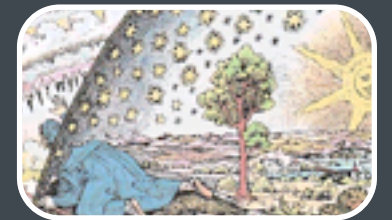


Simulation

L5: An Attempt Of An Overview

Design, Engineering, Architecture • Science



L6: Simulation and Design

Digital Chain • Monte Rosa • Future Cities Project



L7: Computation and Complexity

Simulation of Complex Systems



Simulation: Exercise 2

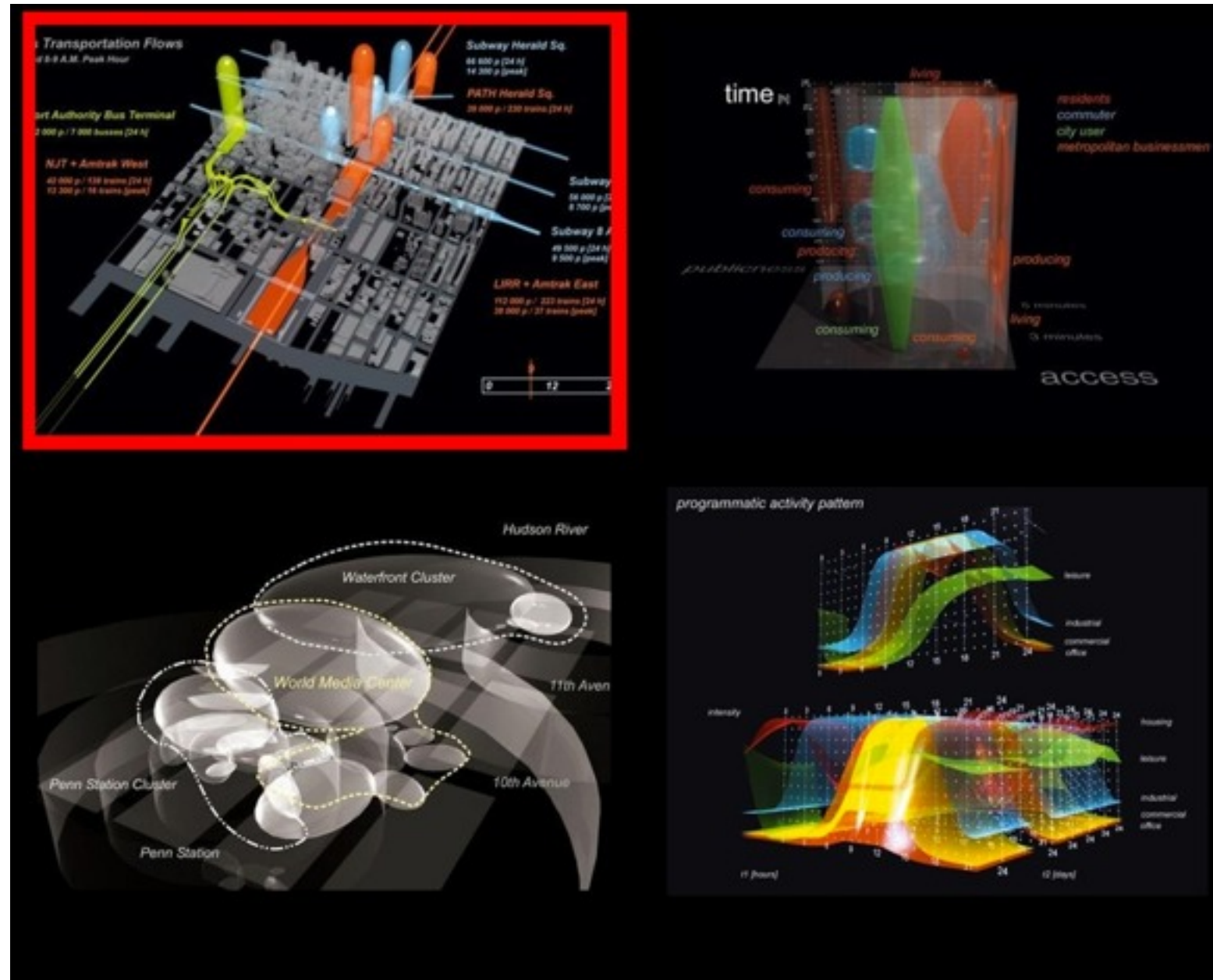
One Image and short description of architectural or urban design simulation from your perspective

To be handed in per e-mail until April 12, 2010 to

coleman@arch.ethz.ch

Format: Powerpoint or Keynote

Aiste Plentaite



The Image is an urban proposal of UN STUDIO for West Manhattan (competition entry IFCAA year 1999). In this image the 3D model of Manhattan is constructed which is a basis for diagrams and simulation of different flows. Generated diagrams visualize the existing user flows related to program, time and location. The diagrams map the performance of Manhattan in order to extract parameters for the development of the site.

Roderick Trompert



SARA urban augmented reality application in Layar

The world's first building to appear in three dimensions on the smartphone via augmented reality is the eye-catching Market Hall which is currently under construction in Rotterdam's Blaak area. The Market Hall was designed by architects MVRDV and is being built by Provast. With SARA, an urban augmented reality application, you can see and experience the built environment of the past, present and future, via Layar Browser. The NAI (Netherlands Architecture Institute) has set itself an incredible challenge: to make the Netherlands the first country in the world to have its entire architecture viewable on smartphones thanks to augmented reality

Severin Neukom

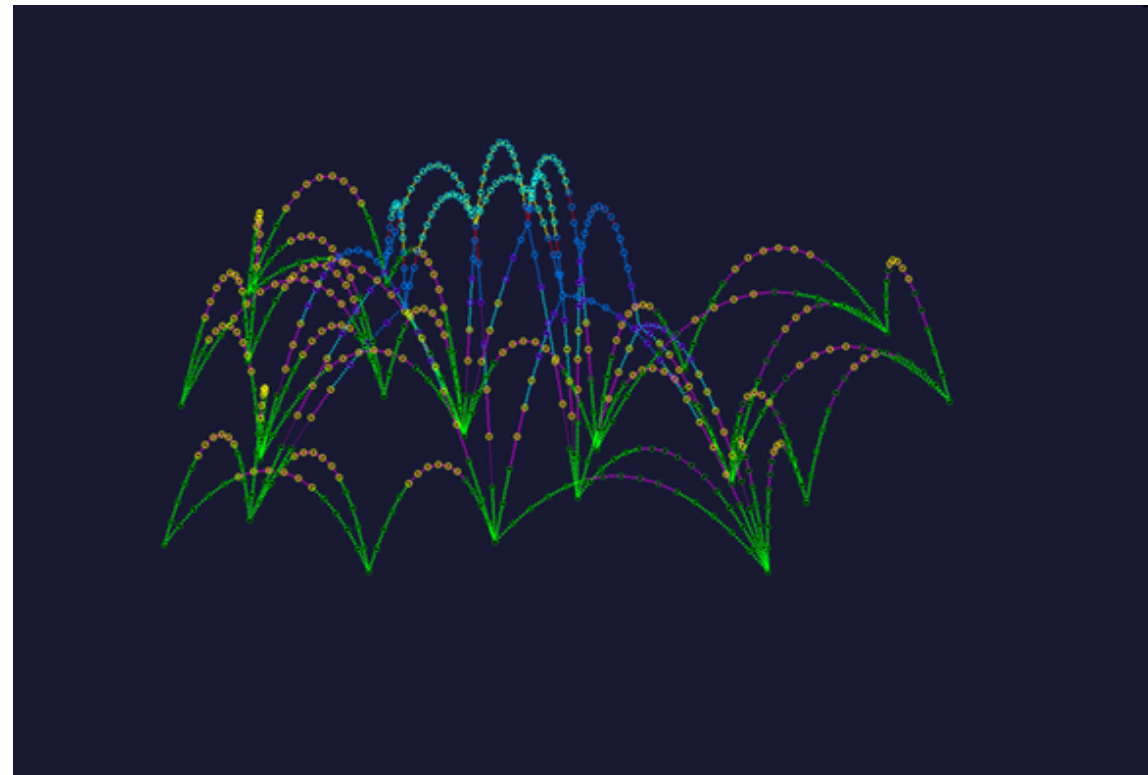


Acrobat 3D Commercial Architecture Walkthrough

Matthew Huber



Gaudi Chain Model



MOS Catenary Software

Gaudi used analog simulation tools. All digital models are the translation of real physical forces into abstract rule sets. In digital simulation, theorization becomes increasingly important as abstract further disconnects the outcome from intuitive understandings of real phenomenon. Though, digitalization offers unrivaled capacities for modeling complexity.

Jingzhi XU



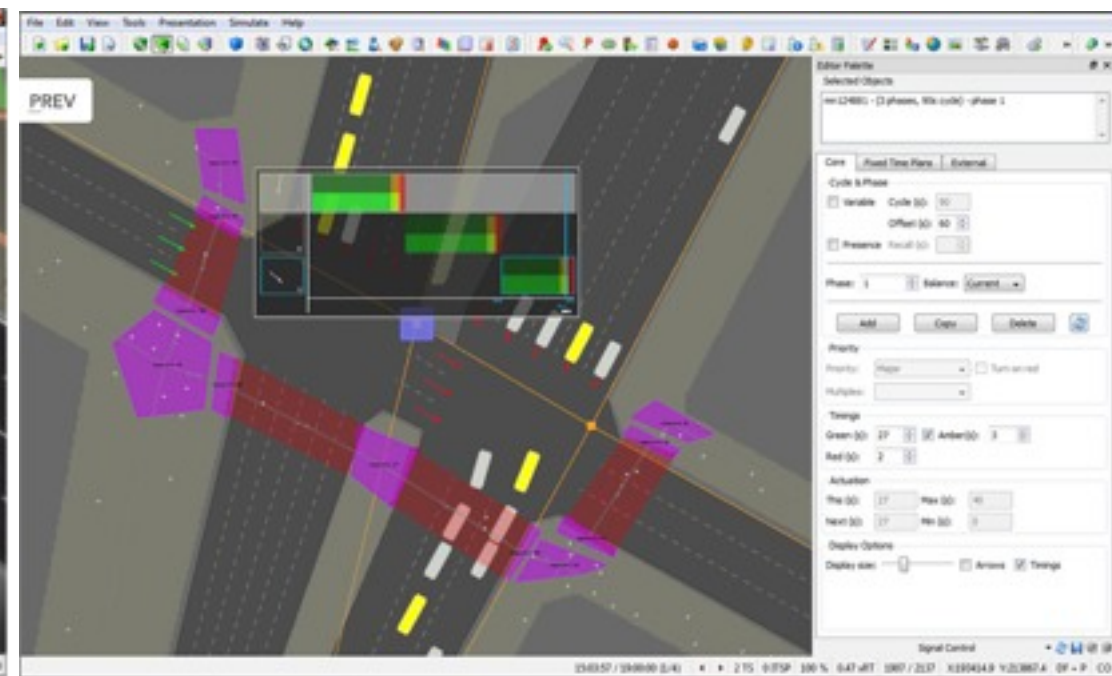
Mode Gakuen Cocoon Tower stands as a symbol of innovation and exception in educational design. The 50 level building contains 3 different schools: Tokyo Mode Gakuen (fashion), HAL Tokyo (IT and digital contents) and Shuto Iko (medical treatments and care). The building's innovative shape and cutting edge façade embodies Kenzo Tange's unique "Cocoon" concept, which not only use the cocoon shape, but the inter-frame structure has also absorbed many advantages of cocoon.

Nicolas Schwab



Pedestrian Presentation Graphics
Image 1 of 2

CLOSE X



Walk / Don't Walk blocking regions connected to signal phases
Image 2 of 2

CLOSE X

Jingzhi Xu

"Quadstone Paramics provides a realistic representation of the "friction" to traffic flow caused by pedestrians. The pedestrian modelling system allows users to obtain a realistic model of pedestrian flow. The pedestrians are free space agents; simulated people who can move freely within the study area defined by the user." This could be used in Urban city planning for instance.

Source: <http://www.paramics-online.com/pedestrian-modeling.php>

Michèle Skarpetowski



Dieses Bild zeigt ein Rendering eines tollen Gefährts in der Stadt.

F. Cihan Kuyucu



Urban Design Simulation

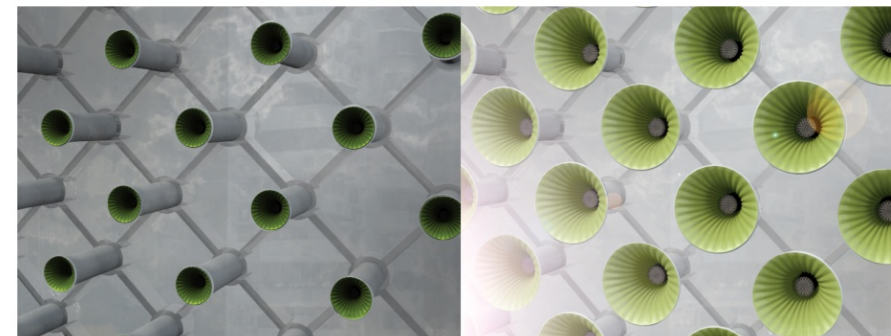
Lukas Hüsser



What if we dramatically reduce the car traffic? In Copenhagen they have a 200% luxury tax on new cars and very little parking spots. They are serious about putting the human traffic completely on the bicycle.

It would be very interesting to simulate a city where everyone moves with public transport and bikes. Where would be new car-free zones, new smaller roads, more public street space? Where would people live/ move to, if no one has a car? How would it affect health cost, street costs and maintaining, pollution? The traffic defines a city. What is its future?

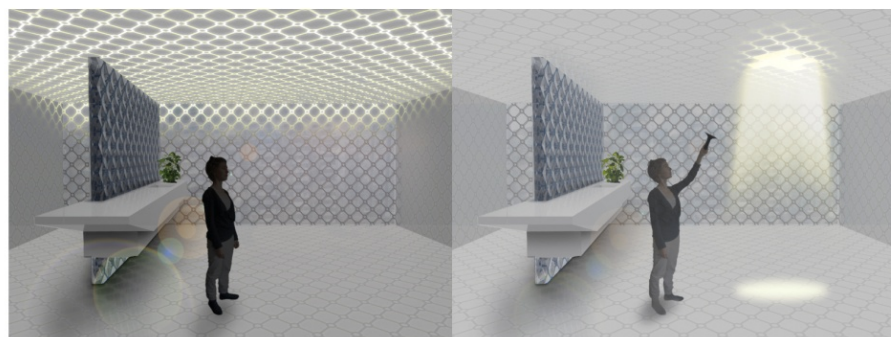
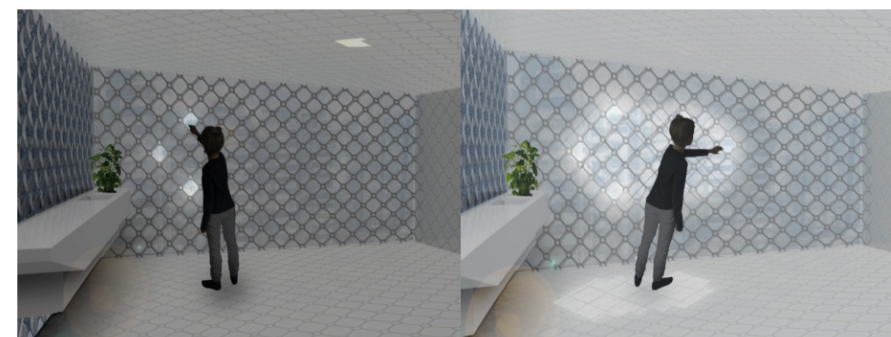
Elvan Dajko



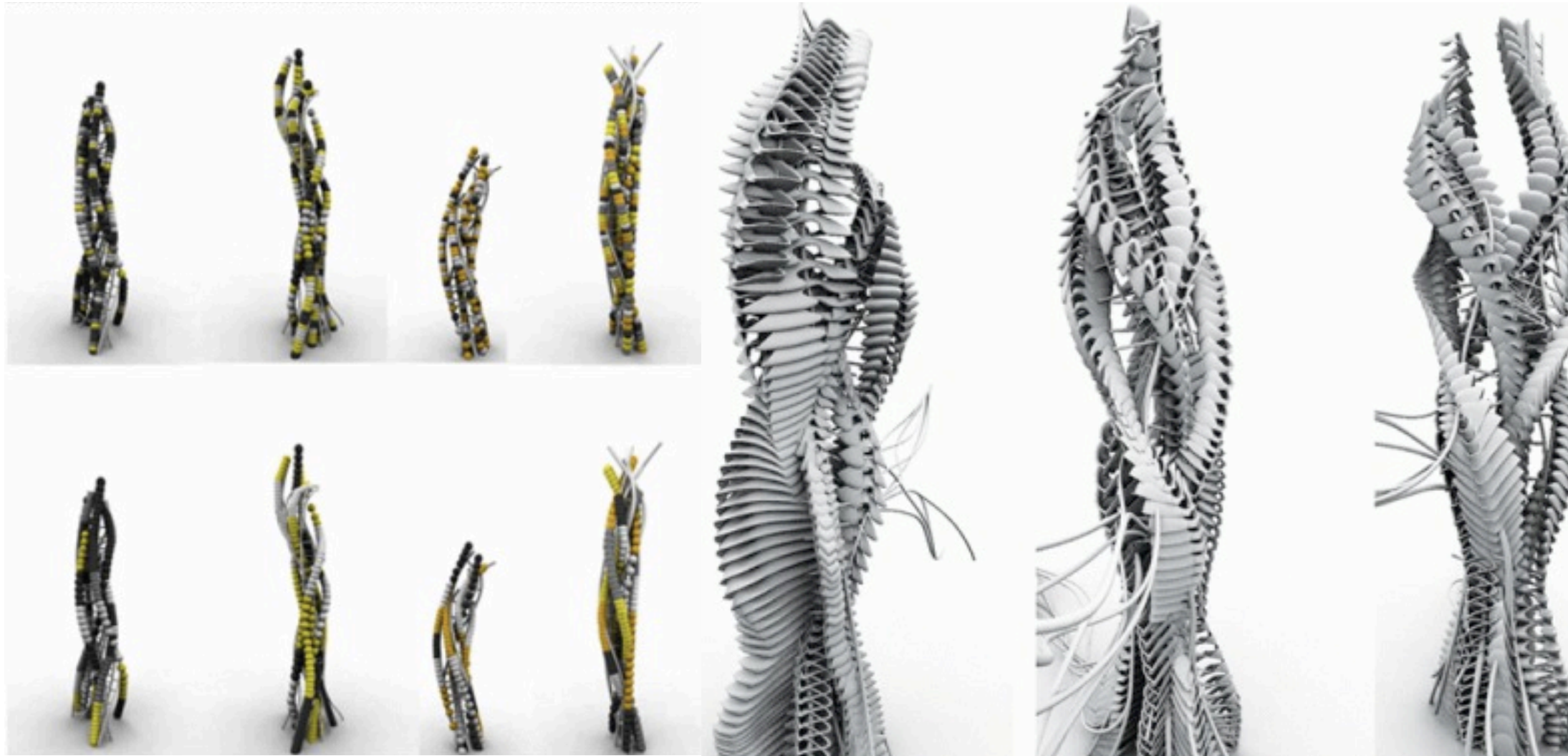
Off the grid: Sustainable Habitat 2020

The whole project is based on the brief to develop sustainable housing for urban megalopolis in China in 2020.

A membrane creates a strong link between the exterior and interior of the habitat and used as a transporter collecting and channeling the elements of air water and light - from the outside feeding into the inside space. Even though is not the best example of simulation (probably a result of rendering or Photoshop), I found it an important example to underline the importance of simulation as probably the only mean to develop such ambitious and expensive projects.



Celi Andrade Diana



This building is a representative structure according to changing programs. The tower shifts or twists when different activities are happening, giving the possibility to have a basic structure and form but with the simulation of the potentialities of spaces that it can provide, new buildings are instantly created according to their necessities. The project was modeled by for a competition of a housing proposal in East London, and the initial structure resembles the back bones. Borrowing rules and functions, the project is an investigation of parametric development adapting to different urban needs.

Nathalie Bodarwé



Truman Show: architectural simulation through "movie decor" aiming to represent the real life situation of a human being



Second life (1): the virtual univers, metaverse, aiming to represent a network of virtual people and virtual activities:

Simulation

L5: An Attempt Of An Overview

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L6: Simulation and Design

Digital Chain • Monte Rosa • Future Cities Project



L7: Computation and Complexity

Simulation of Complex Systems



Simulation

design analysis
and simulation

submission/
competition

drawings,
models,
3D-models,
etc.

sketch(es)
ideas

building

launch

facility
managment

maintenance/
renovation

use analysis
and simulation

ia

Chair for Information Architecture

Simulation

Why should architects use simulation tools?

- to predict that and how a building will work
- to achieve low energy building life cycles
- to reduce emission (e.g. CO₂)
- to optimise processes
- to improve life and work qualities for users

Simulation tools support architects to design sustainable architecture

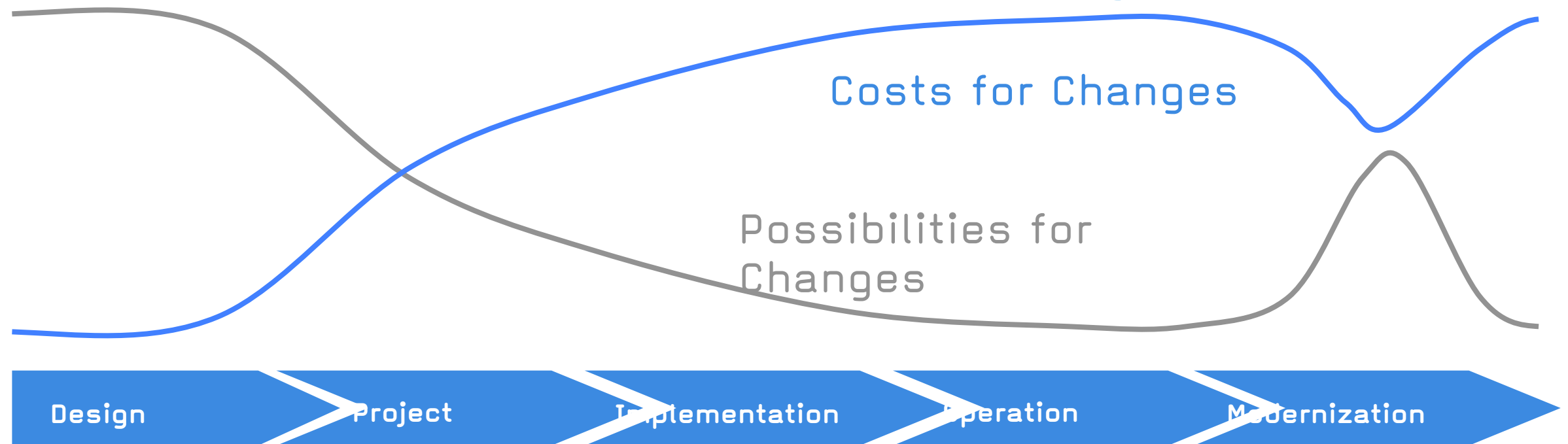
Glacier retreat simulation

Simulation: Climate Change

New Monte Rosa Hut, Switzerland, Andrea Deplazes
In May 2009 construction has started on one of the world's largest and highest altitude building sites.

Simulation

Simulation within the lifecycle of a building



Potential capacities of simulation



Diagram from HTA Luzern

Simulation

Cost for simulation tasks

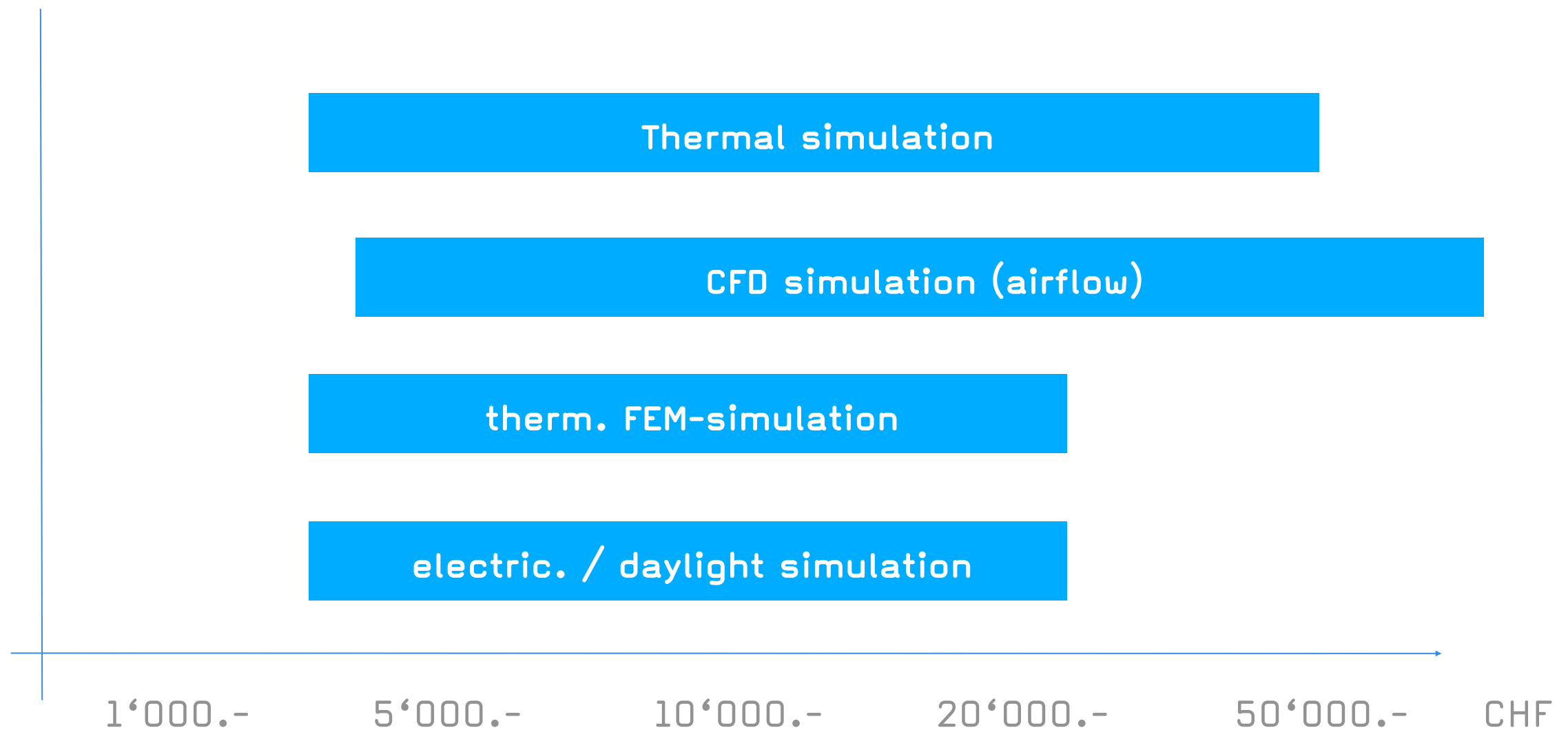
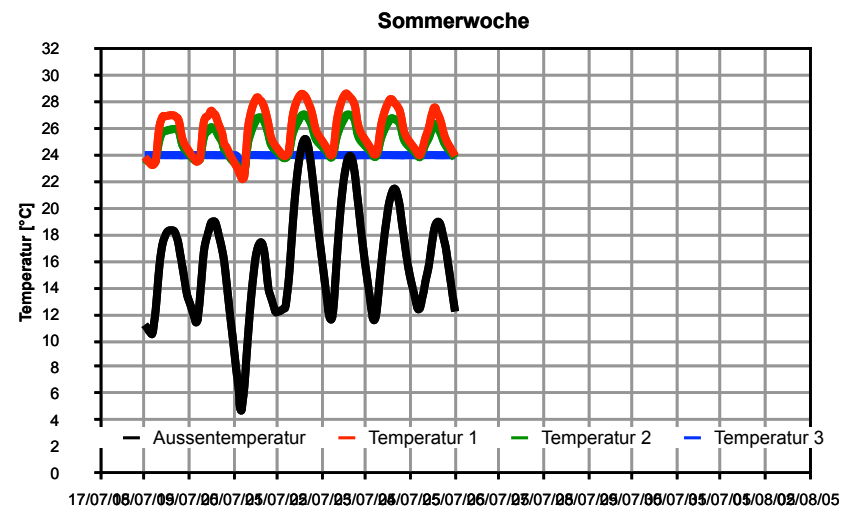


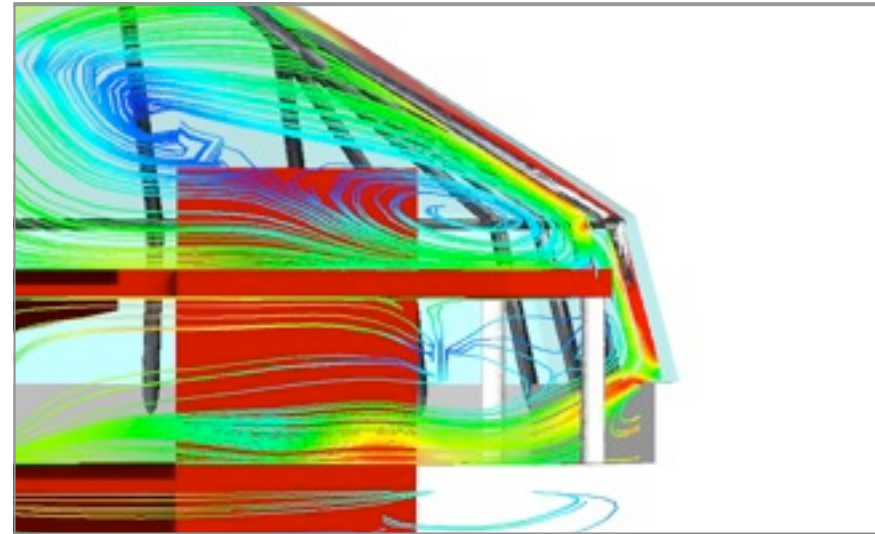
Diagram from HTA Luzern

Simulation

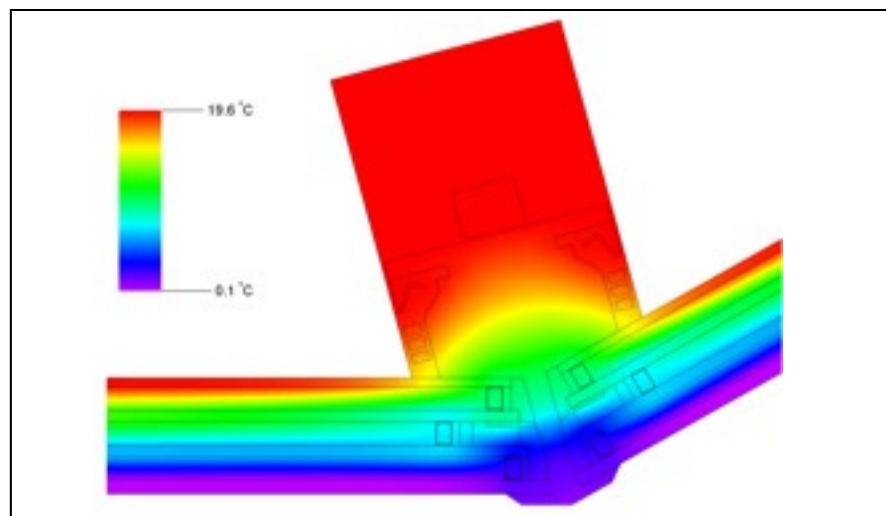
Types of simulation



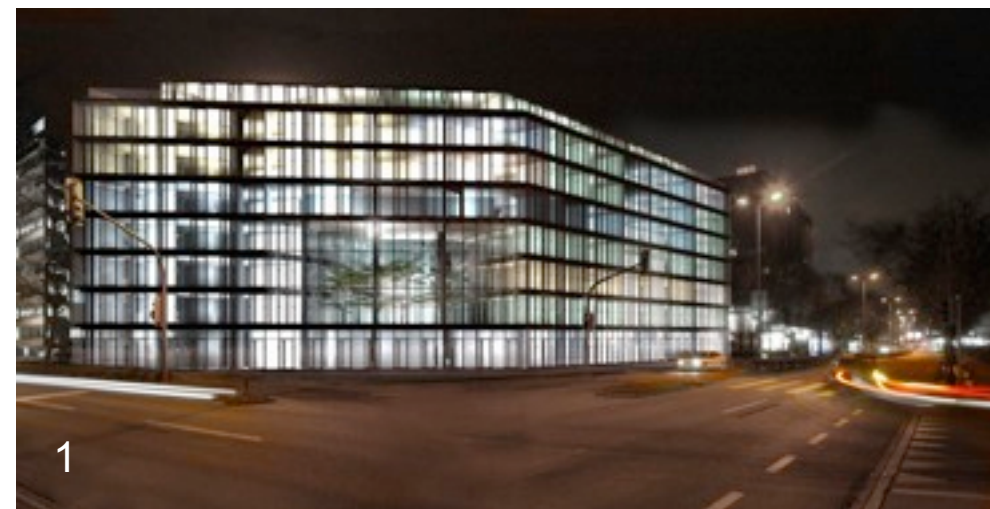
thermal space simulation



CFD simulation



FEM simulation



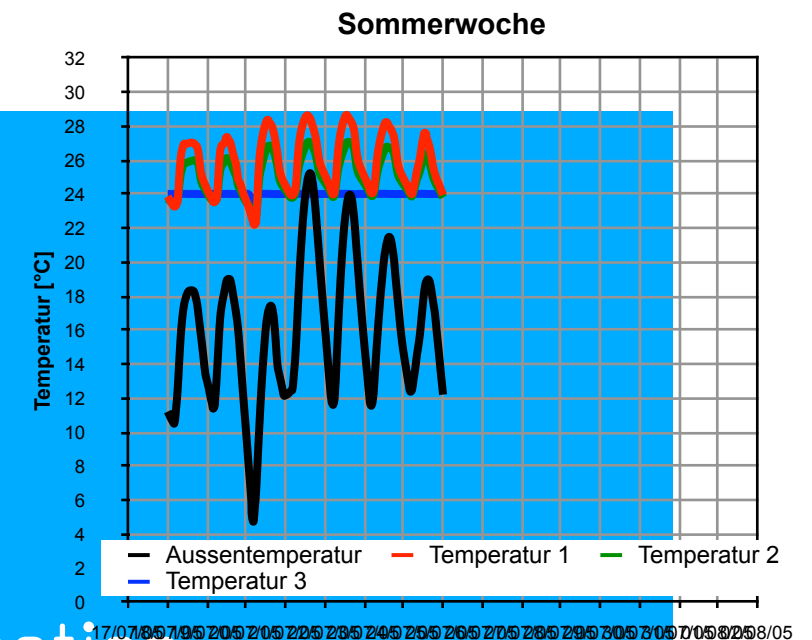
electrical / daylight simulation

Diagram from HTA Luzern
1 Vogt-Partner, Winterthur

Simulation

Thermal room simulation

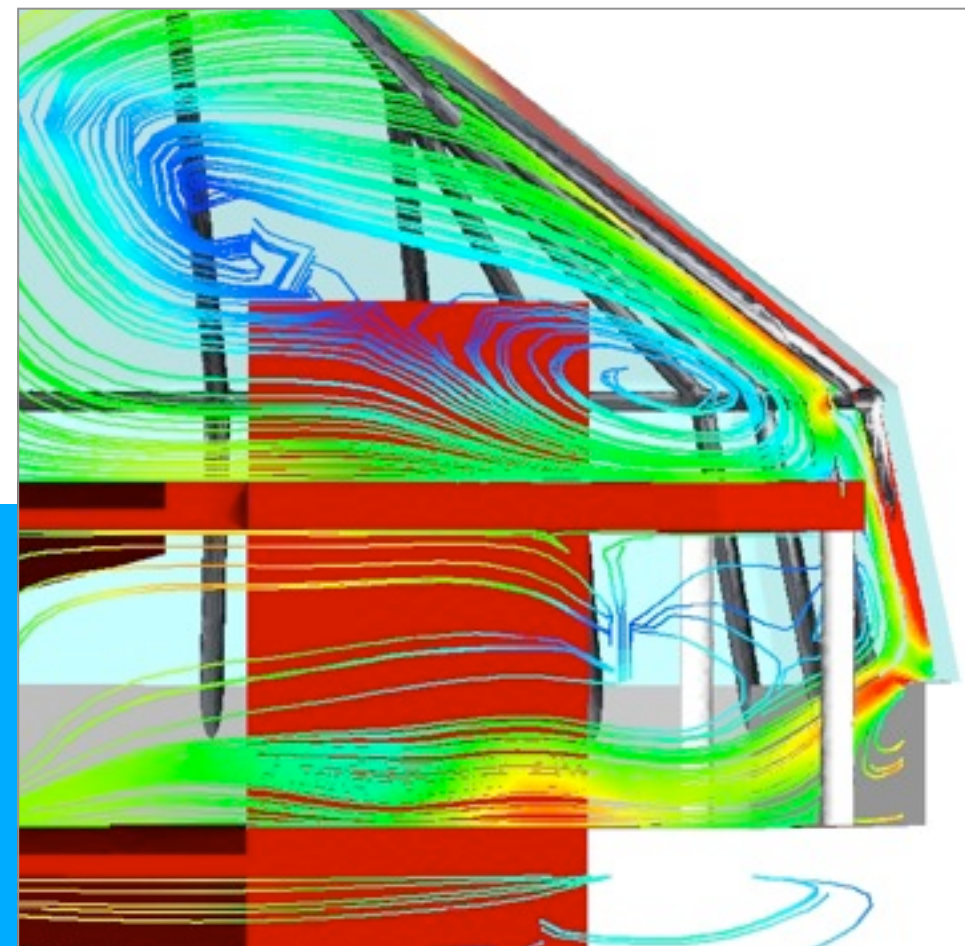
- comfort:
 - air temperature inside rooms
 - on surface temperature
 - CO₂ concentration
 - humidity
- building technology:
 - performance and energy consumption
 - system temperatures
 - operation and controlling strategies
- dynamic consideration of
 - external demands (temperature, radiation, airflow)
 - internal demands (devices, people, lighting)
 - operation of housing technology



Simulation

CFD Airflow simulation

- Airflow inside buildings
 - air draft
 - natural ventilation
- Temperature distribution
 - temperature layers in large spaces
- Airflow around buildings
 - wind pressure / suction on building facades
- Fire safety
 - fume distribution



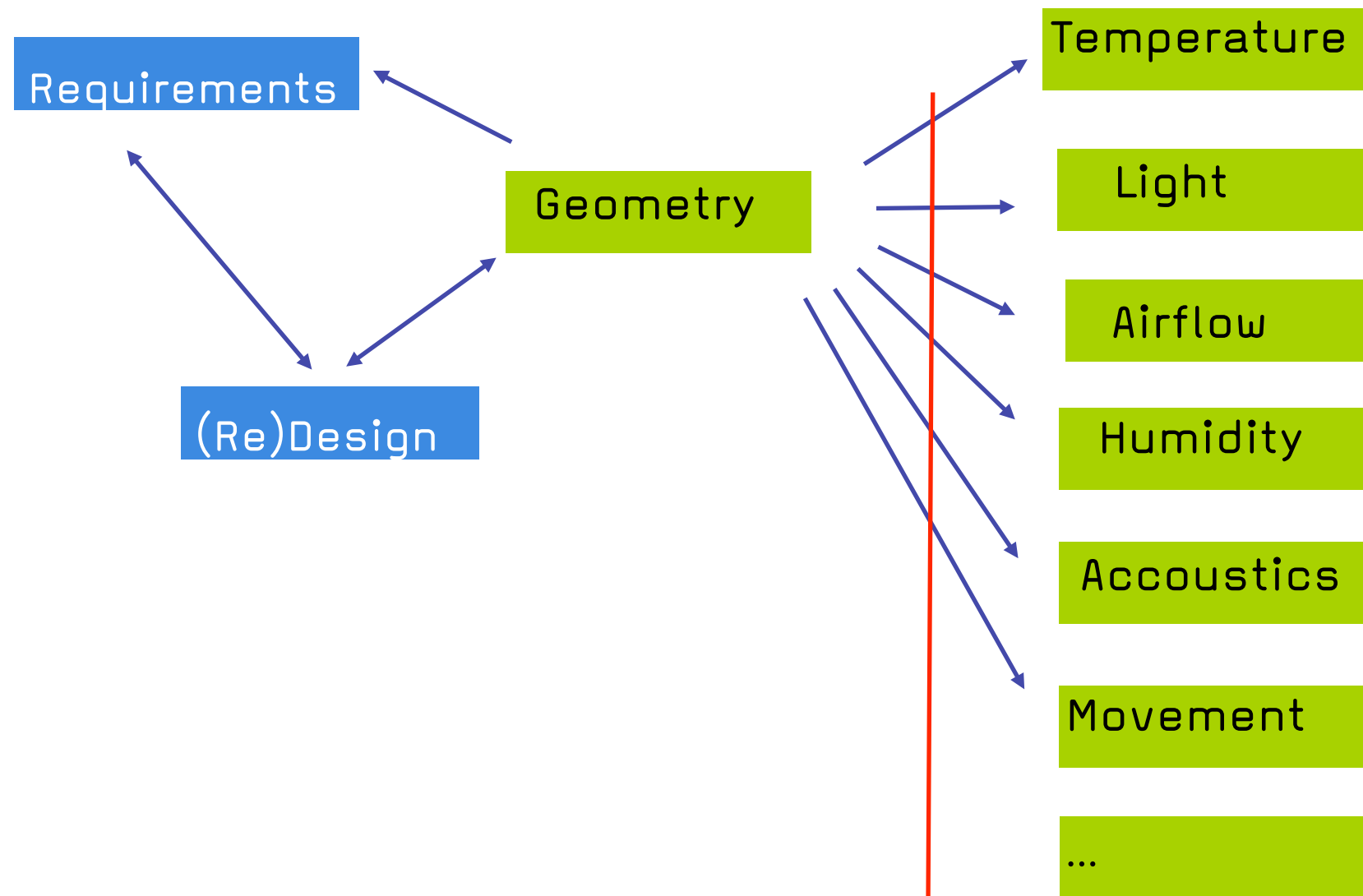
Simulation

FEM simulation

- Thermal transmission
- Thermal bridges
 - connections, window frames, penetration
- Thermal storage properties of building elements
 - thermo-active building element systems, floor heating
 - thermal losses into ground
- Surface temperature
 - risk of condensation
- fire protection

Simulation

Today's simulation tools are used by experts and detached from the design process

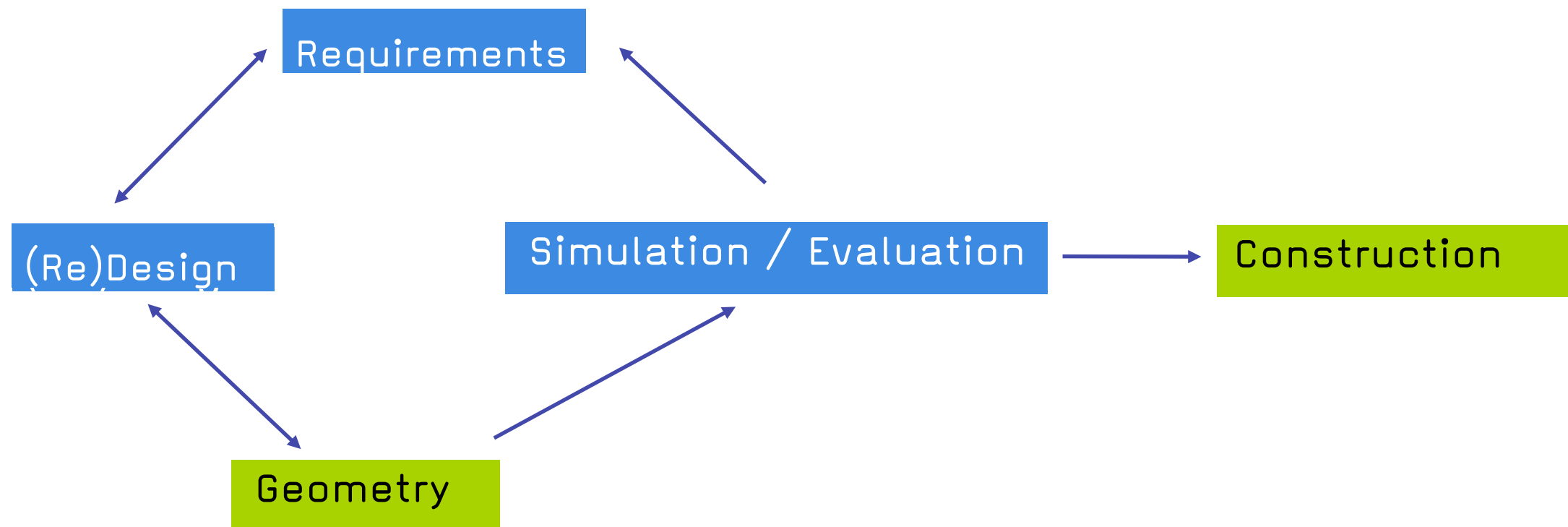


There is no integrated approach for architects
Feedbacks are difficult to implement.

The right effort must meet the right time, the
right geometry and the right instruments for
insights.

Simulation

Next step: One integrated design and evaluation solution.



(Building design lifecycle)

FS2010 Lecture 7

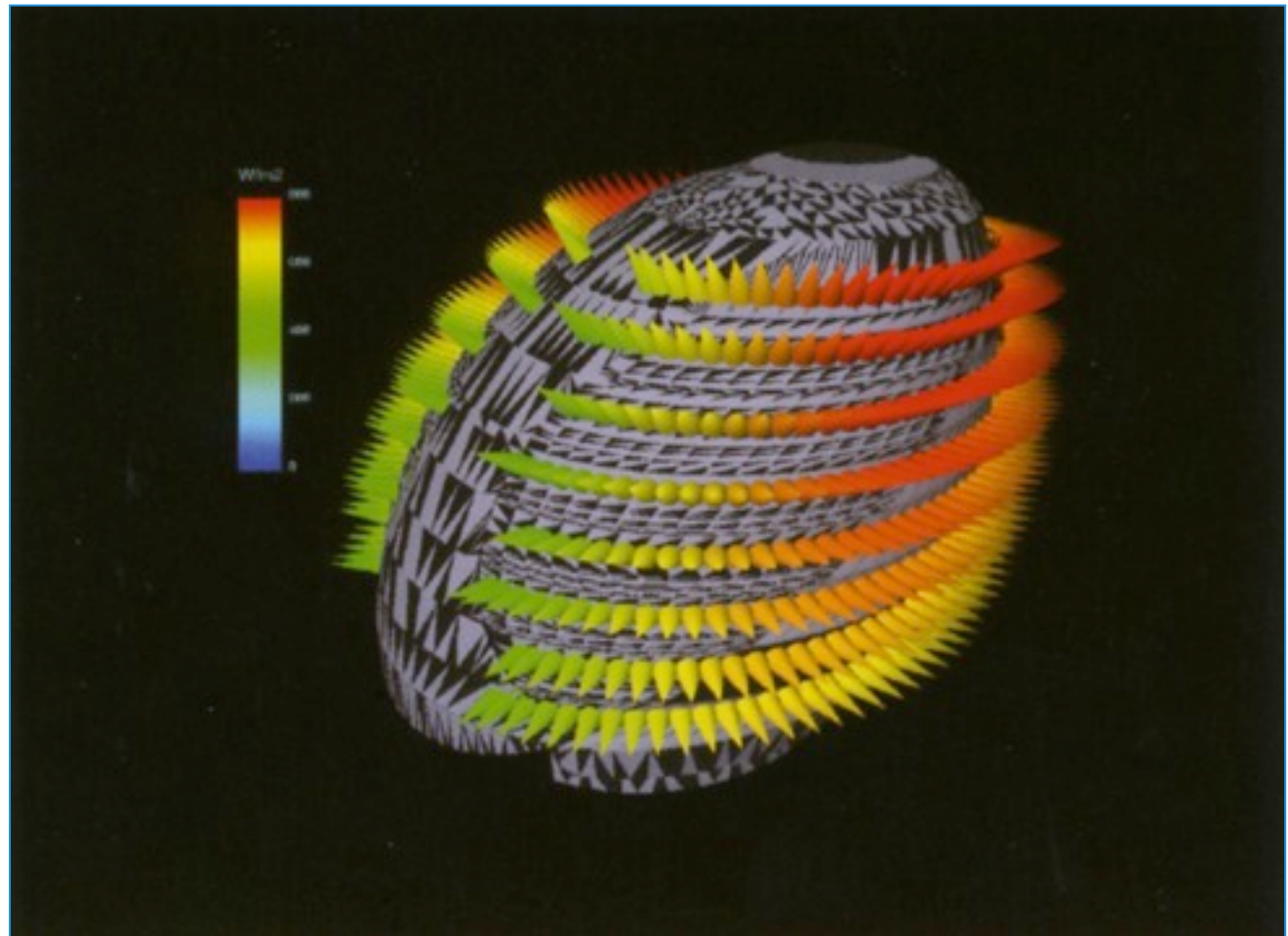
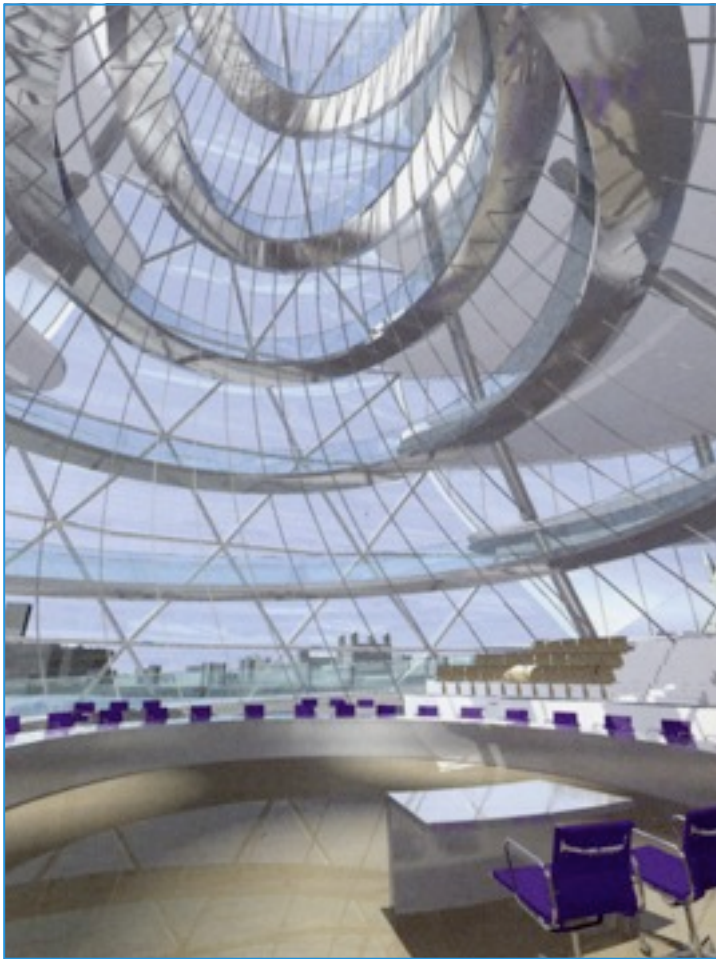
Simulation



To design Below Zero Energy Buildings
Simulation tools help us to design sustainable architecture

Simulation

Simulating Light

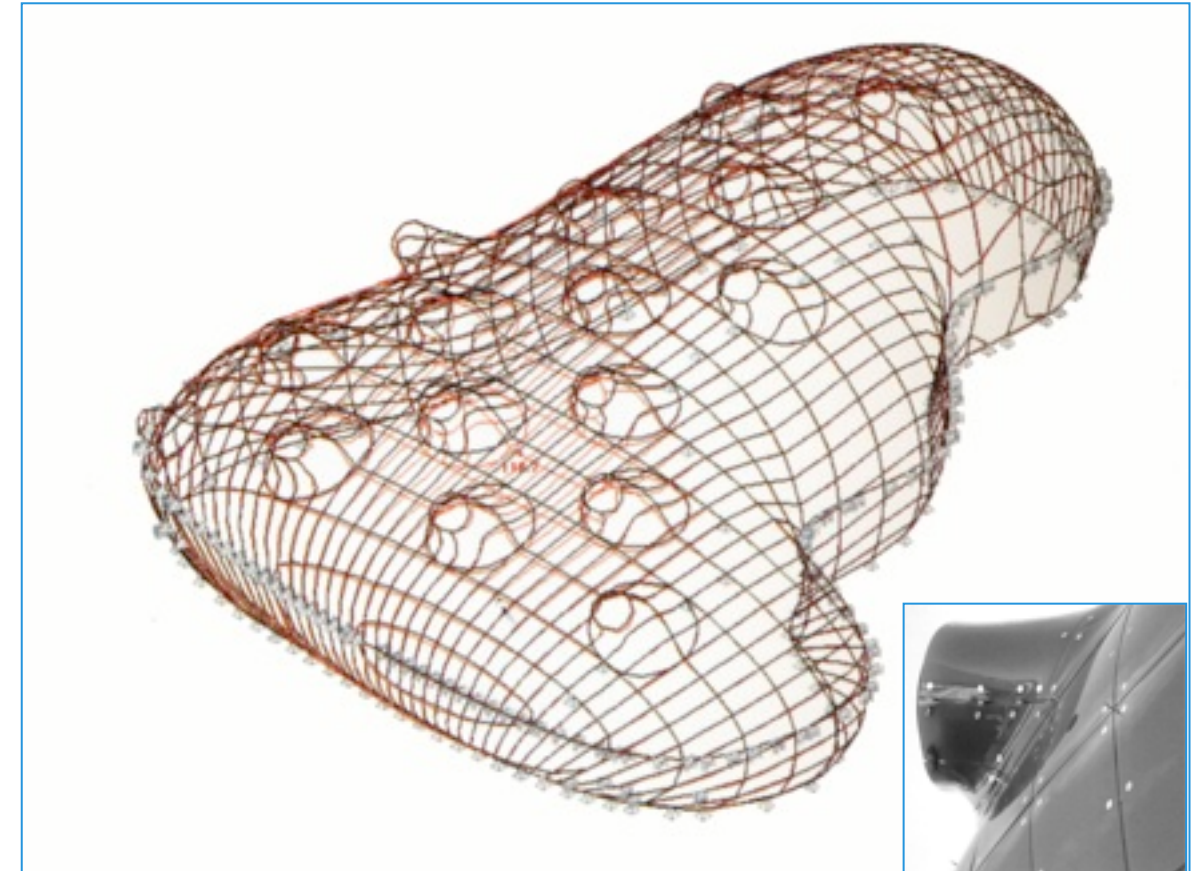


- to assure quality of life
- to utilize principles of thermodynamics

City Hall: Foster & Partner, London UK, 1998 - 2002

Simulation

Simulating Geometries

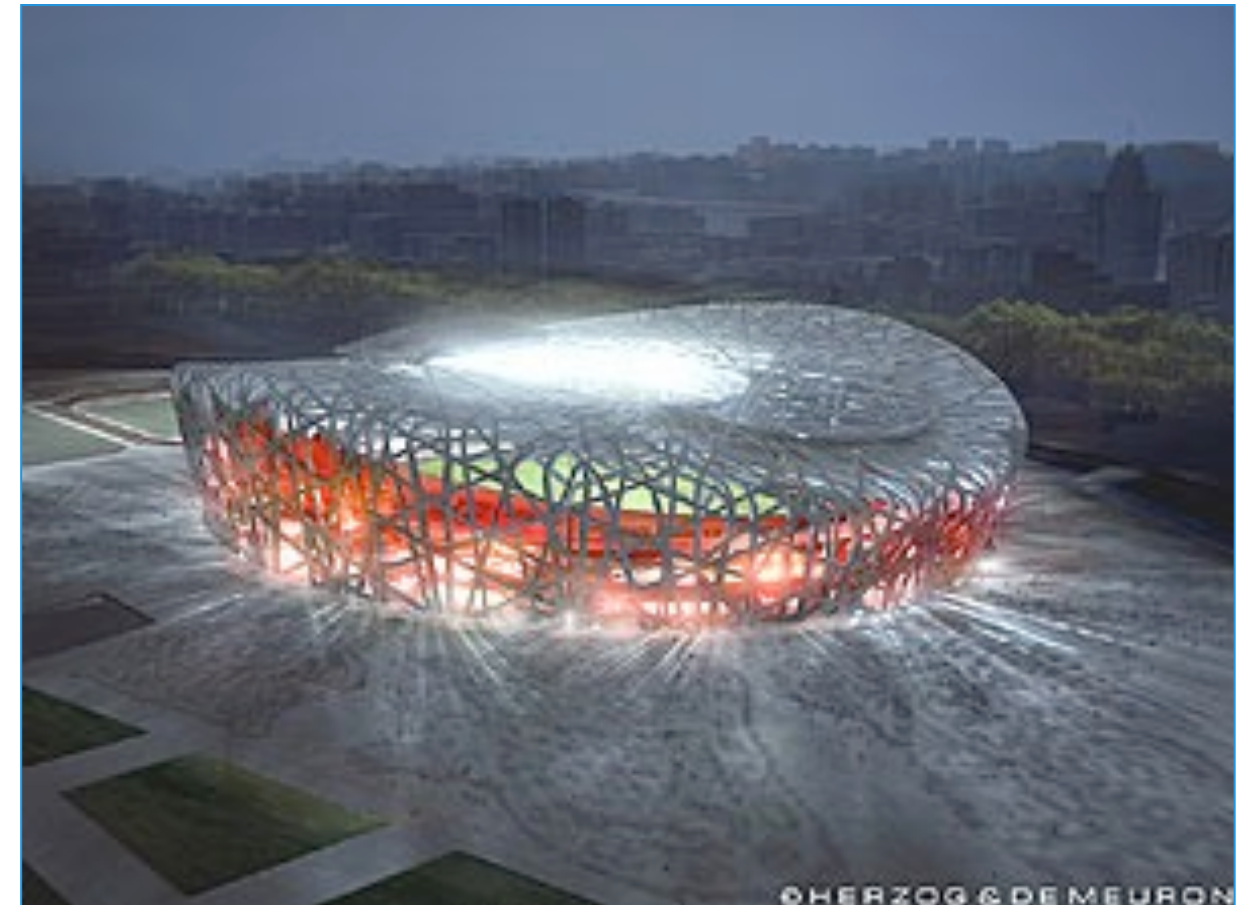
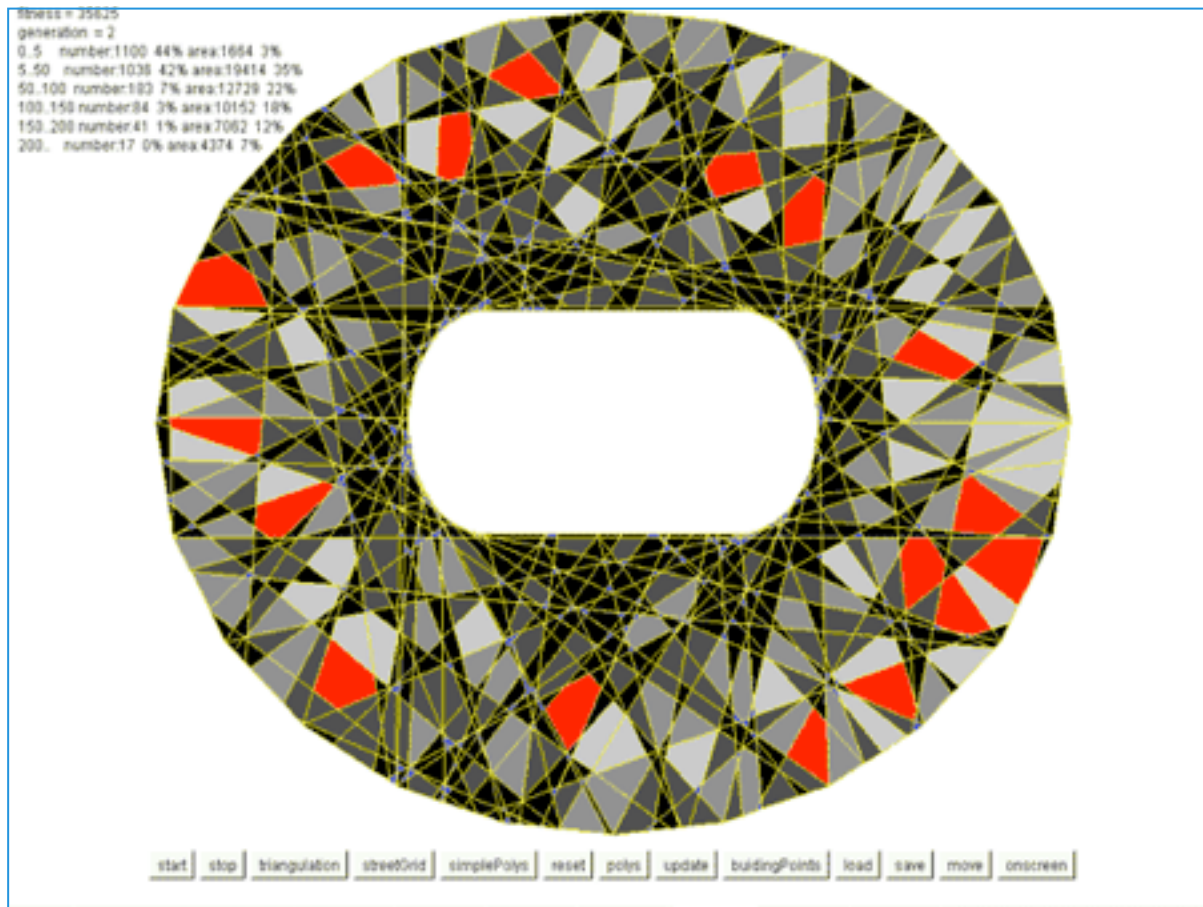


- to plan and build non-common designs

Kunsthaus Graz: Cook & Fournier, AU, 2003

Simulation

Simulating Structure

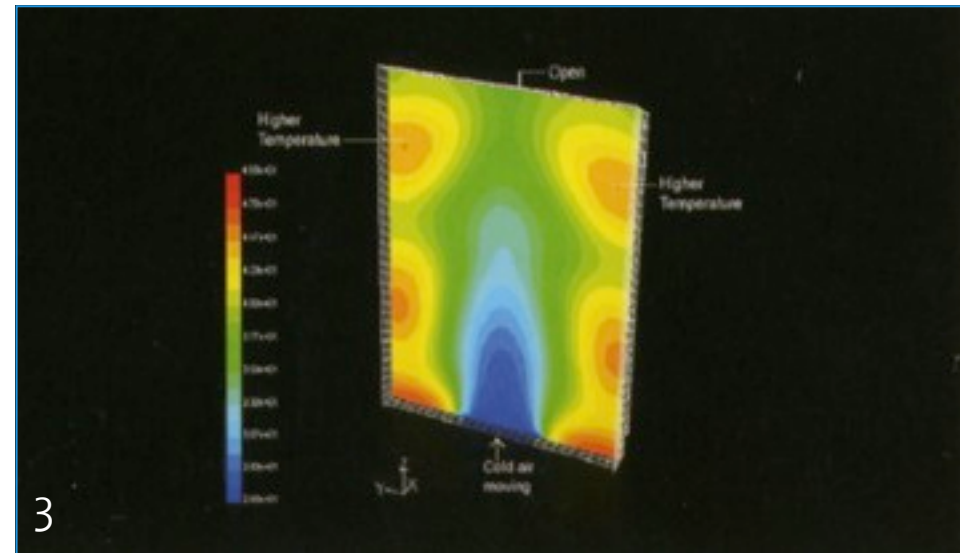
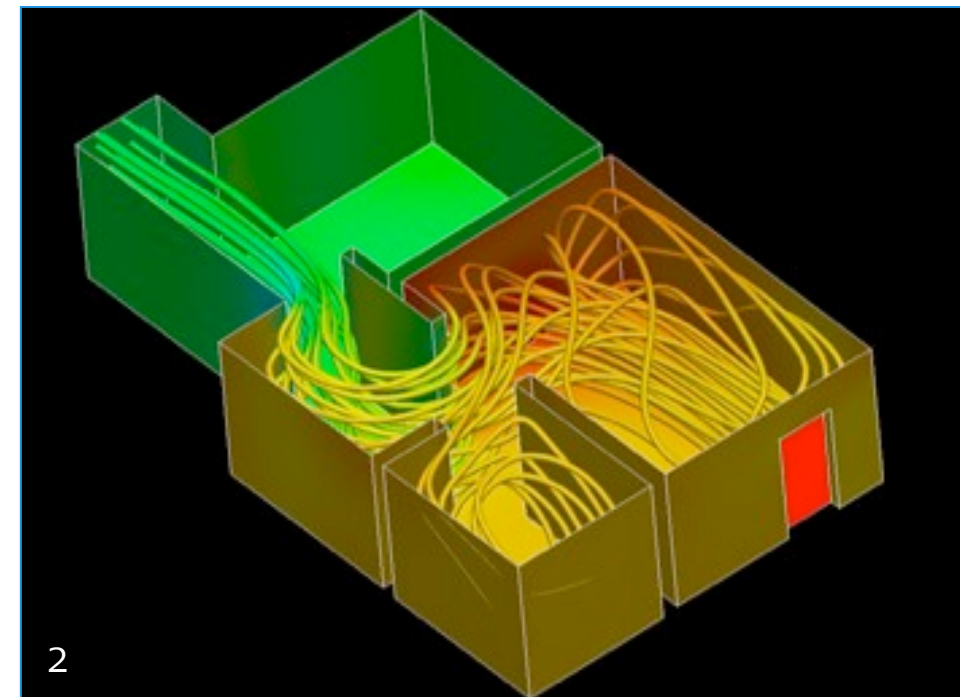
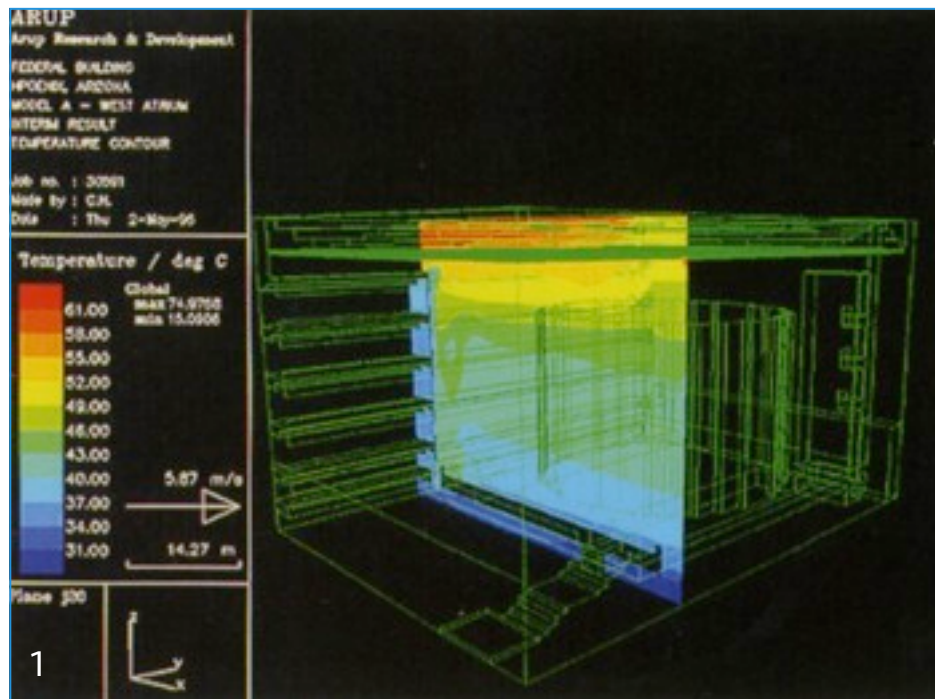


- to push expressive designs ahead
- to guarantee safety

Peking Stadion: Herzog & Meuron / CAAD.ETHZ

Simulation

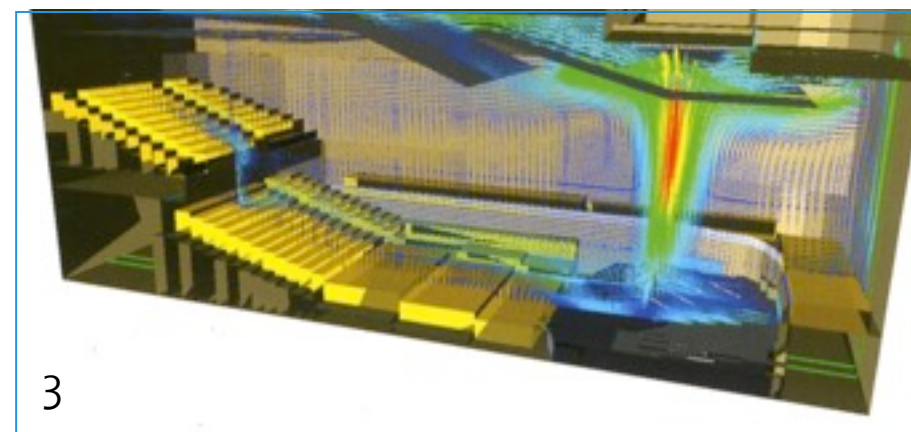
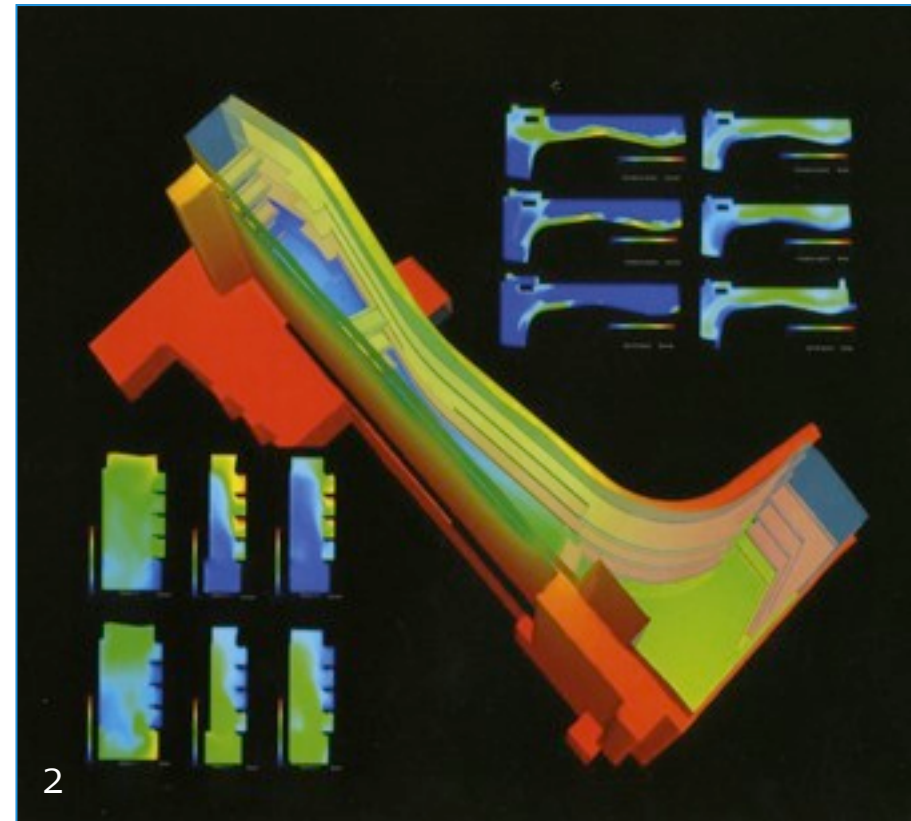
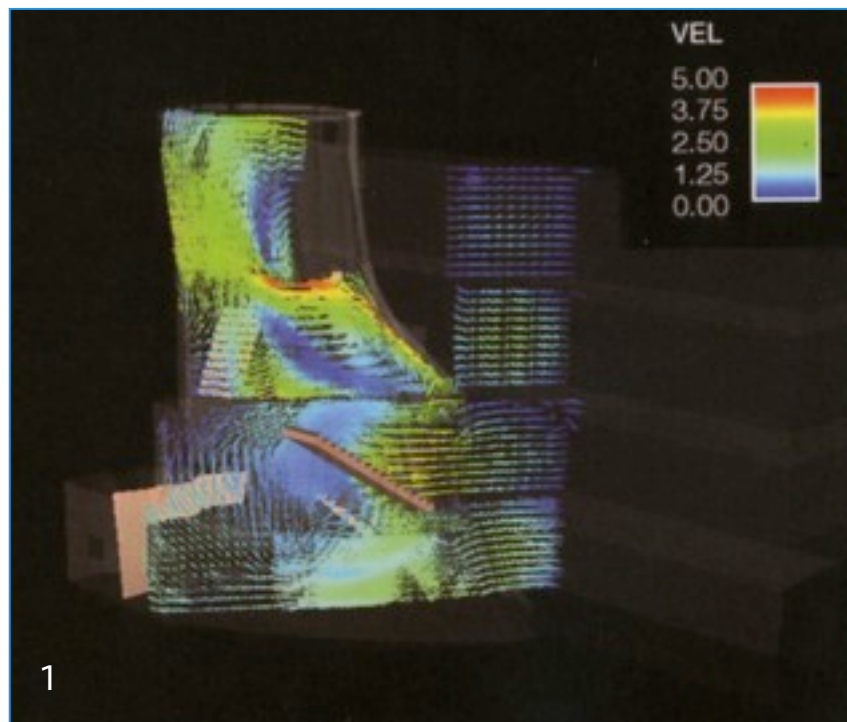
Simulating Temperature



1. Federal Courthouse: Meier & Partners, Phoenix USA, 1995 - 1998
2. Simulation of apartment heat & air circulation by Ninsight.at
3. Thermoanalysis of facade-piece of New York Police Station

Simulation

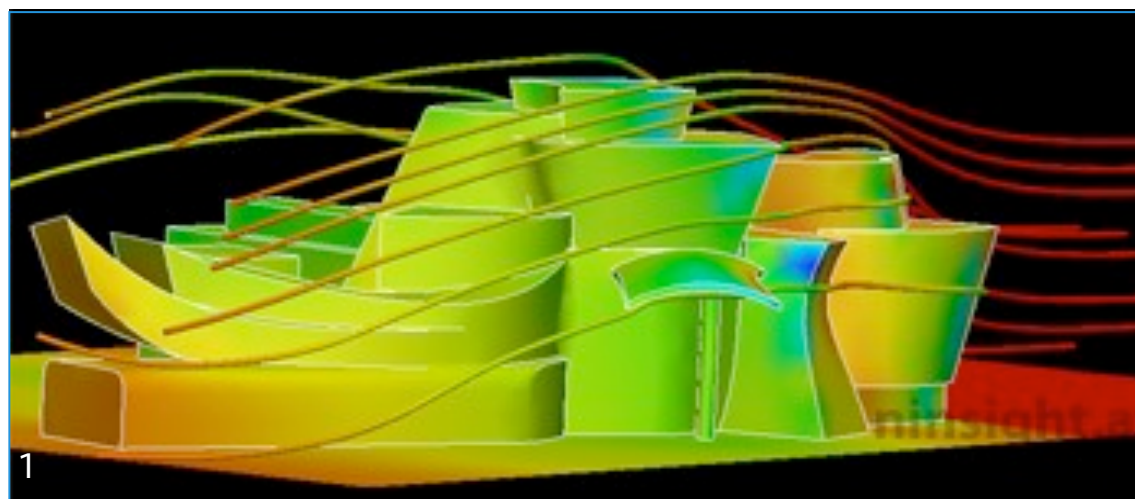
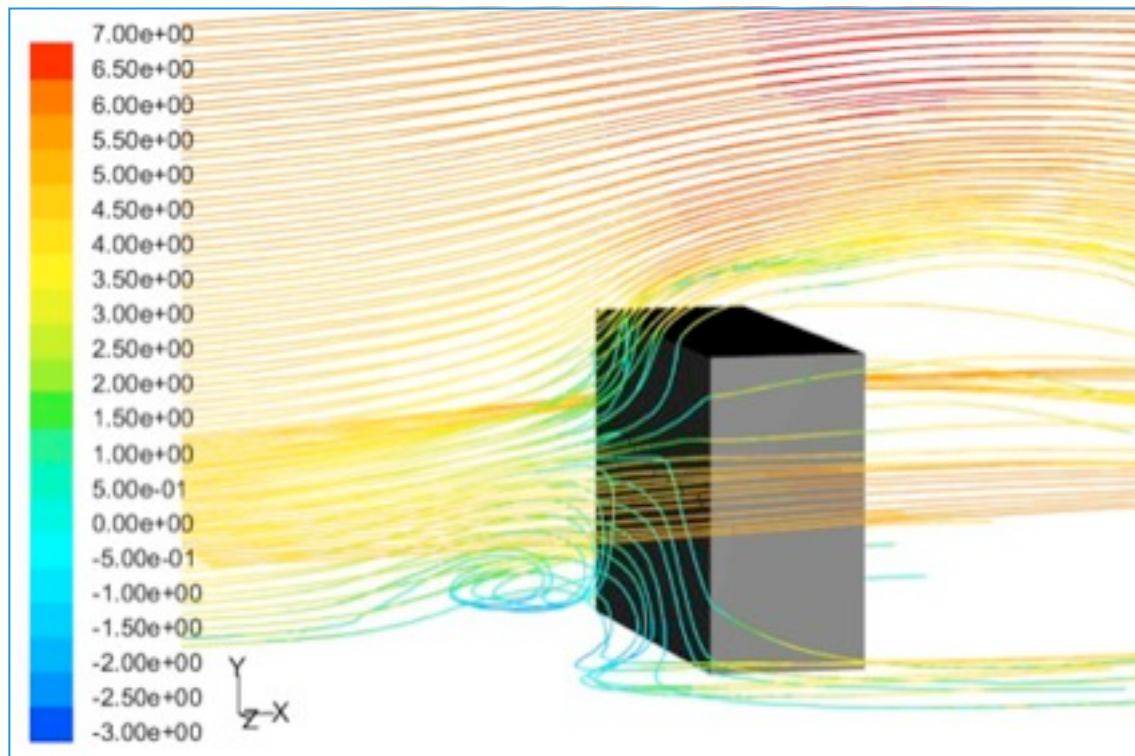
Simulating Airflow inside buildings



1. Simmons Hall: Steven Holl, Cambridge USA, 1999 - 2002
2. Biomedical Research Building: Polshek Architects, Michigan USA, 2001
3. Experimental Media & performing arts Center: Grimshaw, Troy USA, 2003.

Simulation

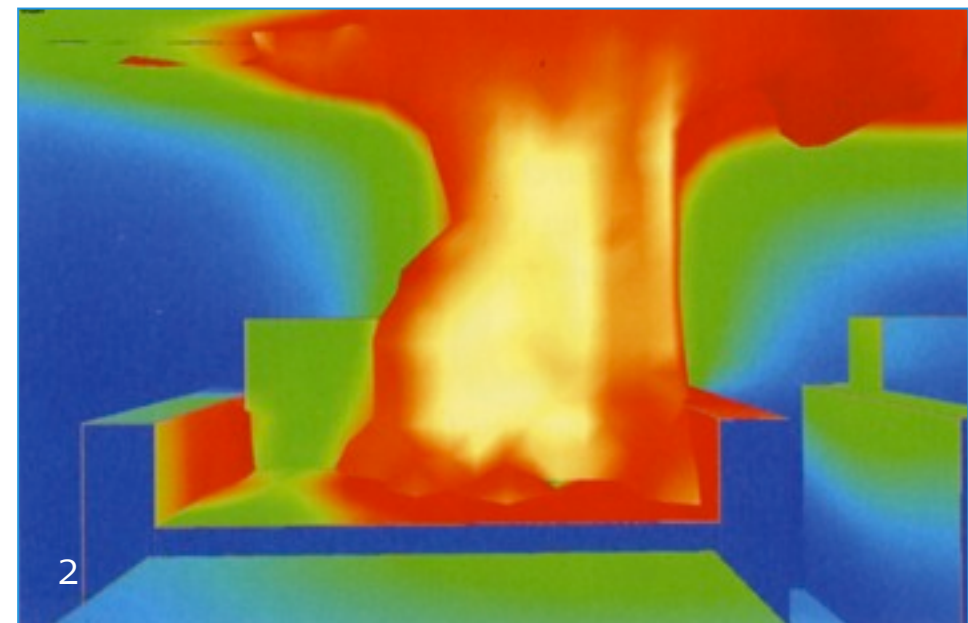
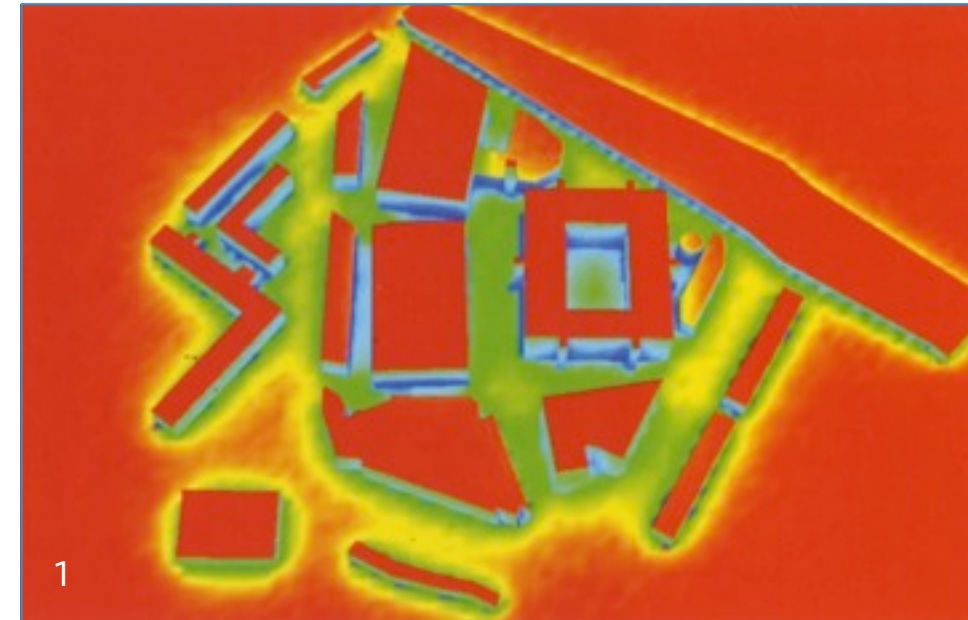
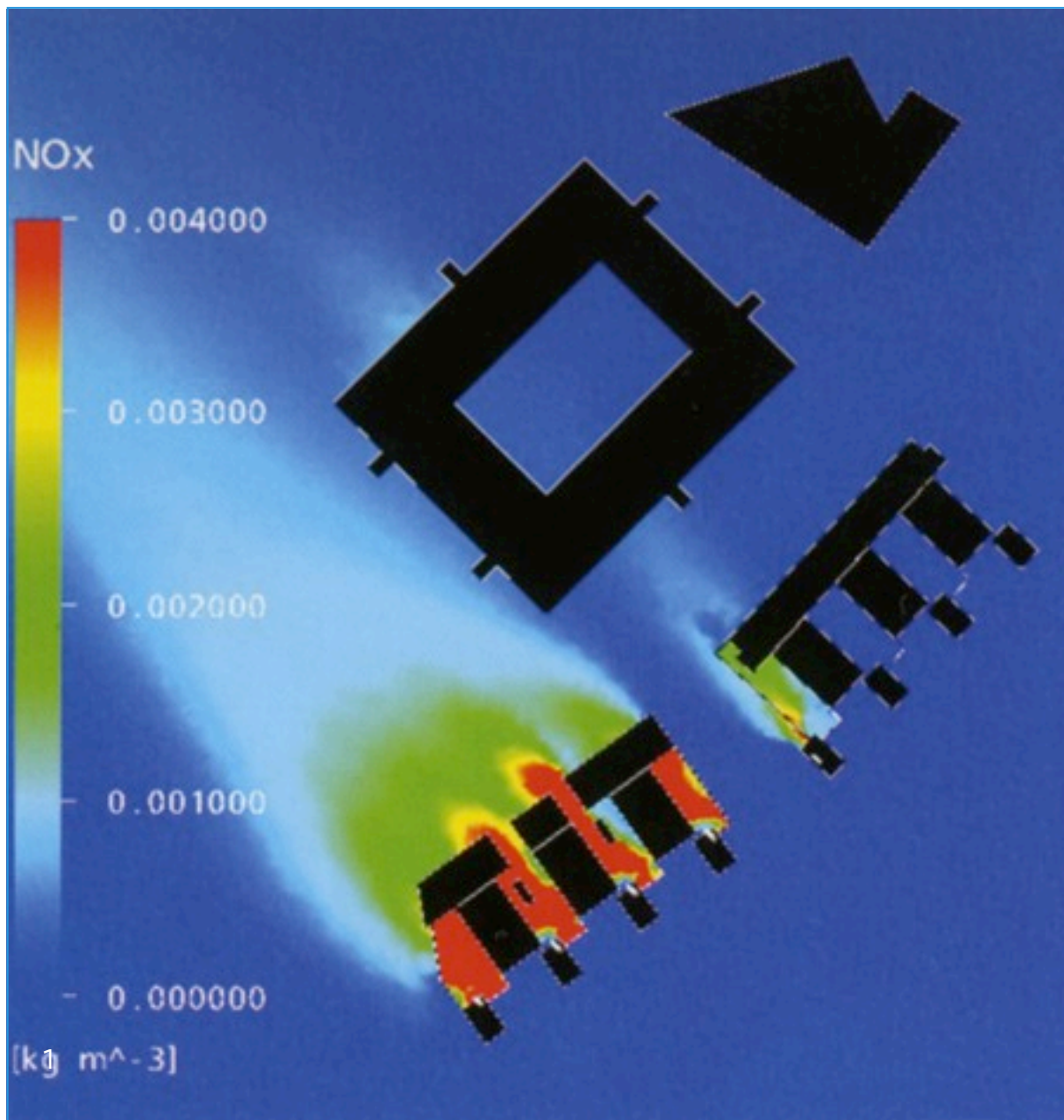
Simulating airflow outside of buildings



1. Guggenheim Museum : Ninsight.at
2. Concept with integrated wind power. ZED: Future Systems, UK, 1995

Simulation

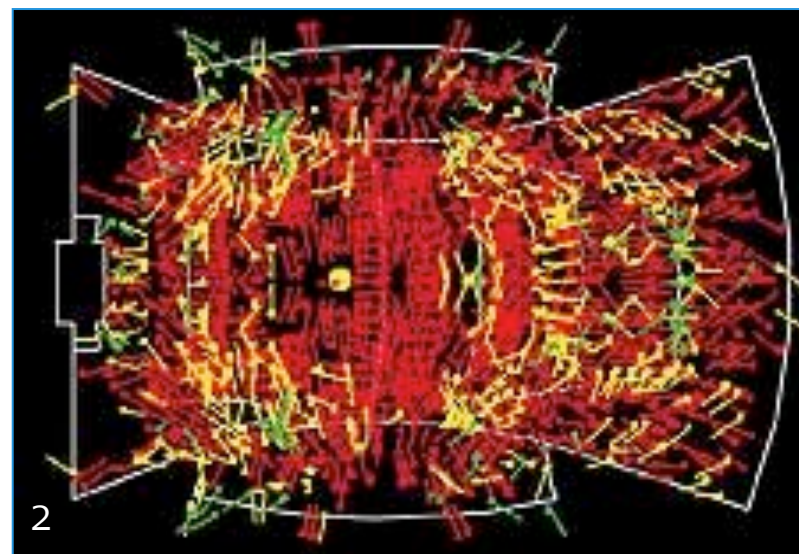
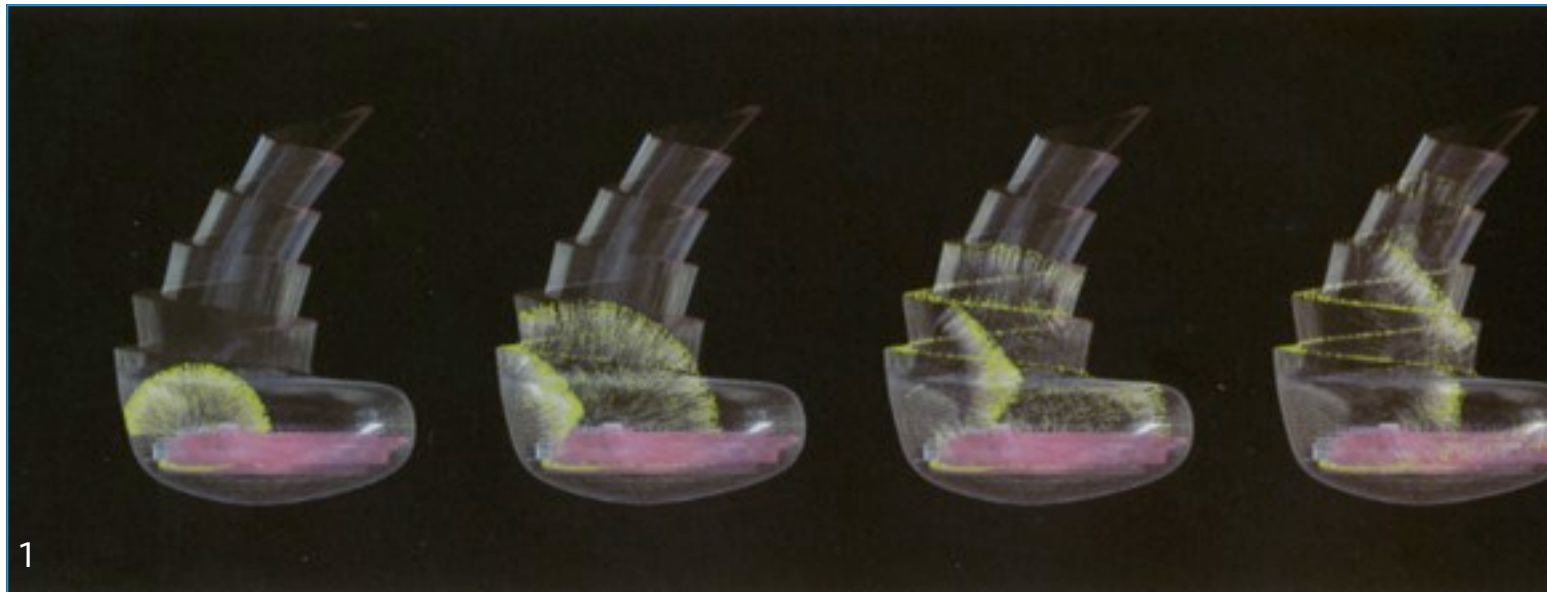
Simulating Dust, Smoke, Pollution, Fire



1. BBC White City: Allies & Morrison , London UK, 2002
2. Smokeview from tool Fire Dynamics Simulator

Simulation

Simulating Acoustics



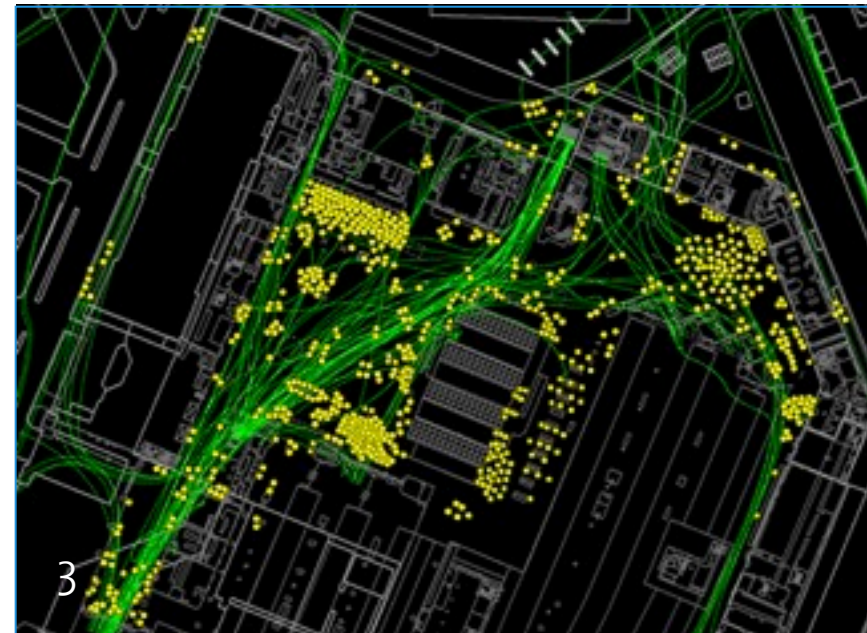
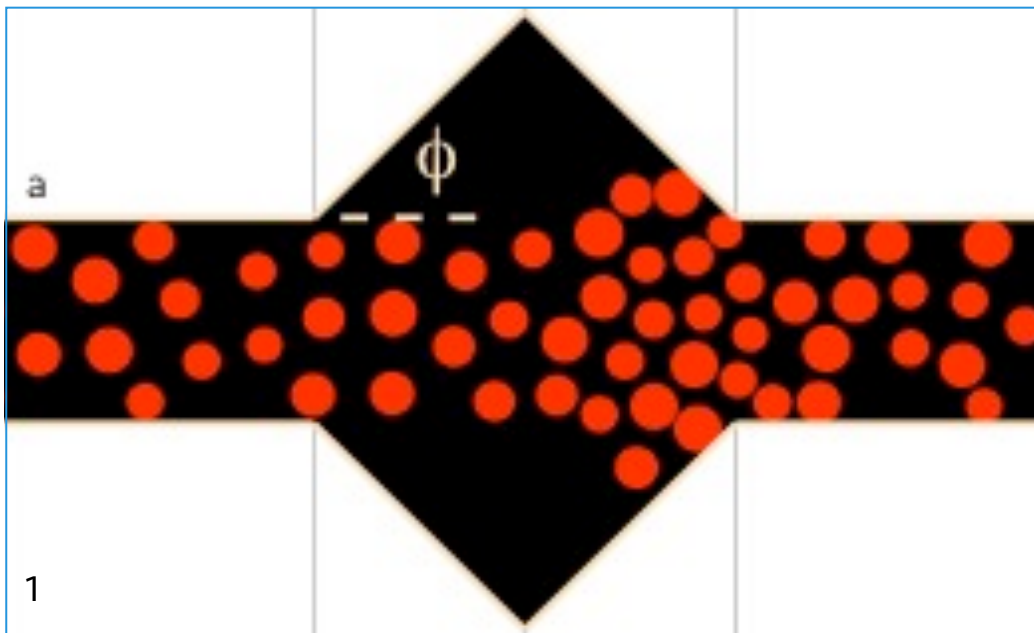
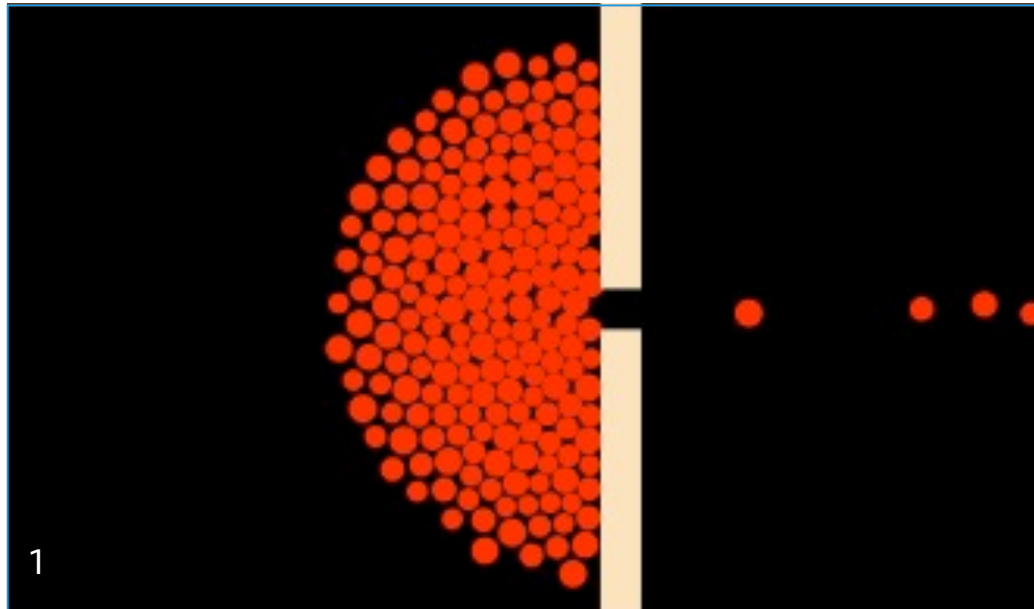
1. Greater London Assembly: N. Foster, UK, 1999 - 2001
2. Disney Concert Hall: F.O.Gehry, USA, 1987 - 2003

Simulation: Visual Imagery



Simulation

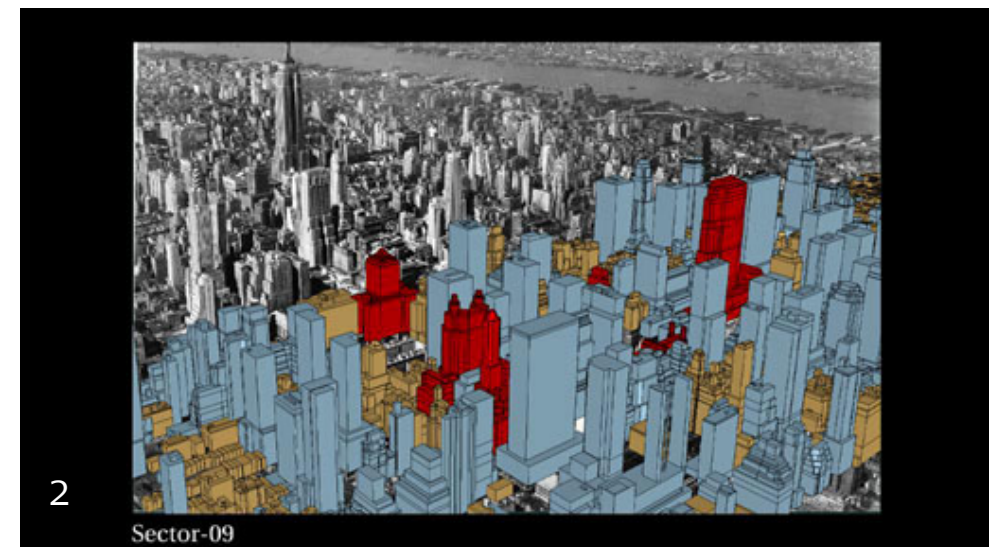
Simulating Crowds



1. Escape Simulation: A.Helbling, University Duisburg, 2000
2. Arsenal Stadium - Crowd flow simulation: HOK Sport, London UK, 2001
3. Analysis of Wayfinding: Space Syntax, ongoing

Simulation

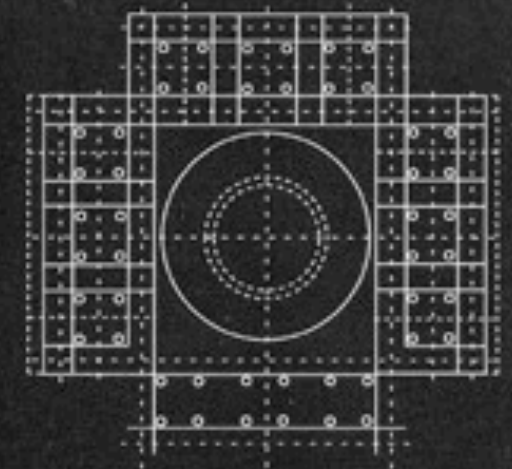
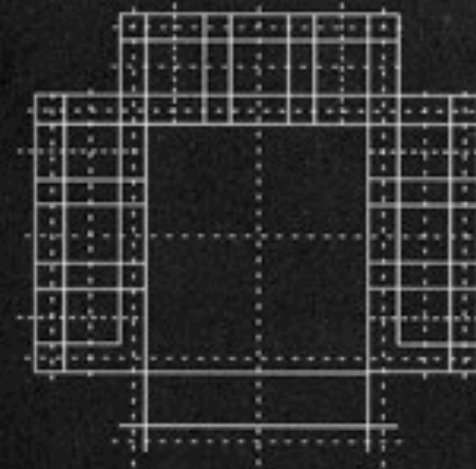
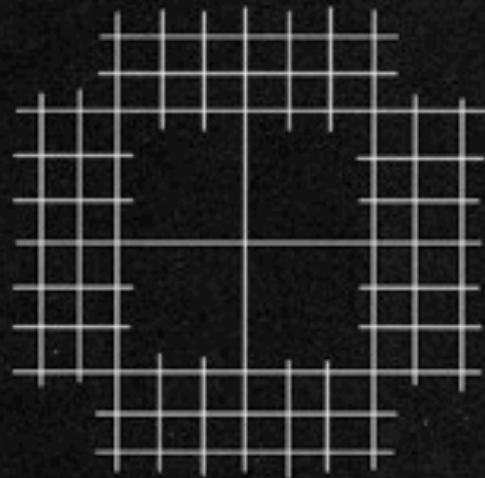
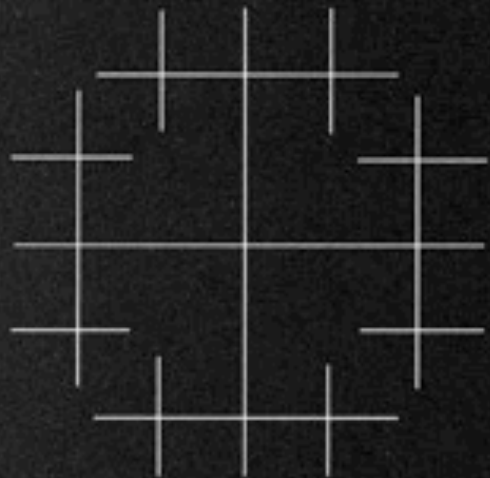
Simulating Cities



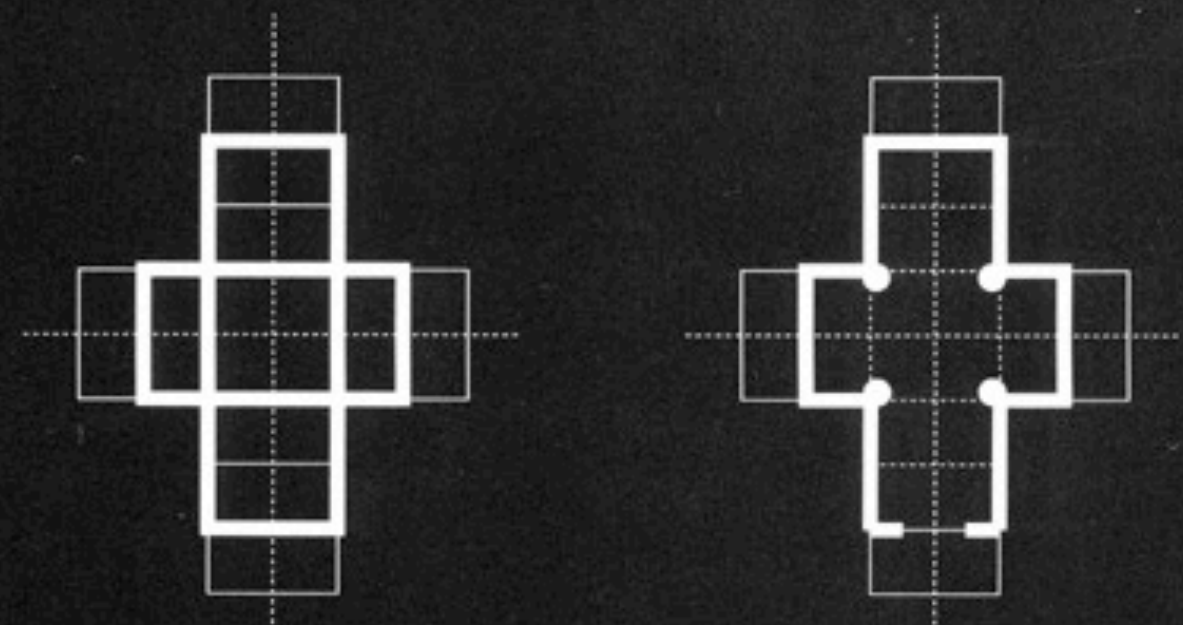
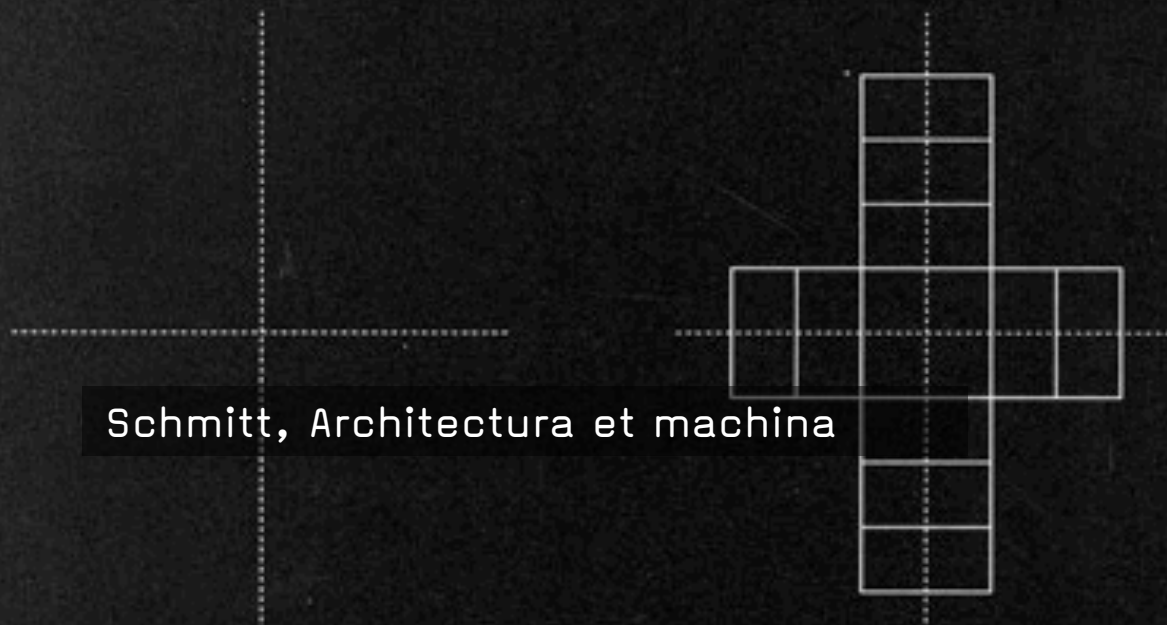
1 CityEngine, P.Müller, Computer Vision Laboratory, ETH Zürich

2 CityBot for movie King Kong, Chris White, Universal Studios (from CGarchitect.com, 24.10.2006)

From Information to Architecture – Shape abstraction



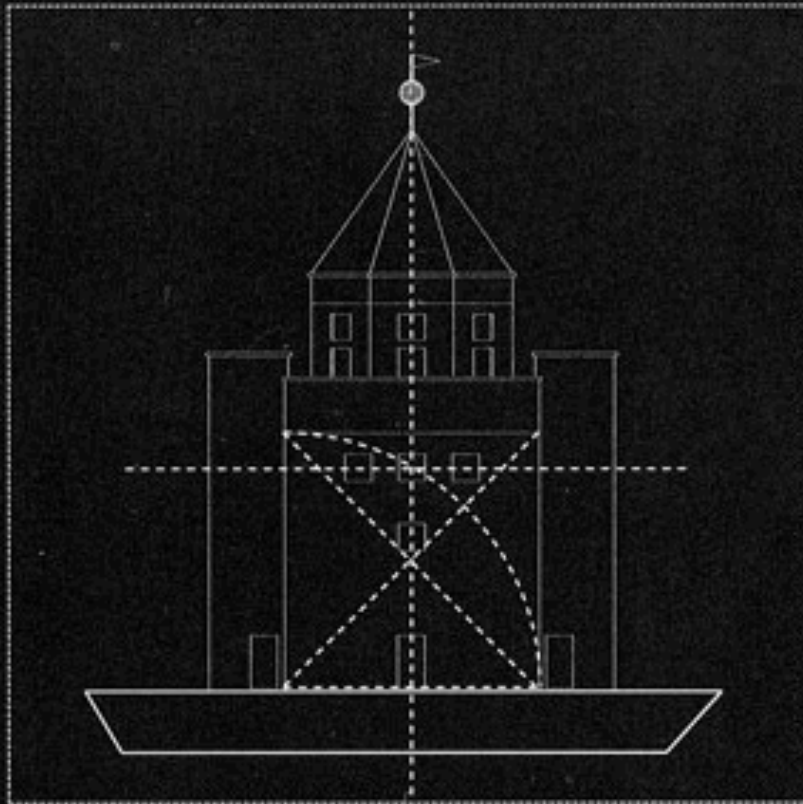
Schrittweise Verfeinerung eines
Grundrisses nach Durand



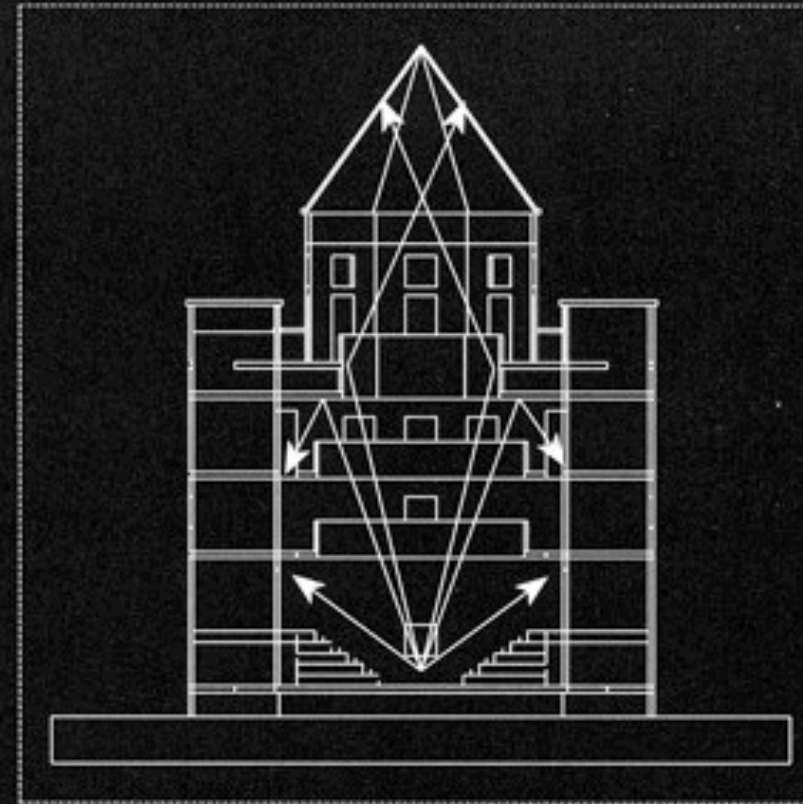
Schmitt, Architectura et machina

From Information to Architecture – Space abstraction

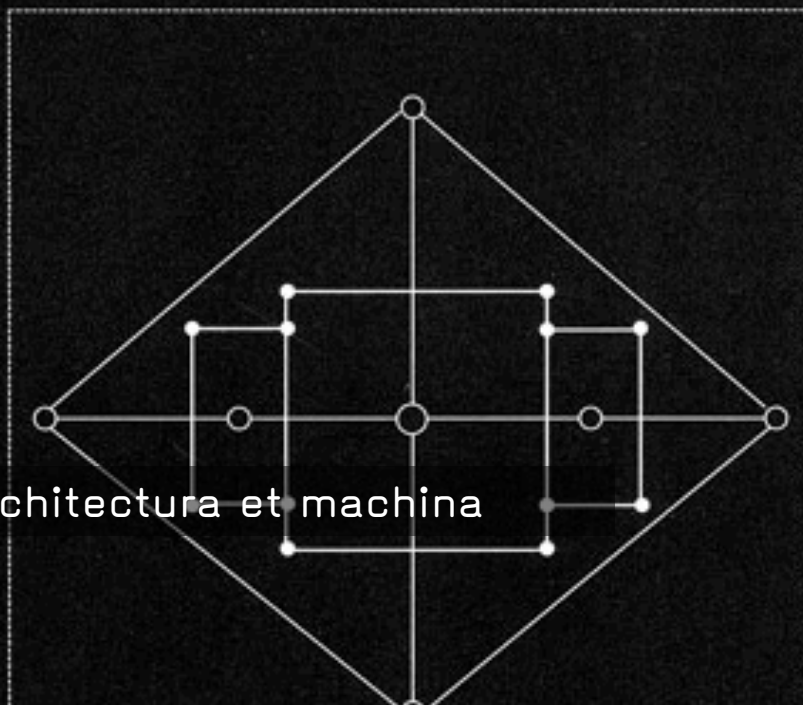
Abstraktion:
Geometrie



Abstraktion:
Akustik

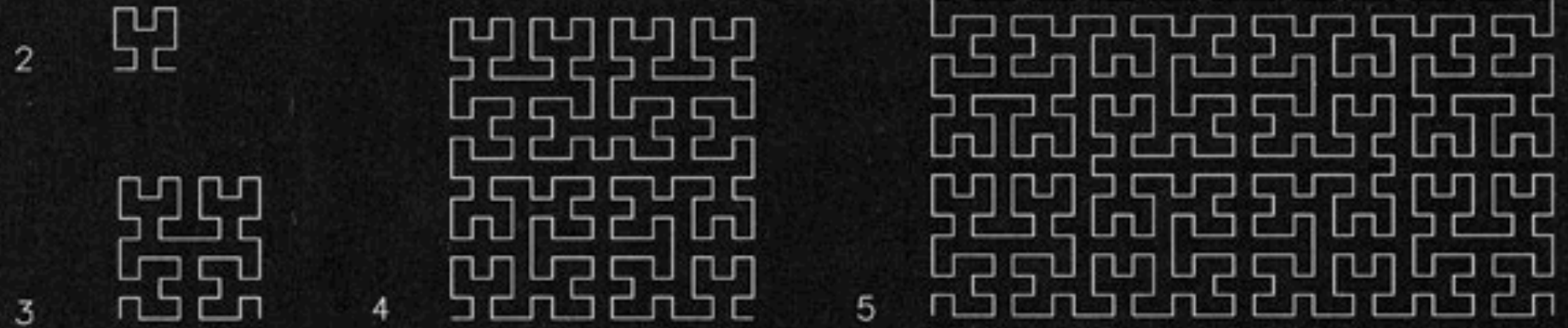


Schmitt, Architectura et machina

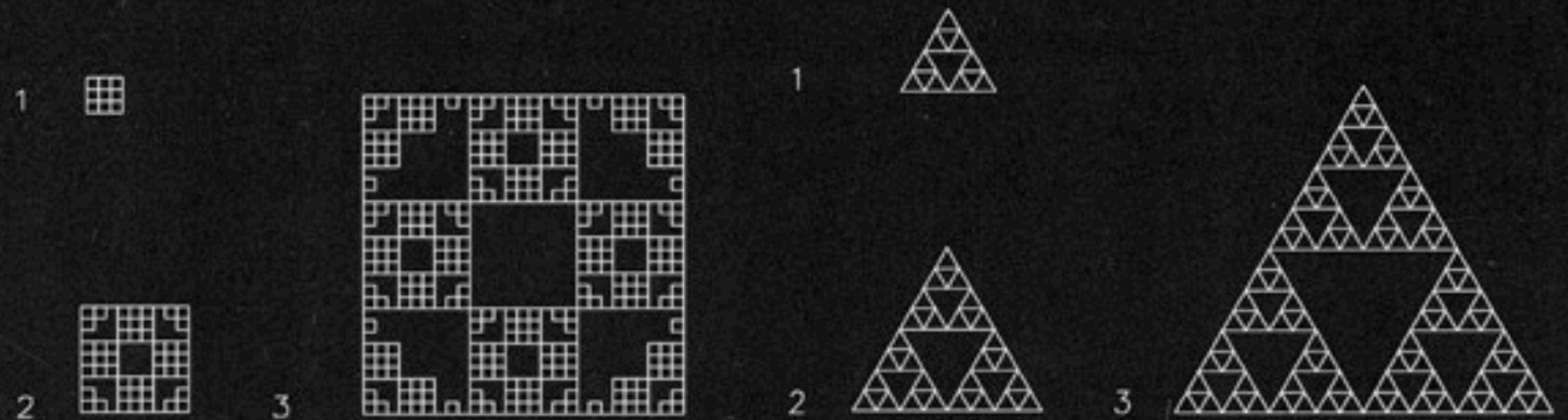


From Information to Architecture – Shape rules

Hilbert-Kurve

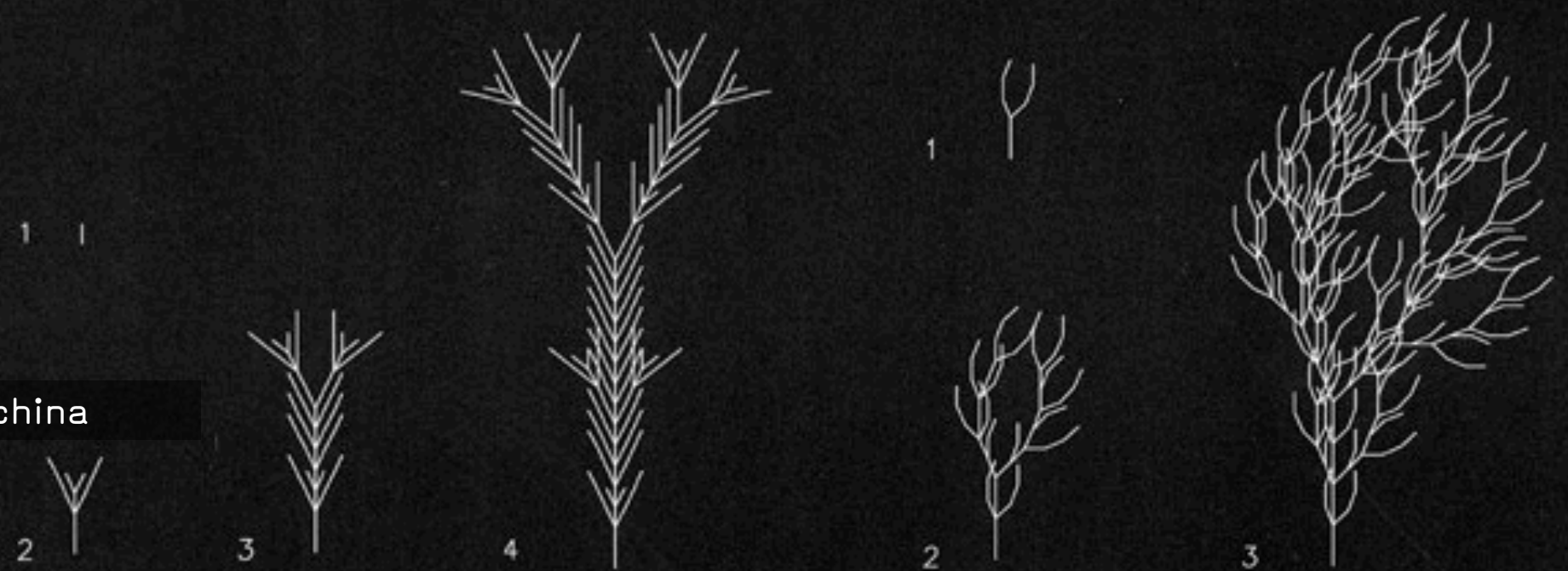


Sirpinsky-Kurve

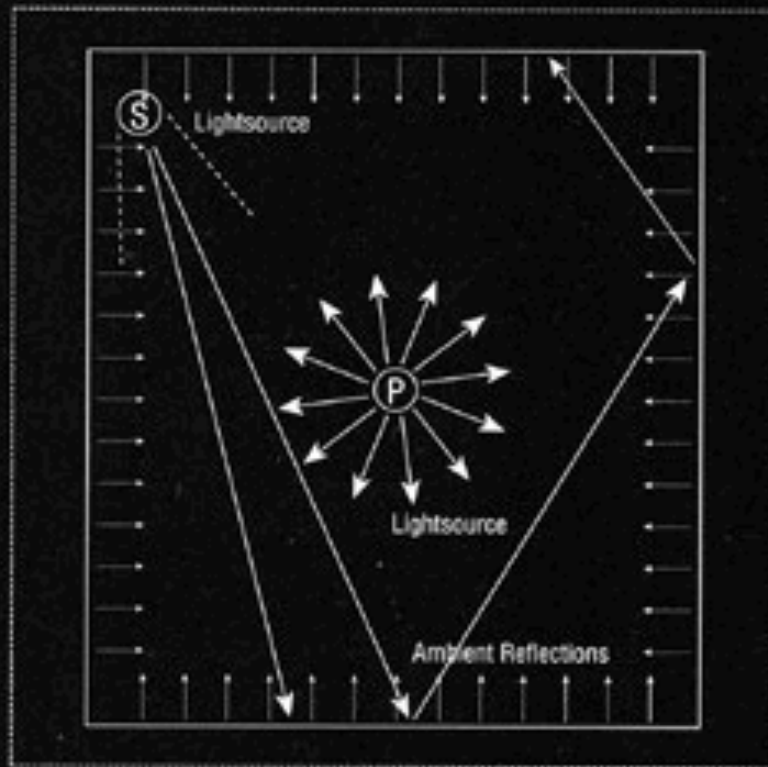


Schmitt, Architectura et machina

Vegetation, Shih 1990



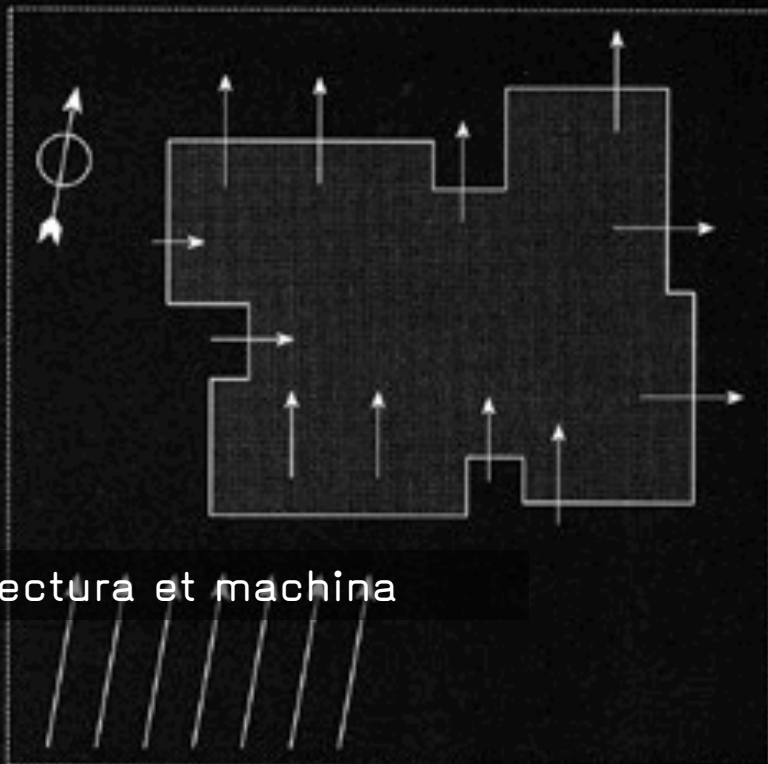
From Information to Architecture - Simulation



Licht: Abstraktion

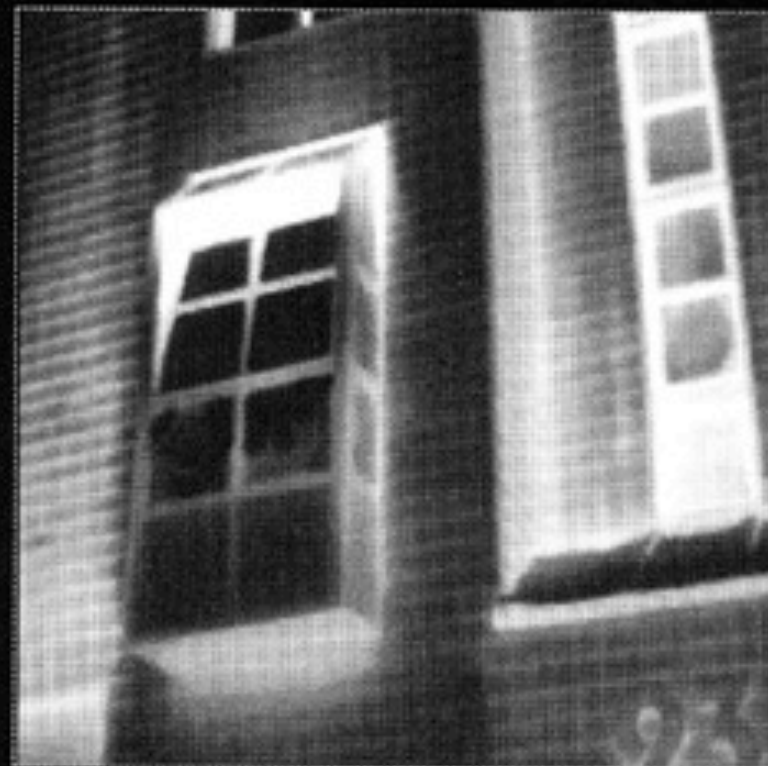


Licht: Simulation



Schmitt, Architectura et machina

Energie: Abstraktion



Energie: Simulation

Simulation

Applications in city planning



A. Ulmer, J. Halatsch, A. Kunze, P. Müller, L. Van Gool, “Procedural Design of Urban Open Spaces”, eCAADe 2007

Simulation

Information Science Lab, HIT, ETH Zürich



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(prov. Minergie Zertifikat ZH-800)

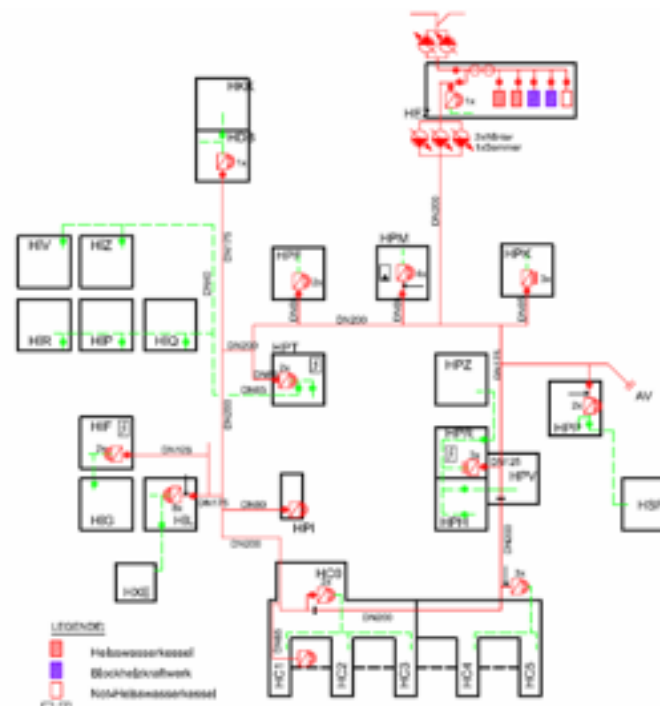
Master plan Energy Supply

■ Strategy

Supply

Distribution

Consumption



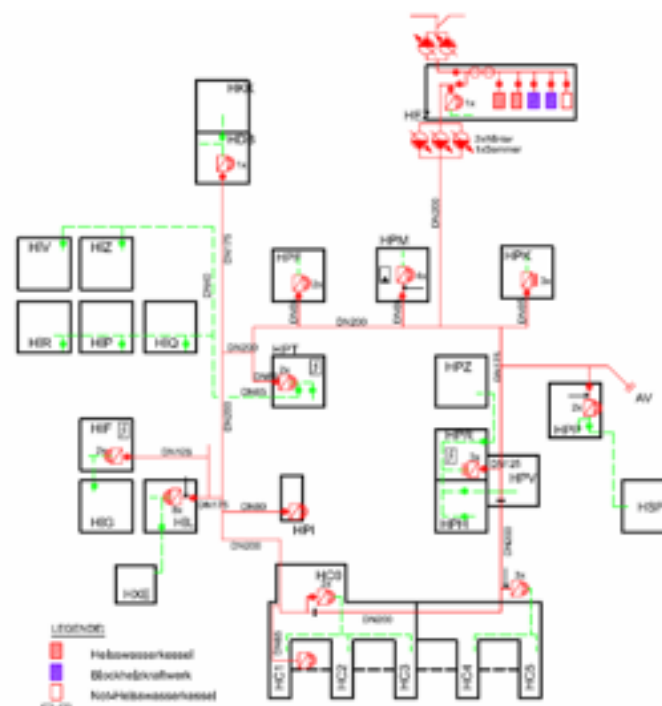
Master plan Energy Supply

■ Strategy

Supply

Distribution

Consumption



Energy supply
CO₂-reduced
by utilising renewable energy sources

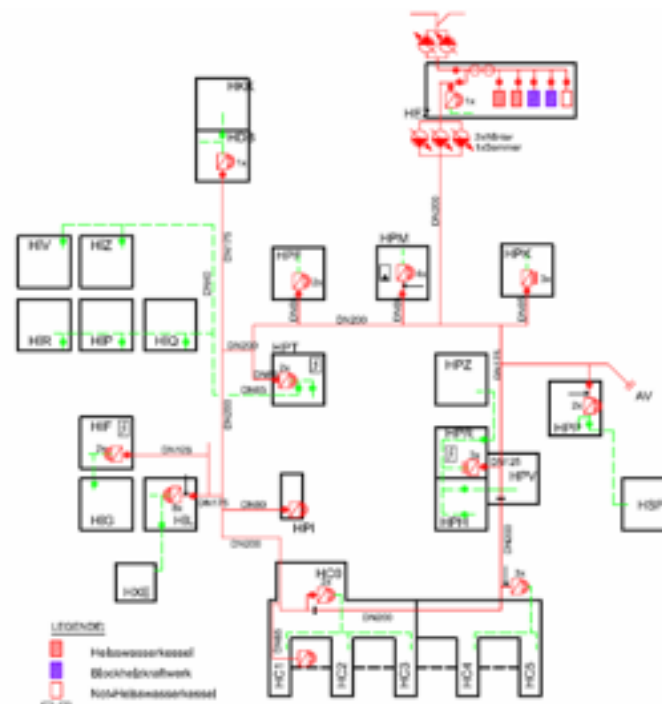
Master plan Energy Supply

■ Strategy

Supply

Distribution

Consumption

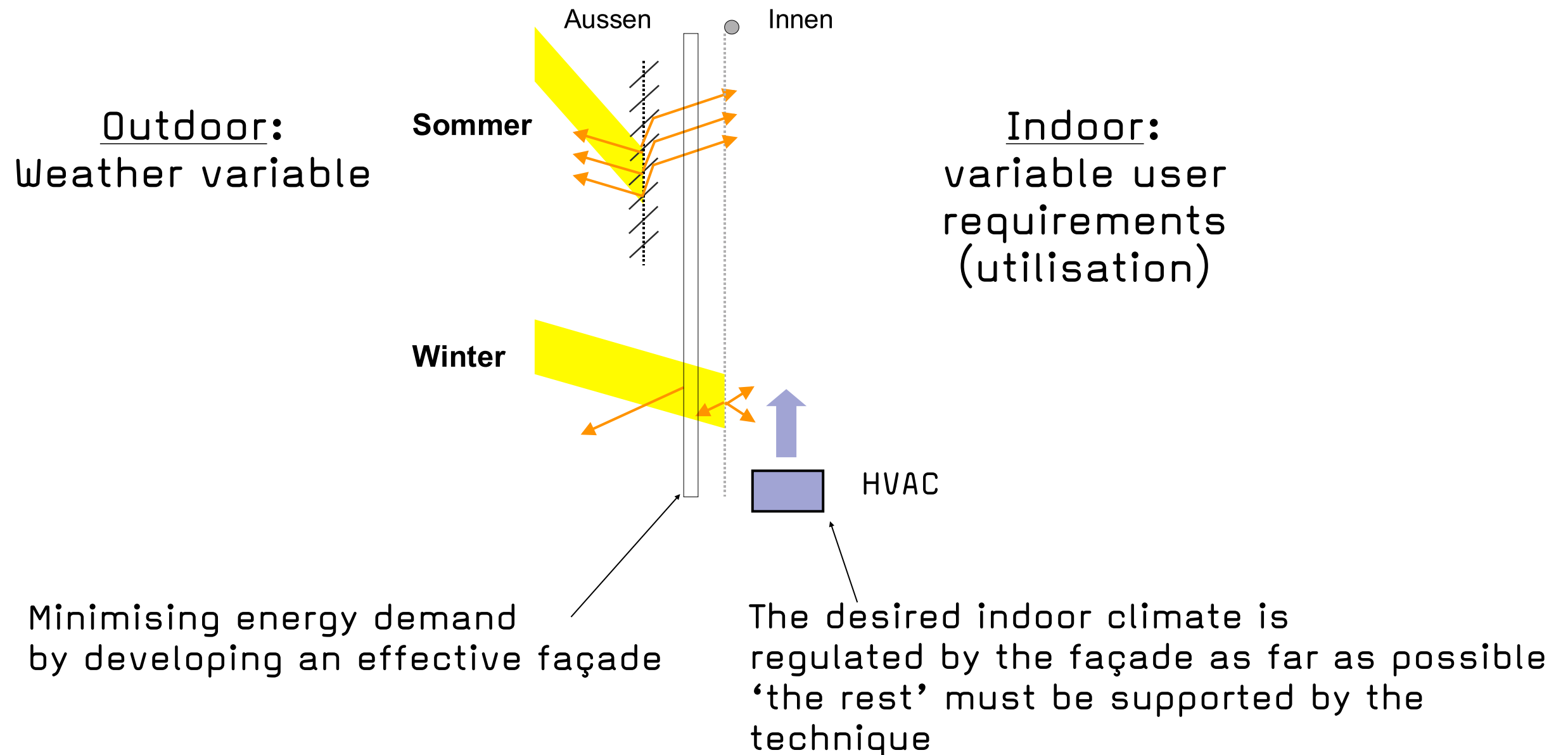


Energy supply
CO₂-reduced
by utilising renewable energy sources

Minimising
energy consumption

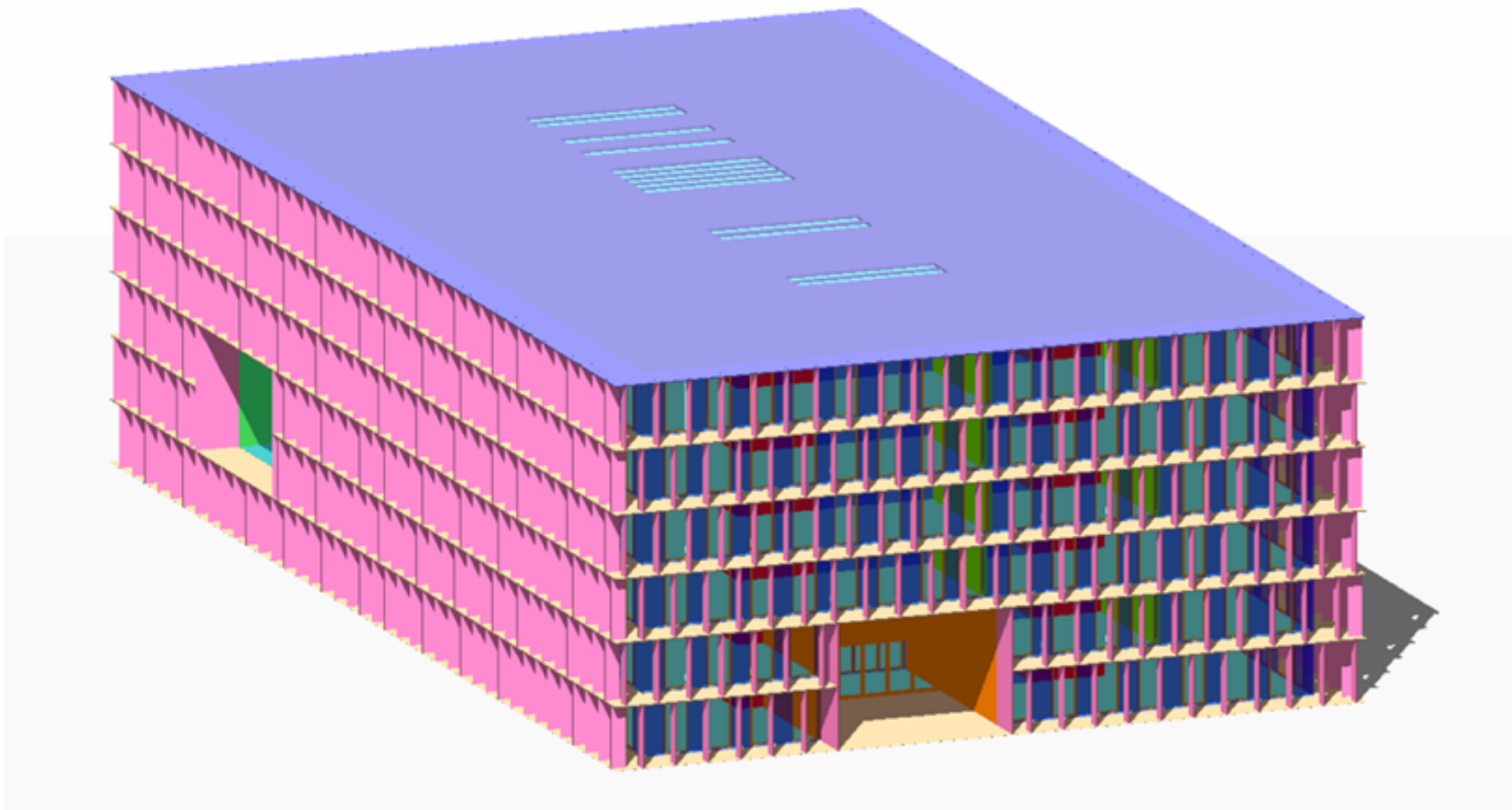
Implementation (1. Task)

- Minimising energy consumption



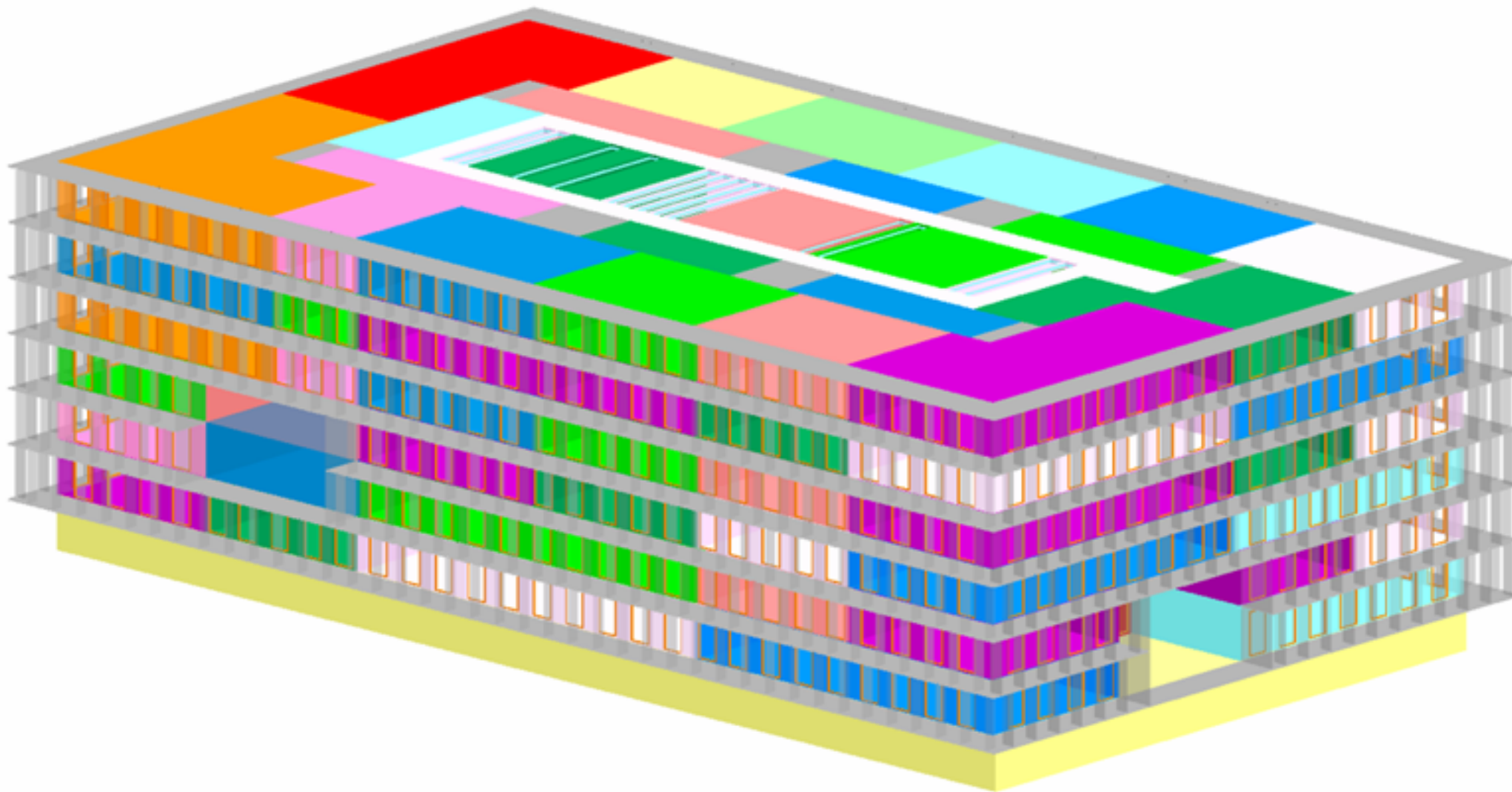
Minimising Energy Demand, HIT

- Digitalisation of the Building



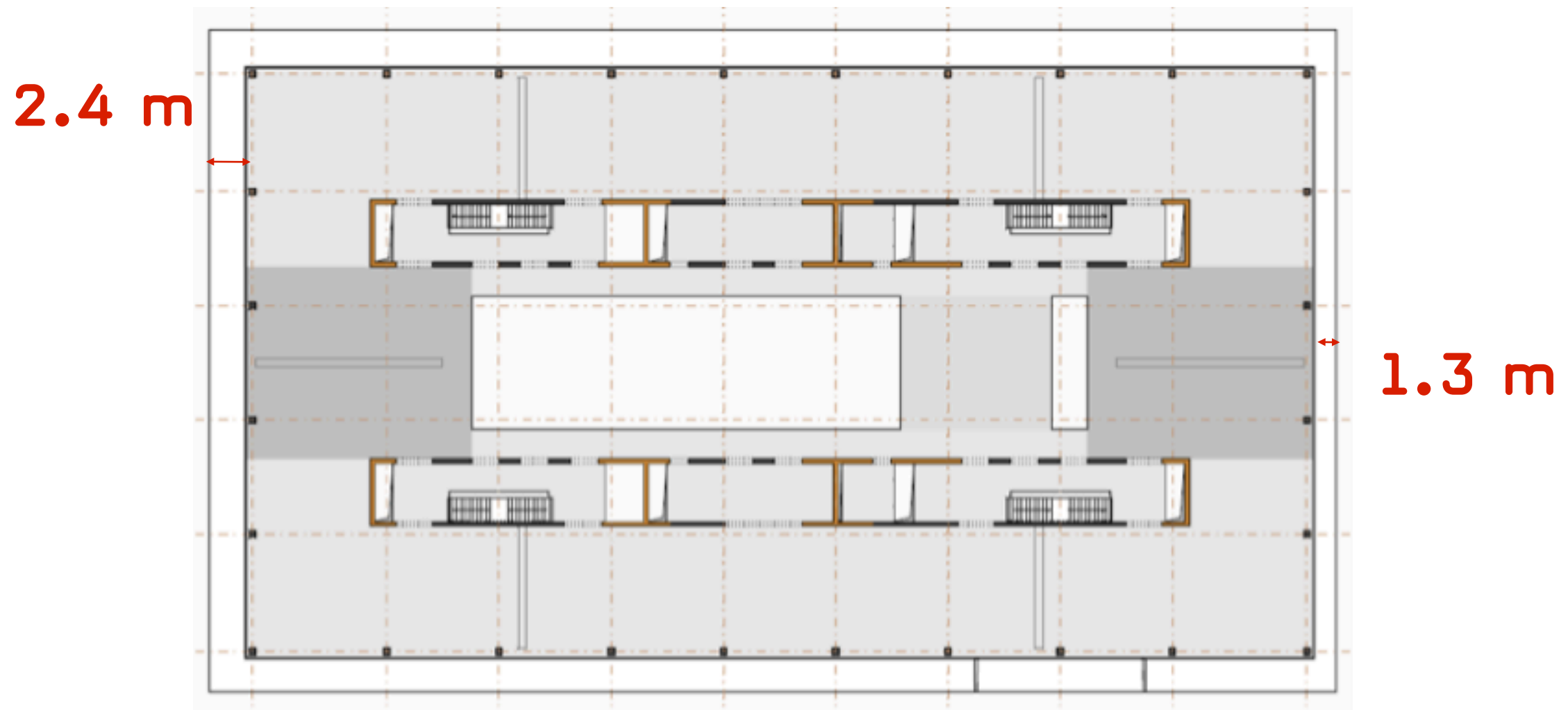
Minimising Energy Demand, HIT

- Digitalisation of the Building: > 160 Zonen

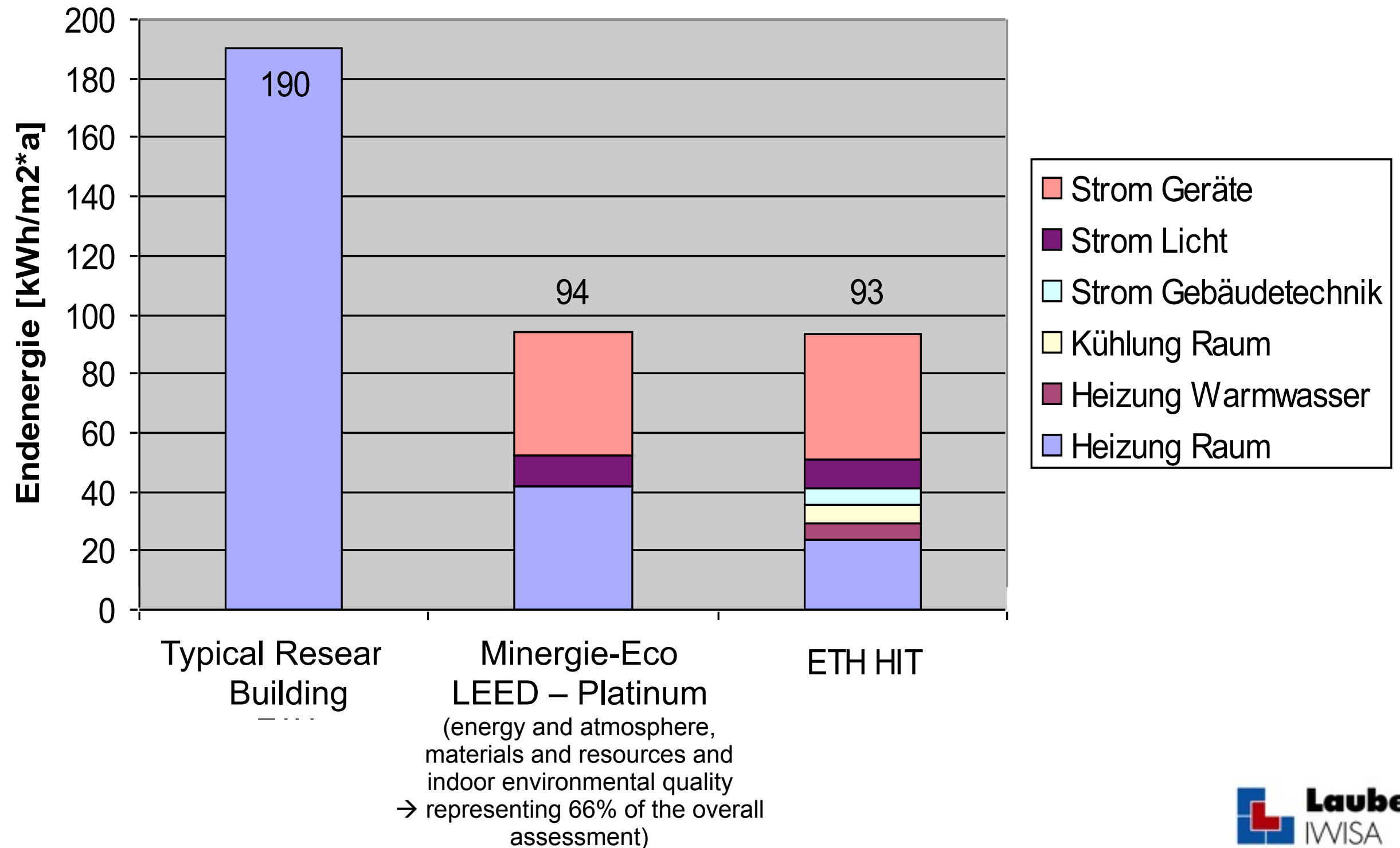


Minimising Energy Demand, HIT

- Variable balcony depth



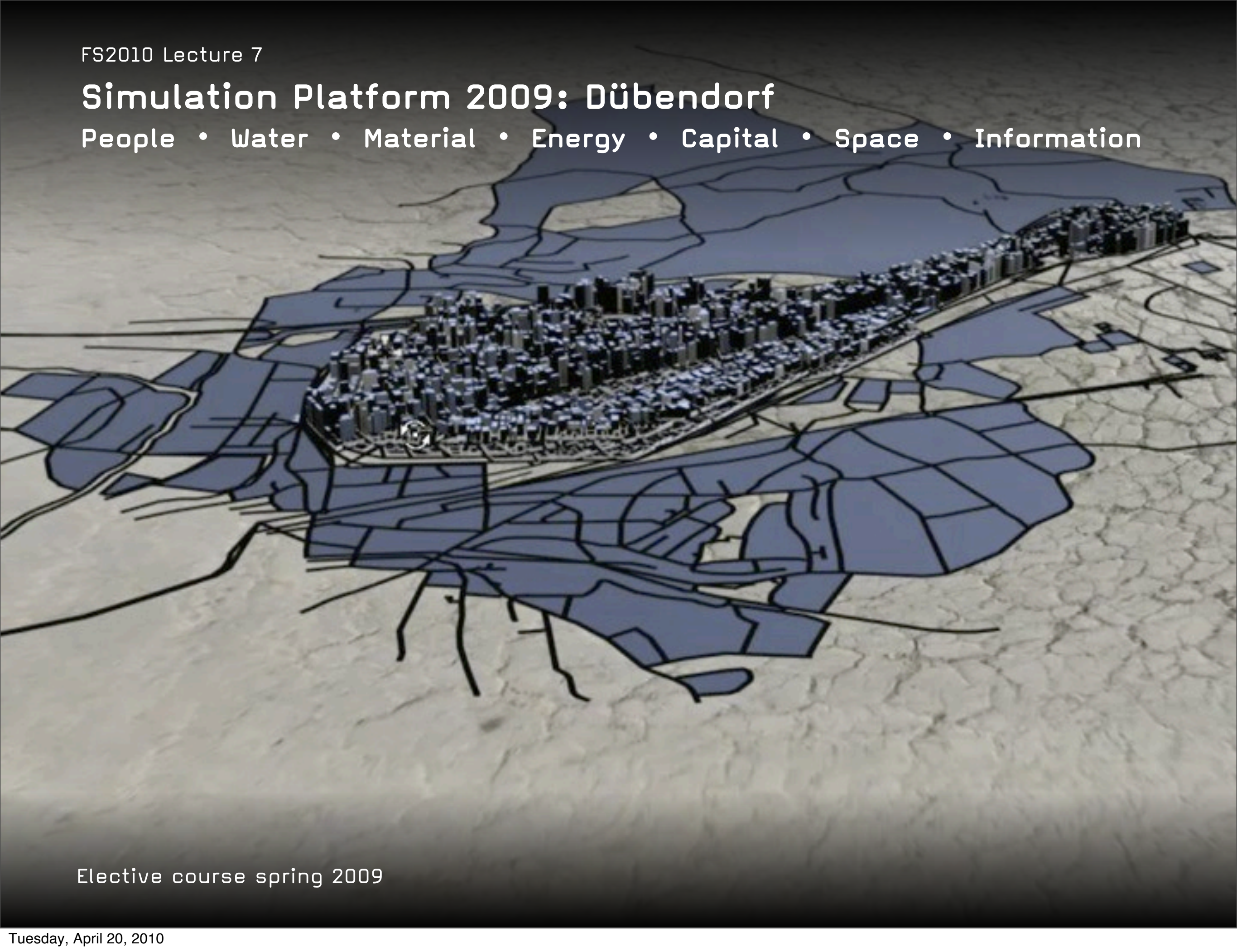
Minimising Energy Demand, HIT



FS2010 Lecture 7

Simulation Platform 2009: Dübendorf

People • Water • Material • Energy • Capital • Space • Information



Elective course spring 2009

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Simulation: Model



Inauguration of KAUST, Saudi-Arabia, 23. September 2009

Simulation: Presentation of past and future



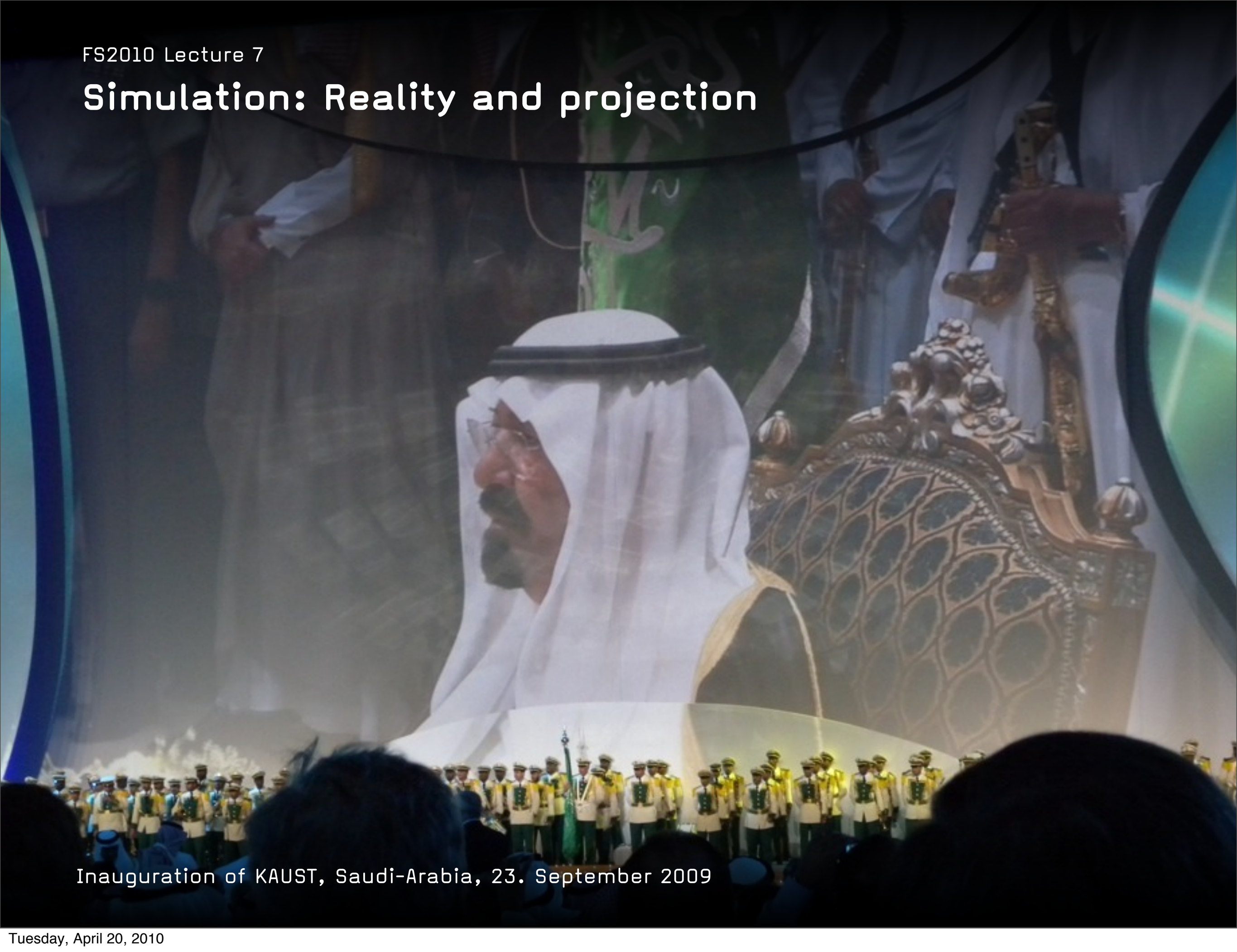
Inauguration of KAUST, Saudi-Arabia, 23. September 2009

Simulation: Mixed media presentation



Inauguration of KAUST, Saudi-Arabia, 23. September 2009

Simulation: Reality and projection



Inauguration of KAUST, Saudi-Arabia, 23. September 2009

Simulation: Expanded reality



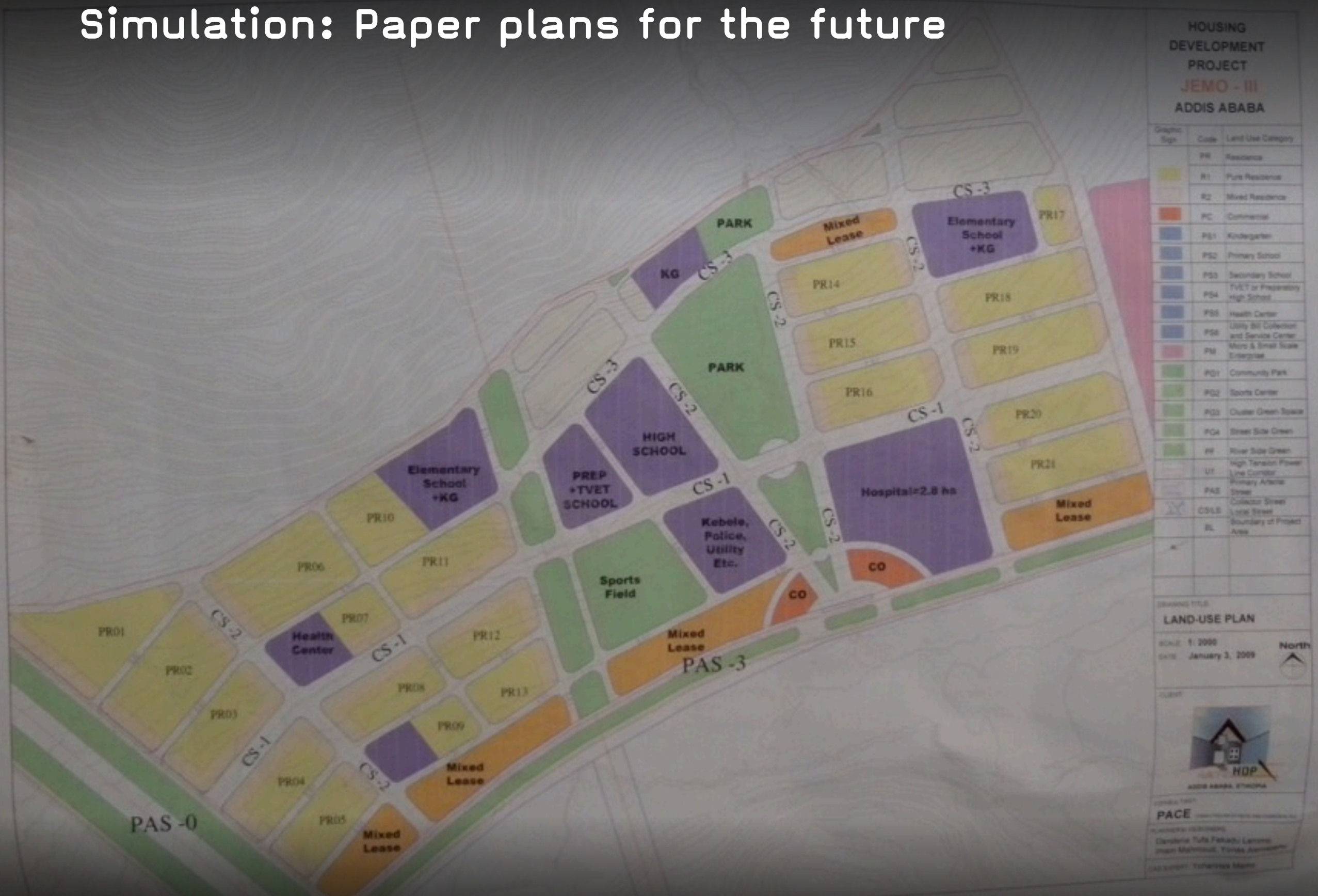
Inauguration of KAUST, Saudi-Arabia, 23. September 2009

Simulation: Display only



Inauguration of KAUST, Saudi-Arabia, 23. September 2009

Simulation: Paper plans for the future



Addis Ababa, October 23, 2009

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Simulation: Translation into reality



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Simulation: Translation into reality

Addis Ababa, October 23, 2009

Simulation: ETH translation into reality



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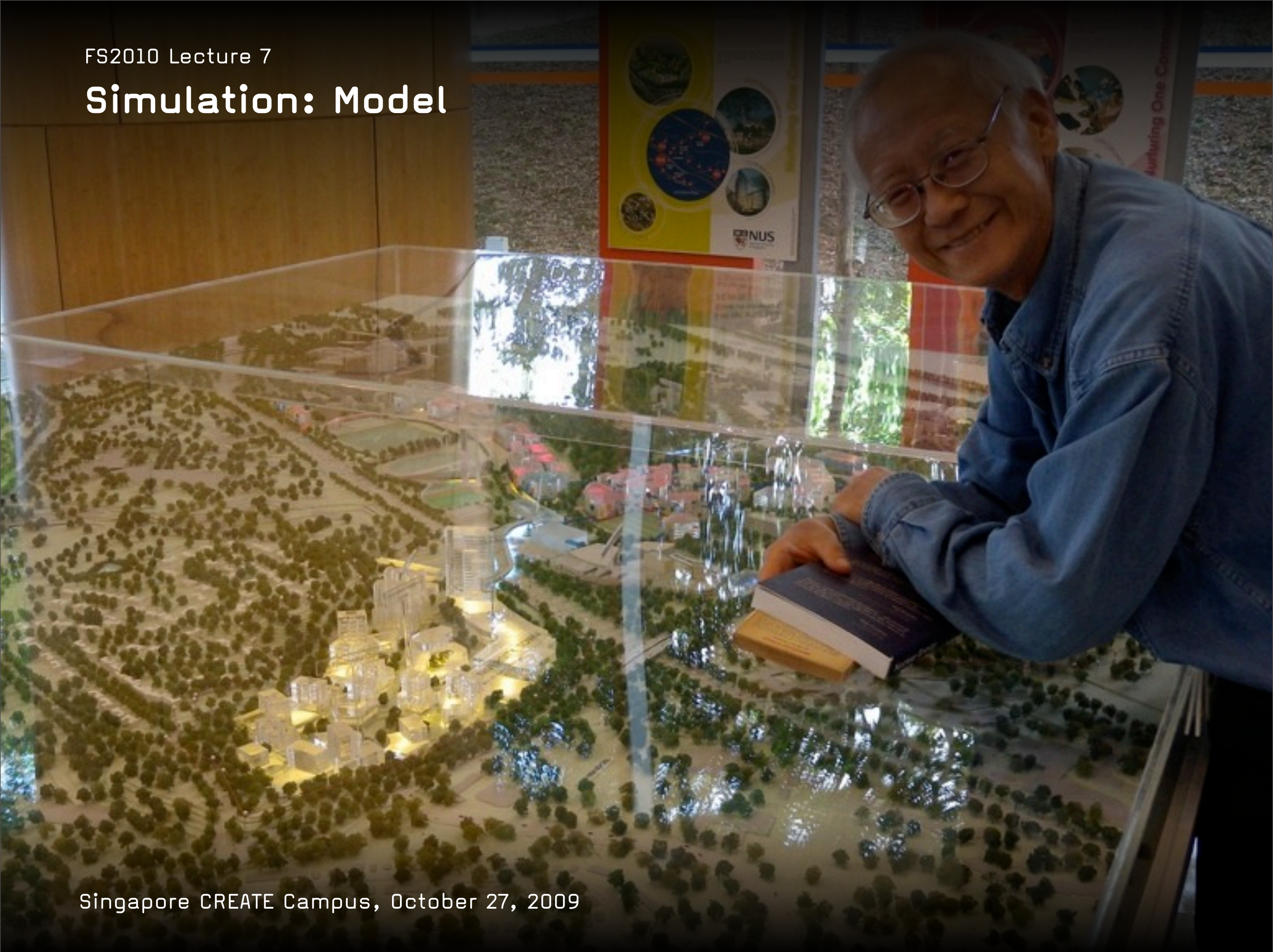
Simulation: Next generation



Addis Ababa, October 23, 2009

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Simulation: Model



Singapore CREATE Campus, October 27, 2009

FS2010 Lecture 7

Simulation: Translation into reality



Singapore CREATE Campus, October 27, 2009

Simulation: Translation into reality



Singapore CREATE Campus, October 27, 2009

Simulation Platform 2009

People • Water • Material • Energy • Capital • Space • Information



Value Lab, ETH Science City, Zurich

Conclusions - Simulation 3

- **What?** Simulation is a method next to theory and experiment in science, next to theory and design in architecture. It helps to predict form and behavior of complex systems, such as Architecture and Cities
 - **How?** Simulation can start with imagination, design, and model building. Increasingly, computational methods help to generate desired and realistic future scenarios
 - **Why?** Simulation should occur in the early design phase and in the early building management phase to reduce costs and to increase sustainability of Architecture
- ➡ Simulation is one of the most powerful methods to increase design quality and sustainability both locally and globally

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Preview

L8 | 26.04.2010 New Methods in Architectural and Urban Design

Jan Halatsch