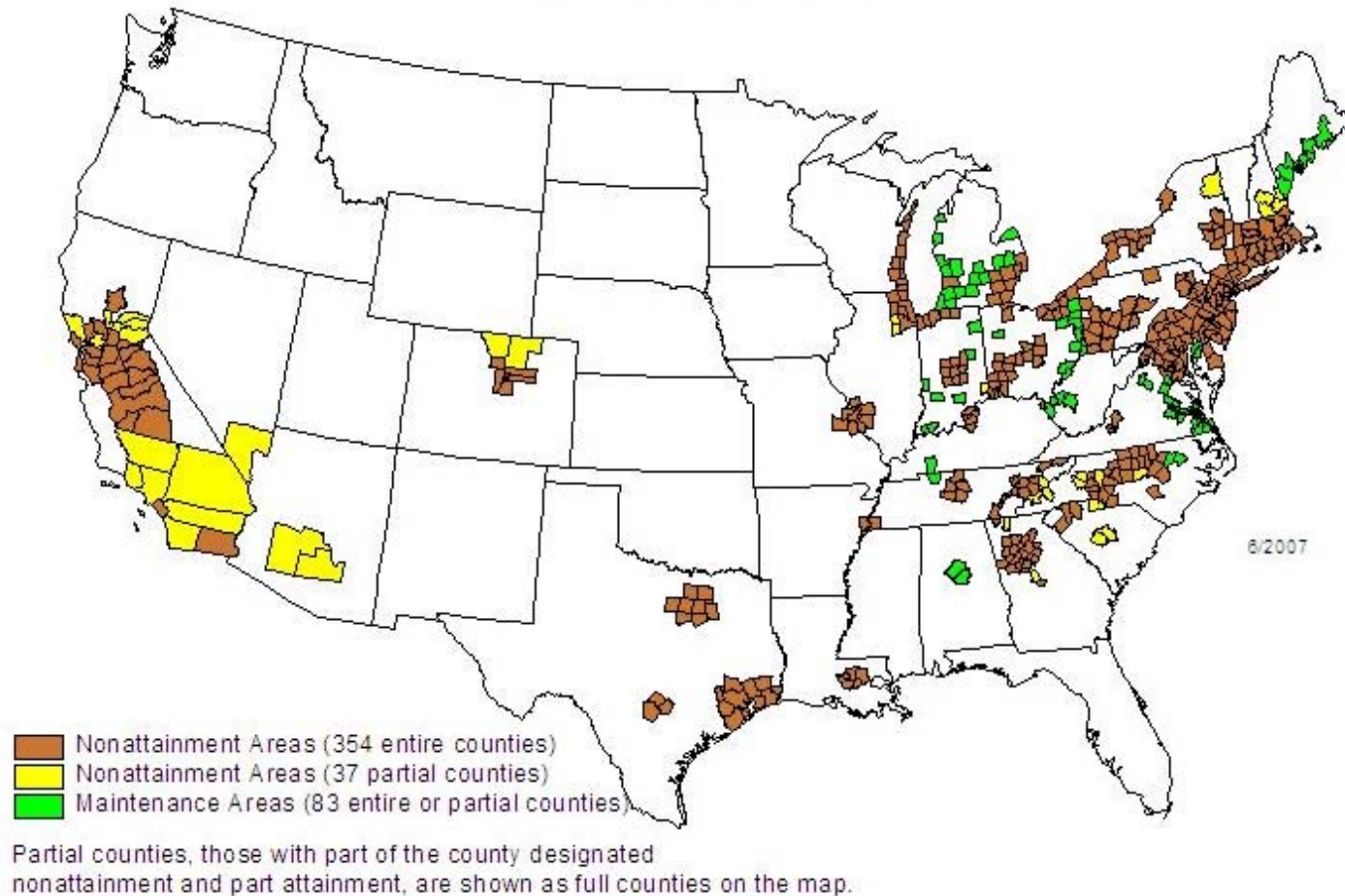


Smog, Summersmog, LA type



Smog, Summersmog

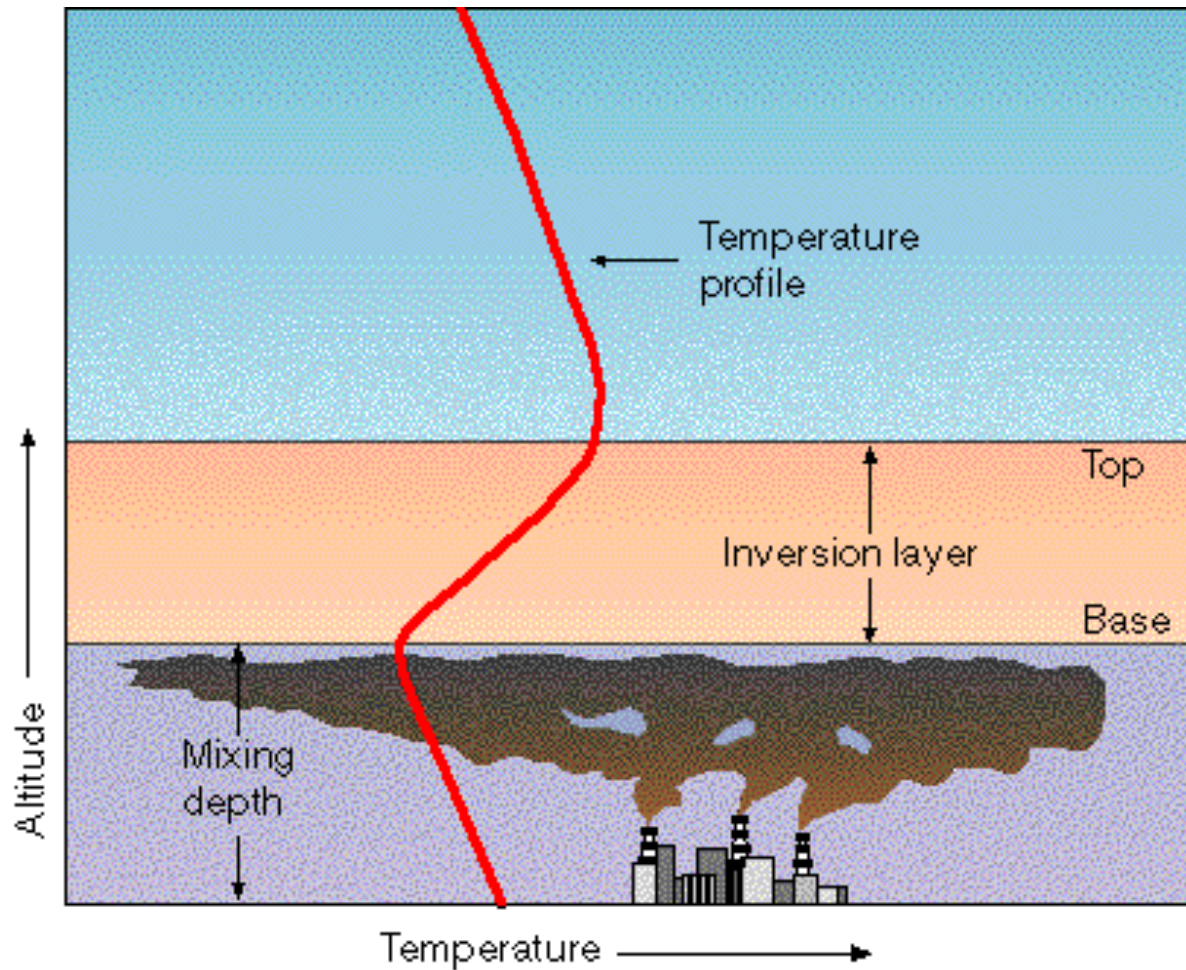
Nonattainment and Maintenance Areas in the U. S.
8-hour Ozone Standard



Smog, Summersmog, Russia heatwave 2010



Smog, Wintersmog

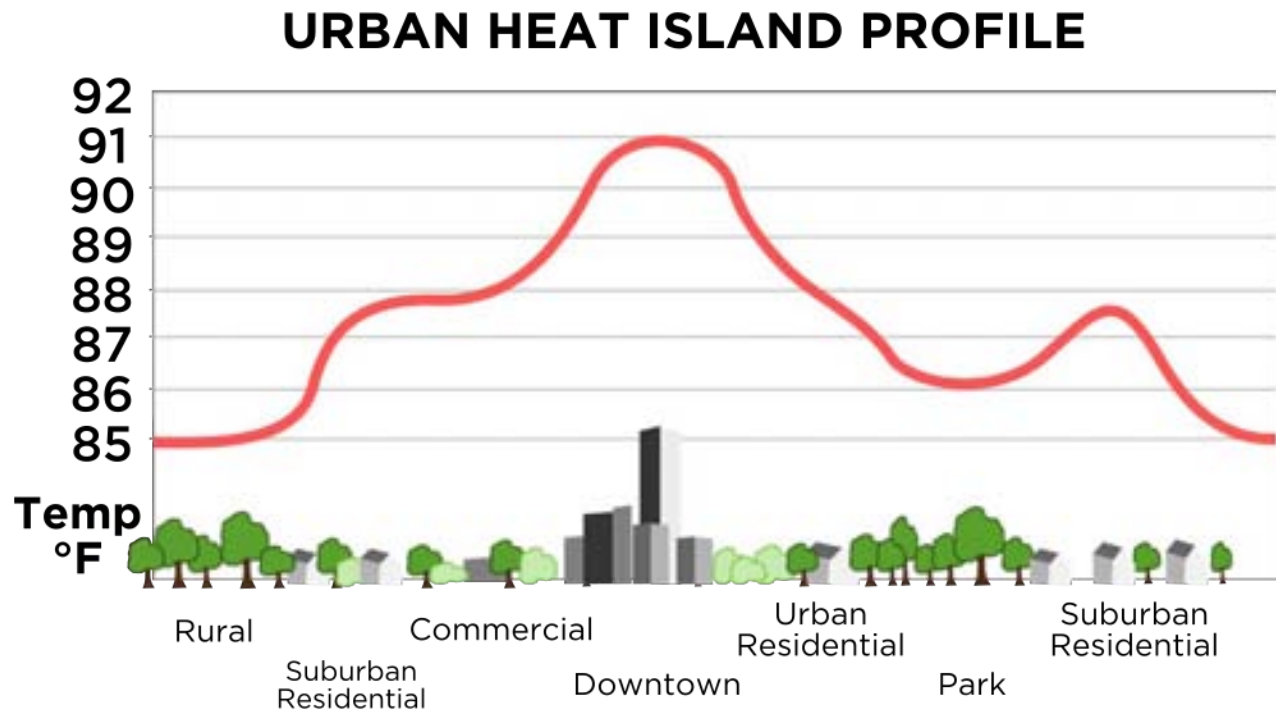


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Smog, Wintersmog



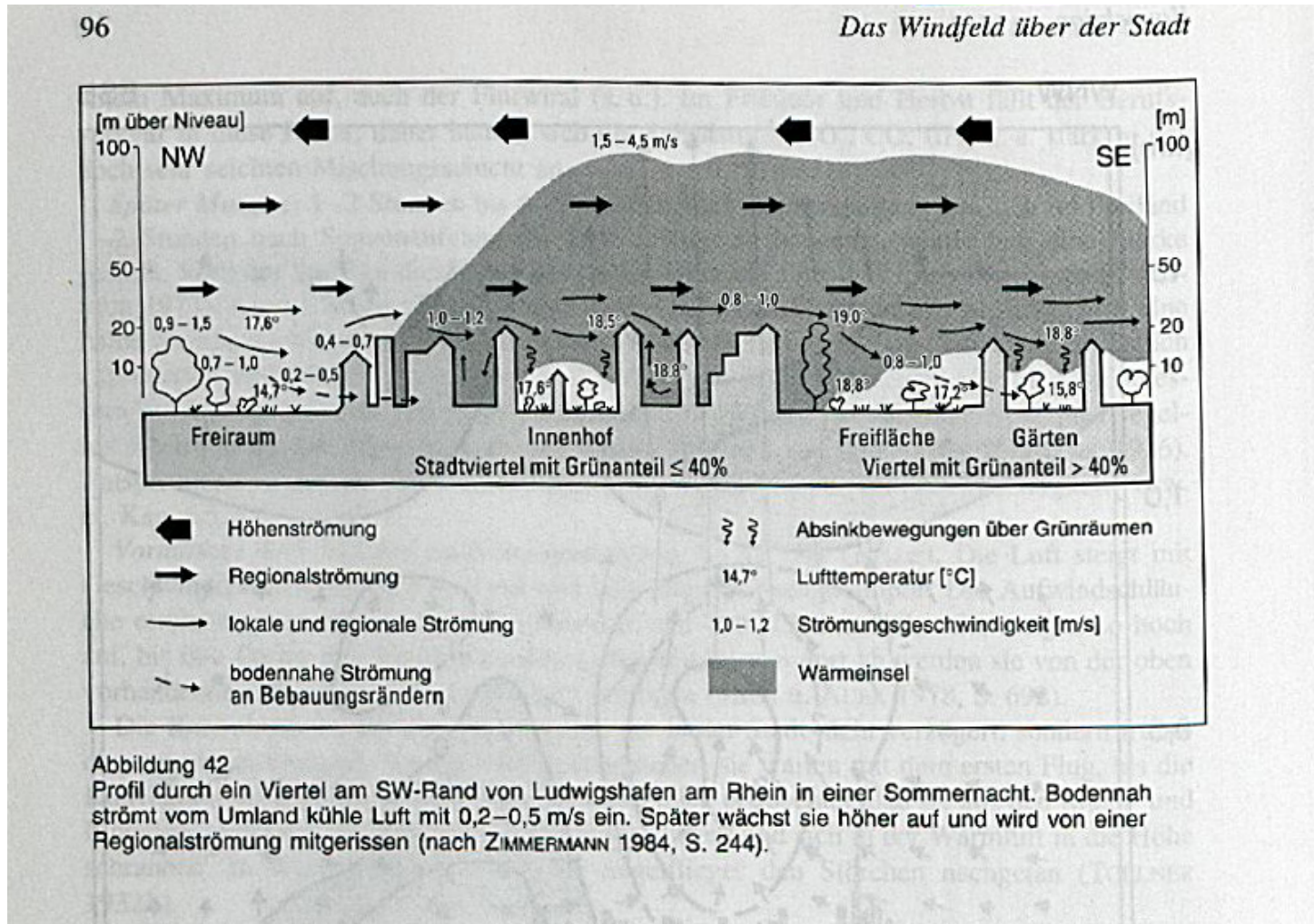
Heat Island



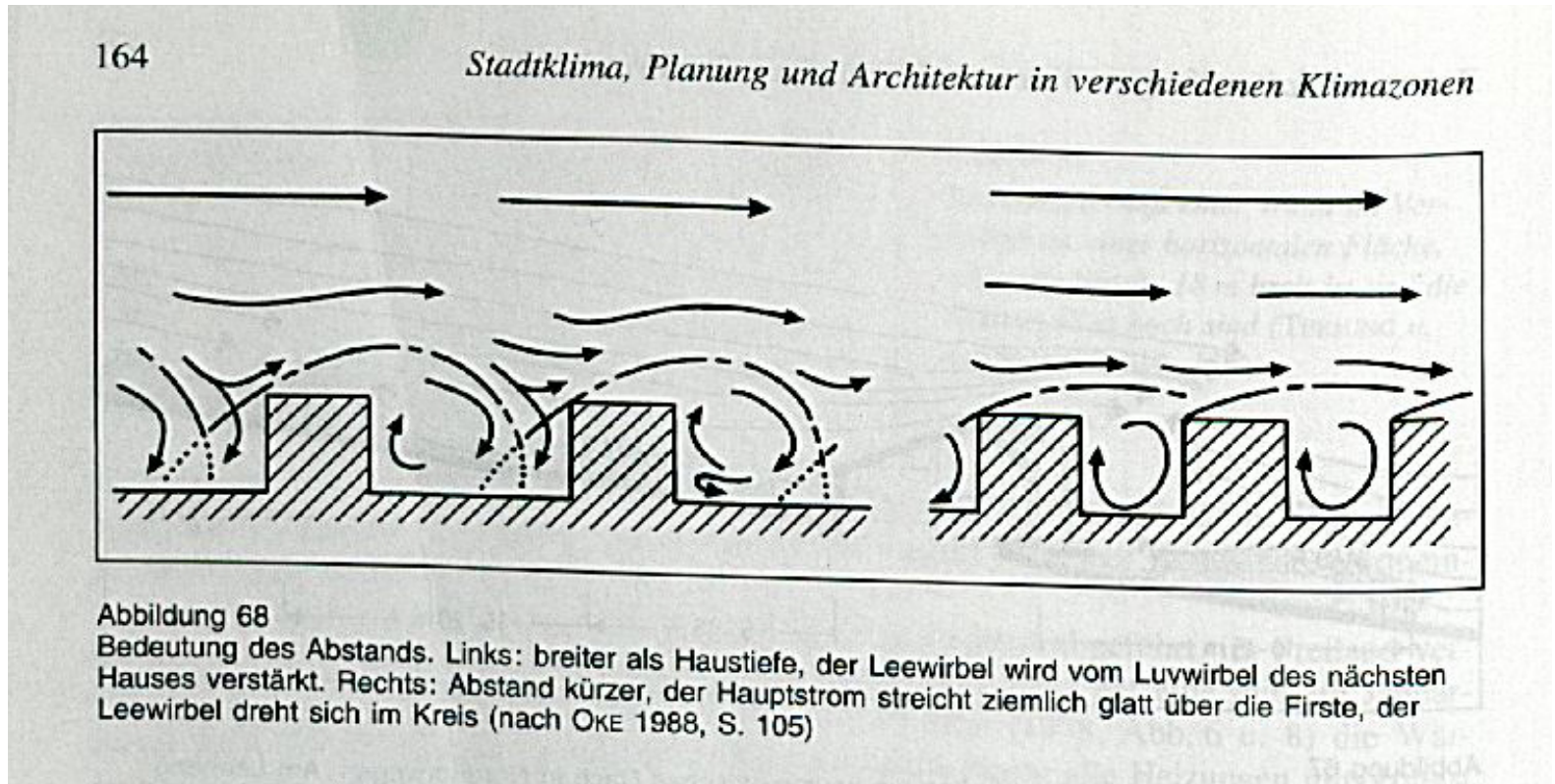
Heat Island



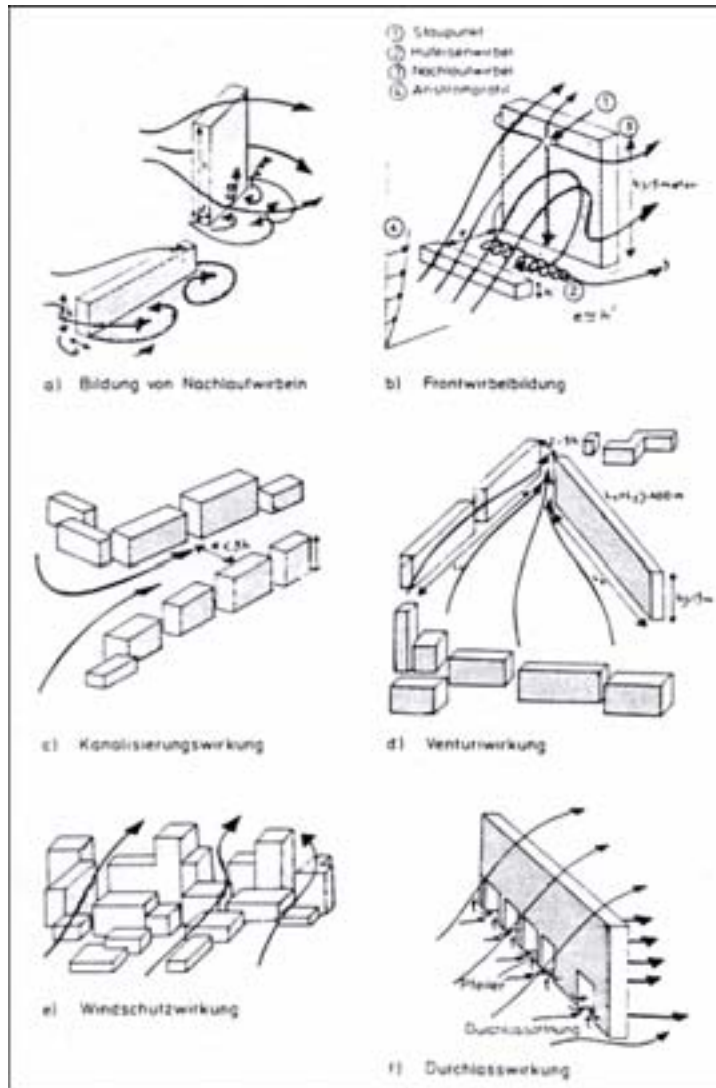
Airflow, Fezer, Klima der Städte



Airflow, Fezer, Klima der Städte



Airflow, Fezer, Klima der Städte



Airflow, Franke, Stadtklima

Abb. 9 Windschutz durch Windschirm

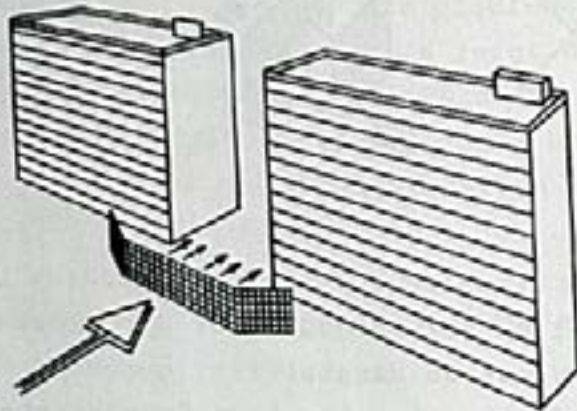
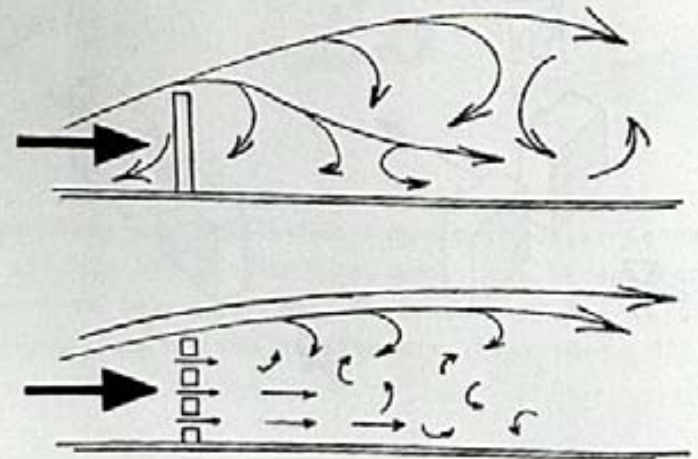
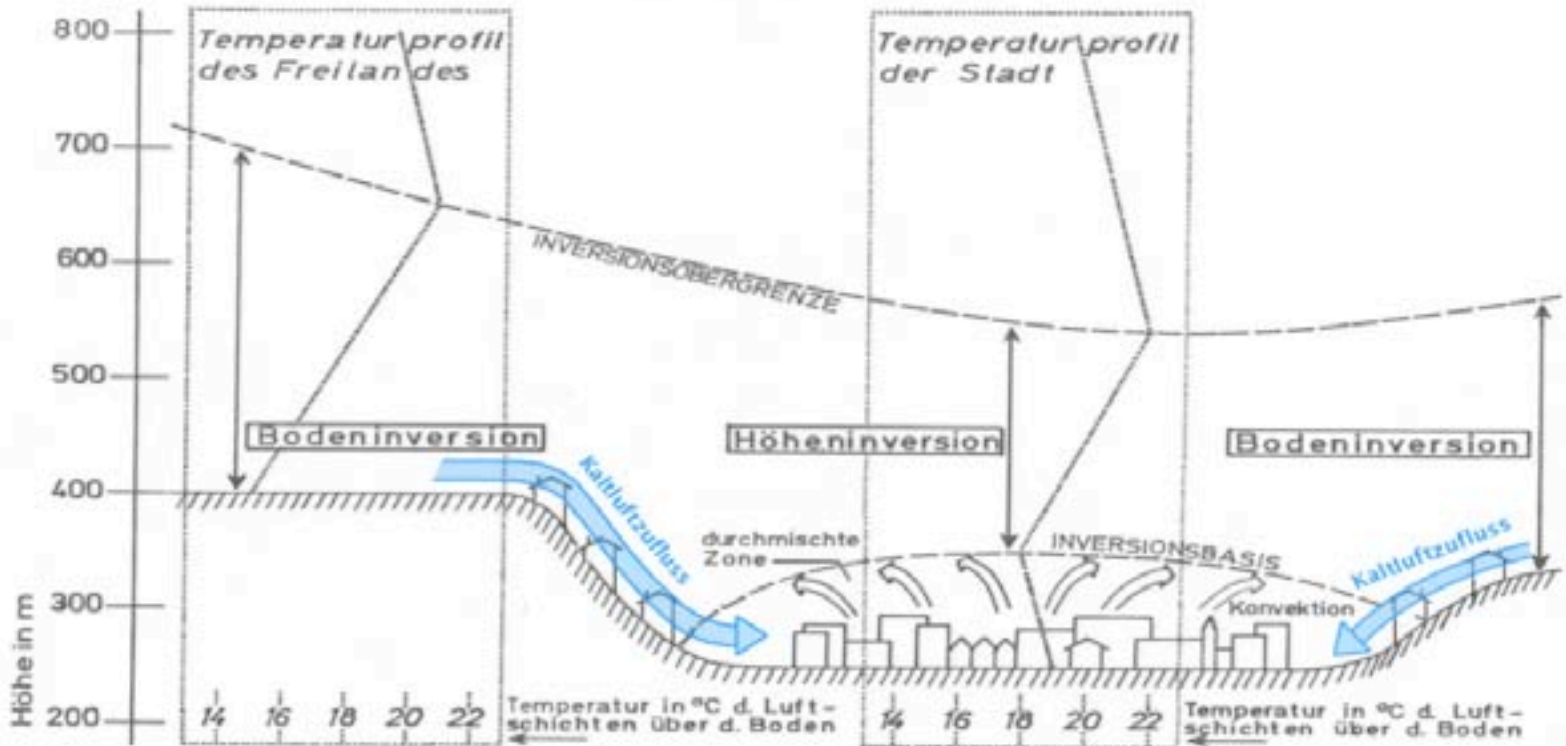


Abb. 10 Wirkung verschiedener Windschirmarten

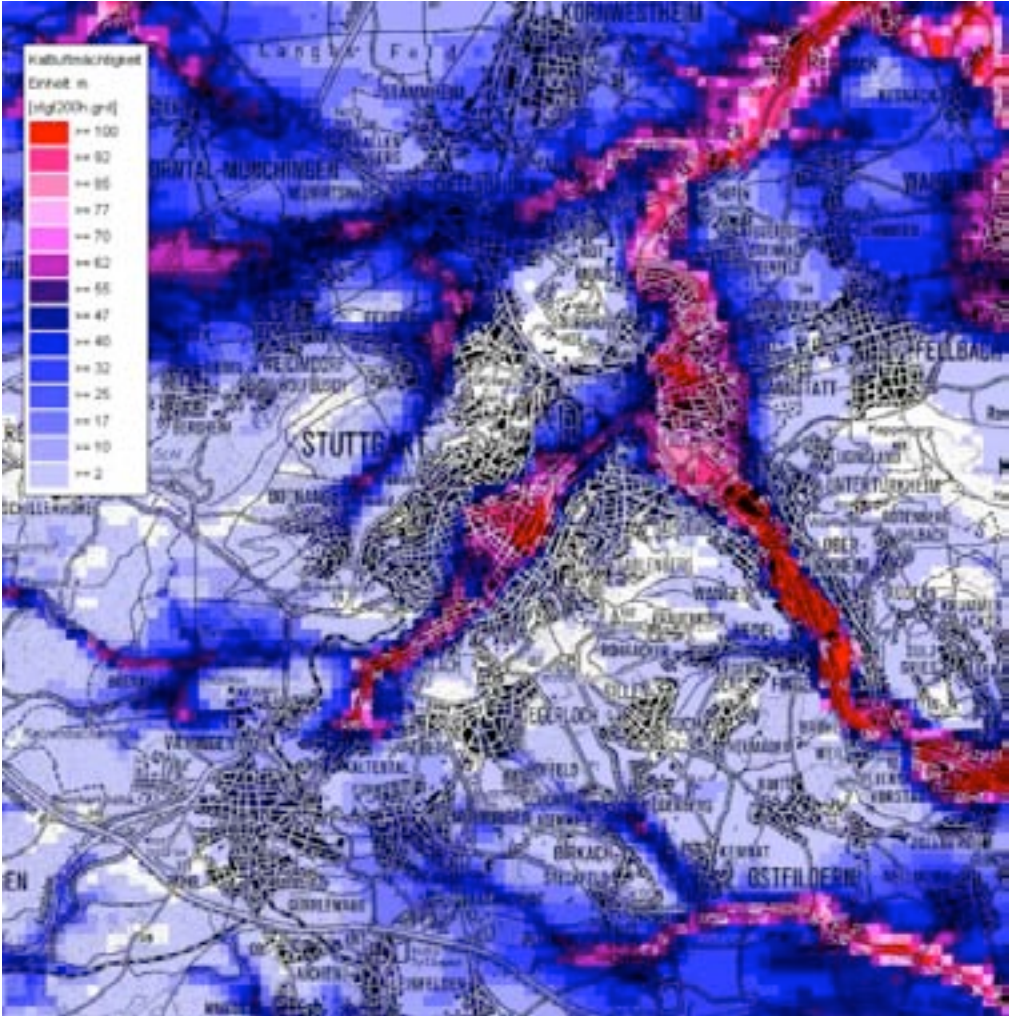


Urban Heat Island mediation: cold night air flows

Kaltluftabfluss

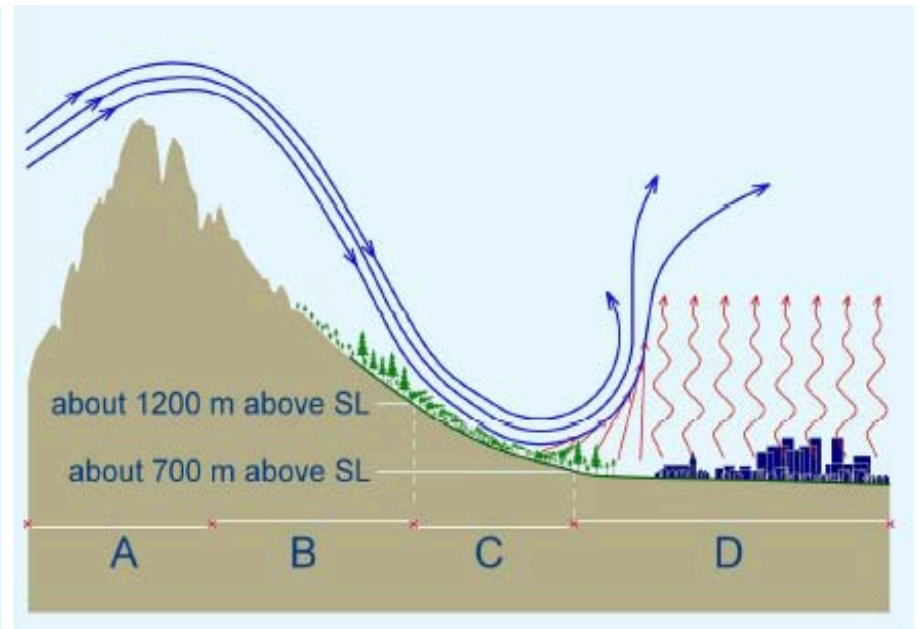
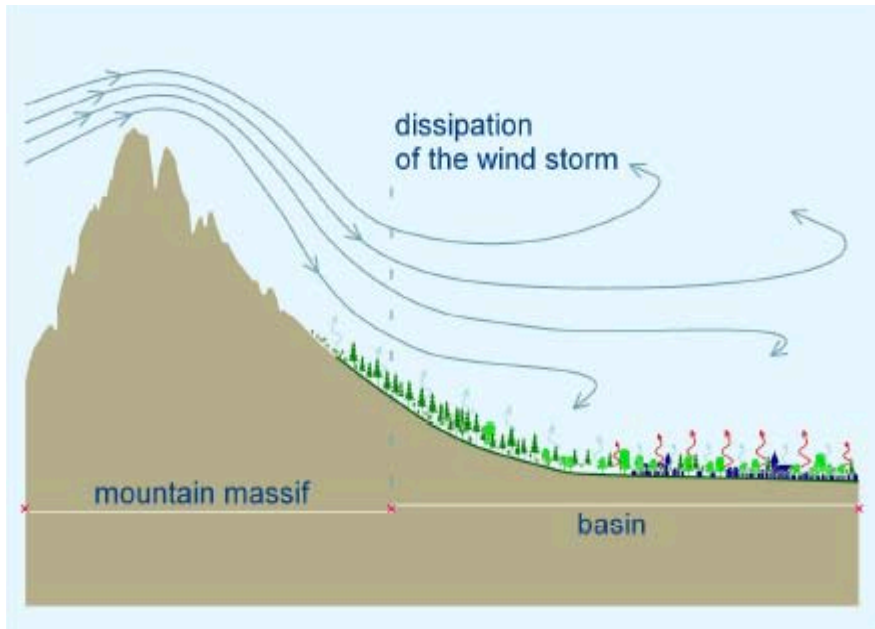


Cold and hot space: Stuttgart

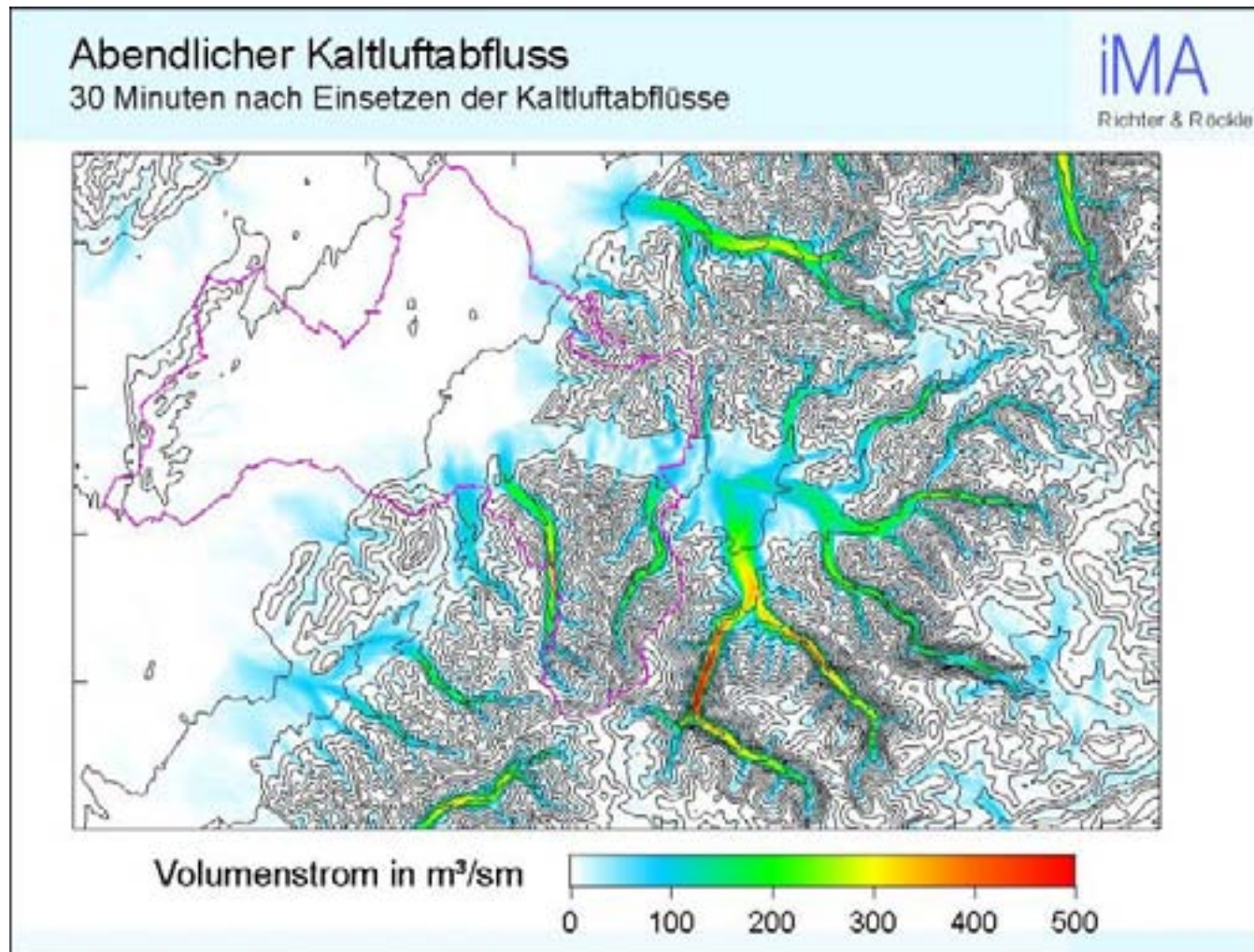


Incursion of cold air, Tatra Region, 1800 vs. 2000

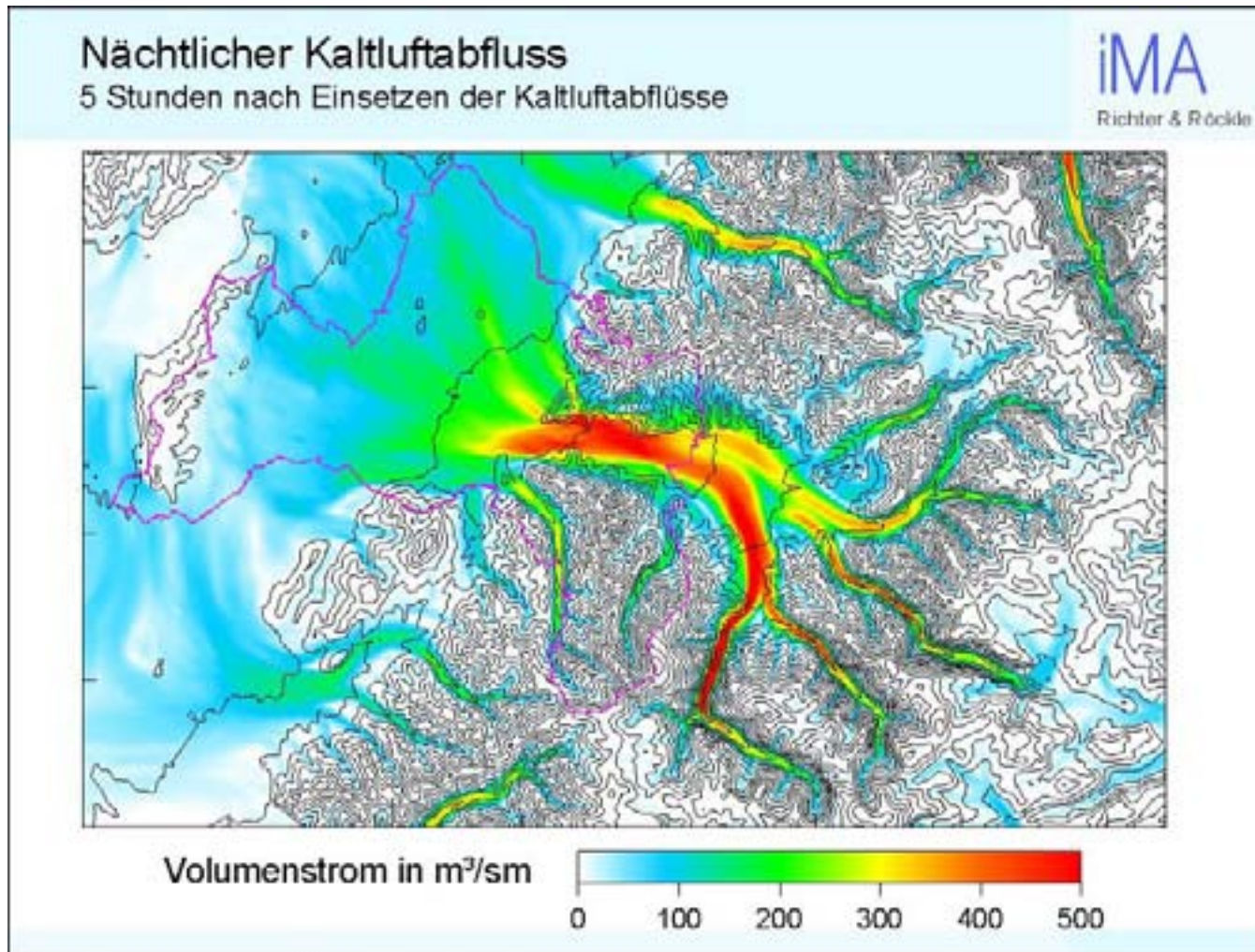
Insufficient cold air corridors into the city



Kaltluftabfluss: Freiburg



Kaltluftabfluss: Freiburg



Morphologies

High density v Low density Urbanization

Traditional livable well serviced city v the post-suburban and post-industrial low density settlement model (Zwischenstadt)

City regions and Regional ecologies

Regional context as flows of people, traffic, goods and information together with flows of air, water, plants, and animals.

How do we actively engage the free work of their natural systems?

Global urbanization and the Market

Urban development in the NORTH and SOUTH.

What are the consequences of the speeding up of urbanization processes

Transit and Actors

Transit: travel and flows of tourists (NORTH) v movement and migration of peoples (SOUTH).

Actors: new forms of self-governance, organization and action.

Design

Architectural and urban thermodynamics

- Expo 92 Seville
- Eco Boulevard, Madrid
- Digestible Gulf Stream, Venice Biennale, 2008. Philippe Rahm

Metereological architecture

- „blur“ Swiss Expo 2002. Diller + Scofidio
- SANAA - Valencia Institute of Modern Art

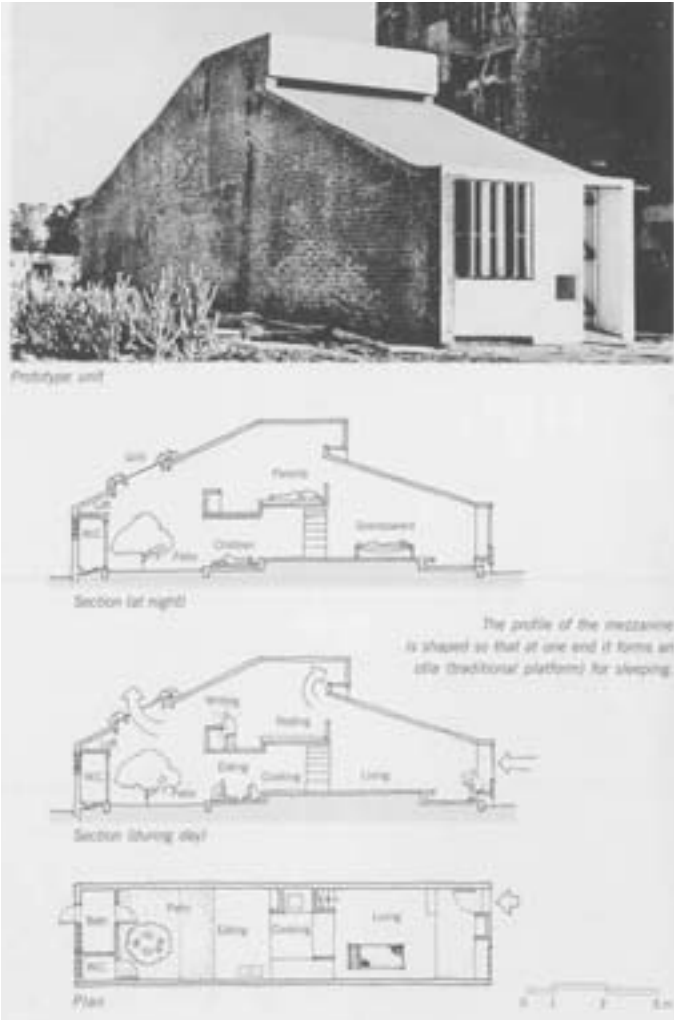
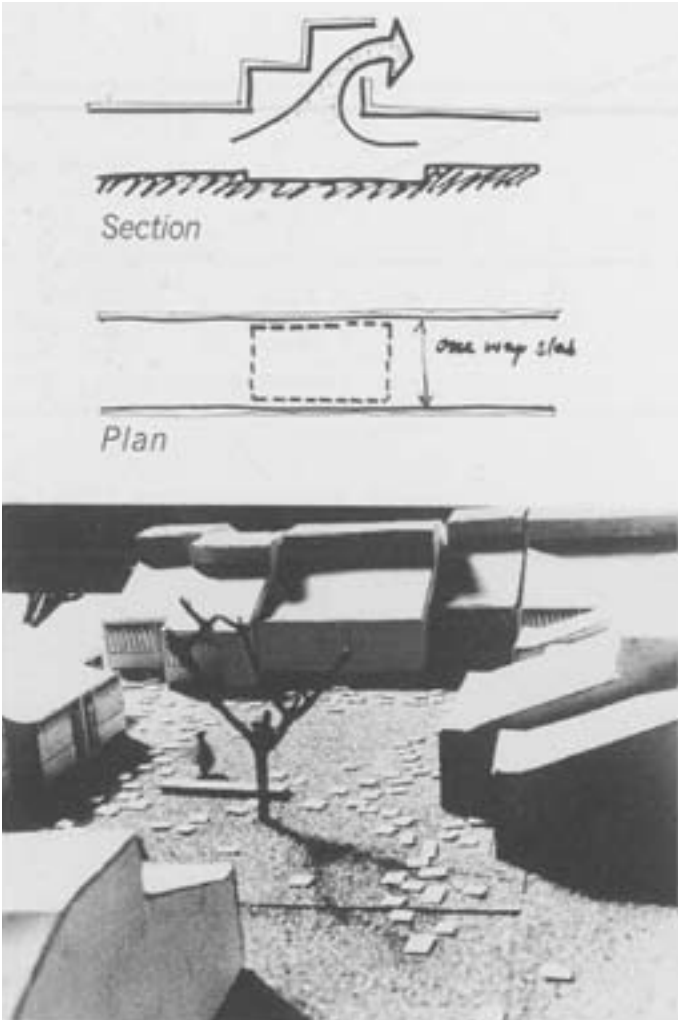
Projects from different climate zones by Comparison

- SMAQ, Xeritown, Dubai
- BIG, Reciprocity, Low2no, Jätkäsaari , Helsinki, Finland

Low Tech vs High Tech

- Ken Yeang, Menara Mesiniaga Tower, Selangor, Malaysia, 1992
- Charles Correa, Tube House, 1961, Ahmedabad, India

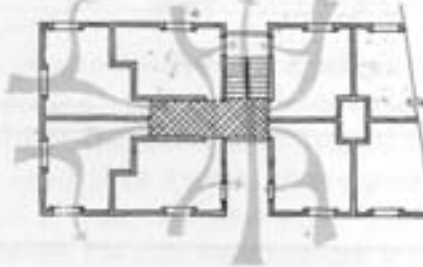
Charles Correa, Tube House, 1961, Ahmedabad, India



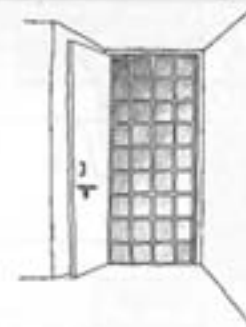
Charles Correa, Kanchanjunga, 1970-83, Bombay, India



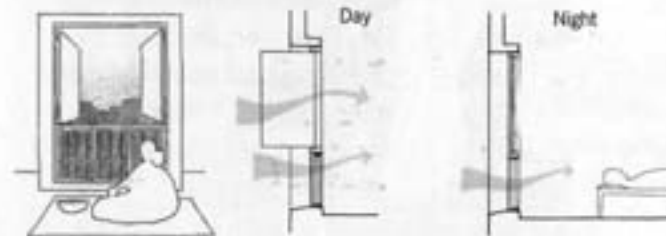
In the hot humid climate of Bombay, cross-ventilation is essential – and is integrated into the design at various stages. To begin with, every unit is a corner unit, allowing for cross-ventilation. Furthermore, the staircases, placed between blocks, ensure the flow of air:



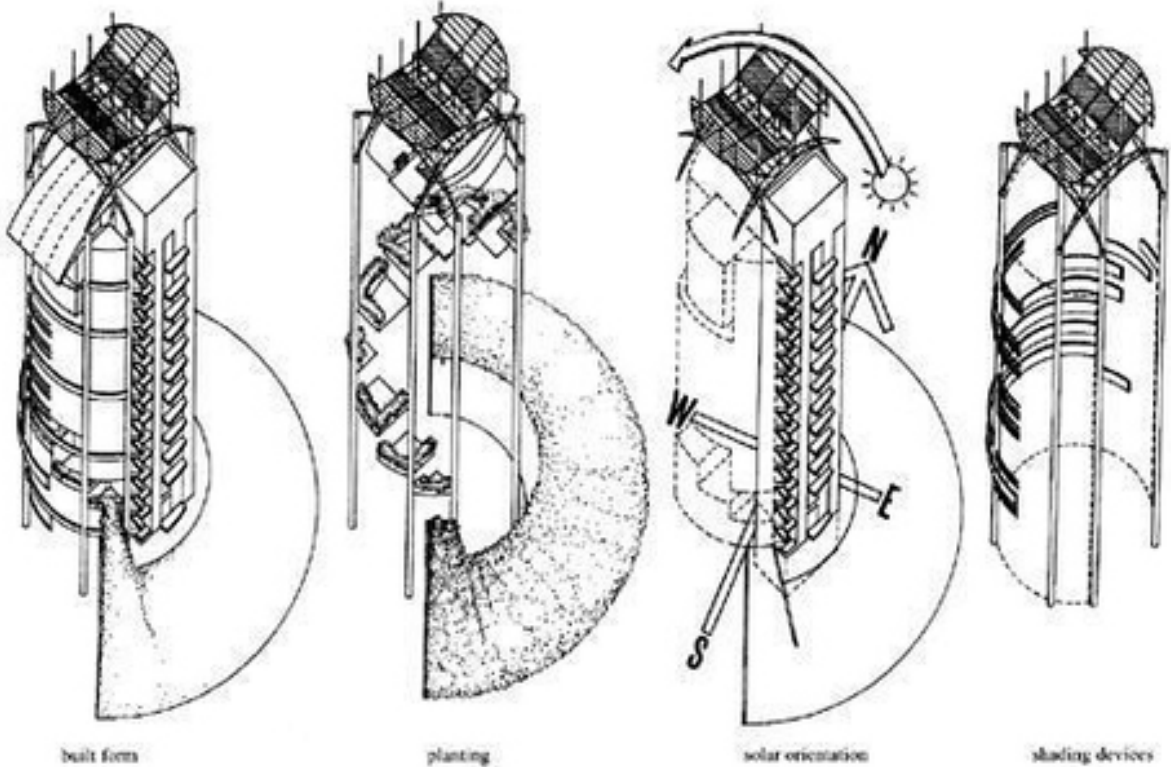
Then again, the front door has 2 shutters. During the day, the wooden one will be left open, and the metal grill closed for security:



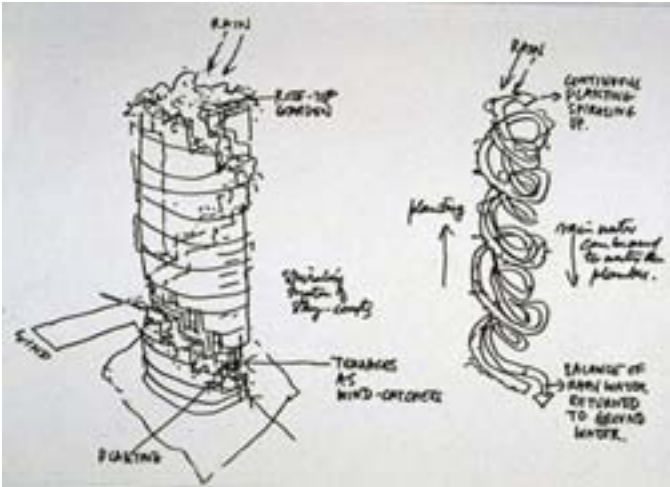
The windows are based on traditional examples, found all over Bombay:



Ken Yeang, Menara Mesiniaga Tower, Selangor, Malaysia, 1992



Ken Yeang, Menara Mesiniaga Tower, Selangor, Malaysia, 1992



EXPO '92 Seville



EXPO `92 Seville



EXPO `92 Seville



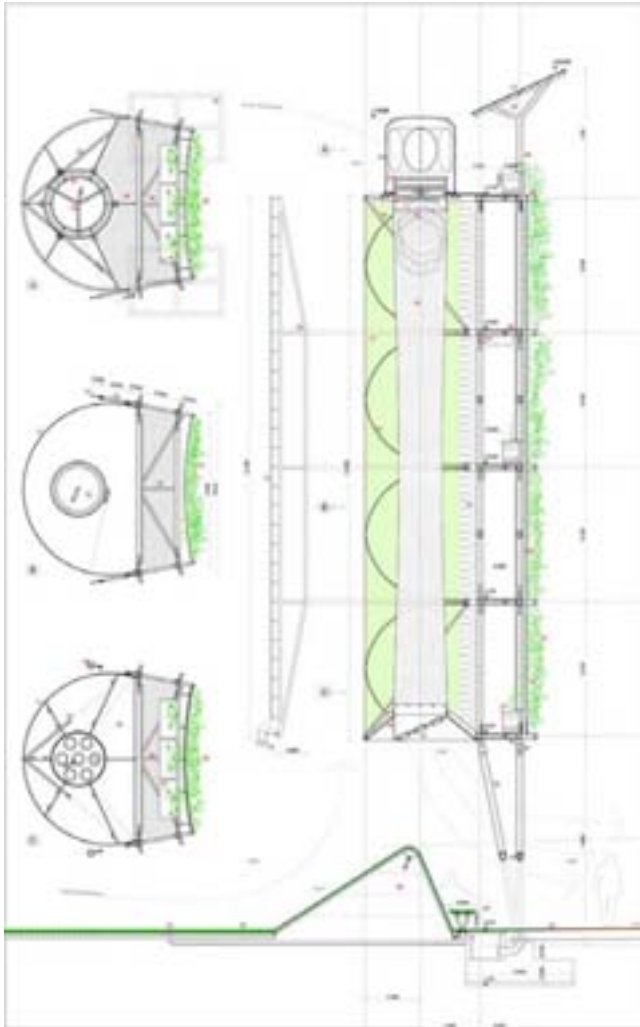
Eco Boulevard – „Air Trees“ ecosistema urbano, Madrid



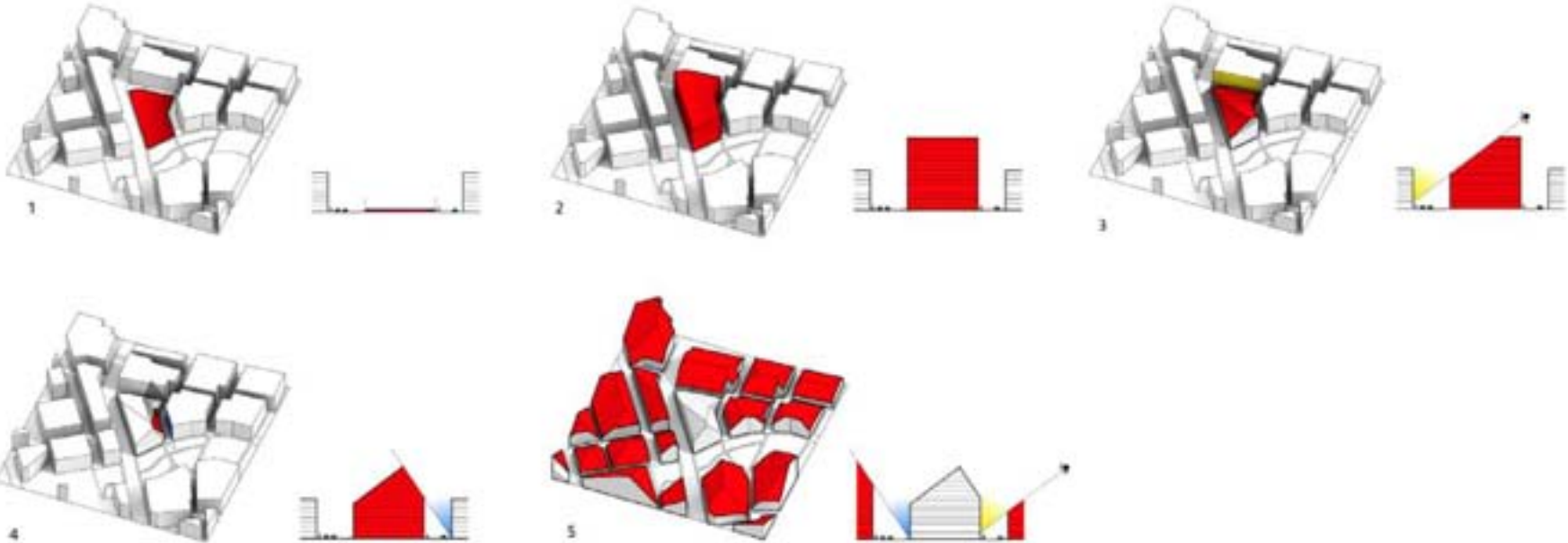
Eco Boulevard – „Air Trees“



Eco Boulevard – „Air Trees“

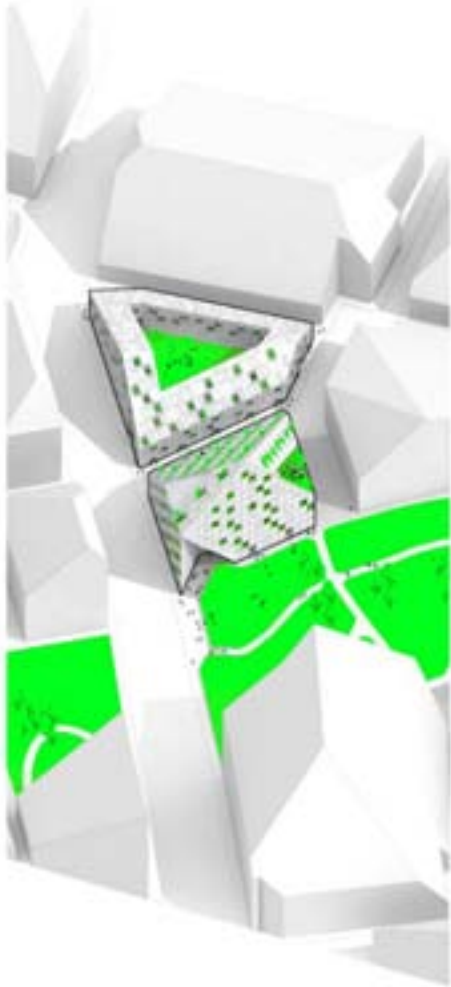
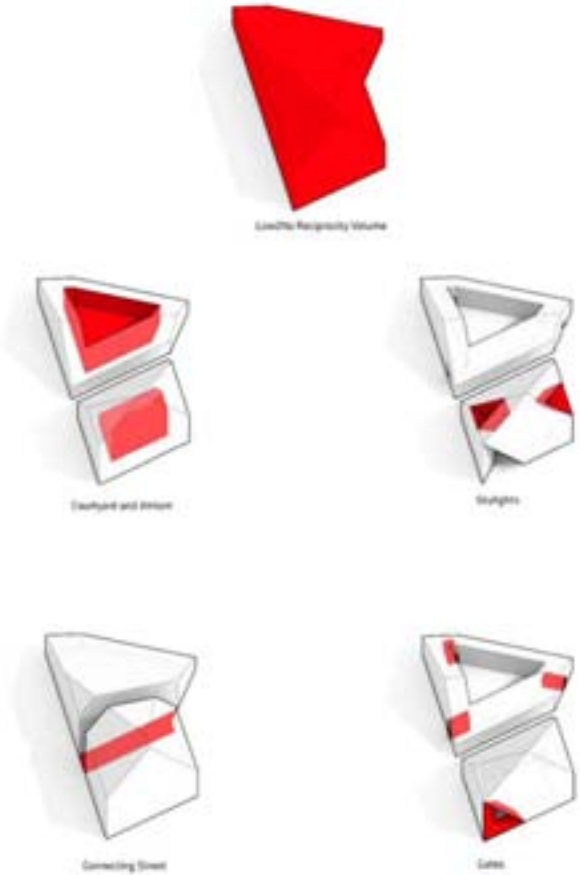


BIG, Reciprocity, Low2no, Jätkäsaari , Helsinki, Finland



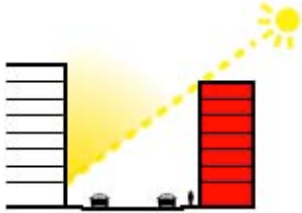
BIG, Reciprocity, Low2no, Jätkäsaari , Helsinki, Finland

Vision: Building Block

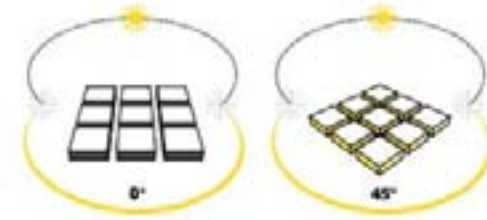


BIG, Reciprocity, Low2no, Jätkäsaari , Helsinki, Finland

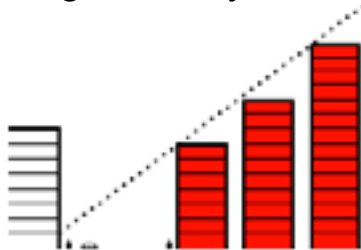
Building Heights and Massing



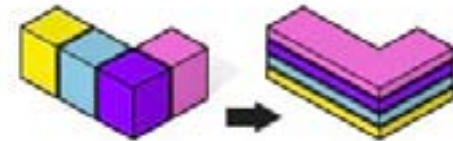
Street Orientation



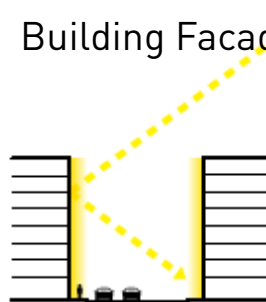
Right of Way Width



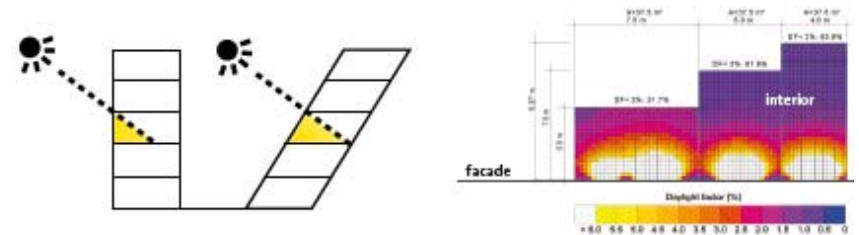
Distribution of Program / Mixed use



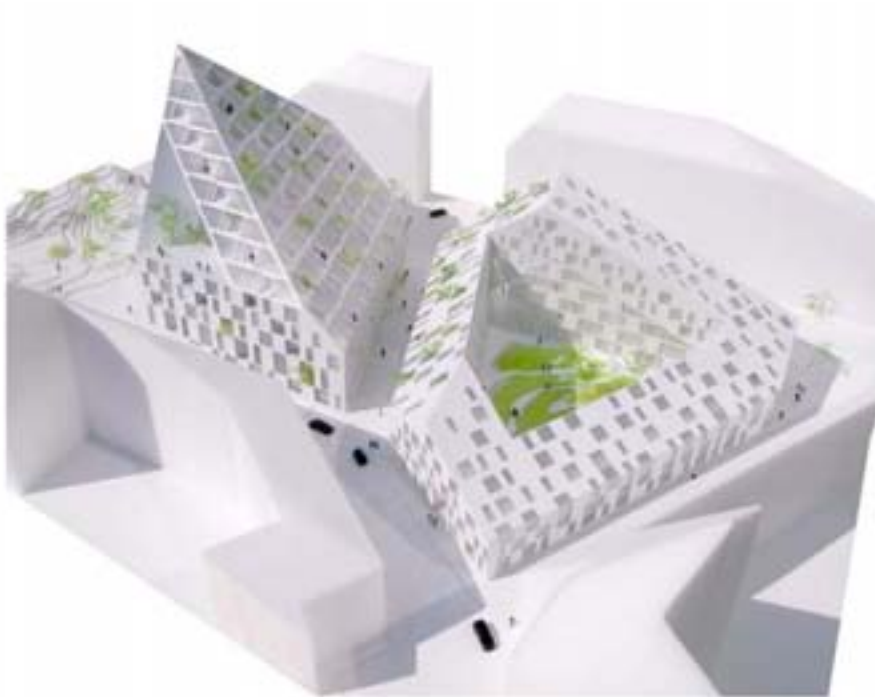
Building Facade Reflectivity



Floor plate Depth and Glazing Percentage



BIG, Reciprocity, Low2no, Jätkäsaari , Helsinki, Finland



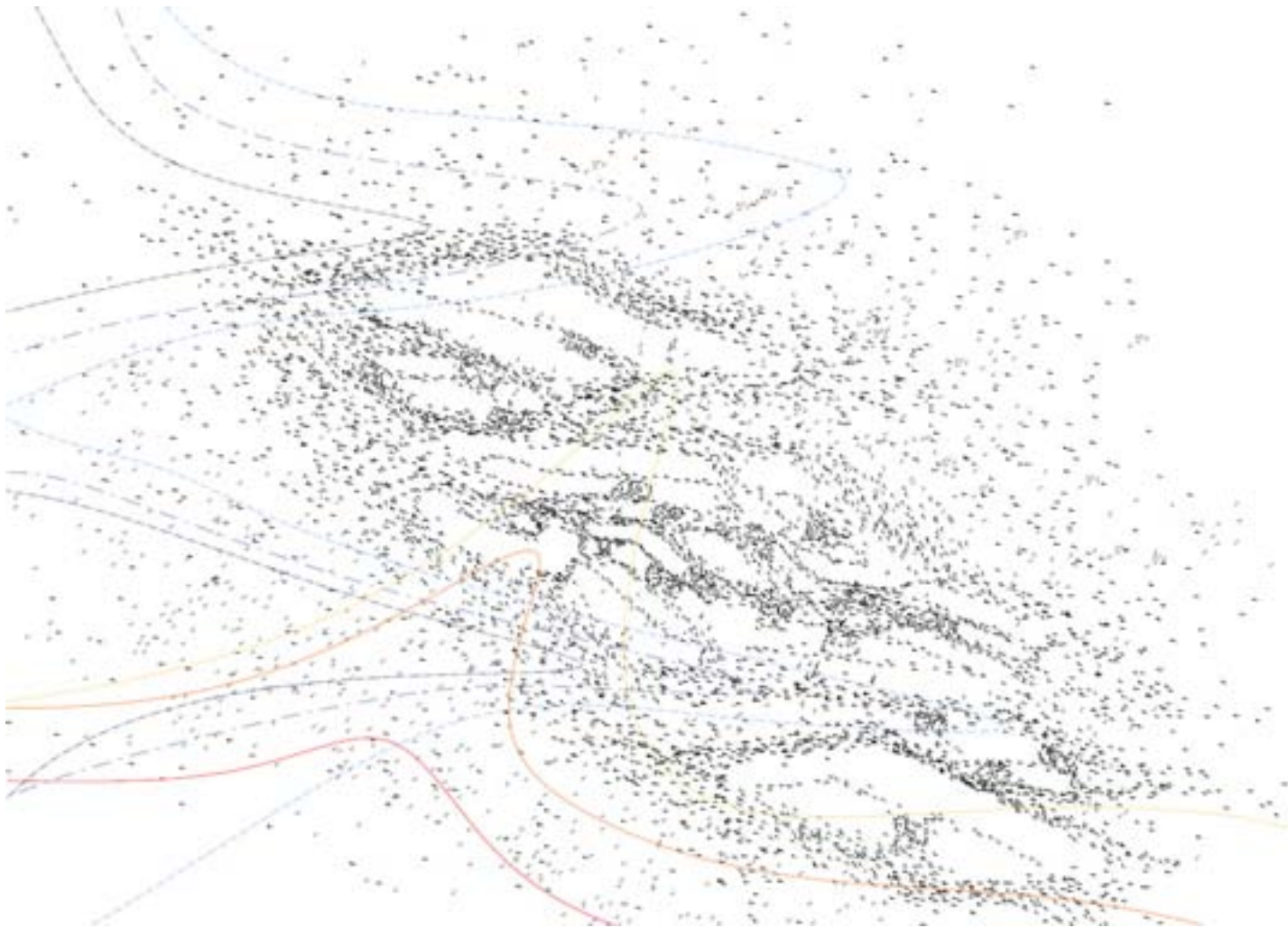
SMAQ, Xeritown, Dubai



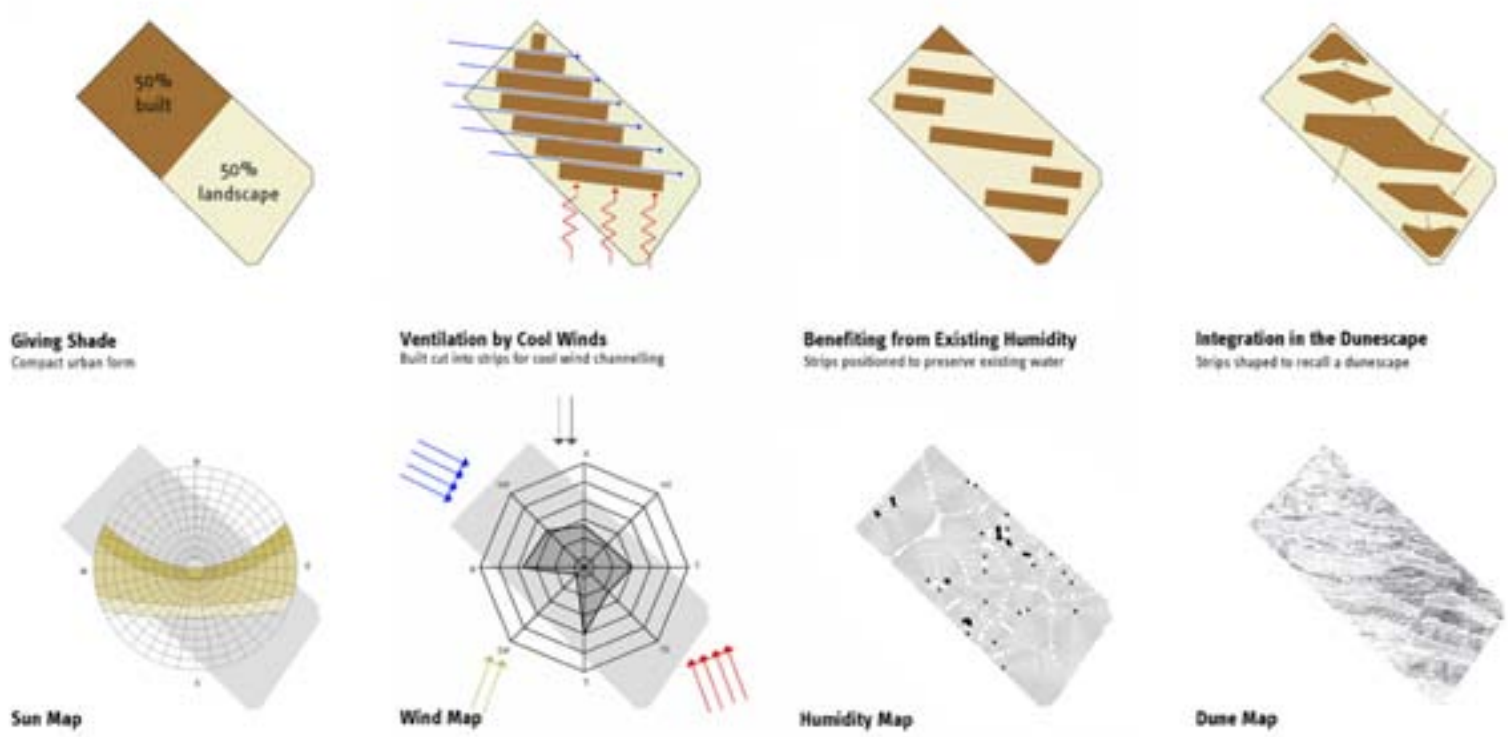
SMAQ, Xeritown, Dubai



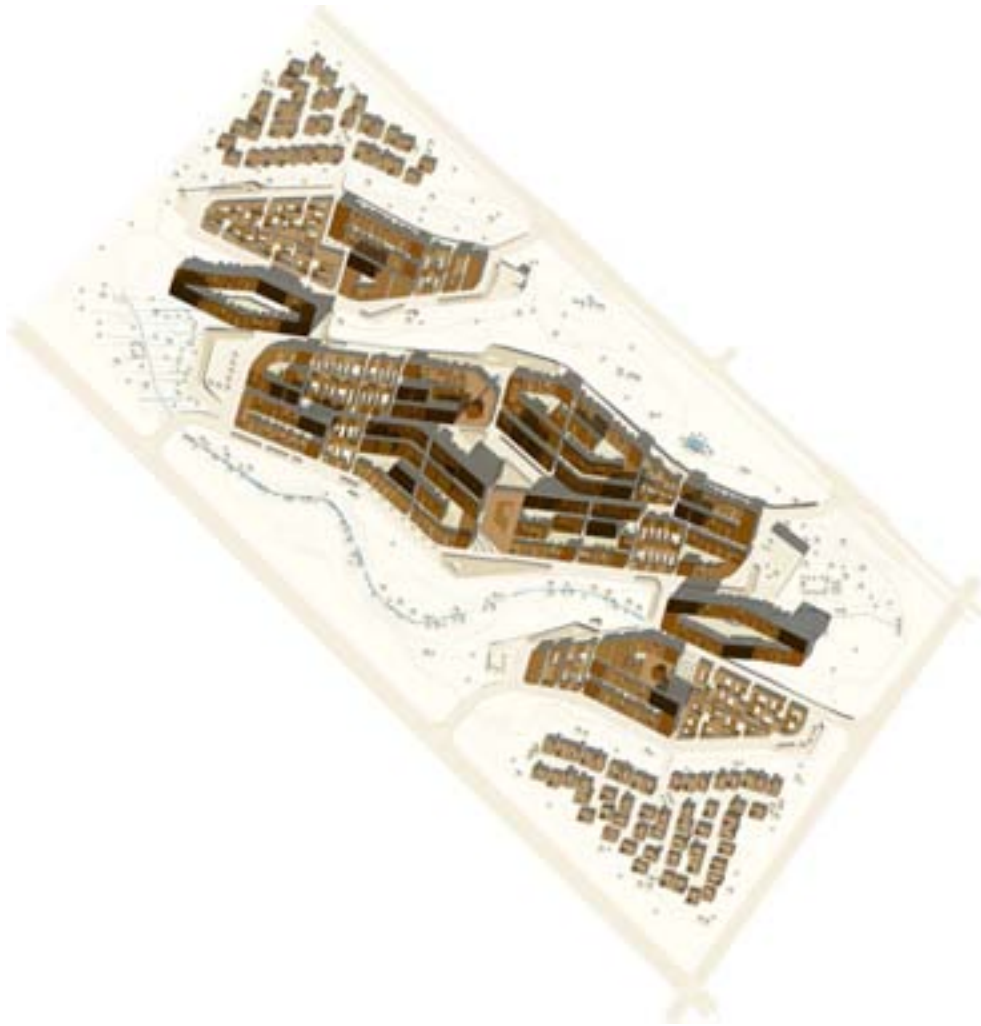
SMAQ, Xeritown, Dubai



SMAQ, Xeritown, Dubai



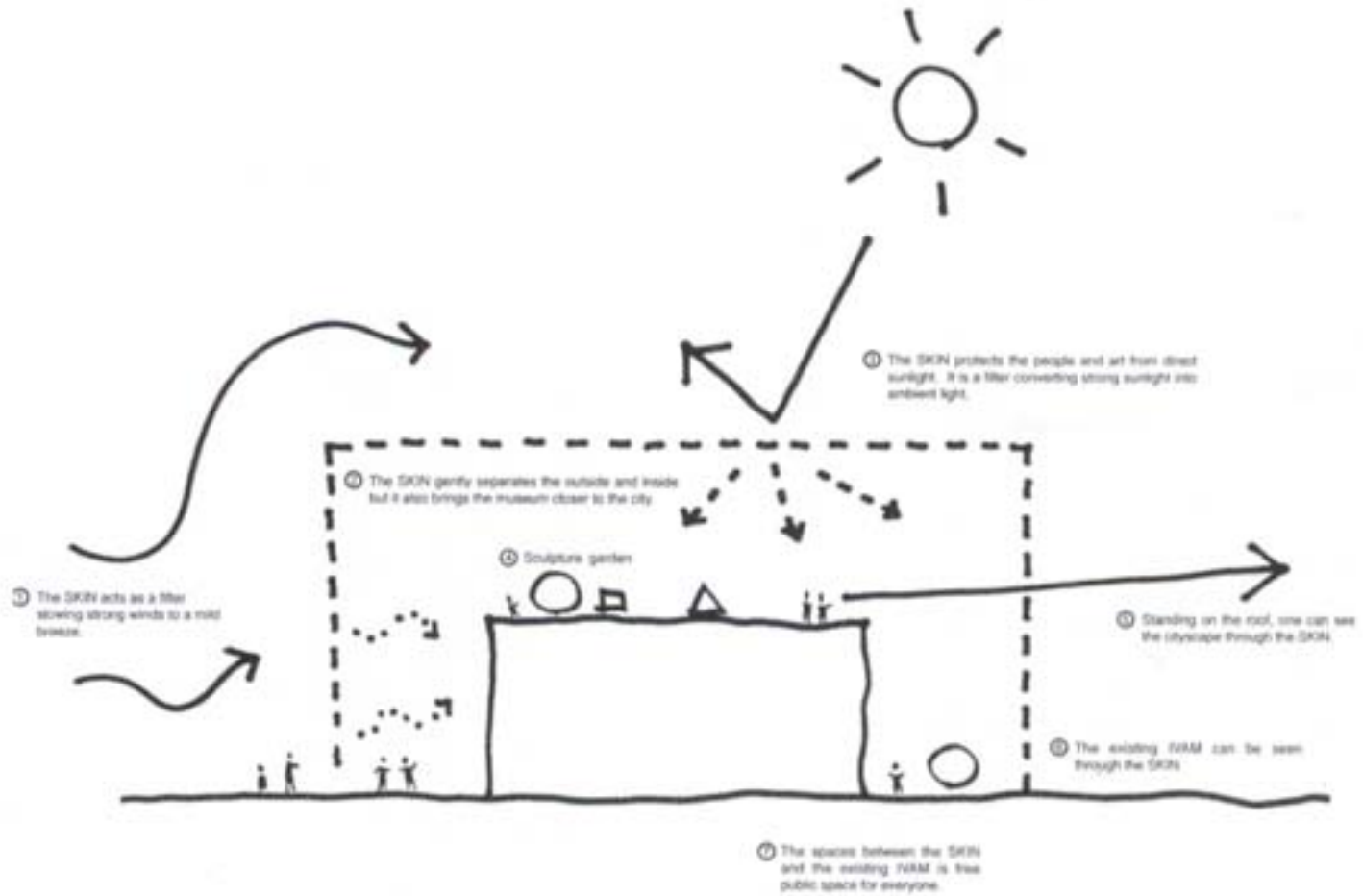
SMAQ, Xeritown, Dubai



SMAQ, Xeritown, Dubai



SANAA - Valencia Institute of Modern Art



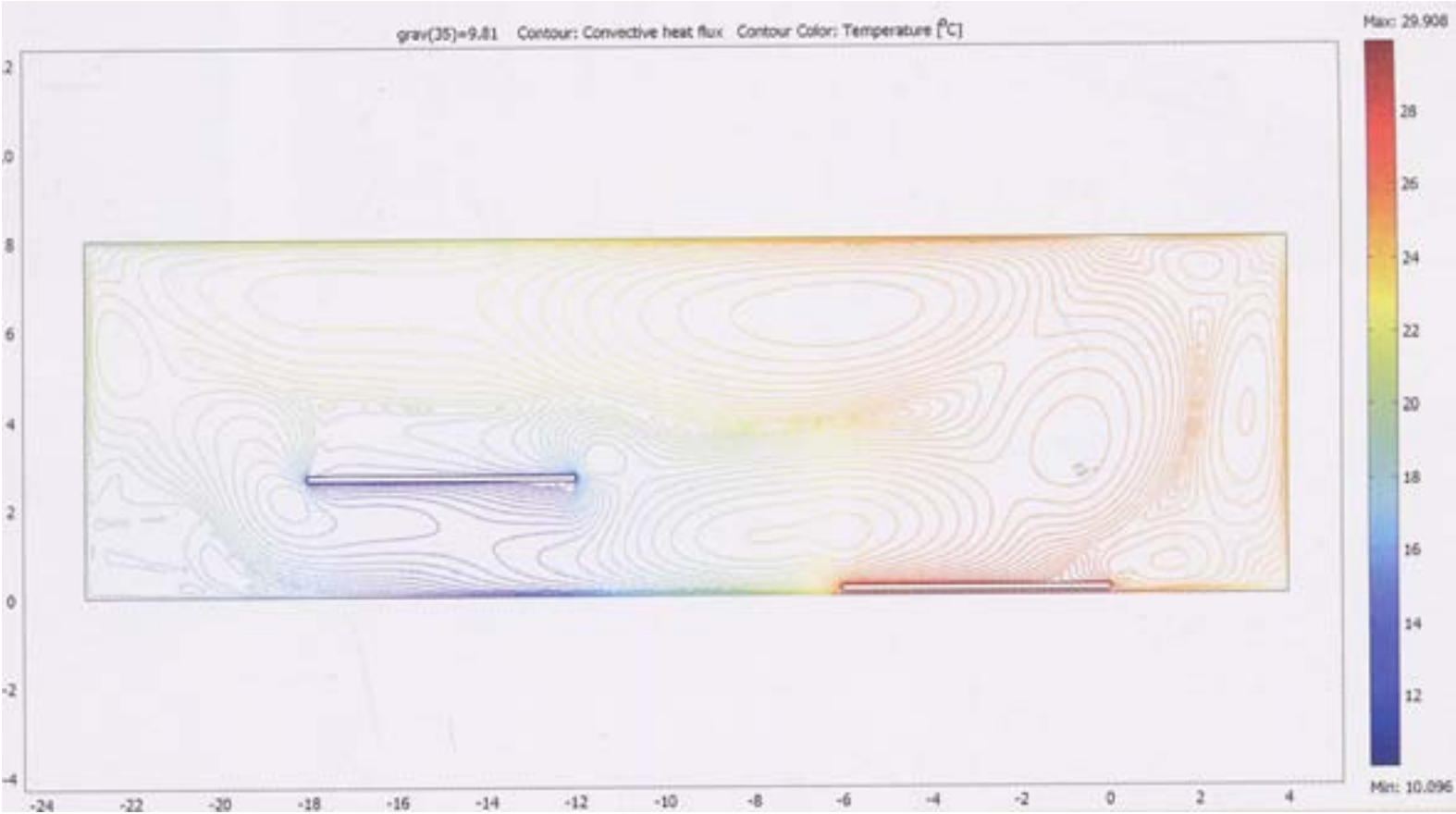
SANAA - Valencia Institute of Modern Art



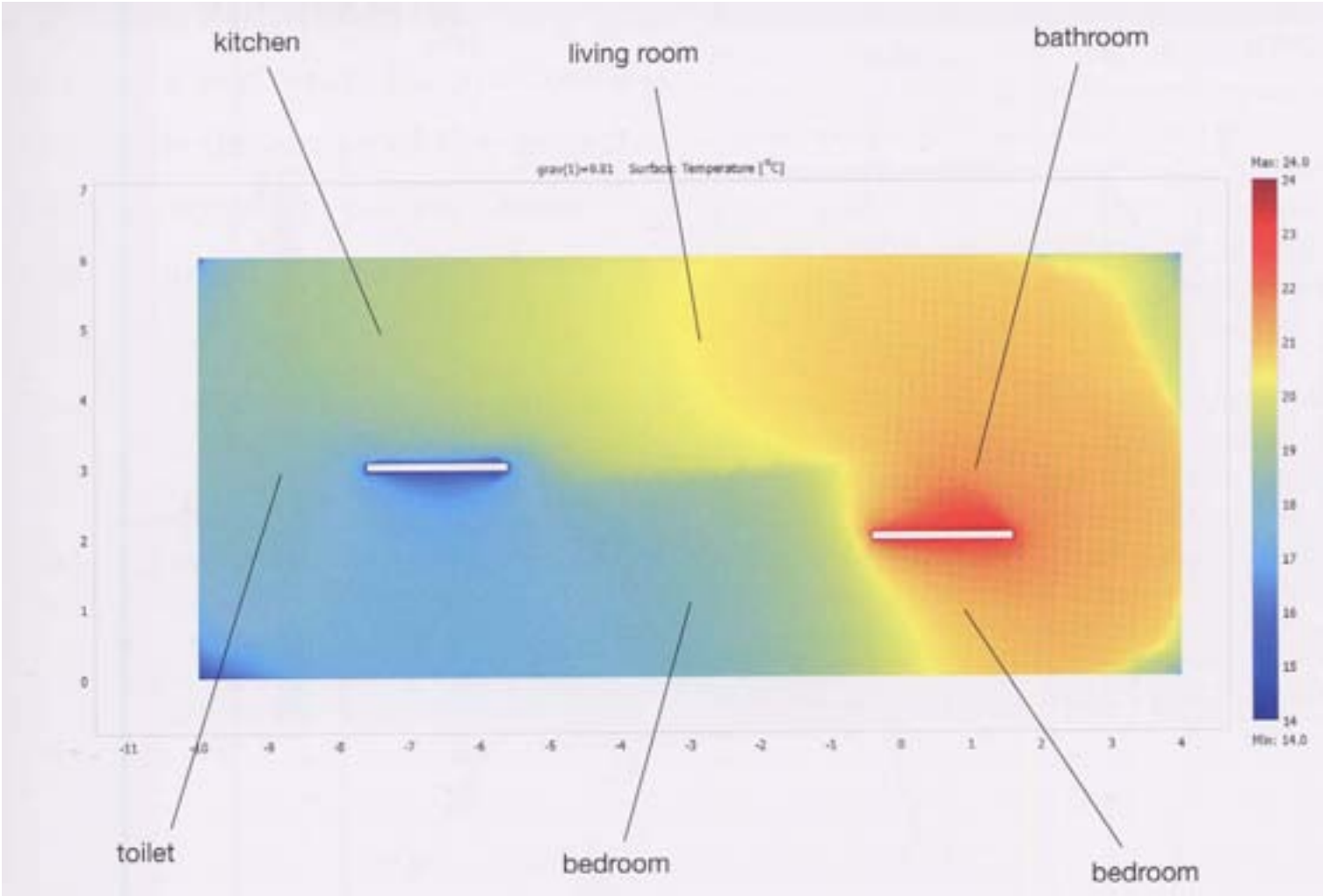
Sean Lally



Research House for D. G-F, 2008. Air-temperature contours



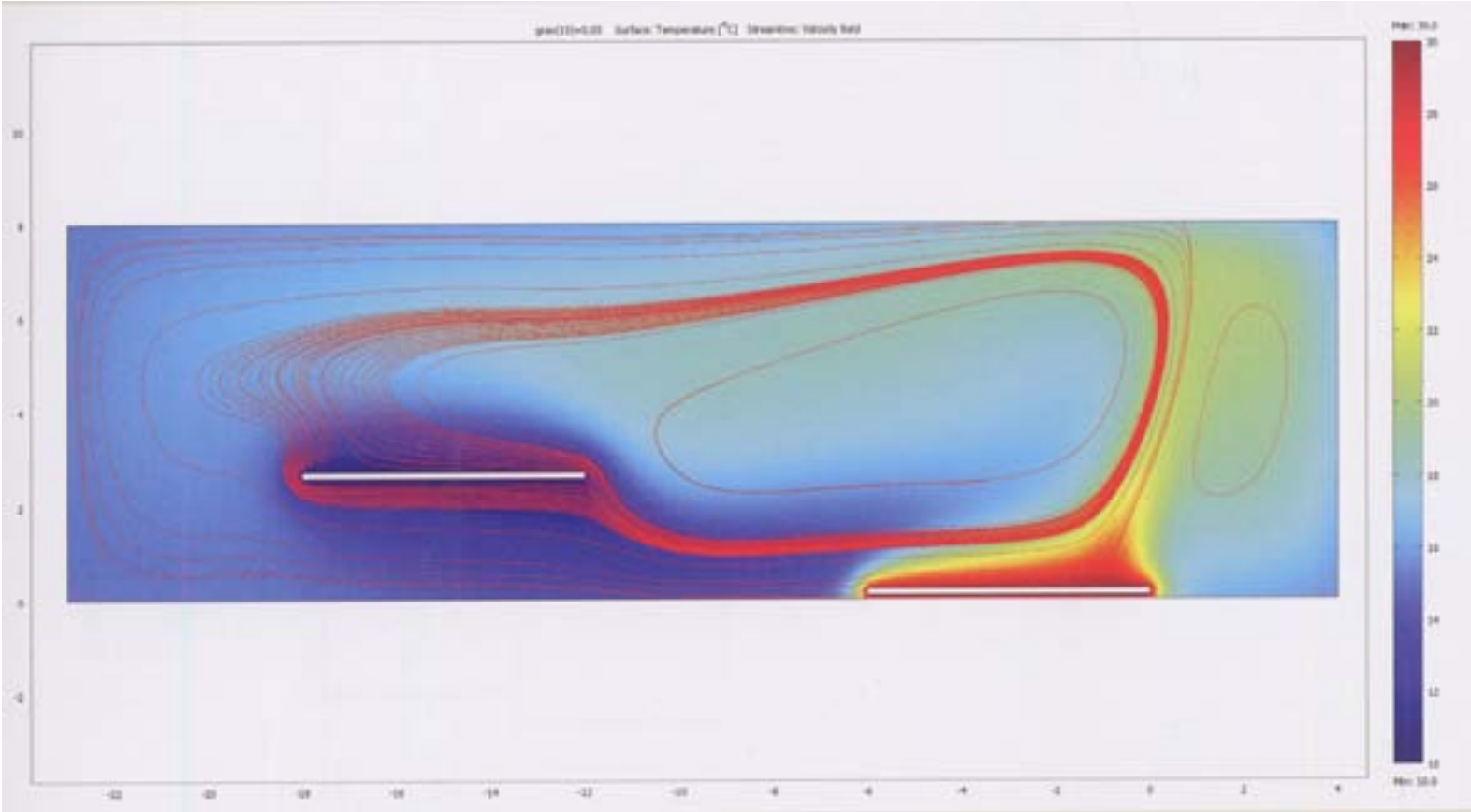
Research House for D. G-F, 2008. Philippe Rahm



Research House for D. G-F, 2008. Philippe Rahm



Digestible Gulf Stream. Surface temperature - velocity field



Digestible Gulf Stream, Venice Biennale, 2008. Philippe Rahm



„blur“ Swiss Expo 2002. Diller + Scofidio



„blur“ Swiss Expo 2002. Diller + Scofidio



„blur“ Swiss Expo 2002. Diller + Scofidio

