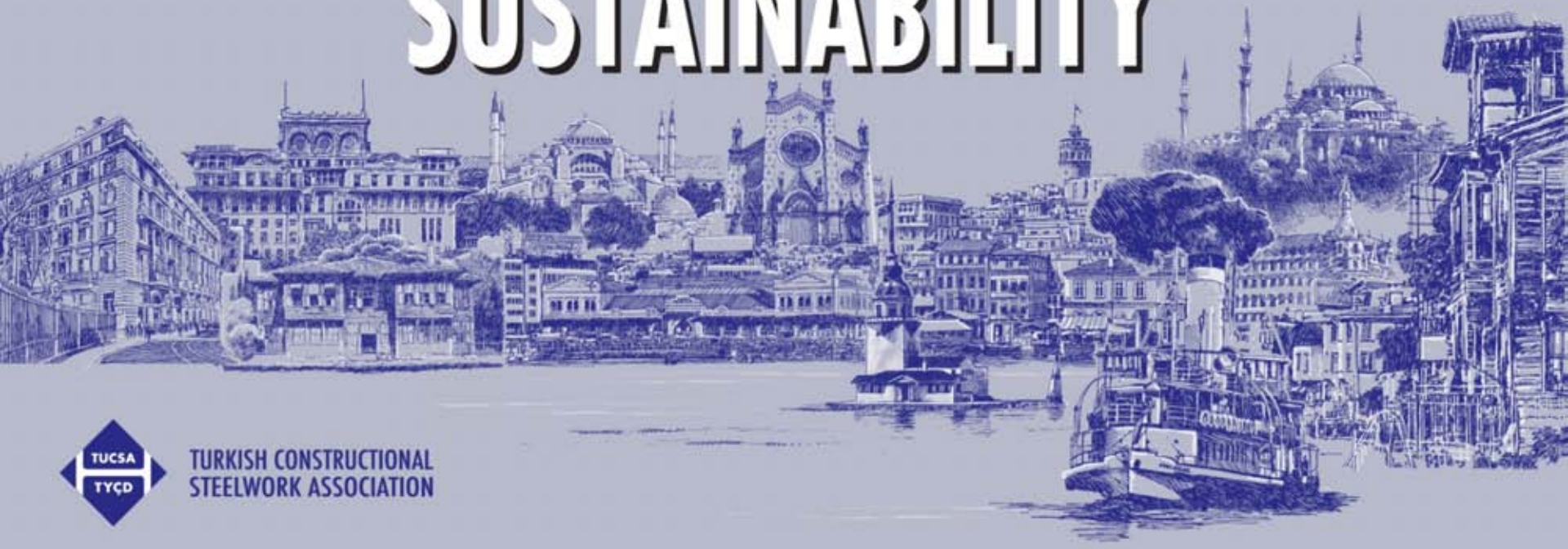
INTERNATIONAL SYMPOSIUM

21-23 September 2010

Istanbul, Taksim The Marmara, TURKEY

# STEEL STRUCTURES: 2010 CULTURE & SUSTAINABILITY



TUCSA TYÇD

TURKISH CONSTRUCTIONAL STEELWORK ASSOCIATION

Key-note Lecture

# Fire Engineering, Architecture & Sustainability

by

Prof. Eng. Jean-Baptiste Schleich
Kockelscheuer-Luxembourg


DUESSELDORF
INTERNATIONAL AIRPORT
ON FIRE 11.4.1996
designed for fire resistance ISO R120
BUT LACK of ACTIVE
FIRE SAFETY
17 FATALITIES


# GOETEBORG DISCO FIRE

# 30.10.1998

**Disco approved for 150 people**
**with 2 stairwells serving as escape ways**

- **BUT DISCO WAS OVERCROWDED**
  **and FIRE WAS PUT TO ONE STAIRWELL**
  **MISUSED FOR STORAGE of CHAIRS**
- **INSUFFICIENT ESCAPE MEANS**
  **& NO SMOKE DETECTION**
- **63 YOUNG PEOPLE DIED**

# *Steel Structures: 2010 Culture & Sustainability*

## *FIRE ENGINEERING ÷ Essentials*

**** For materials involved in structural resistance like concrete, steel, timber, masonry and aluminium the correct knowledge on their physical properties shall exist for temperatures varying up to 1000°C i.e. for stress-strain relationship, thermal elongation, thermal conductivity and specific heat.....***

***** a further condition of course is to make use of a consistent thermo-mechanical software permitting to simulate the behavior of slabs, beams, columns or frames in the fire situation but also allowing the analysis of the global behavior of complete structures under f.i. a fire restricted to a compartment.....***

****** this software has to be confronted and checked against fire tests on loaded beams, columns and even frames, so allowing finally to get a design tool permitting to analyse the structural resistance without being obliged to proceed to expensive and time consuming fire tests before starting any construction….***

# *Steel Structures: 2010 Culture & Sustainability*

## *FIRE ENGINEERING ÷ Essentials*

***** the study of real or natural fires, instead of the conventional ISO-fire, has to be performed and credible software shall permit to establish the natural heating curve.. in a compartment in function of the most relevant physical parameters.....*

****** active fire safety measures reduce the potential severity of a fire and even its probability of occurrence, hence probabilistic considerations allow to consider their indirect effect on the structural stability.*

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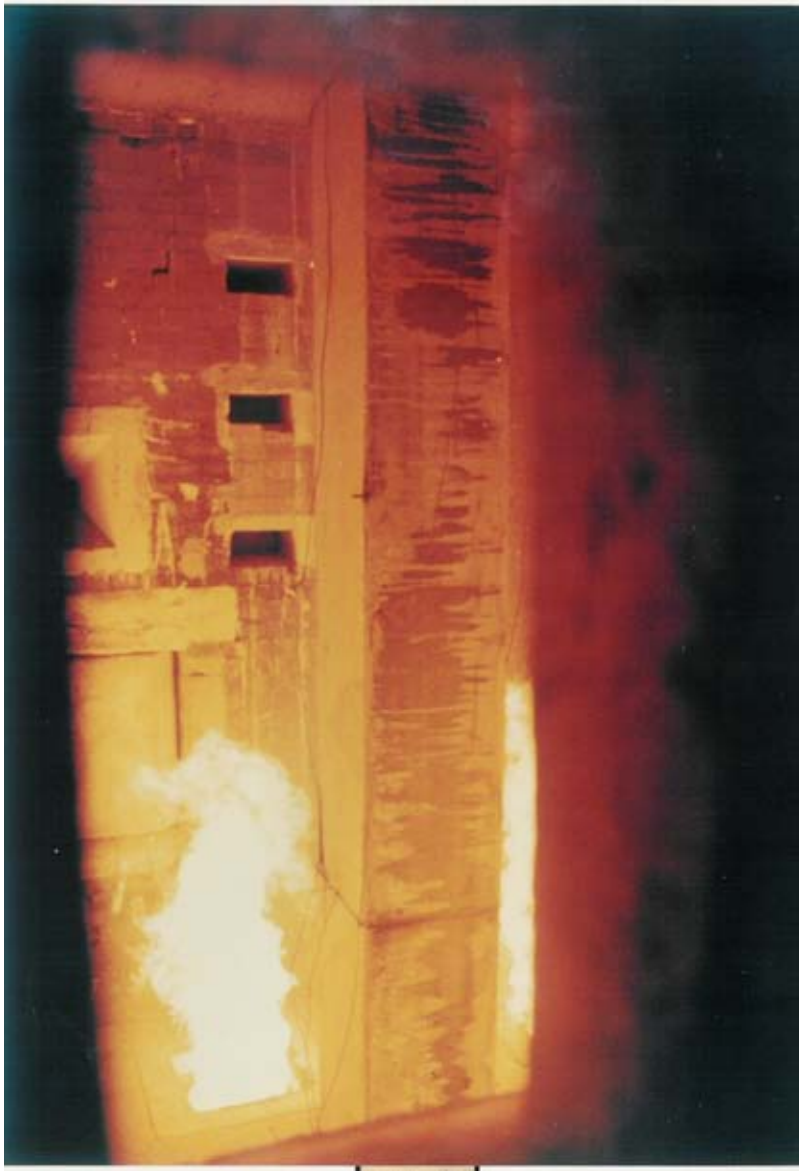
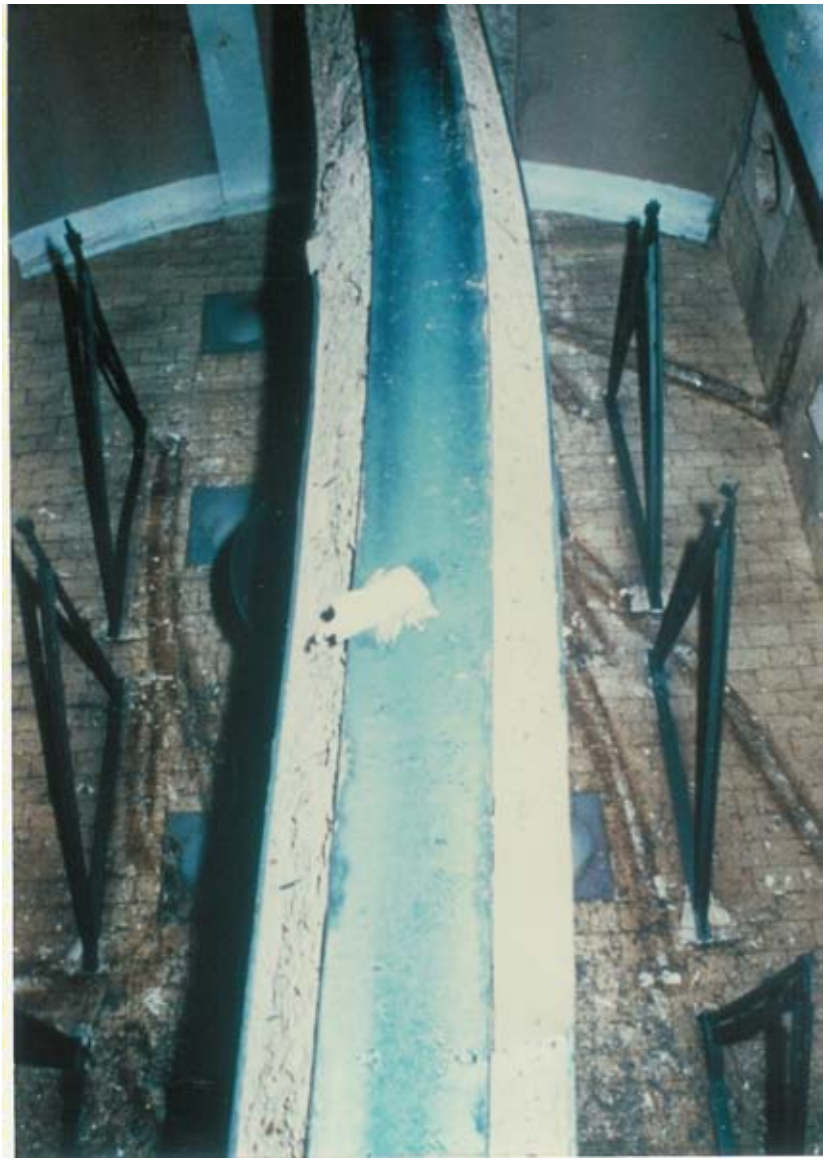
## *FIRE ENGINEERING ÷ Essentials*





# *Steel Structures: 2010 Culture & Sustainability*

## *FIRE ENGINEERING ÷ Essentials*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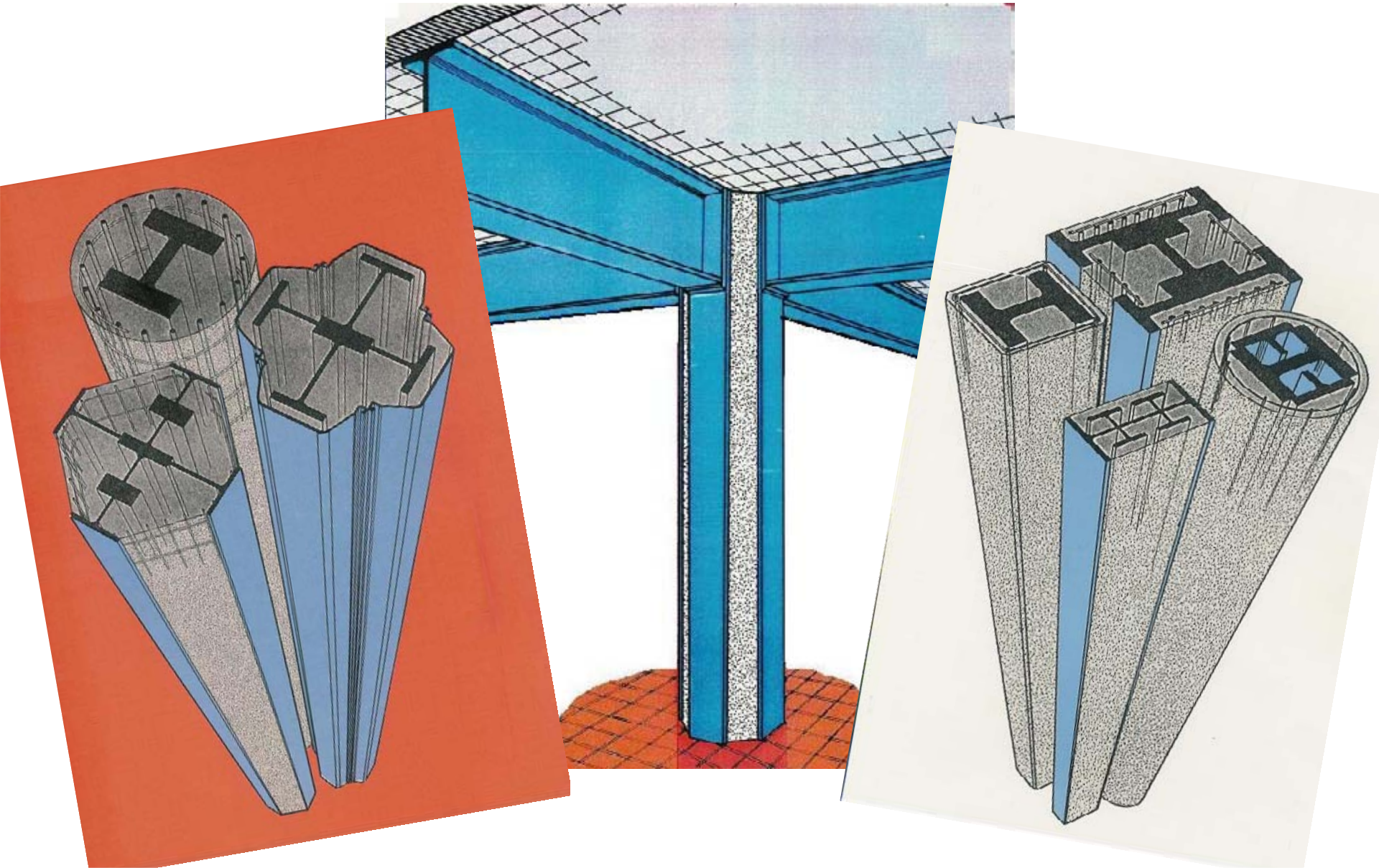
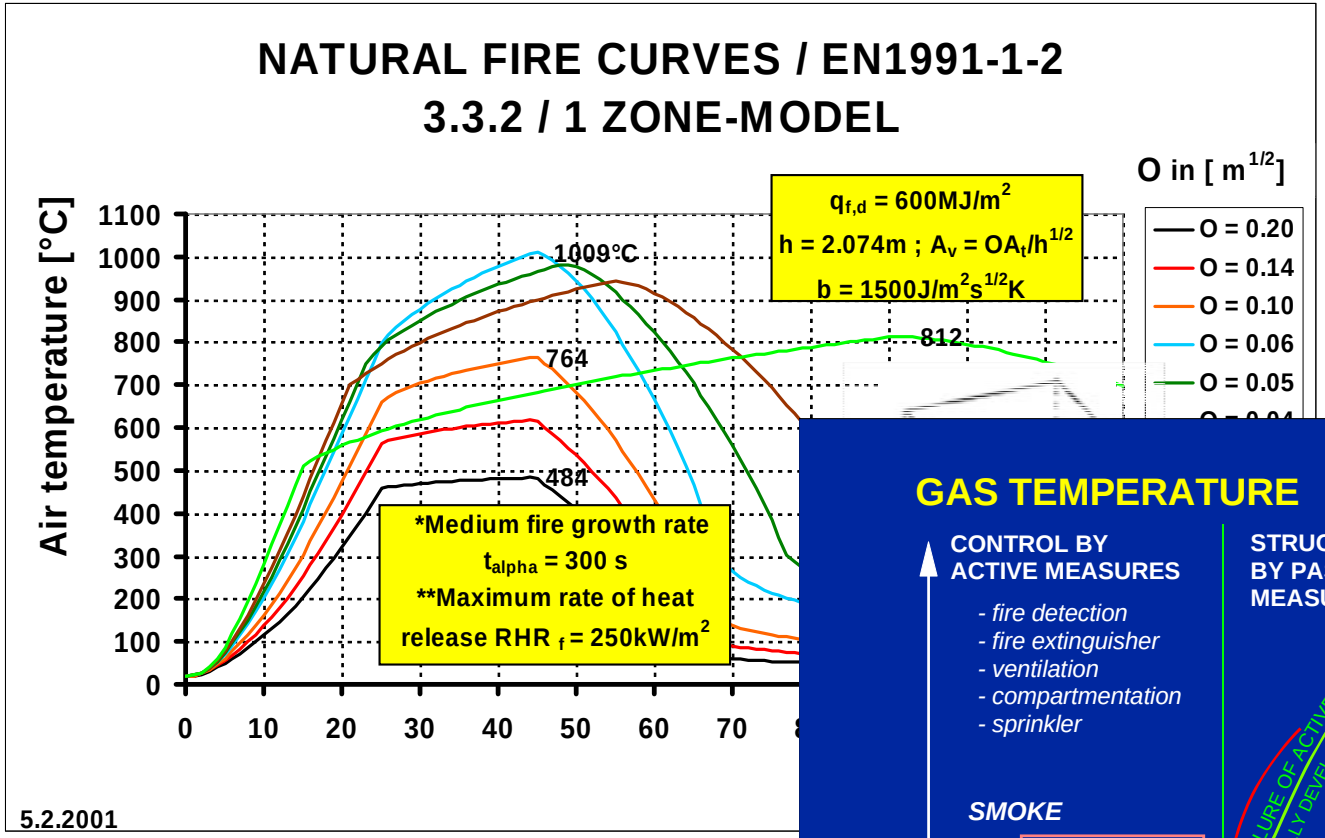
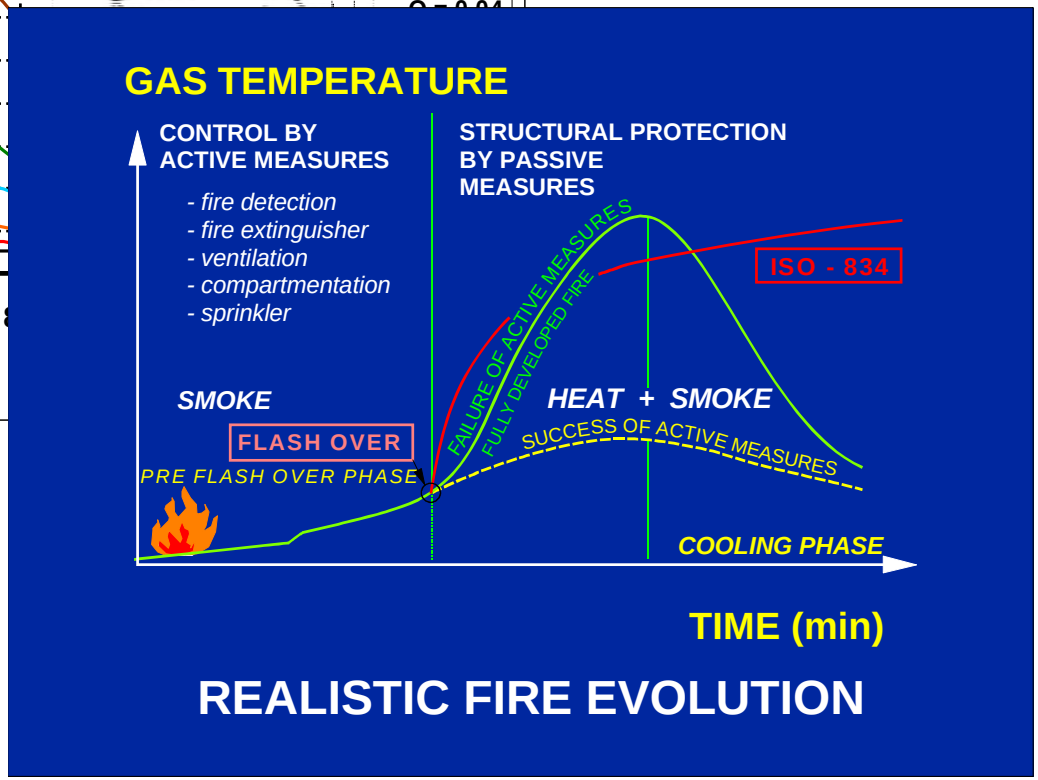


# Steel Structures: 2010 Culture & Sustainability

## FIRE ENGINEERING ÷ Essentials



# *Steel Structures: 2010 Culture & Sustainability*

**** Research undertaken between 1994 & 2000 with the involvement of recognized research institutes in 12 European Countries, allowed to establish the connection between the probability $p_{fi,55}$ of getting a fully fire engulfed compartment during the life time of the building and the global factor $\gamma_{qf}$ affecting the characteristic value $q_{f,k}$ of the fire load.***

***** This procedure was further confirmed through the European Research on the "Natural Fire Safety Concept, involving 100 full scale fire tests" between 1997 and 2000 with the involvement of recognized research institutes in 6 European Countries, a.o. the " Institut für Baustoffe, Massivbau und Brandschutz Technische Universität Braunschweig",***

****** and was included into the European Construction Standard EN1991-1-2, Actions on structures exposed to fire, which in August 2002 was unanimously accepted by all 18 CEN-Member Countries.***

EUROPEAN PRESTANDARD

**EN 1991-1-2**

PRENORME EUROPEENNE

EUROPÄISCHE VORNORM

**DAV 20.11. 2002**

---

ICS 91.040.00

Descriptors : buildings, structures, design, comptutation, fire resistance

English version

# Eurocode 1 – Actions on Structures

## Part 1-2 : General Actions – Actions on structures exposed to fire

Eurocode 1 – Actions sur les structures – Partie 1-2 : Actions Générales – Actions sur les

Eurocode 1 – Einwirkungen auf Tragwerke – Teil 1-2: Allgemeine Einwirkungen –

* *The previous theory is now accepted at various degrees in Europe through the National Annexes to EN1991-1-2.*

*In Germany the corresponding document DIN EN 1991-1-2/NA was published end 2009 and clearly allows for natural fire design and the simultaneous consideration of active fire safety measures.*

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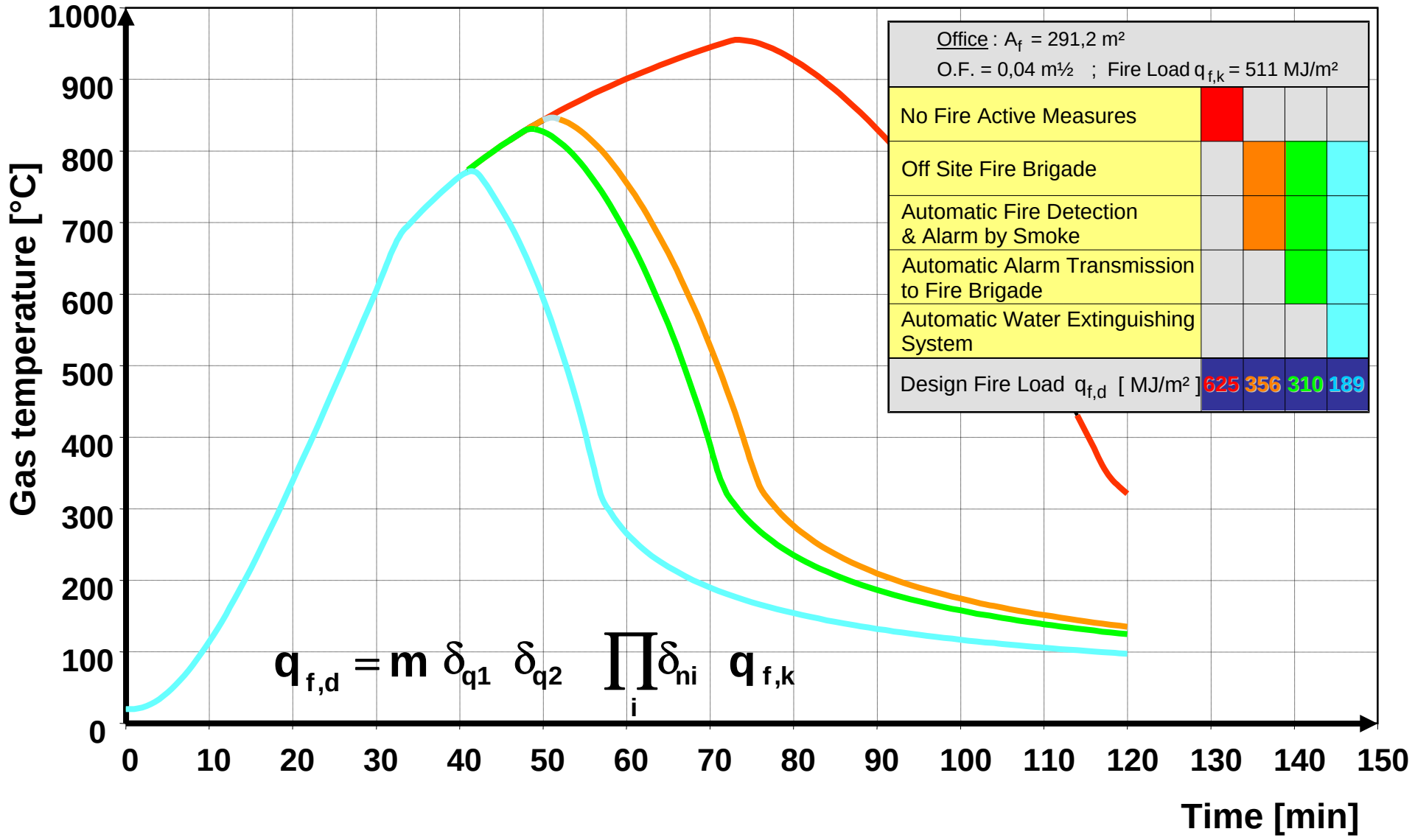

# Steel Structures: 2010 Culture & Sustainability

## ARCHITECTURE÷ INVISIBLE Fire Protection - The FUTURE

*CHAMBRE de COMMERCE / Luxembourg 2002-2004 by Claude Vasconi & Jean Petit*

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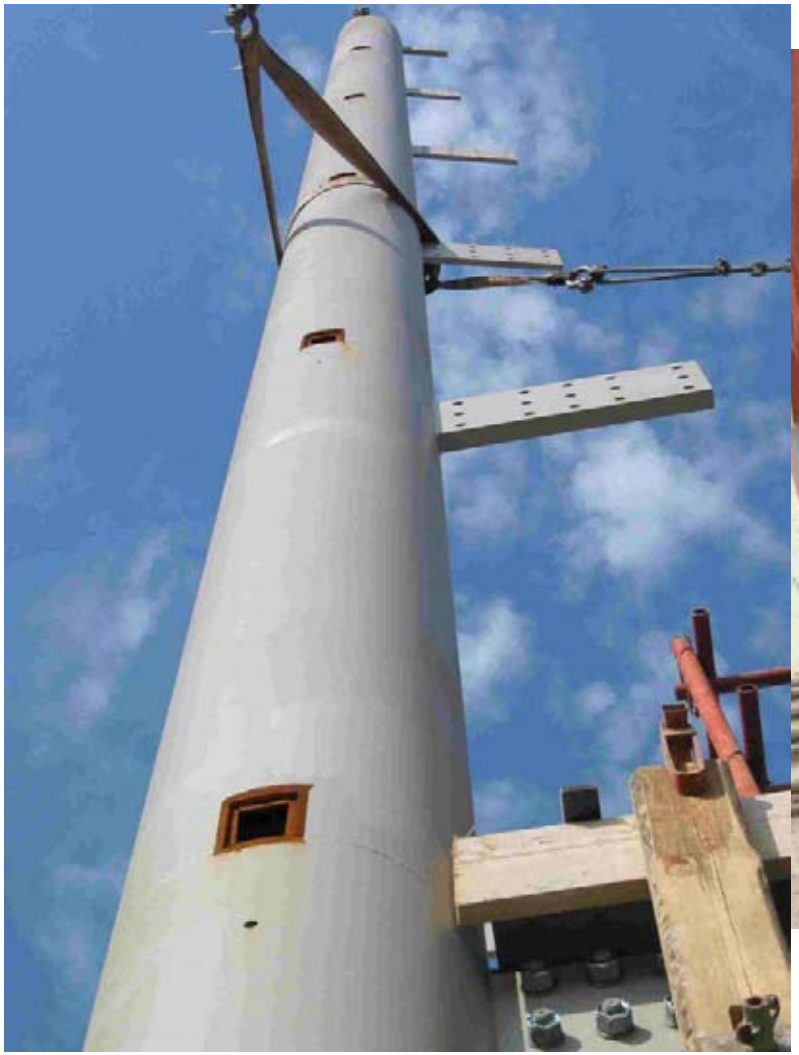

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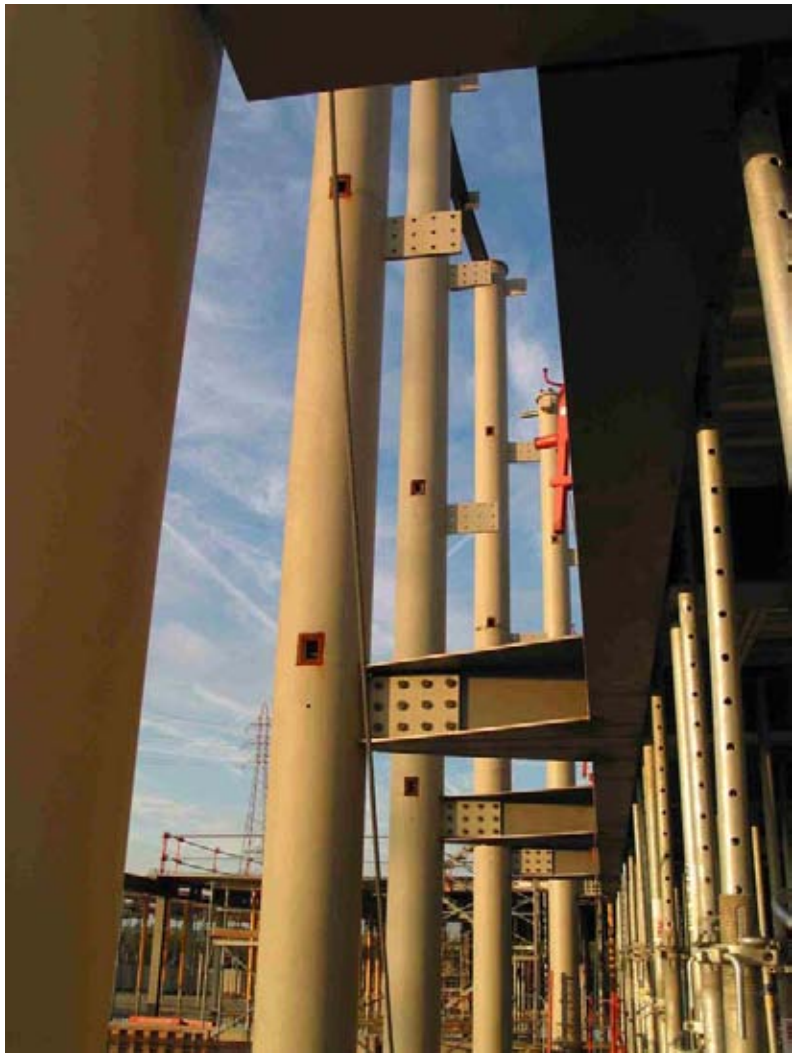

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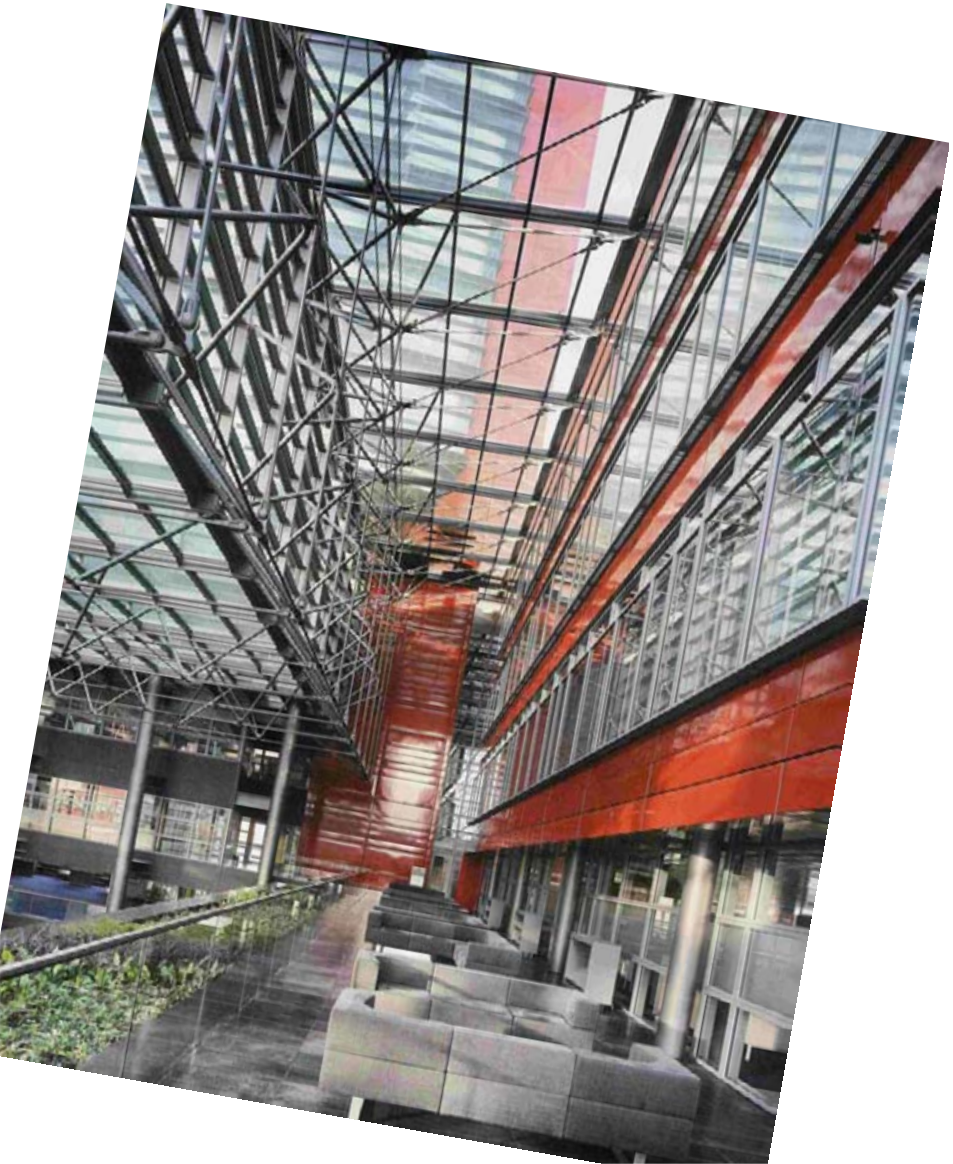

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## *SUSTAINABLE DEVELOPMENT THROUGH STEEL RECYCLING & REUSE*

***PALACE of JUSTICE of the EUROPEAN COMMUNITIES /Luxembourg 2002-2008 by Dominique Perrault, Paczowski & Fritsch and M3 architects***

**BUILT 1972 / Passive fire protection through F90 insulation layer**

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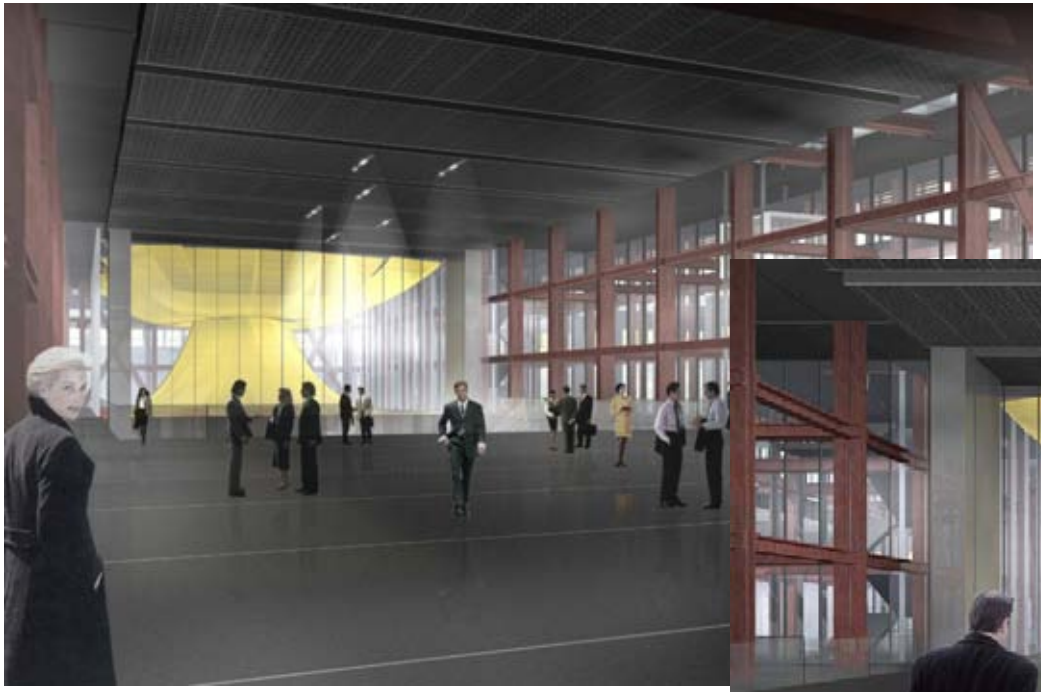

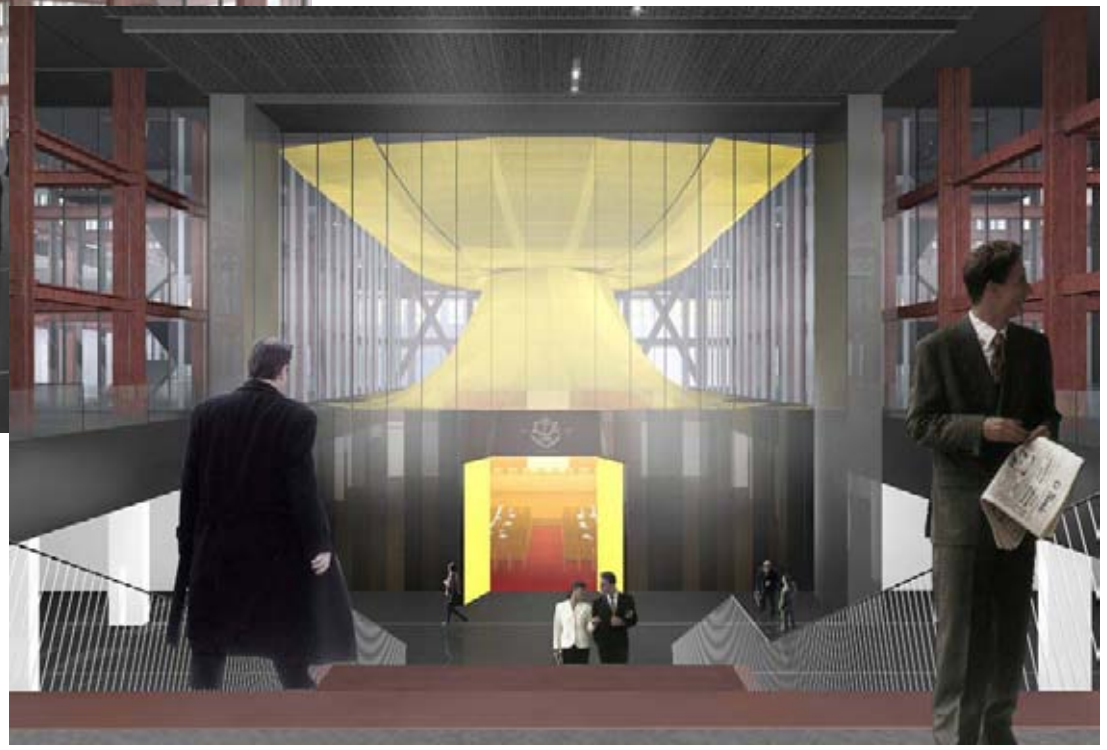

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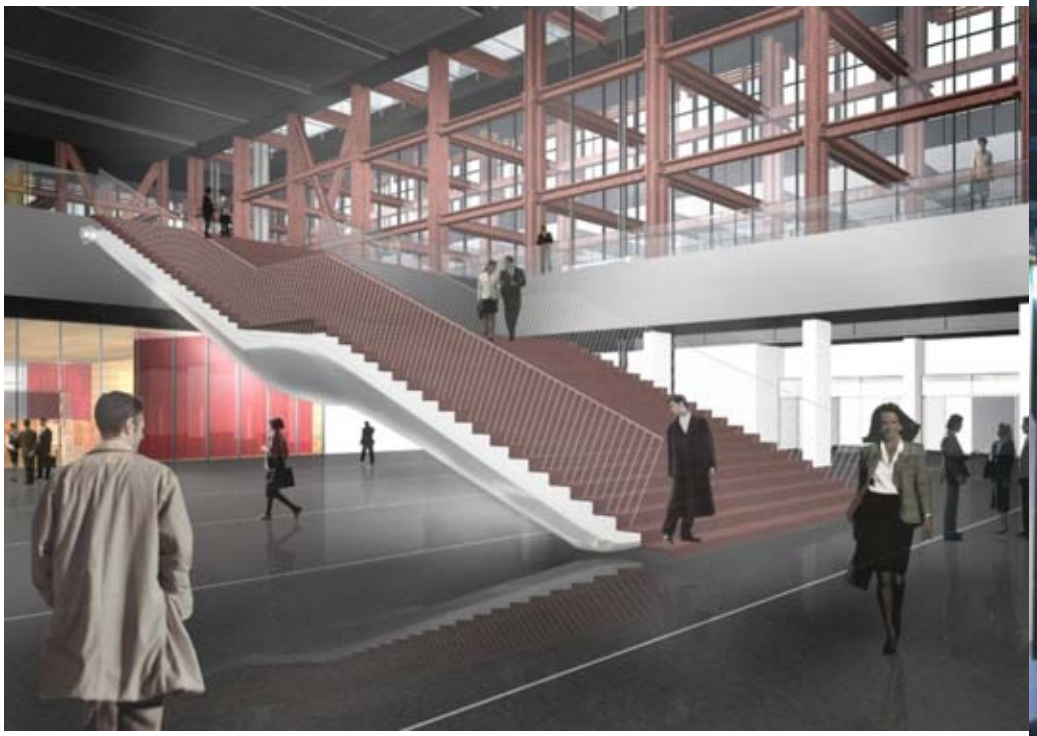

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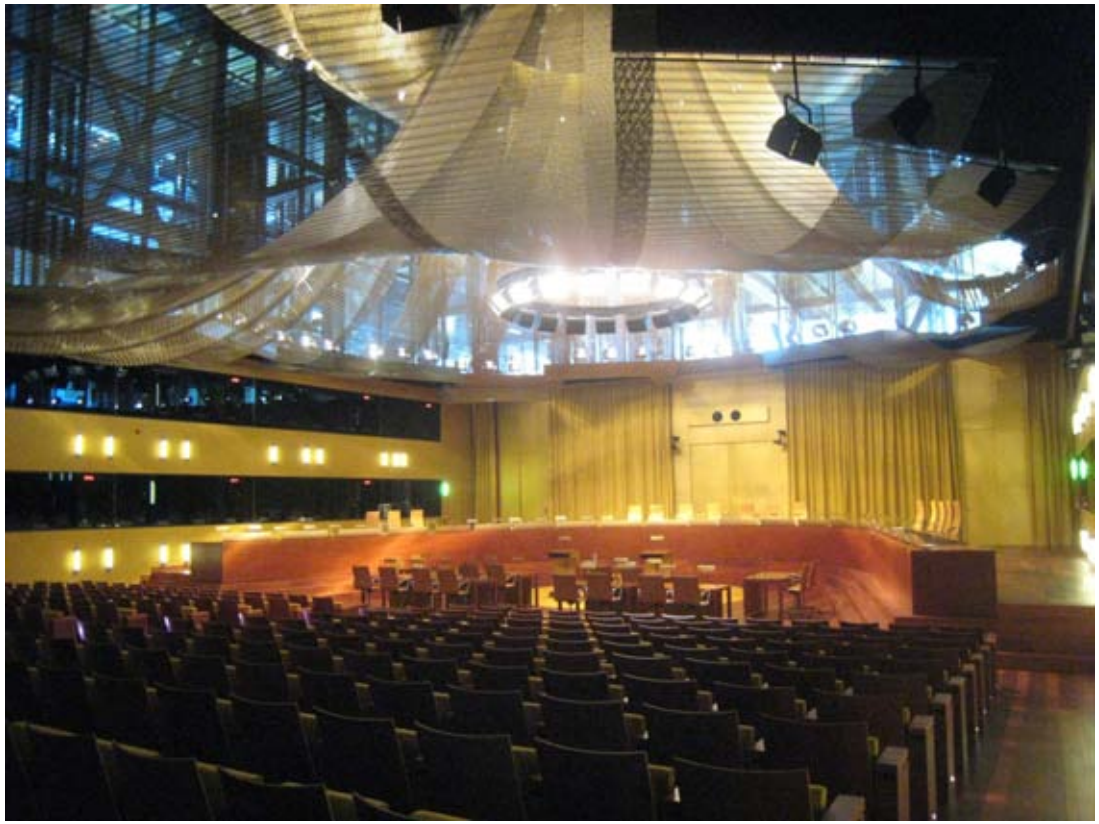

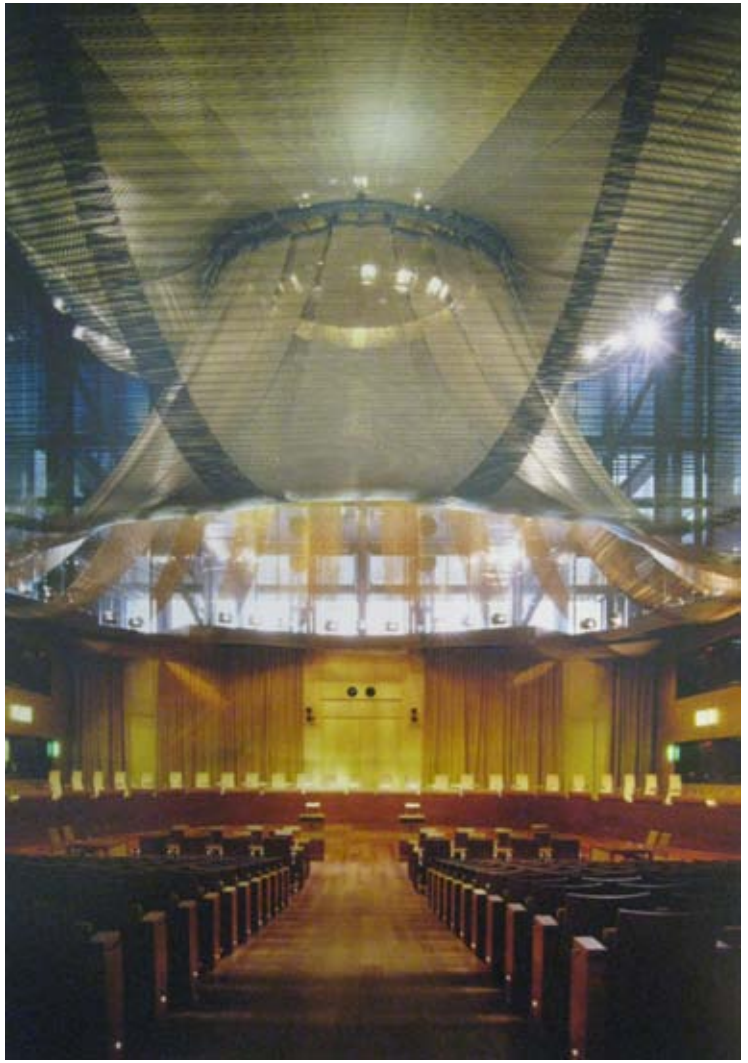

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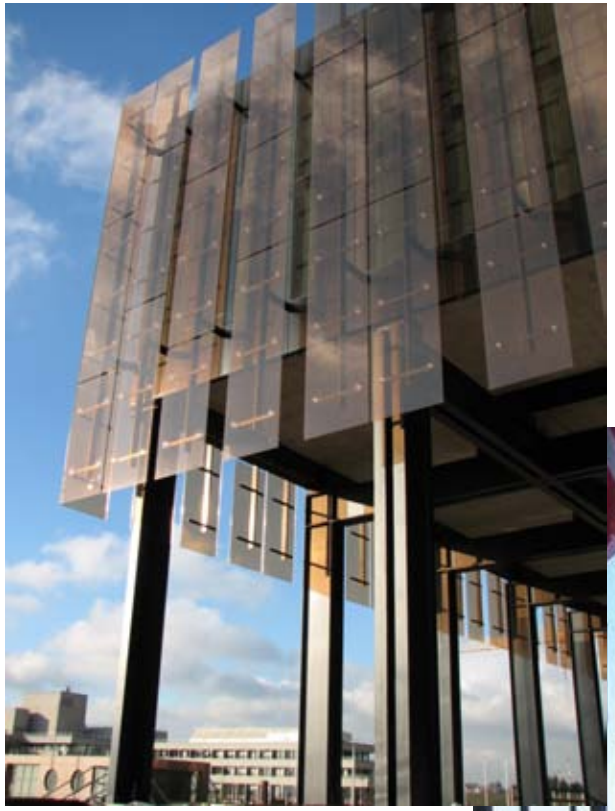

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# *Steel Structures: 2010 Culture & Sustainability*

## *SUSTAINABILITY ÷ A COMPLEX SUBJECT*

***Indeed thoughts and acts are considered as sustainable, if life standards of the present generation are improved without damaging the conditions of life of the future generations.***

***Furthermore a building or a dwelling may be called sustainable if, apart from its traditional required properties concerning architecture, occupancy and technical performances, it also has an everlasting minimized impact on the environment.***

***Hence the relation has to be considered between the Social Situation of People, the Environment and also the Economic Aspect, not forgetting that these three entities are on one side embedded in the worldwide problem of Demography and could on the other side only be properly approached by a transparent Democracy.***

# *Steel Structures: 2010 Culture & Sustainability*

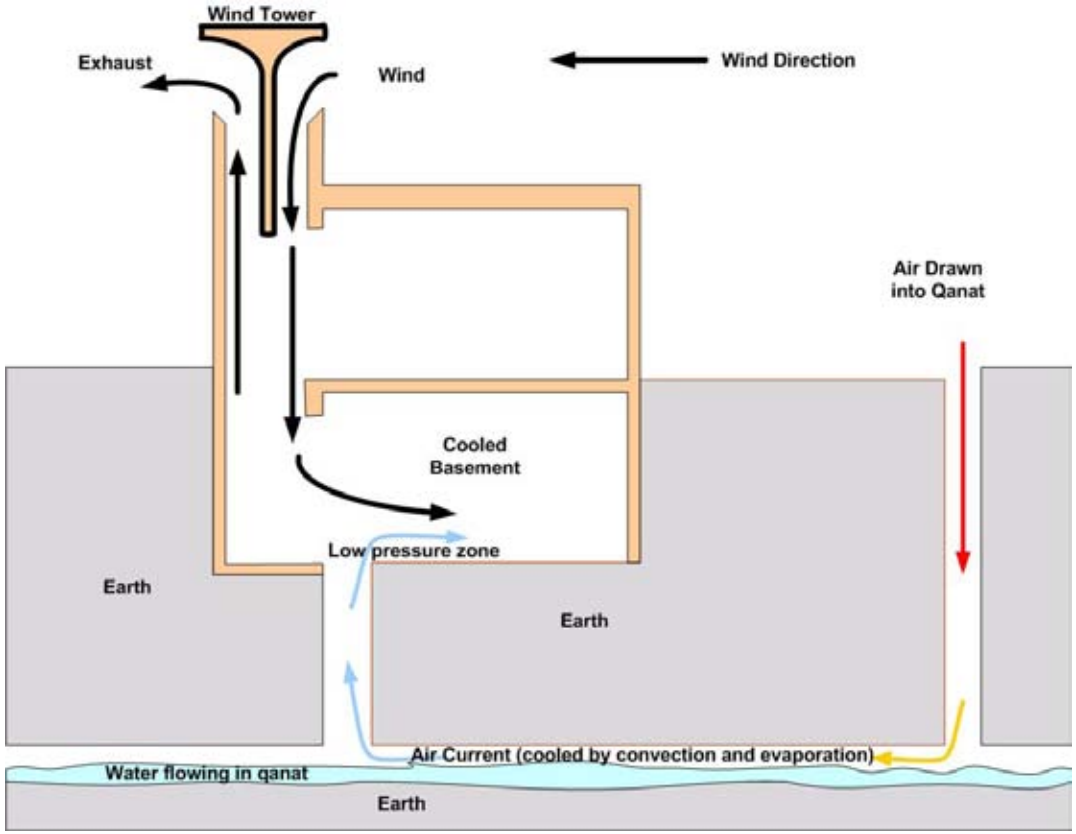
## *SUSTAINABILITY ÷ STATEMENT*

***Applying active cooling by using energy to make buildings 'comfortable,' as well as using heating, ventilation and air-conditioning technology has meant that comfort has become a commodity, to be purchased continually all year, rather than a natural benefit of good building design that is free for most of the year.***

***So we shall try to push rational design as there is much that we can learn from the ideas and design concepts, skills and even rules that have been adopted with increasing experience throughout history.***

# Steel Structures: 2010 Culture & Sustainability

## Natural Ventilation by Wind Catcher-Badgir or Wind Tower

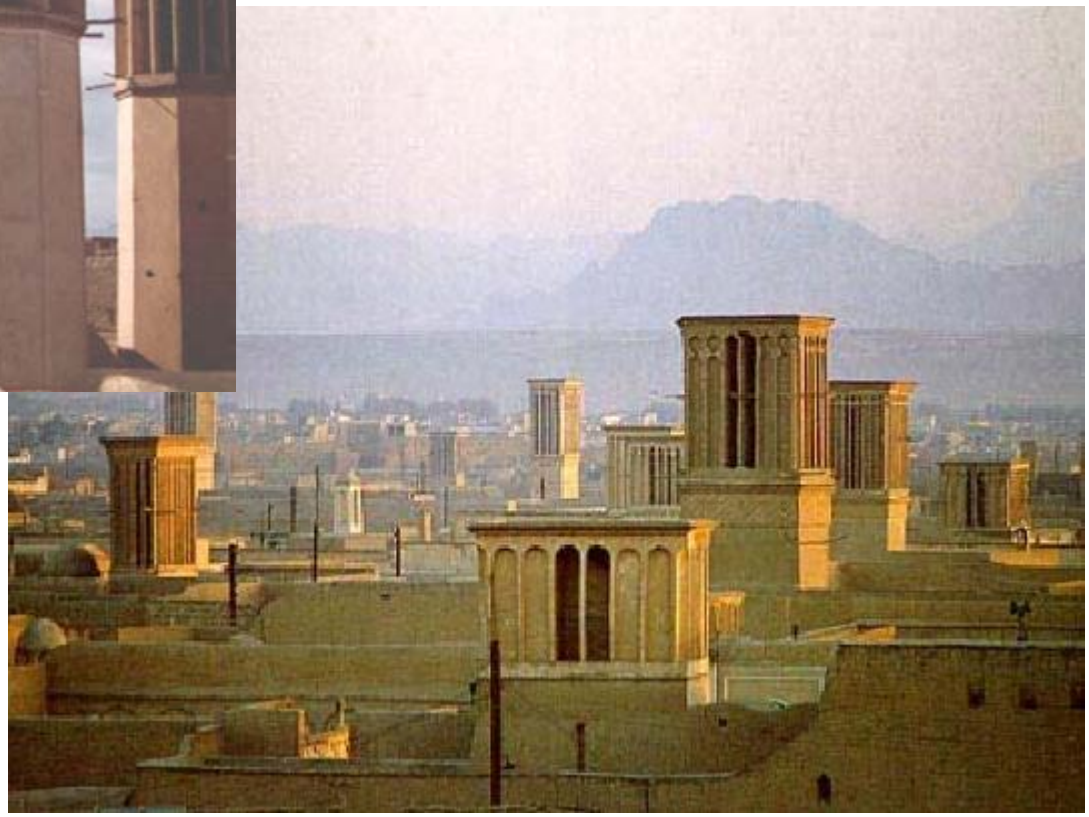



*A Wind Catcher is a traditional Persian architectural device used since 2500 years to create natural ventilation in buildings.*

*It allows to create a pressure gradient which sucks at least a small amount of air upwards through a house. This dry air, being pulled over f.i. a pool inside the building evaporates some of that water and consequently the air is cooled down.*

# *Steel Structures: 2010 Culture & Sustainability*

## *Natural Ventilation – YAZD the city of Wind towers, IRAN*



# *Steel Structures: 2010 Culture & Sustainability*

## *Natural Ventilation by Cooling Tower at Center for Global Ecology / Carnegie Institution of Washington*

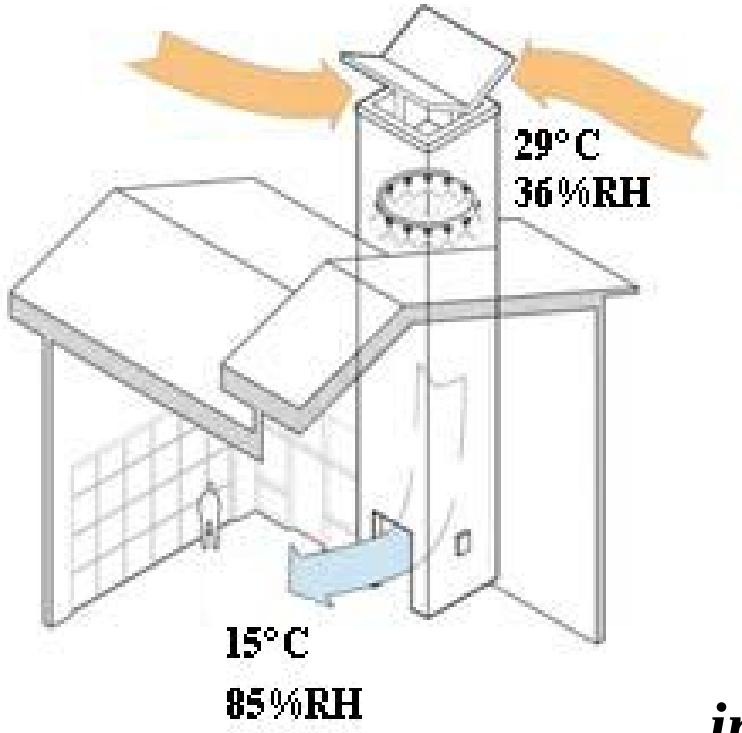
***The lobby represents an indoor/outdoor space with large bi-fold doors included in walls.***

***A Cooling Tower provides a small amount of cooling to the space even when the doors were open.***

***A carefully-designed "windcatcher" captures breezes from above the roof line and directs them down into the lobby area.***

# *Steel Structures: 2010 Culture & Sustainability*

## *Natural Ventilation by Cooling Tower at Center for Global Ecology / Carnegie Institution of Washington*




***Spray nozzles are ejecting water droplets which, when evaporating, increase the air humidity and density while dropping its temperature, and so induce a thermally-driven downdraft to carry cool air into the lobby.***

# *Steel Structures: 2010 Culture & Sustainability*

## *Natural Ventilation by Solar Chimneys at the French School*

## *“Lycée Charles de Gaulle” 2008, Damascus*

# *Steel Structures: 2010 Culture & Sustainability*

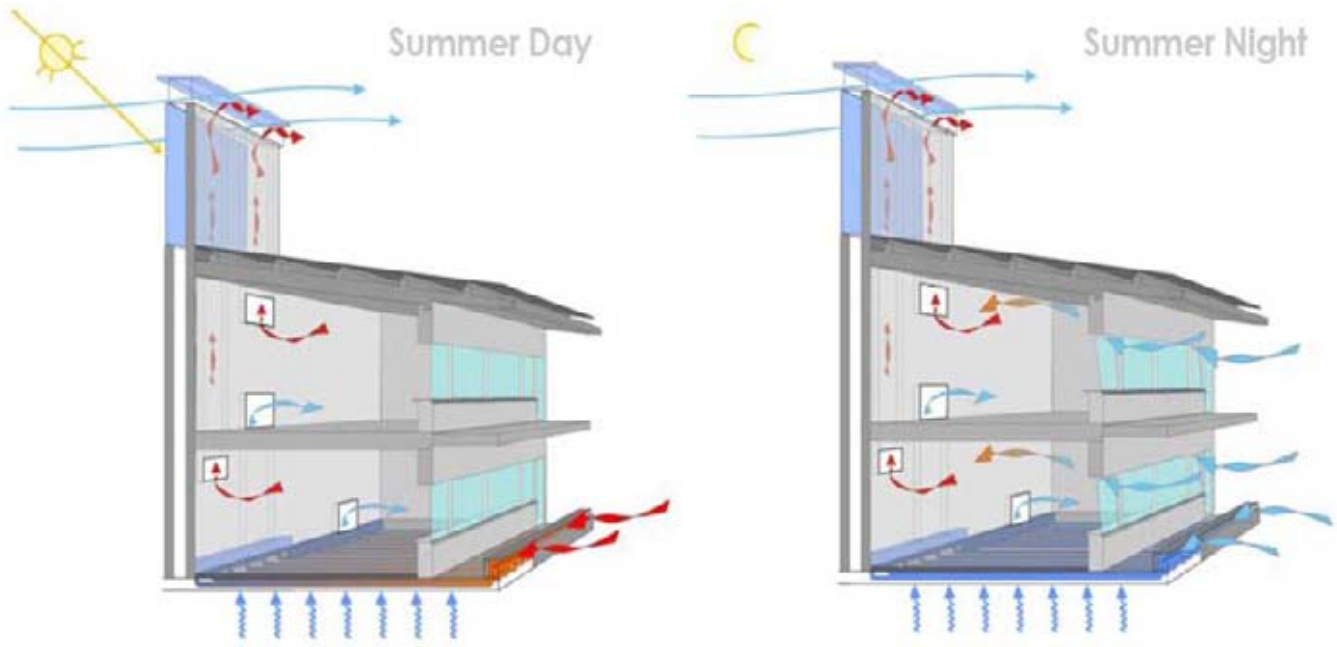
## *Natural Ventilation by Solar Chimneys at the French School "Lycée Charles de Gaulle" 2008, Damascus*

***The solar chimneys are an integral part to the school's ventilation strategy, used to drive natural cross-ventilation through the classrooms. The chimneys, which dominate the school's form and skyline, are oriented towards the south and are covered with black-painted polycarbonate sheet to trap solar radiation at the top of the chimney. This trapping of heat enhances the stack effect inside the chimneys, pulling warm air from the classrooms below. The chimneys are also designed to use wind to create negative pressure at the top of the chimney which further improves the stack air movement inside the chimney.***

# *Steel Structures: 2010 Culture & Sustainability*

## *Natural Ventilation by Solar Chimneys at the French School*

## *“Lycée Charles de Gaulle” 2008, Damascus*




***During night time, the thermal mass of the chimney releases the heat it stored during the day and thus continues to draw air through the open windows and the earth ducts, which helps cool the structure further for the following day.***

# *Steel Structures: 2010 Culture & Sustainability*

## *Natural Ventilation by Removable Shading Devices at the French School "Lycée Charles de Gaulle" 2008, Damascus*

***The removable shading devices above the courtyards provide solar protection during summer days and are opened for cooling at night by radiation to the sky. In winter the operation of the solar shading is reversed, opening it during the day to capture solar gains and closing it at night to prevent their loss to the clear night sky***

# *Steel Structures: 2010 Culture & Sustainability*

## *Traditional Middle Eastern Shading Strategy for Riyadh Tower Design, February 2010*

***In February 2010, the design for Al-Birr Foundation Headquarters in Riyadh, Saudi Arabia, has been named as the winner of the 2010 Architectural Review / Future Projects Awards under the 'tall buildings' category.***

***The project – height ~200m – designed by Perkins+Will's New York Office was concieved as a sustainable urban tower that responds to the environmental characteristics and the microclimate of the city of Riyadh, which is a challenging climate to address given the extreme solar exposure and the heat conditions of Riyadh.***

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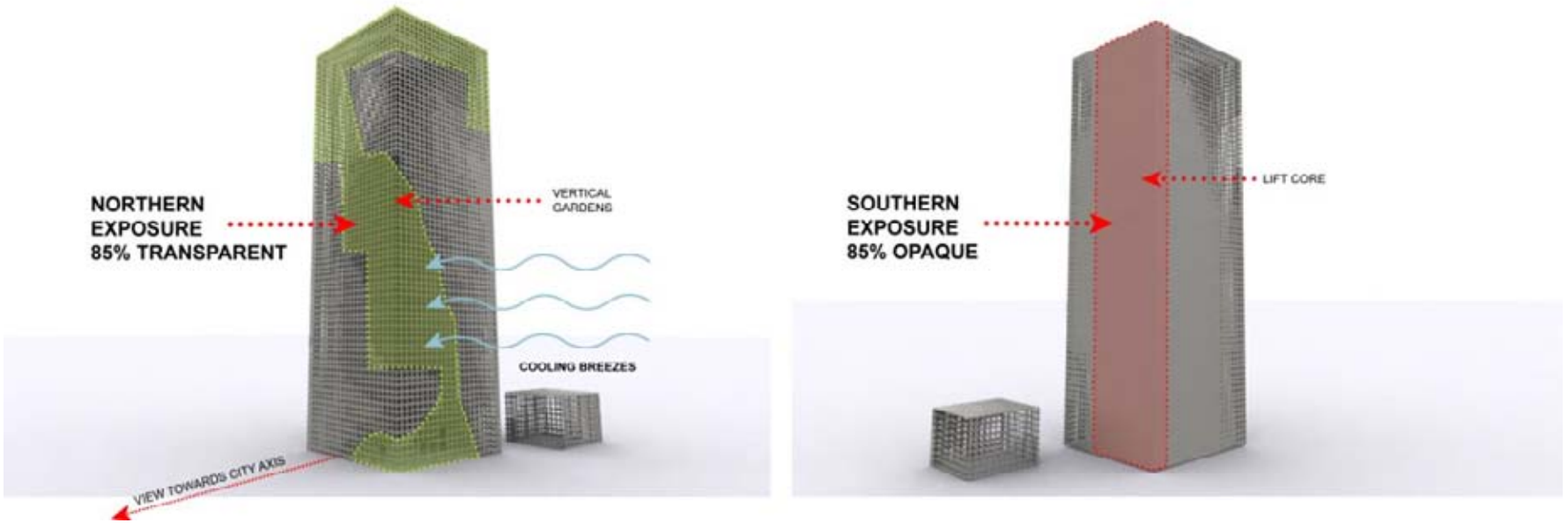
## *Traditional Middle Eastern Shading Strategy for Riyadh Tower Design, February 2010*




***The result was an envelope that resembles a mesh of varying densities, that helps the building reduce its solar heat gain while maintaining its views towards the city.***

***This response to solar radiation, as well as the manipulation of larger to smaller opening as a light control measures, is inspired by the traditional Middle Eastern wooden latticework screen.***

# *Steel Structures: 2010 Culture & Sustainability*

## *Traditional Middle Eastern Shading Strategy for Riyadh Tower Design, February 2010*

***The design's emphasis on reducing solar exposure not only represents a shift from the standard approach of importing US office building designs of deep floor plates and unshaded glazed envelopes, but also starts the long awaited development of environmentally responsive design in the Middle East, that learns from traditional design elements of the region.***

# *Steel Structures: 2010 Culture & Sustainability*

## *Active building through wind and solar energy recuperation for Erdberg Office Tower, Vienna 2010*

***For this building project – height 128m / 30 floors - conceived by COOP HIMMELB(L)AU, the intention was to generate a building which responds to the principles of sustainability through an energy active facade and an integrated wind turbine.***

***Hence the building is producing more energy than it would actually consume.***

# *Steel Structures: 2010 Culture & Sustainability*

## *Active building through wind and solar energy recuperation for Erdberg Office Tower, Vienna 2010*

***That building produces electric energy in two ways: on the one hand through wind energy by means of a large turbine on top of the tower in a bar-shaped construction, which is optimally oriented with respect to the locally dominant wind direction, on the other hand the façade panels are provided with a photovoltaic lamination, which produces electric energy through the sun.***

# *Steel Structures: 2010 Culture & Sustainability*

## *The problem with cities:*
## *Greenhouse gas emissions and energy consumption*

***Cities occupy two percent of the world's land mass, yet contribute to more than 15% of global greenhouse gas emissions.***

***In addition to being more willing to take risks than larger government bodies, cities have easy access to their citizens and local businesses, schools and institutions, and therefore the effects of new policies may be immediate and meaningful.***

# Steel Structures: 2010 Culture & Sustainability

## The problem with cities:
## Greenhouse gas emissions and energy consumption

***More than one-third of energy is consumed in buildings worldwide. The built environment is therefore a critical part of the climate change problem – and solution. Most existing buildings were not designed for energy efficiency, but by retrofitting with up-to-date products, technologies and systems, a typical building can realize significant energy savings. Improving the energy efficiency of buildings is a priority for reducing greenhouse gas emissions and energy costs.***

# Steel Structures: 2010 Culture & Sustainability

## The problem with cities:
## Greenhouse gas emissions and energy consumption


***Particular action fields concern waste reduction and recycling, capture and use of methane gas to generate power, improved outdoor lighting to reduce energy use up to 70%, developing urban transportation like Bus Rapid Transit systems, make use of solar energy as far as possible and push by all means to drive down the cost of the solar power technology.***

# *Steel Structures: 2010 Culture & Sustainability*

## *The problem with cities:*
## *Greenhouse gas emissions and energy consumption*

***Clinton Climate Initiative CCI helped the city of Seoul retrofit 21 public buildings, making them more energy-efficient.***

# *Steel Structures: 2010 Culture & Sustainability*

## *The problem with cities:*
## *Greenhouse gas emissions and energy consumption*

***CCI is helping the city of Chicago implement its Climate Action Plan and dramatically reduce its greenhouse gas emissions.***

# Steel Structures: 2010 Culture & Sustainability

## *The problem with cities:*
## *Greenhouse gas emissions and energy consumption*

***In a groundbreaking project with New York City, CCI a.o. are helping to retrofit the Empire State Building to reduce annual energy consumption by 38 percent.***

# Steel Structures: 2010 Culture & Sustainability

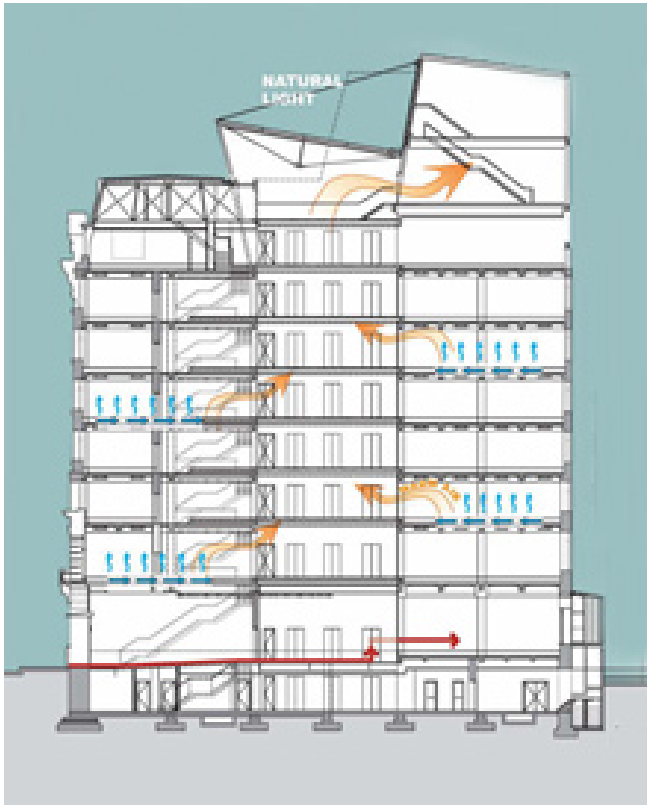
## *The problem with cities: Refurbishment and not Demolition*


***39 Hunter Street in Sydney's central business district was nearly a century old at the time of refurbishment.***

***It retains all the classic features and aesthetic advantages of its era, while design interventions have ensured it meets modern standards for efficiency and sustainability.***

# Steel Structures: 2010 Culture & Sustainability

## The problem with cities:
## Refurbishment and not Demolition




***The spectacular refurbishment of the 90-year-old building included a central atrium to enhance daylight and decrease the need for internal lighting.***

***Arup's acoustics team developed methods of creating sound pathways through the atrium that would not disturb those working in the multi-tenant building. The atrium also serves as a return air plenum and smoke spill path for the commercial floors.***

# Steel Structures: 2010 Culture & Sustainability

## *The problem with cities: Refurbishment and not Demolition*

***Building reuse and adaptation easily lend themselves to the ideals of green building, like lower embodied energy, longevity and cultural significance. In Essen, Germany, the Madako Architects have transformed an historic water tower into an imaginative space for living and working with lasting environmental considerations.***

# Steel Structures: 2010 Culture & Sustainability

## The problem with cities:
## Refurbishment and not Demolition

***In its initial form, the water tower in Essen-Bredeney stood untouched under Germany's' historic building protection and culturally significant landscape protection. These two designations prevented demolition and maintained the water tower as part of the heritage landscape until 2002.***

***Then, between 2003 and 2006, with little alteration to the exterior, the water tower was transformed into an eight-story, multi-use building.***

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***The ground level space serves as an office and the lofty top level unit offers conference space with views of the surrounding natural landscape. Three two-story apartments welcome the sun with open, flowing floor plans and high ceilings. Natural day light, thermal mass and convective cooling are inherent building qualities.***

# *Steel Structures: 2010 Culture & Sustainability*

## *The problem with cities:*
## *Refurbishment and not Demolition*

***Is refurbishment always more sustainable than new build?***

***Not always!!! As a general rule, refurbished buildings reduce embodied energy compared with new construction and can improve operational energy performance. But there are some building types such as deep plan offices and those with very low ceilings and inherent cold bridging that are problematic in achieving human comfort as well as reduced energy consumption.***

***To present such a refurbishment as a wonderful task for architects is quite silly. With many commercial buildings, and a vast amount of housing, we need to knock down old hulks and build more new designs to refresh the building stock.***

***We should finally think innovation, not conservation.***

# *Steel Structures: 2010 Culture & Sustainability*

## *STATEMENT by Norman Foster 2003*

***"If sustainability is to be more than a fleeting fashion, architects in the future must ask themselves some very basic questions.***

***For example, why do we still insist on using green-field sites when we could build on reclaimed land in our cities?***

***Why do we demolish buildings that could easily be put to new uses?***

***Why do we rely so heavily upon artificial lighting when we can design buildings that are filled with daylight?***

***And why do we continue to rely upon wasteful air-conditioning systems in locations where we can simply open a window? "***

# *Steel Structures: 2010 Culture & Sustainability*

## *STATEMENT by the Author*

***"If sustainability is to be more than a fleeting fashion, some very substantial research needs to be undertaken:***

***A research field with a high potential regarding energy savings would consist in developing a type of glass with the ability of insulating against heating up in summer, whereas in winter the same glass, collecting light from the sun, would rather contribute to the heating up of rooms……***

***For the architects convenient detailing solutions, concerning the integration of structural steel into the other building components respectively its interaction with all existing fluids or power supplies shall be developed……***

***Research in the field of "Façade Engineering" is another appealing target, if but only if that development is supported by the whole construction society including all relevant materials, and performed by experienced engineers with the appropriate allround knowledge etc……."***

***Previous statements are compulsory,***
***at least since the first Oil Crisis in 1975,***
***but rather few if any credible development***
***has been undertaken.***
***It is now time to move….***

***This is a challenge for both of us,***
***Architects & Engineers.***


# Fire Engineering, Architecture & Sustainability

by

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