

EXAMPLES OF NATURALLY COOLED BUILDINGS

100% ECONOMY IN CENTRAL EUROPE CLIMATE

50% ECONOMY IN MEDITERRANEAN CLIMATE

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MARS 2013

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Estia SA

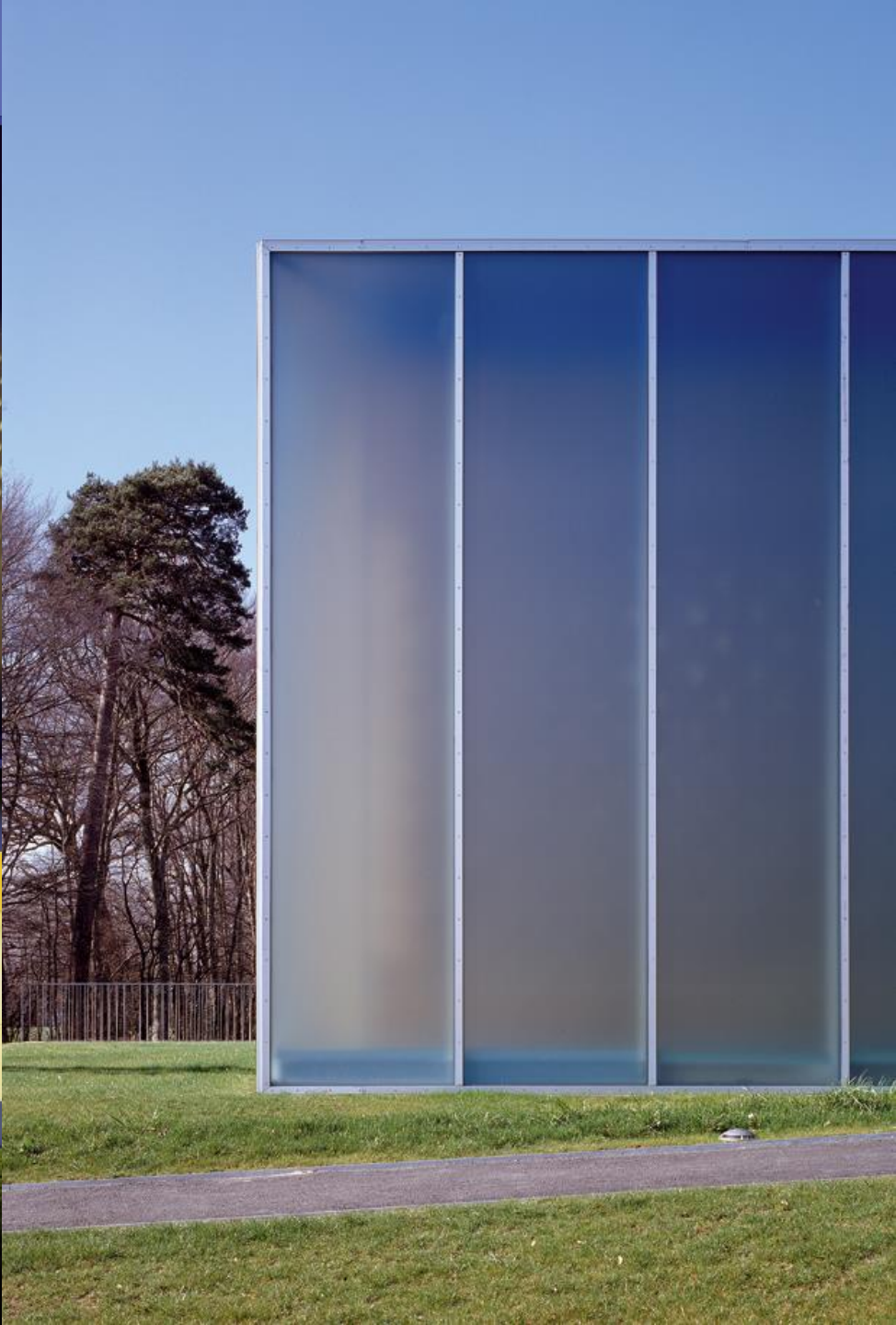
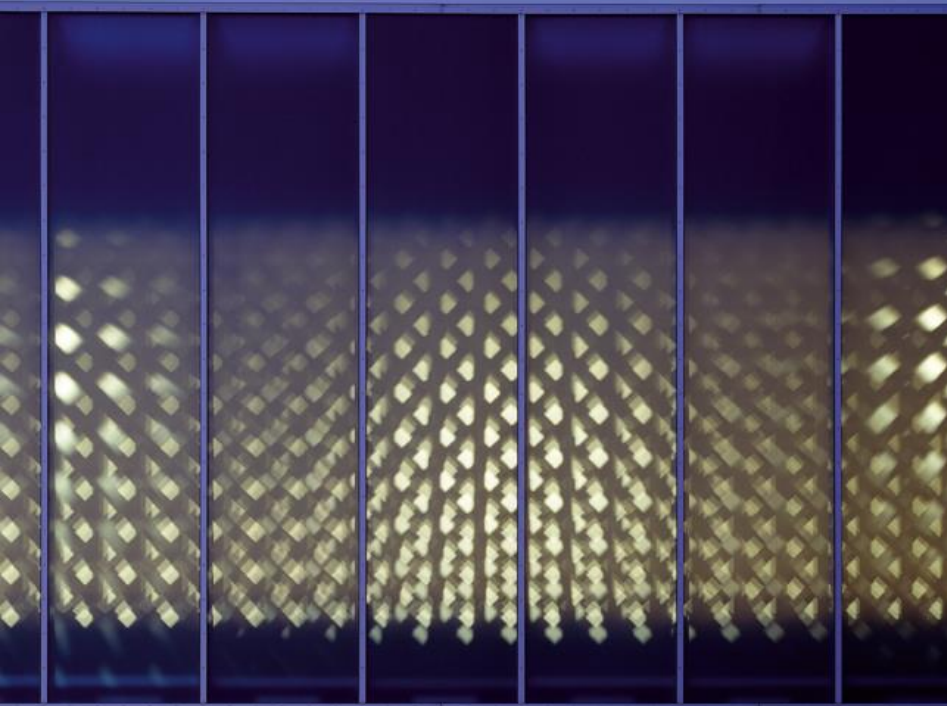
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100% glazing in the East en in the South facades , with no visible opening





no visible duct, no visible ventilation grid



external vue should be pure, without window frames, without accessories

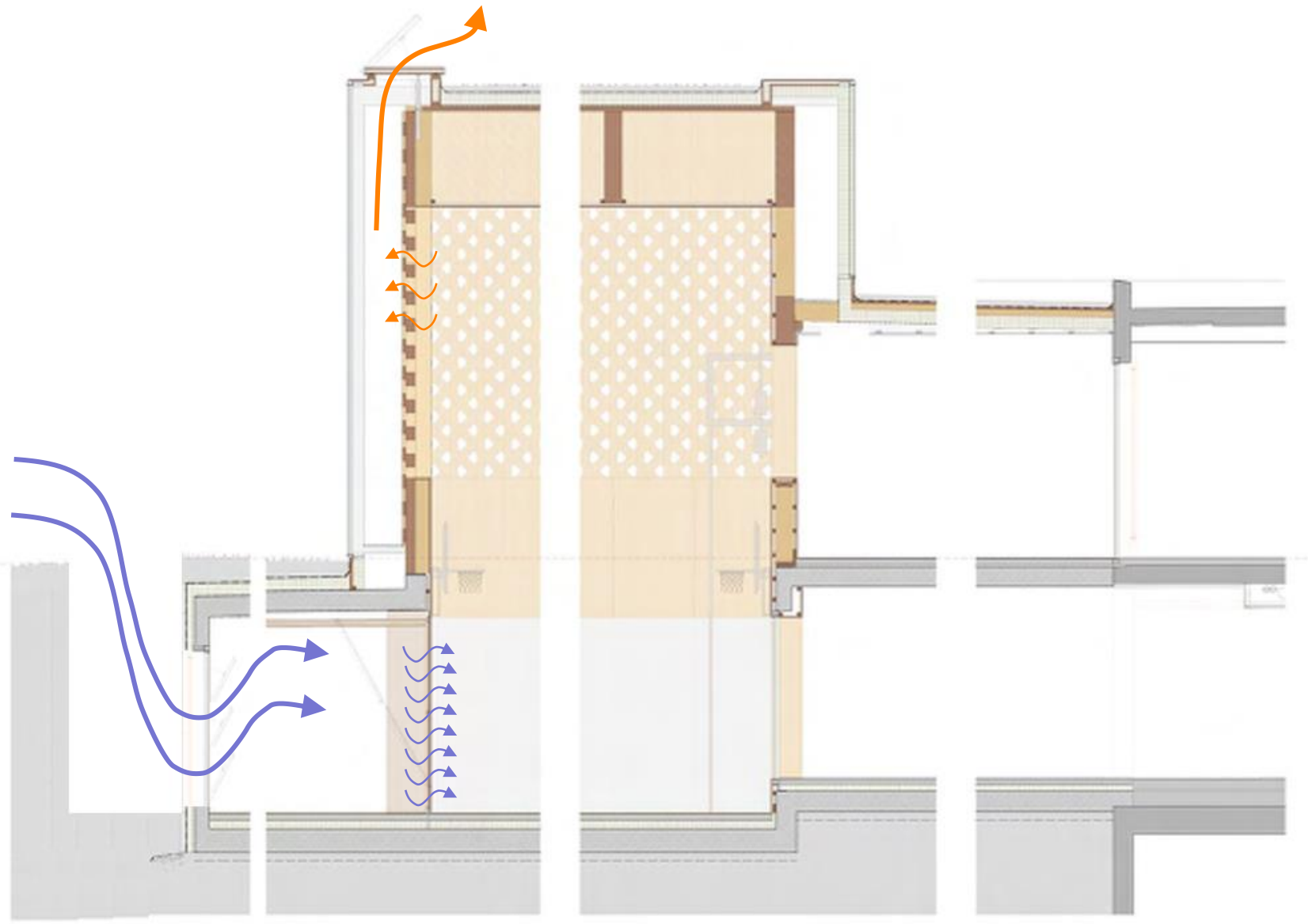
Because

... la vision globale d'un projet est pour nous la plus importante et chaque cas est différent! Ce que les tableaux de calculs ne peuvent transcrire. L'architecture et les qualités des espaces, les atmosphères et les sensations personnelles n'entrent pas compte, car les critères sont subjectifs, ce qui prouve qu'il n'y a pas de recettes miracles et que l'on ne peut pas tout réduire par des calculs et des labels...

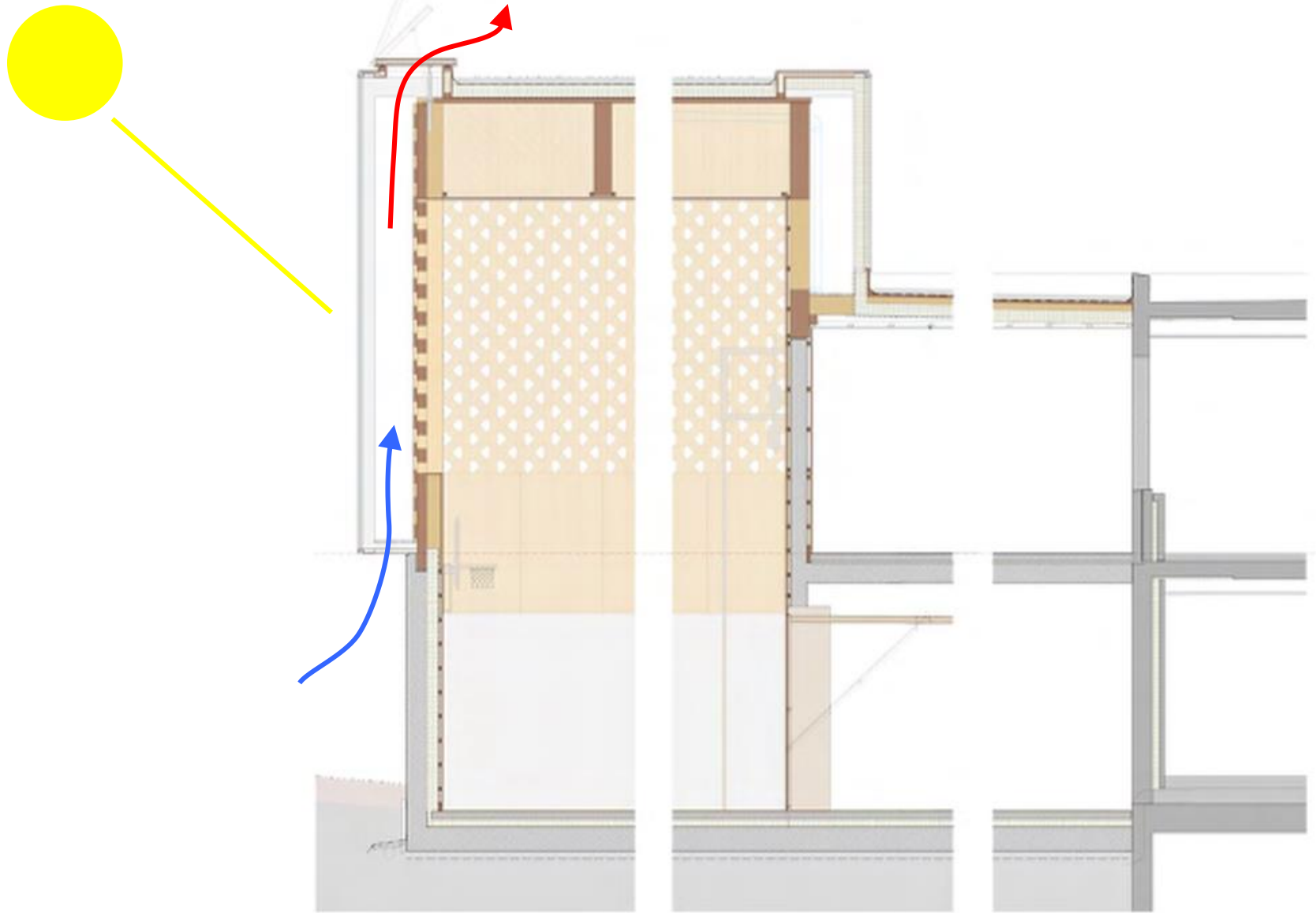
... nous essayons toujours de trouver des solutions les moins techniques possibles pour nos bâtiments. Nous trouvons cela beaucoup plus écologique...

patricia capua mann
graeme mann & patricia capua mann
architectes epfl fas sia
ch de monribeau 2
1005 lausanne

But how ?



flash ventilation when $\text{CO}_2 > 800 \text{ ppm}$ / night ventilation during summer



local heat discharge when sun is striking the facade



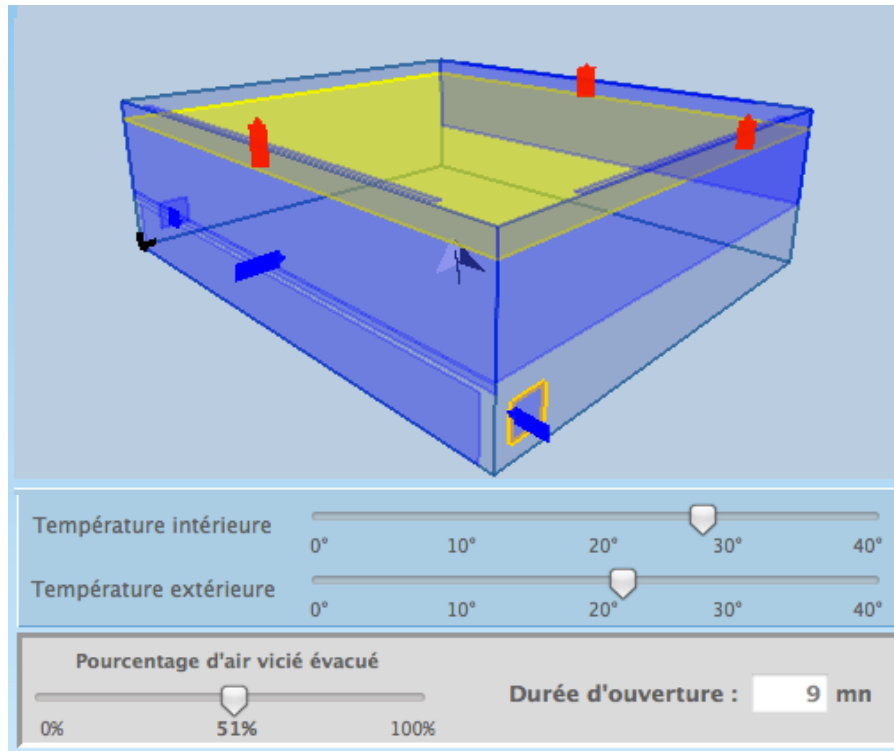
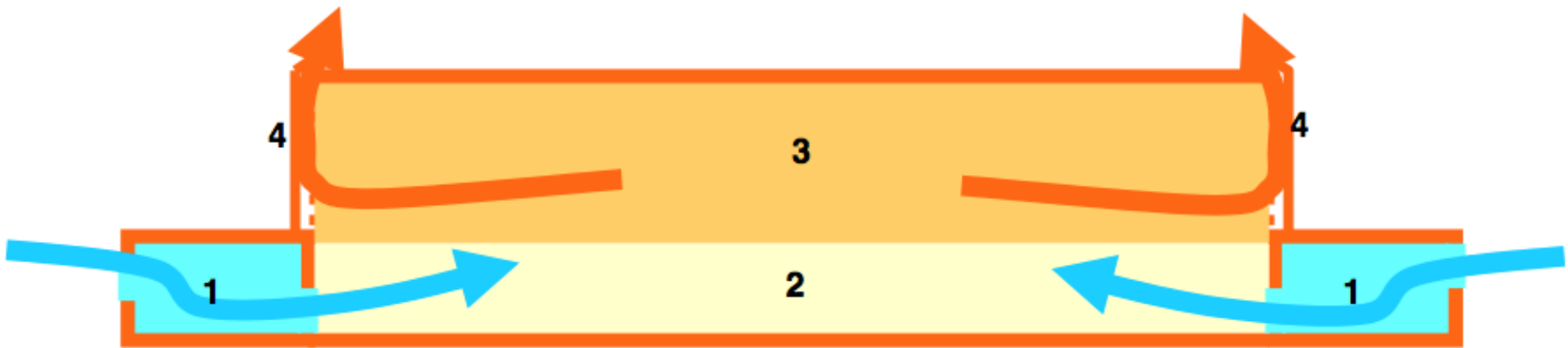
the eco-structure / dynamic solar shading / ventilation duct / acoustic absorber



the ventilation inlet grid / storage room door

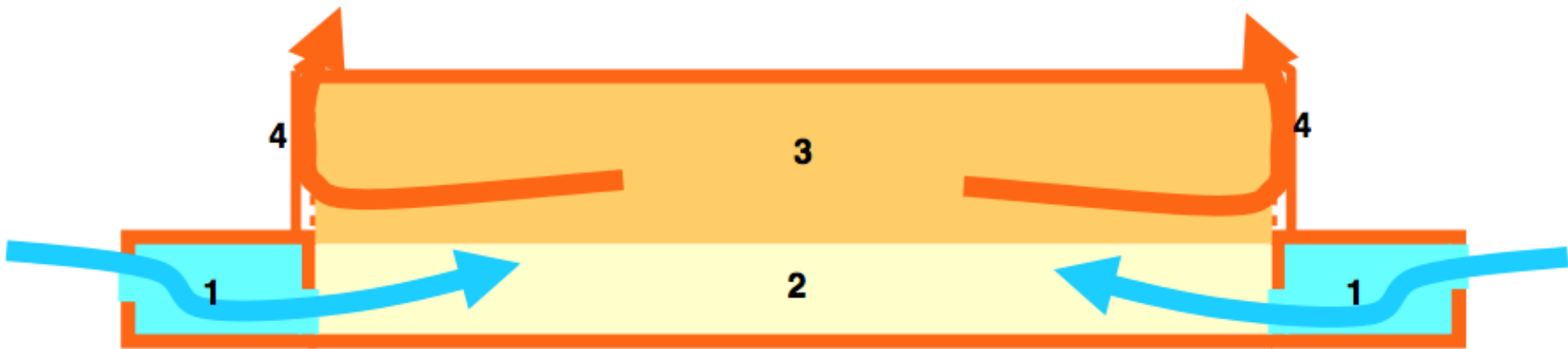


building physics is part of personal sensations, atmospheres and space quality



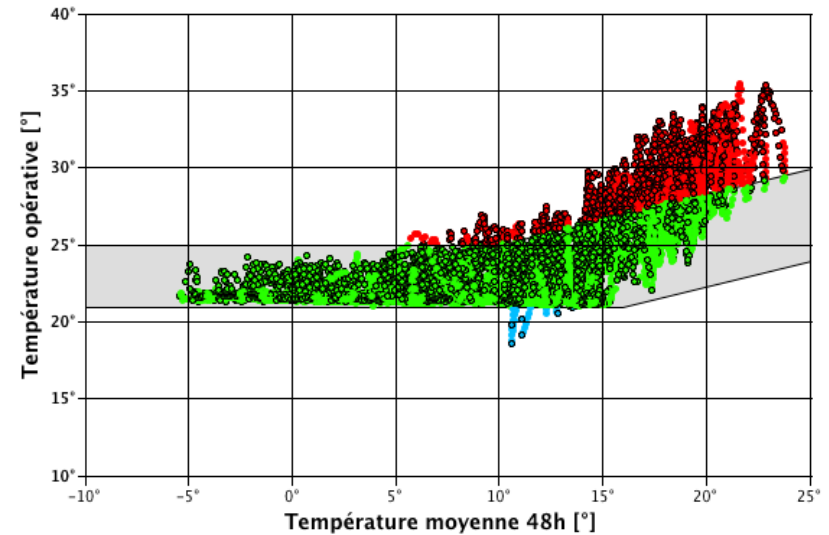
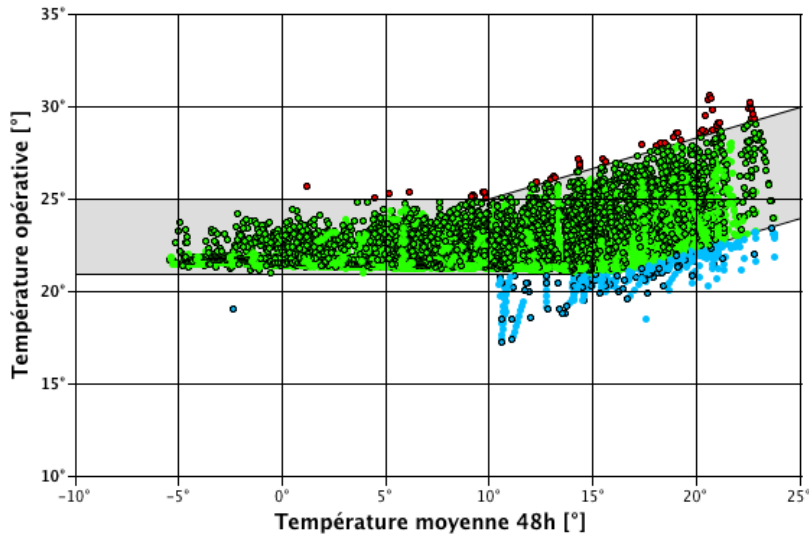
simulation: www.dialplus.ch

$Q_1 = 2 \times 12'237 \text{ m}^3/\text{h}$ at $\Delta T = 6^\circ \text{ C}$, 50% ach in 9 minutes

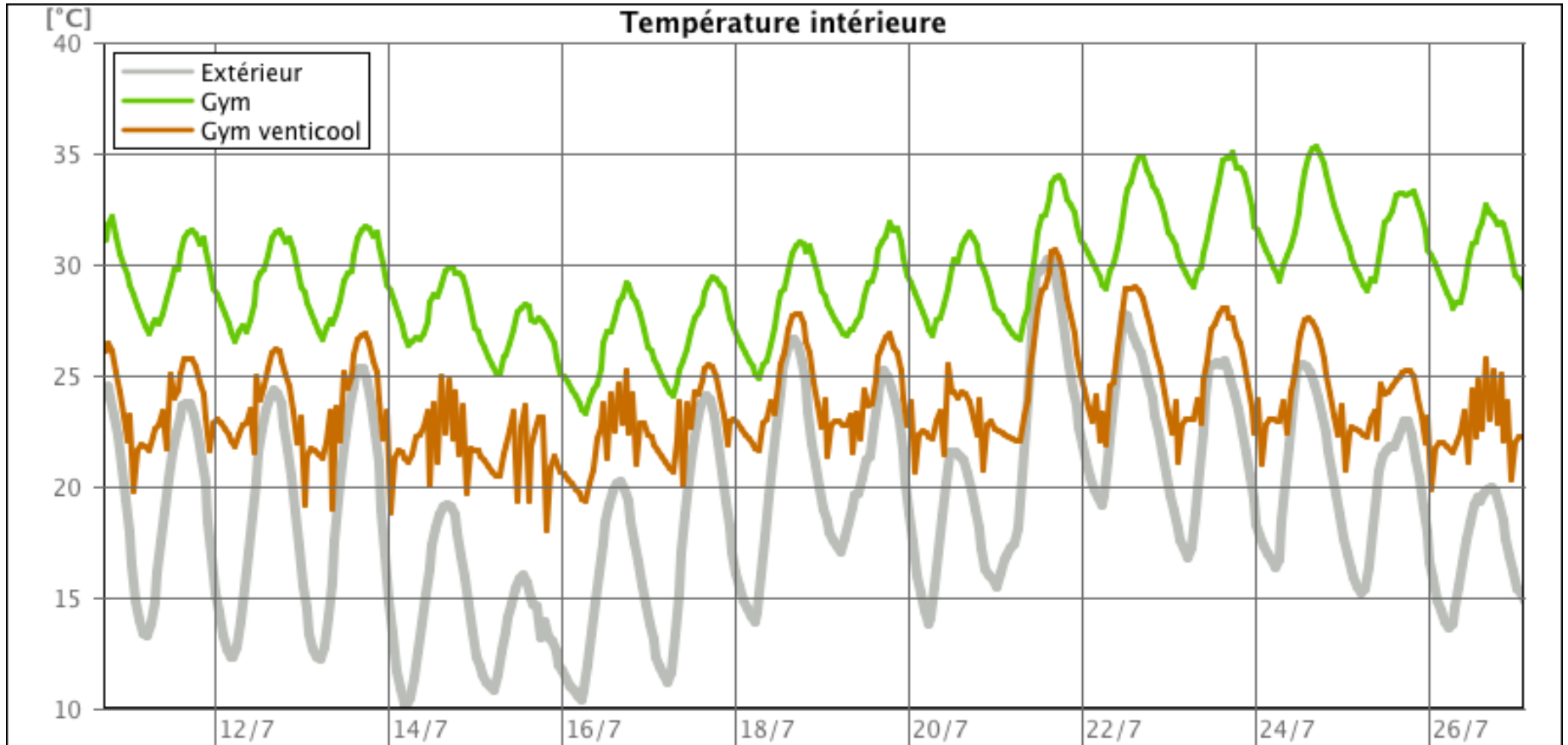


Night ventilation cooling strategy
 DIAL+ simulation: EN 15251 thermal confort

No ventilation cooling strategy
 DIAL+ simulation: EN 15251 thermal confort

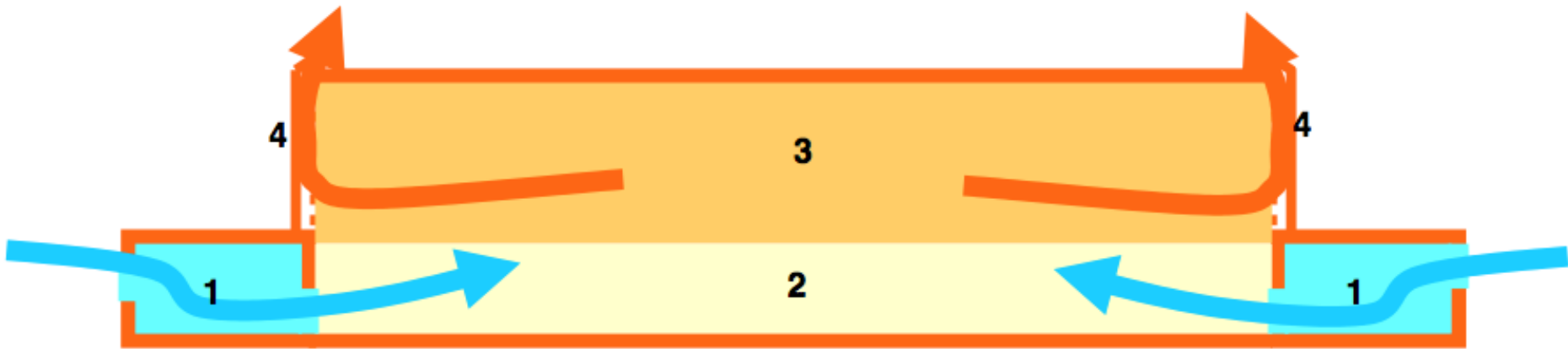


overheating: night ventilation cooling strategy - 55 h / no strategy 1099 h

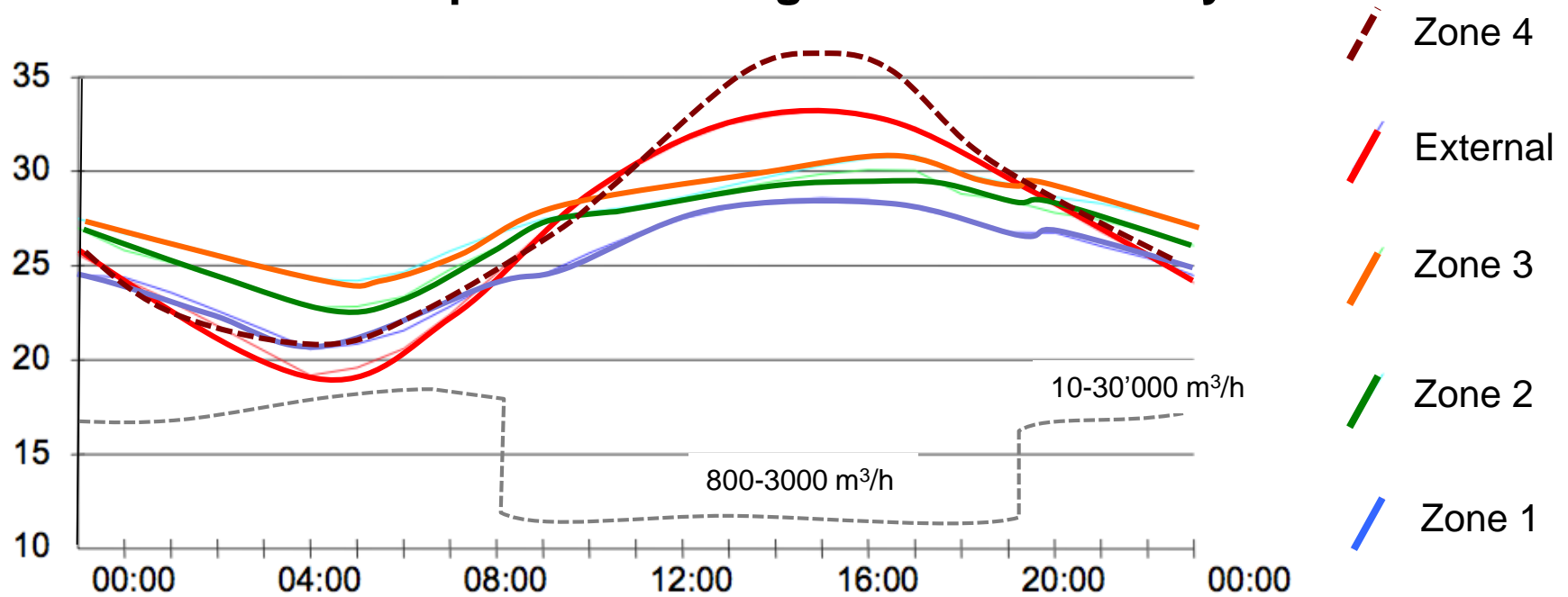


simulation: www.dialplus.ch

overheating: night ventilation cooling strategy - 92 h / no strategy 1112 h



Air temperature during a hot summer day



simulation: lecocool - lesowwww.epfl.ch

stratification strategy: cool the occupied area, avoid ceiling heat trap



Centre médical des Grangettes

Construction du bâtiment d'accueil

Maître de l'ouvrage

Centre médical des Grangettes SA
Chemin des Grangettes
1224 Chêne-Bougeries

Architecte

Eric Dunant
Pont-de-Ville 13

Physique du bâtiment

1224 Chêne-Bougeries
Estia SA

Projet

Parc scientifique EPFL
1015 Lausanne

Réalisation

2003

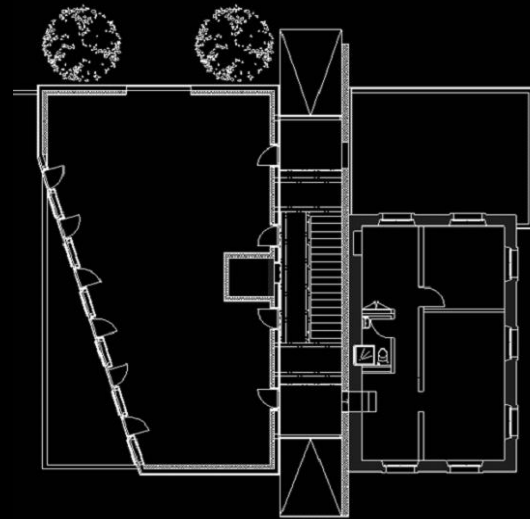
Adresse

2004-2005

Coût de construction

Route de Chêne 110

1224 Chêne-Bougeries
Fr. 3'100'000.-





one of the first eco-buildings labeled Minergie in Geneva



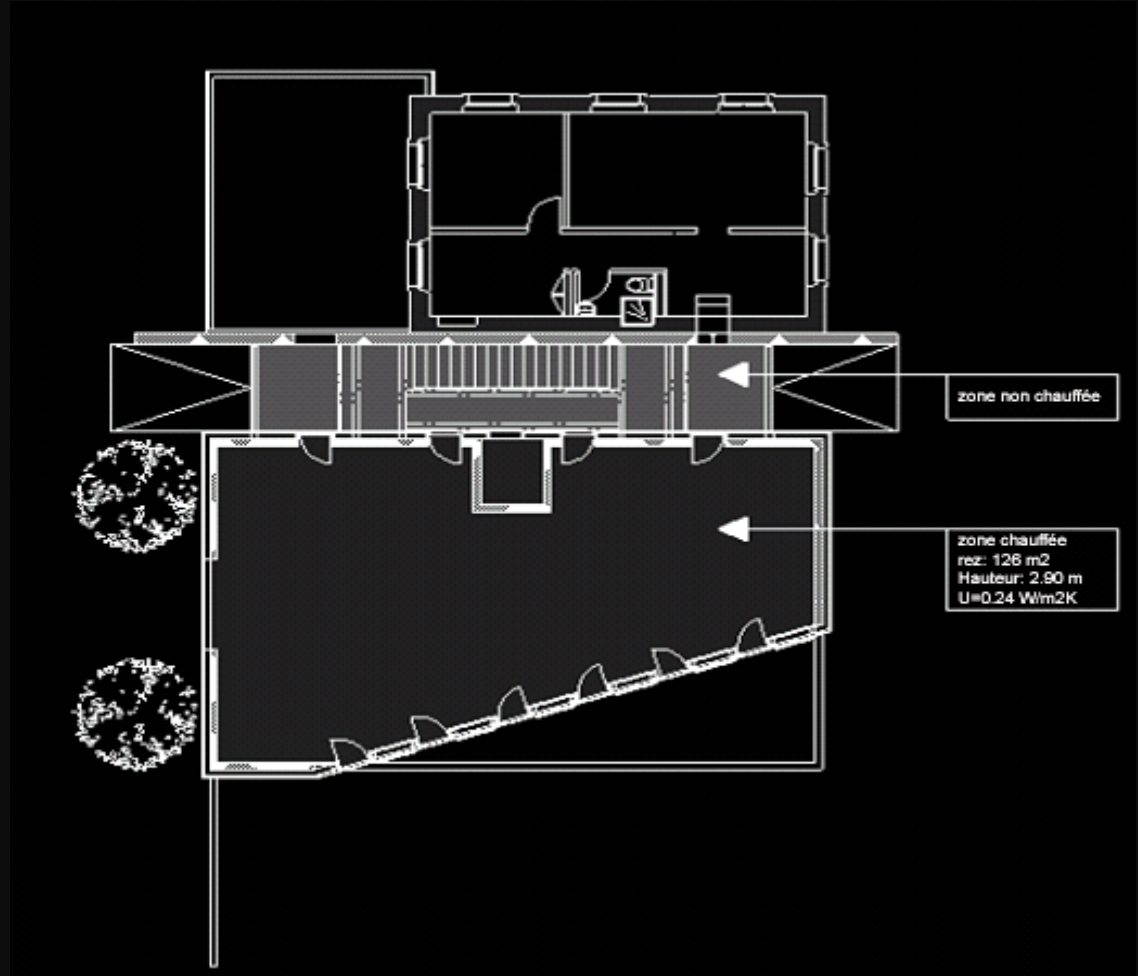
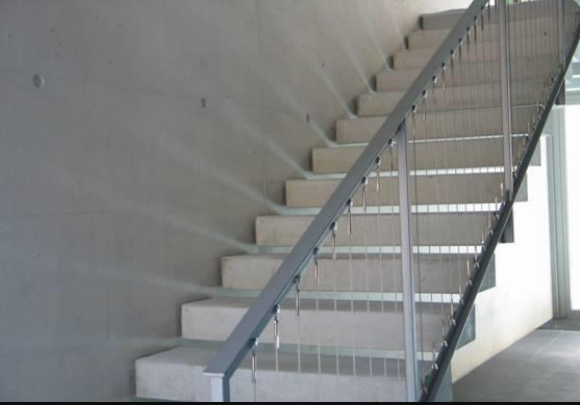
solar shading, color selection, external environment design



T air = 30° C
30° C
34° C
29° C



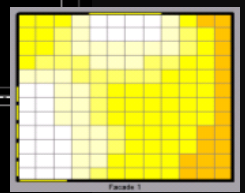
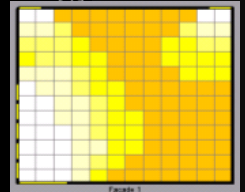
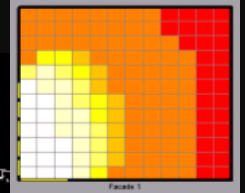
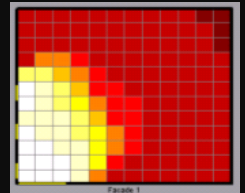
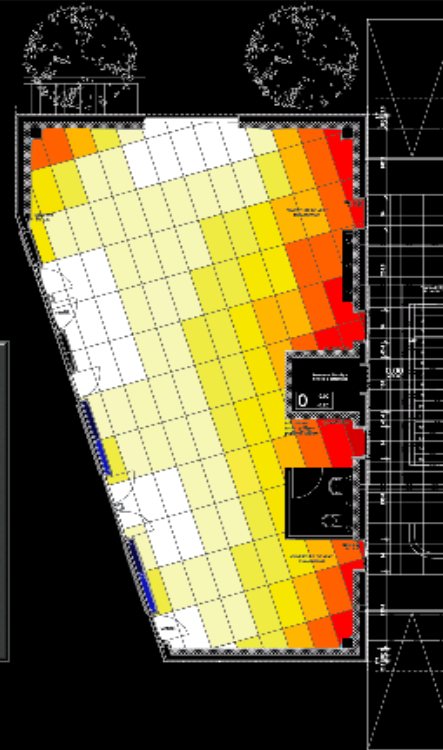
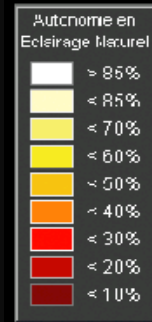
solar protection and exterior colors



3 storey staircase acting like a chimney



autonomy > 65% for 300 lux

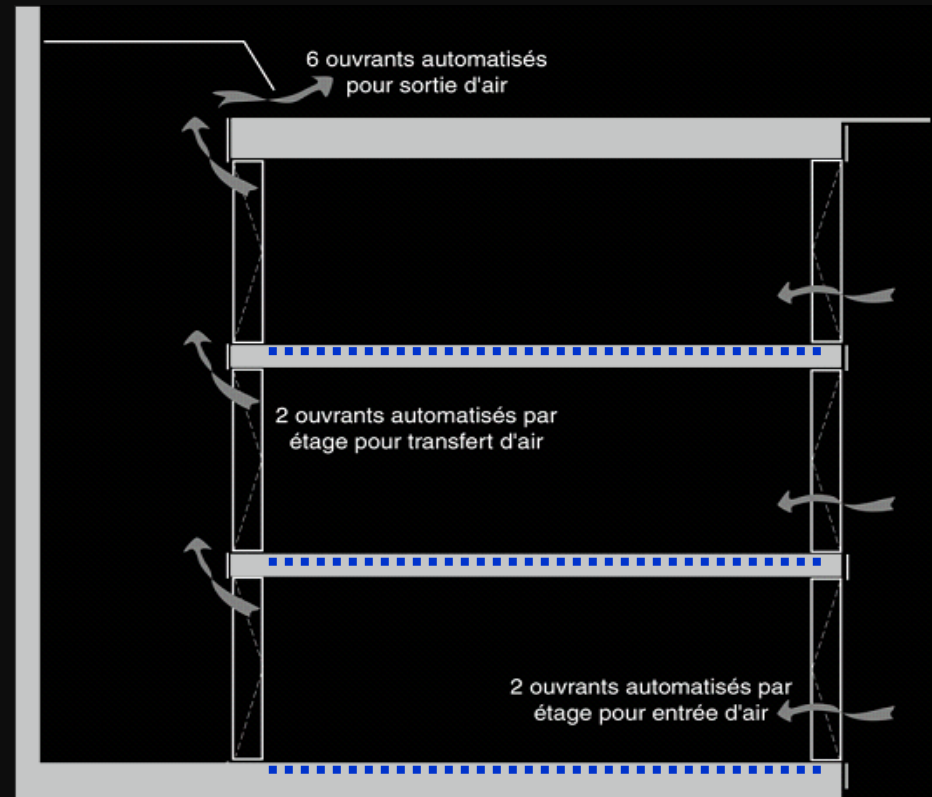


thermal mass for cooling storage and natural light to reduce internal heat gains

inlet air

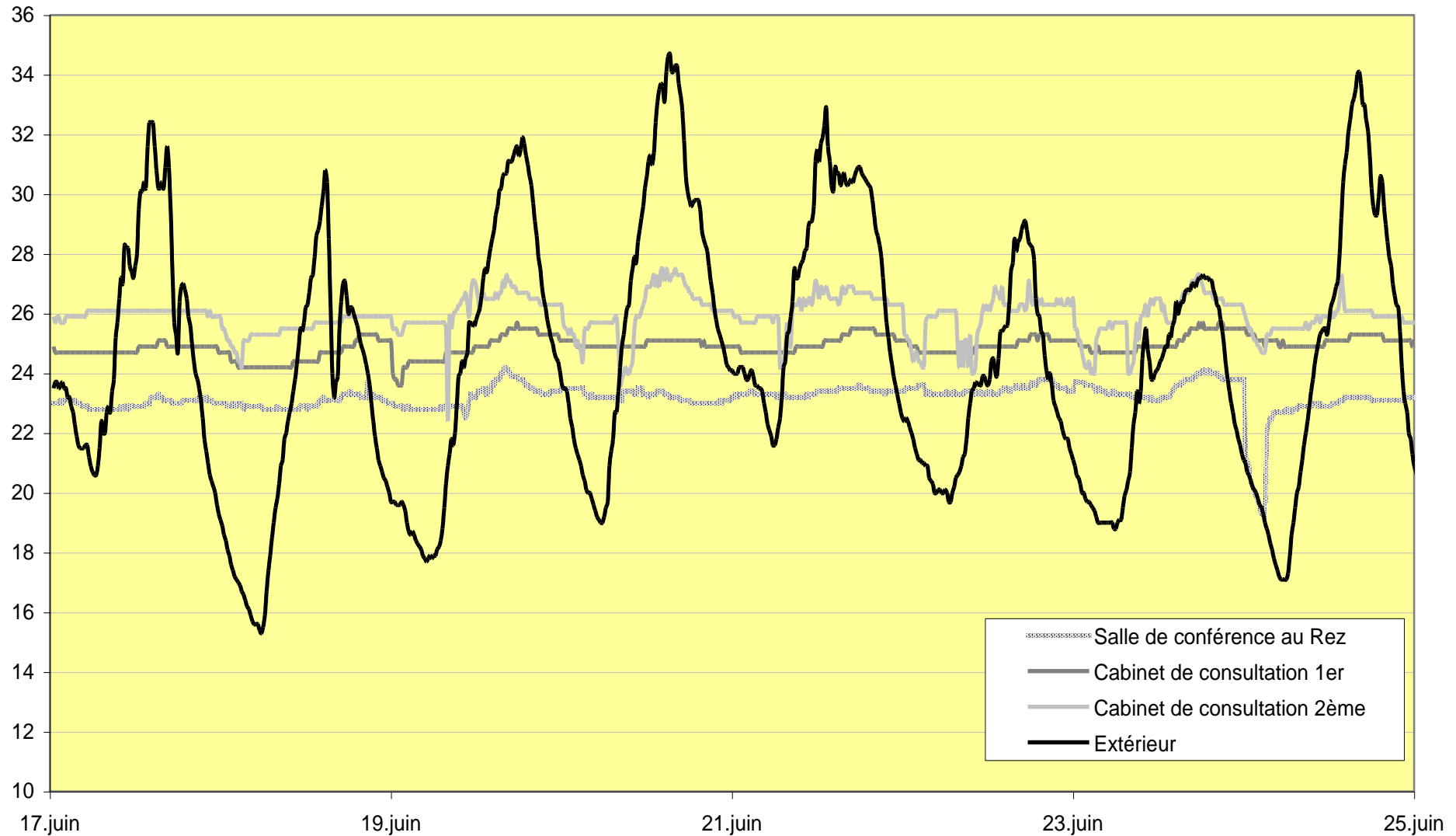


exhaust air



architectural elements act like air ducts, inlet and exhaust devices

Température dans les cabinets de consultation du 17 au 25 juin



during the hottest days of jun internal température < 27/25° C



- **Passive techniques**

- Thermal insulation
- Solar shading
- Window dimensioning
- Neutral level control
- Thermal mass
- Night cooling ventilation
- Free slab geo-cooling
- Exterior cool landscape







Nicosia Municipality. Finance Department - South Facade

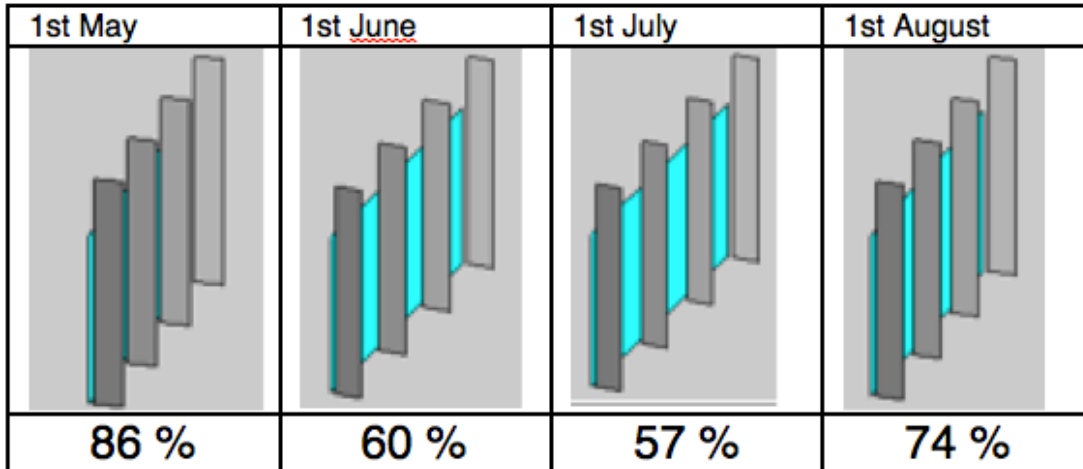
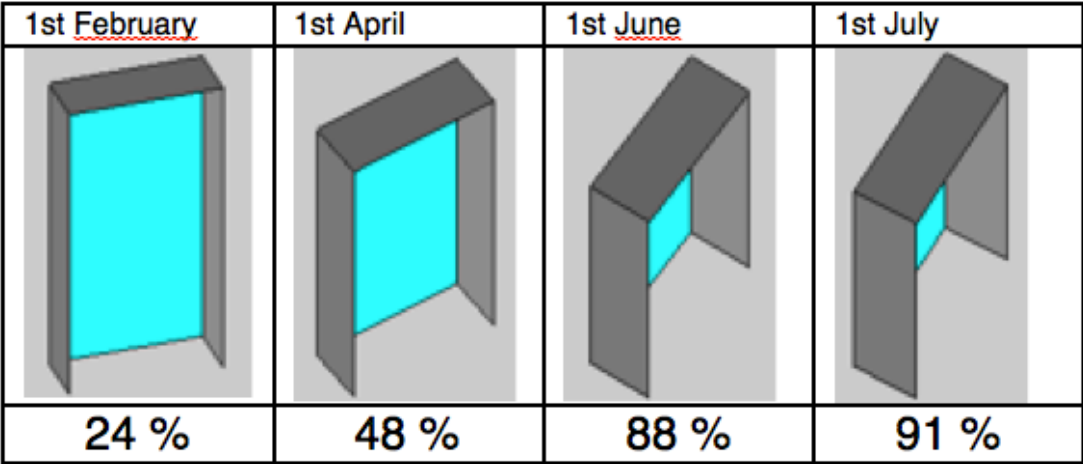
irwinkritioti.architecture



• 10 passive technics

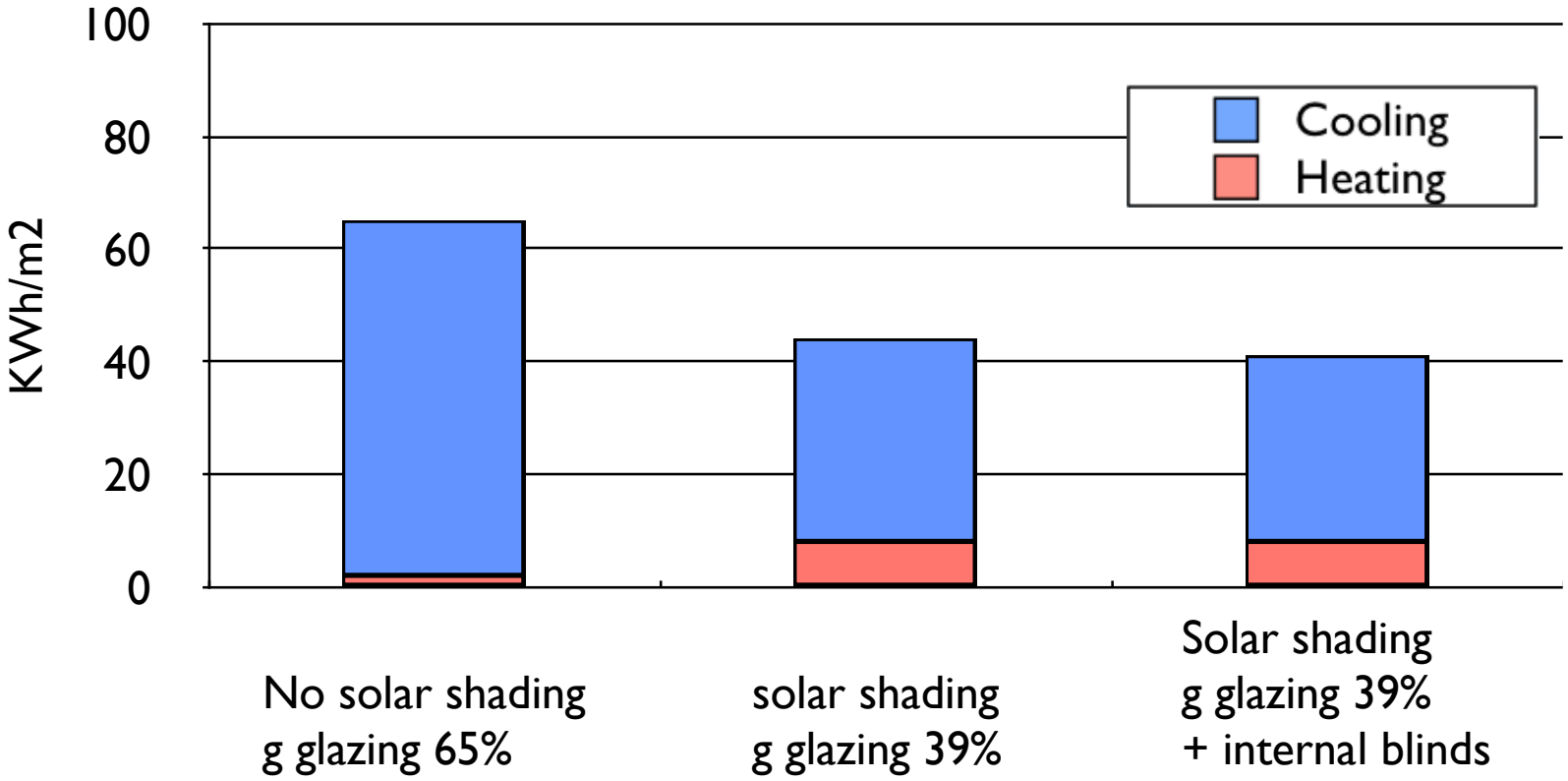
- 10 cm thermal insulation, double glazing low e, no thermal bridges
- Almost perfect solar shading
- High apparent thermal mass
- Optimal dimensioning of openings for passive lighting, heating, solar protection
- 70% of natural light autonomy and high efficiency artificial lighting
- 30 % of surface area is outside of the thermal envelope (staircases, toilets)
- Opening design for optimal night ventilation (summer passive cooling)
- Natural ventilation
- Use of ceiling fans
- 100% Solar hot water

- almost perfect solar shading



→ Permanent solar protection and glazing g-39%, TL-70%

- effect of solar protection



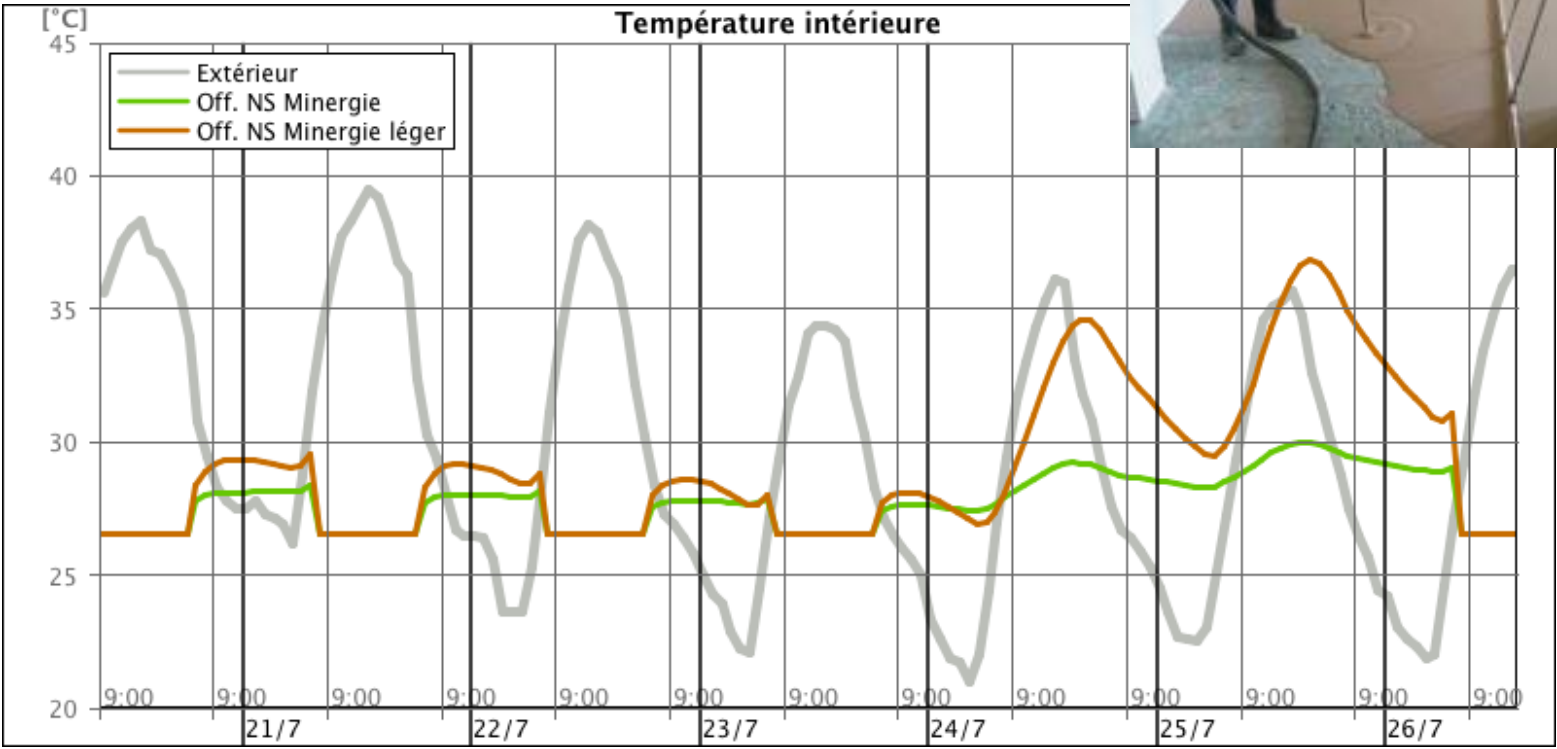
➔ Solar shading and reduced g glazing value saves 37% of energy

- **apparent thermal mass**



→ Unhydrated screed for the floor, apparent clad concrete slab.

- apparent thermal mass



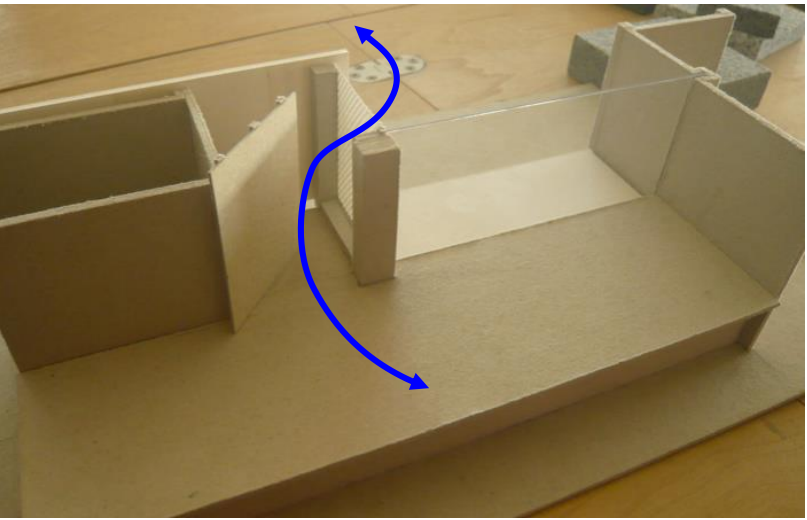
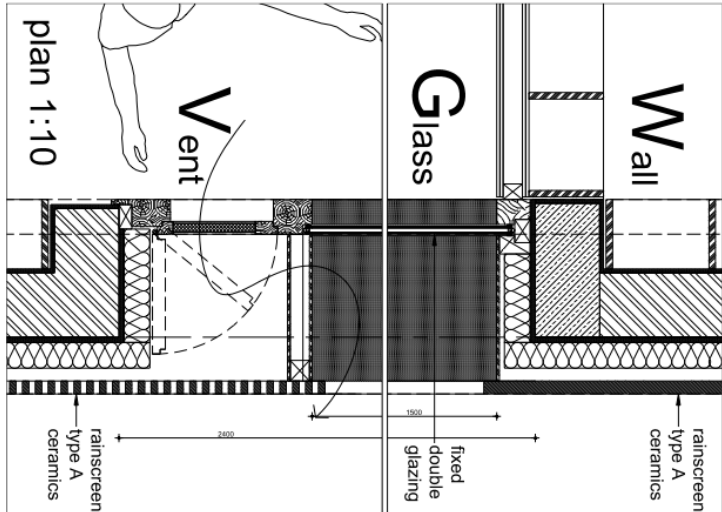
→ Without thermal mass temperature rises to 37° C instead of 30

- **Opening dimensioning**



→ 0% east and west, 1X140X300 south, 2X140X300 north.

- night ventilation design

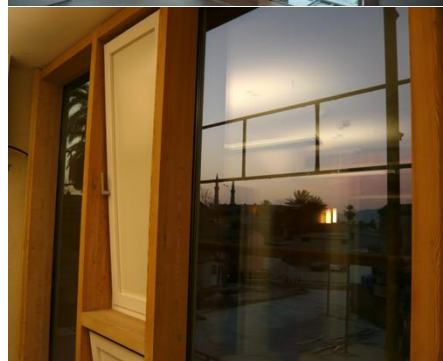


→ safe, protected, flexible openings, dissociation of air from light path

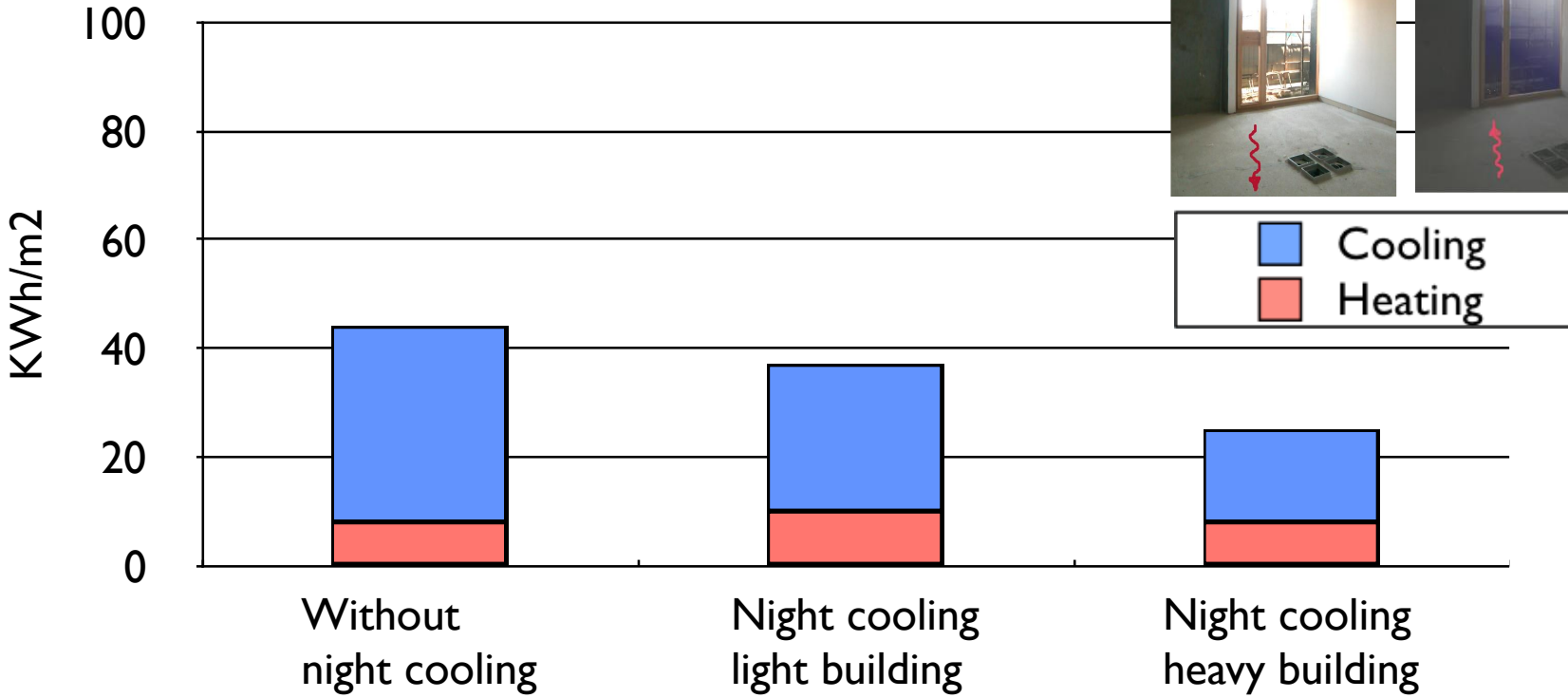
- natural ventilation design

Opening possibilities. 40X300	m ³ /h	
40X300	610	100
40X300.grille	366	60:%
40X122	158	26:%
40X122.+40X122	499	82:%
15X122.à.la.française	59	10:%
7X122	28	5:%
15X122+15X122.à.la.Fr	187	31:%
15.cm.à.l'italienne.(6°)	49	8:%
10.cm.à.l'italienne.(4°)	30	5:%

→ A window offering 30 to 366 m³/h stack effect single sided airflow at ΔT 5° C



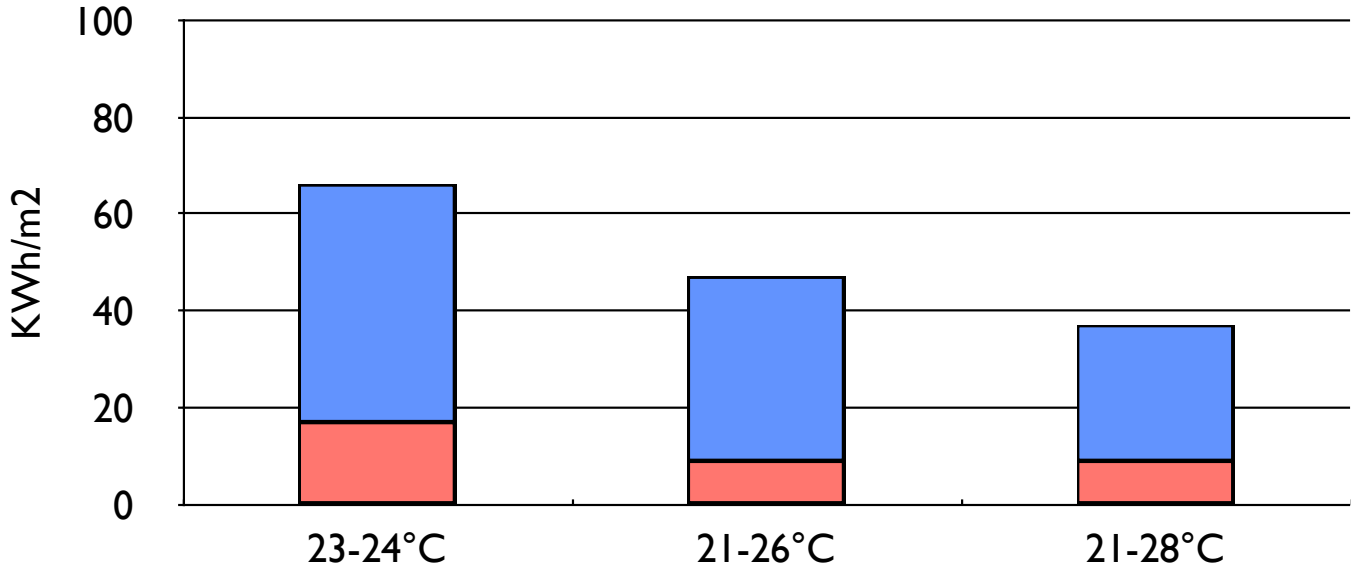
• effect of night cooling



→ Night cooling may reduce cooling need of an already optimised building by 53%, (17 kWh/m²y instead of 36)

→ A light building has only 25% reduction potential

- Use of ceiling fans to keep windows closed and rise set temperature

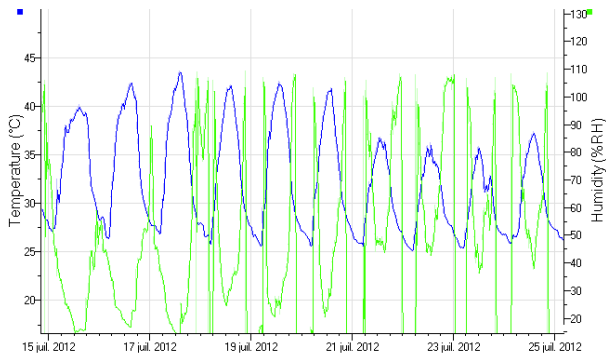


→ 15 % rise of cooling load per ° C of set temperature decrease

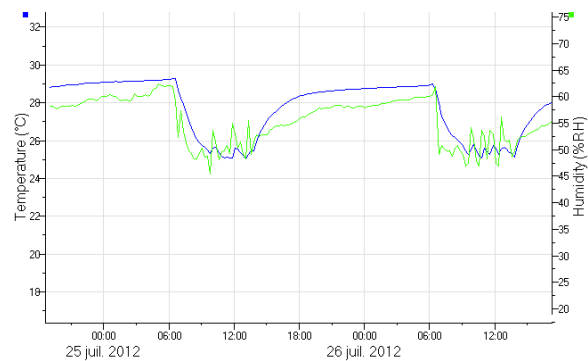
→ Ceiling fans may save 30% of cooling energy consumption

- Monitoring: outside 45° C – inside 27- 30° C

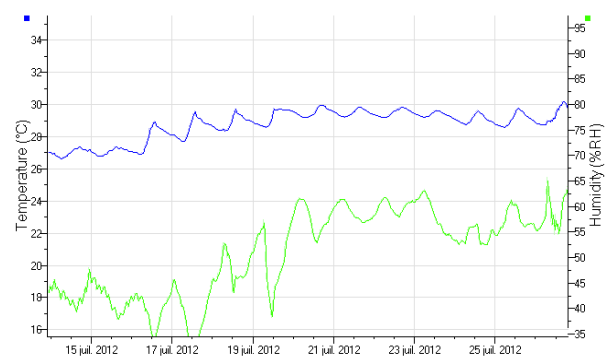
outside



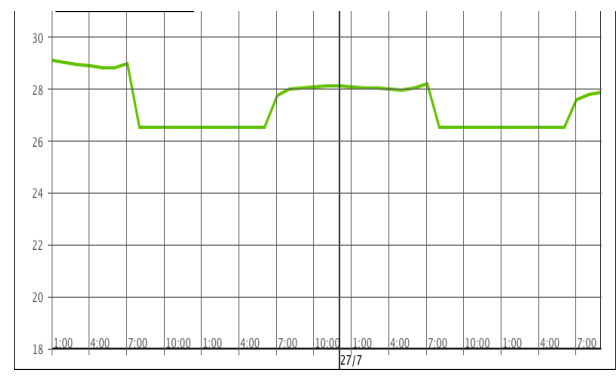
Cooled occupied office



Unoccupied office



simulated occupied office



• Conclusions

- After solar protection and reduction of internal loads, night ventilative cooling is the only passive technique offering significant energy savings for cooling:
 - zero kWh in the central Europe climate
 - 25 - 50% reduction for the hot Mediterranean climates
- Passive cooling is not just openable windows
- Passive cooling design needs simple simulation tools (available engineering fees 5 - 10 000 €)
- There is a need of accounting the energy savings in the national energy regulations. It is the only way to make this technique able to penetrate the market, because there is nothing to sell other than engineering fees.