Bioclimatic and Low Energy Office Building

Center for Renewable Energy Sources & Saving

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Department of buildings

History

Bioclimatic buildings in Greece

Private initiatives
Residential

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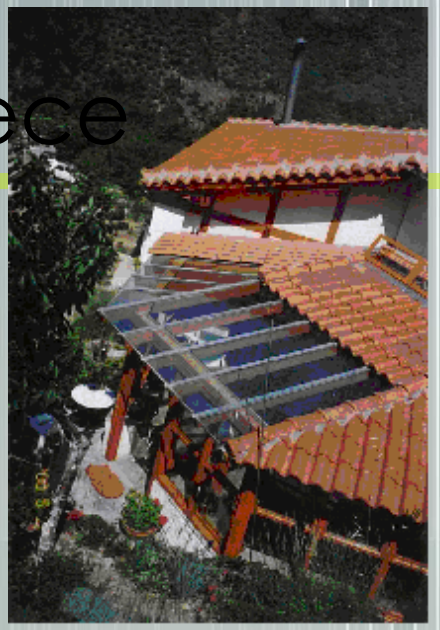
History
Bioclimatic buildings in Greece

- **Passive solar systems**
- **Solar thermal systems**
- **Natural cooling**
- **Daylighting**

May save energy by over **60%**

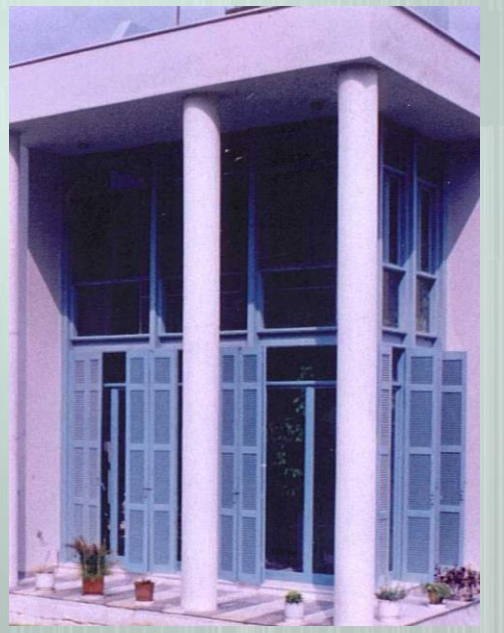
History
Bioclimatic buildings in Greece



- Bioclimatic buildings require 30% less energy than standard new buildings

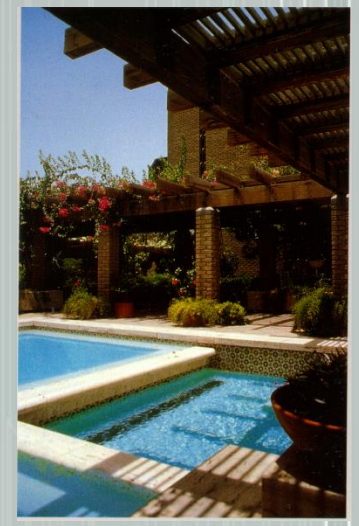
History
Bioclimatic buildings in Greece

Bioclimatic buildings ensure significant thermal comfort even at high exterior summer temperatures



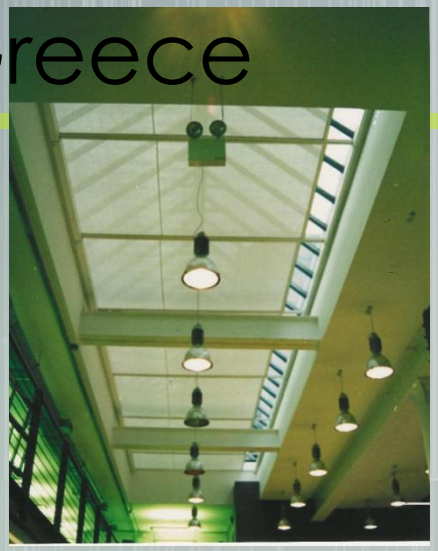
History
Bioclimatic buildings in Greece

In schools and residential buildings integrated natural cooling results in elimination of building cooling loads and the need for air-conditioning systems



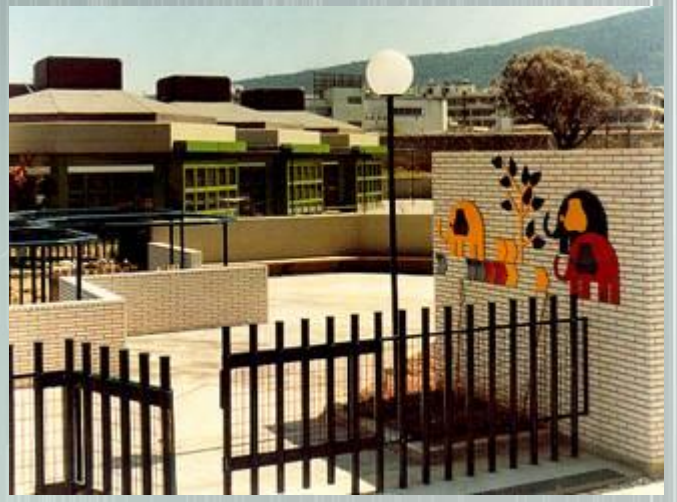
History

Bioclimatic buildings in Greece



Daylighting, coupled to artificial lighting and controls results in up to 60% reduction of electricity demand for lighting.

History
Bioclimatic buildings in Greece



Private initiatives - Tertiary

History

Energy efficient buildings

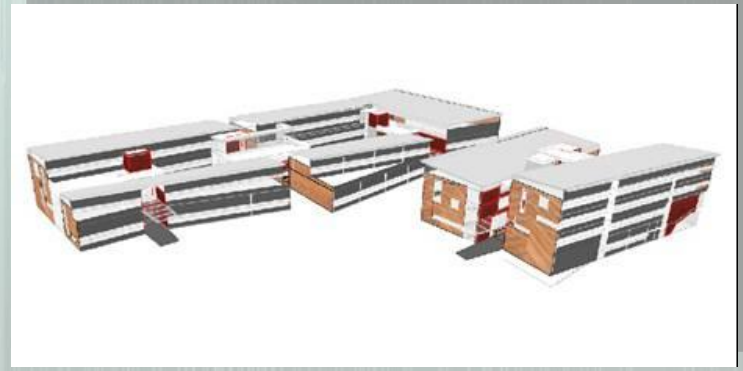
Administration buildings

Airport

History: Energy efficient buildings

Public Buildings

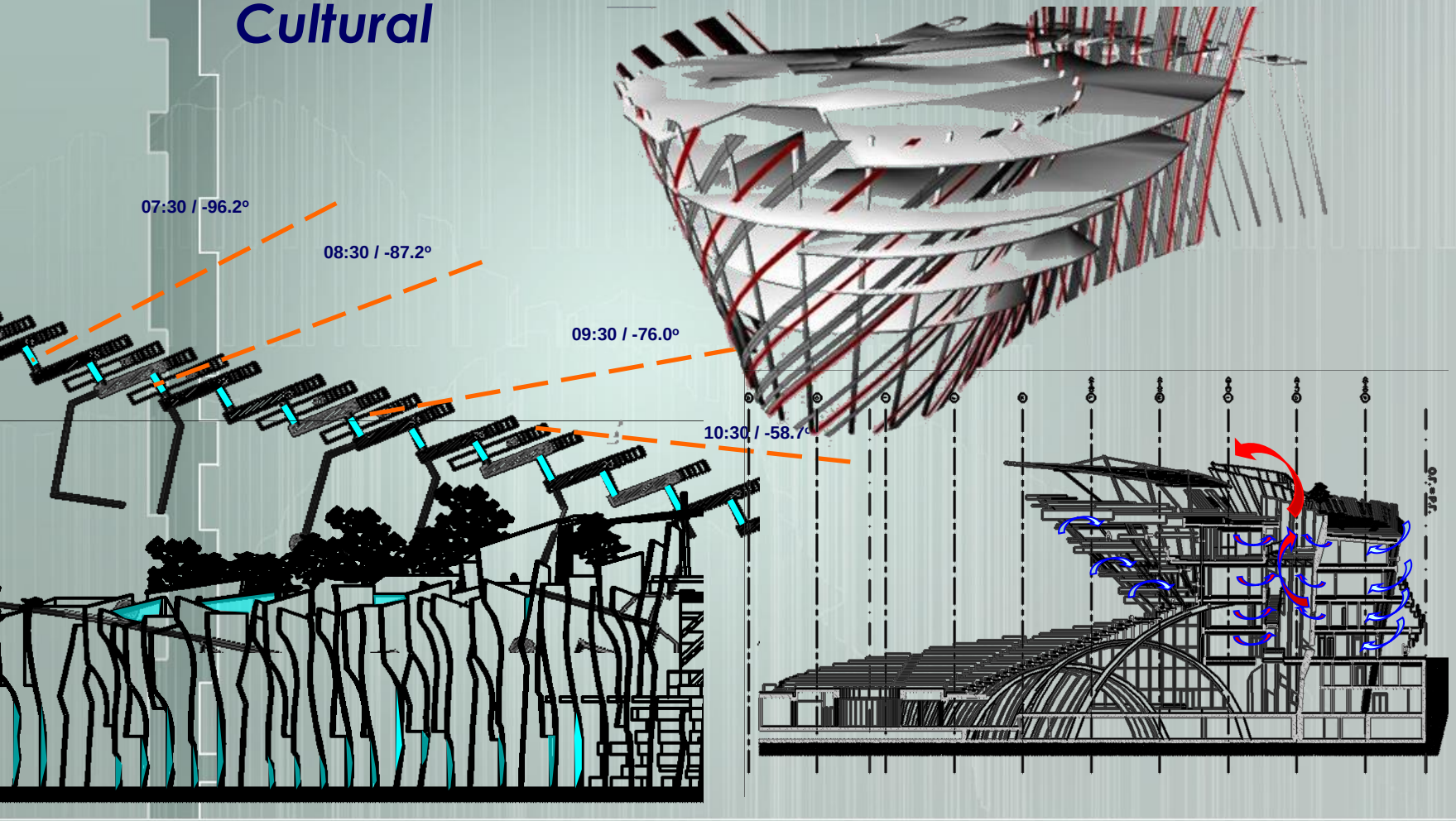
Universities



History: Energy efficient buildings

Public/tertiary Buildings

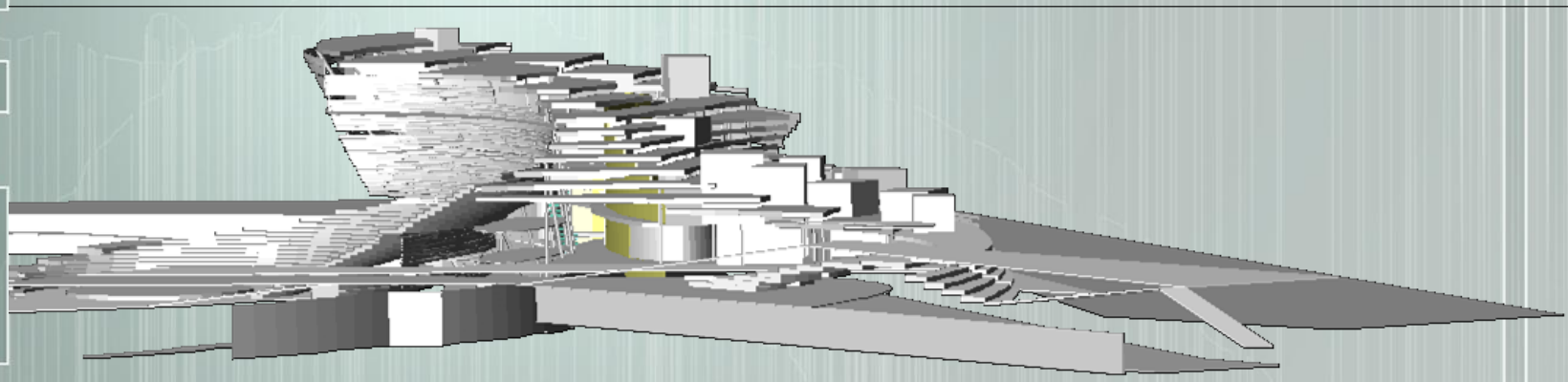
Cultural



History: Energy efficient buildings

Public Buildings

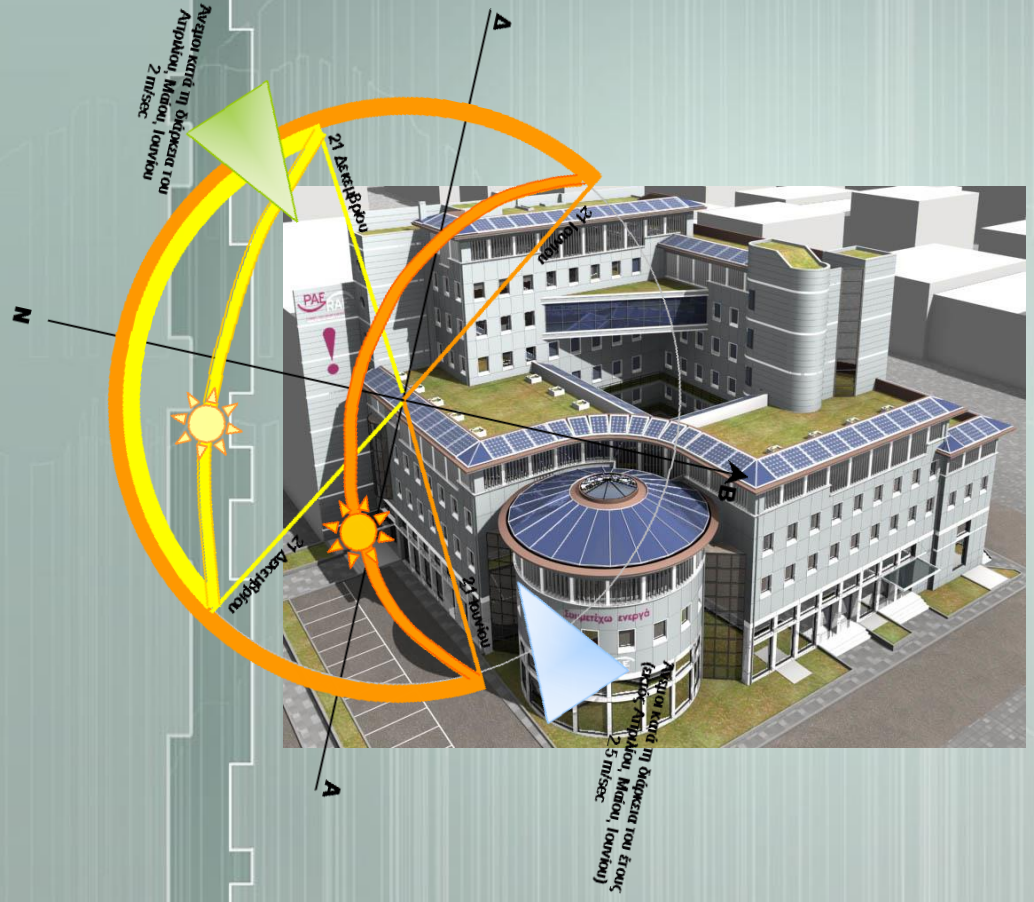
Theatre

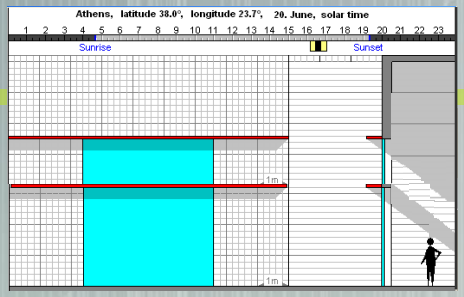


History: Energy efficient buildings

Public/tertiary Buildings

Offices





History

Bioclimatic buildings in Greece

CRES

Climate & Location

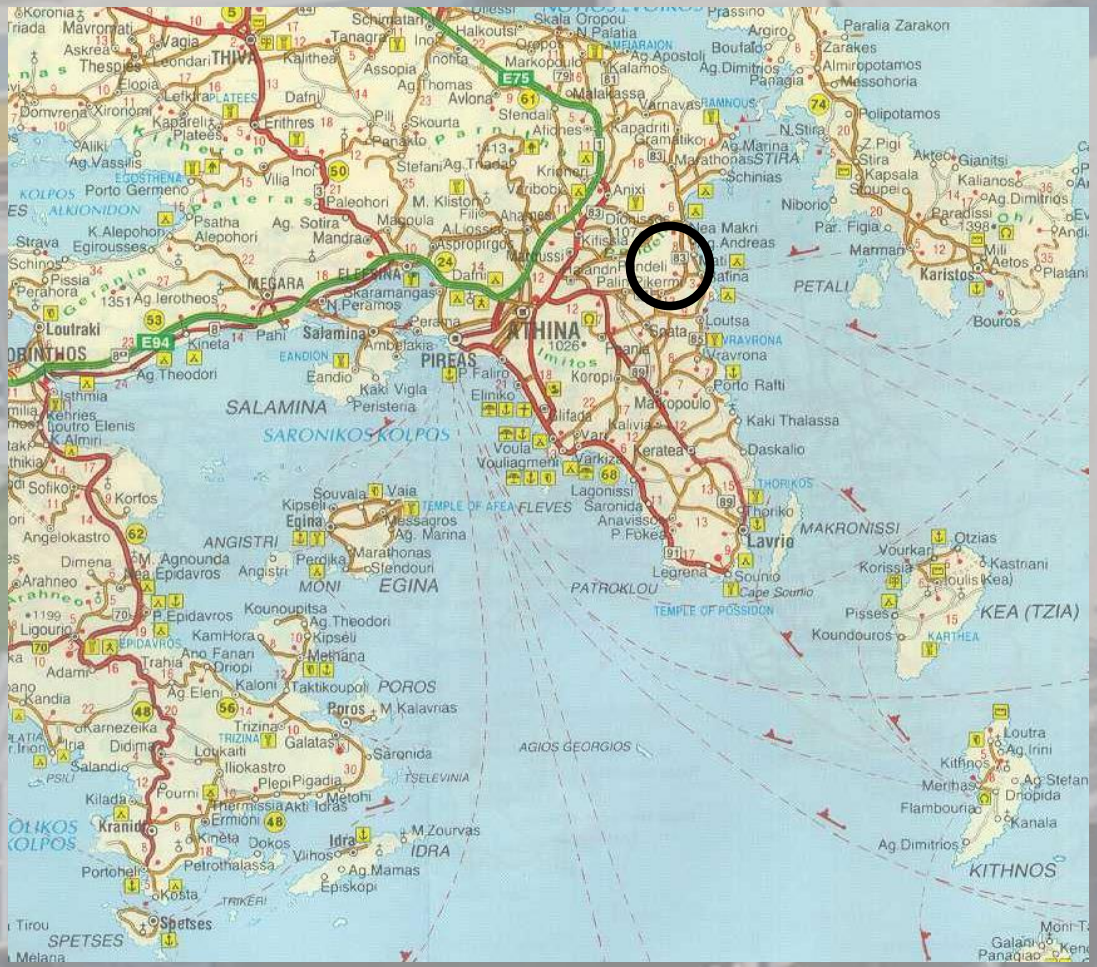
Longt.	**23°.55´**	**E**
Lat.	**38°.01´**	**N**
Altit.	**153**	**m**

Average ambient temperature (annual) **18,7°C**

January	**9,4°C**
July	**28,7°C**

Degree Days (base 19°C) **1218 days**

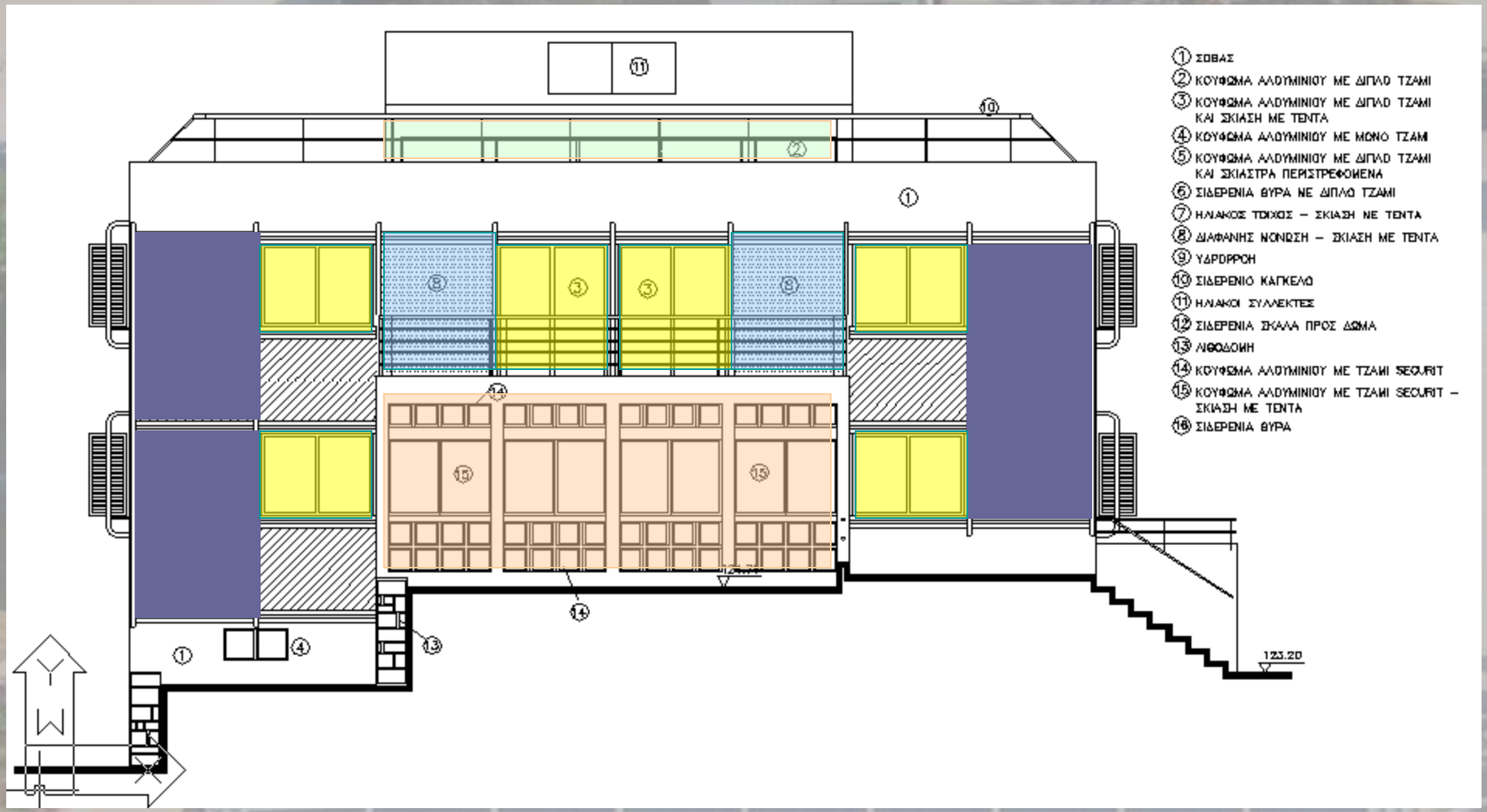
Global irradiation on horizontal (annual) **1747 KWh/m²**



Detail of external brickwork with external insulation

External insulation on the north face of the building

South view of the building – passive solar systems



Solar Air Walls with a total area of 17m²

Solar Atrium (glazed part of the roof of the building with an area of 14 m²)

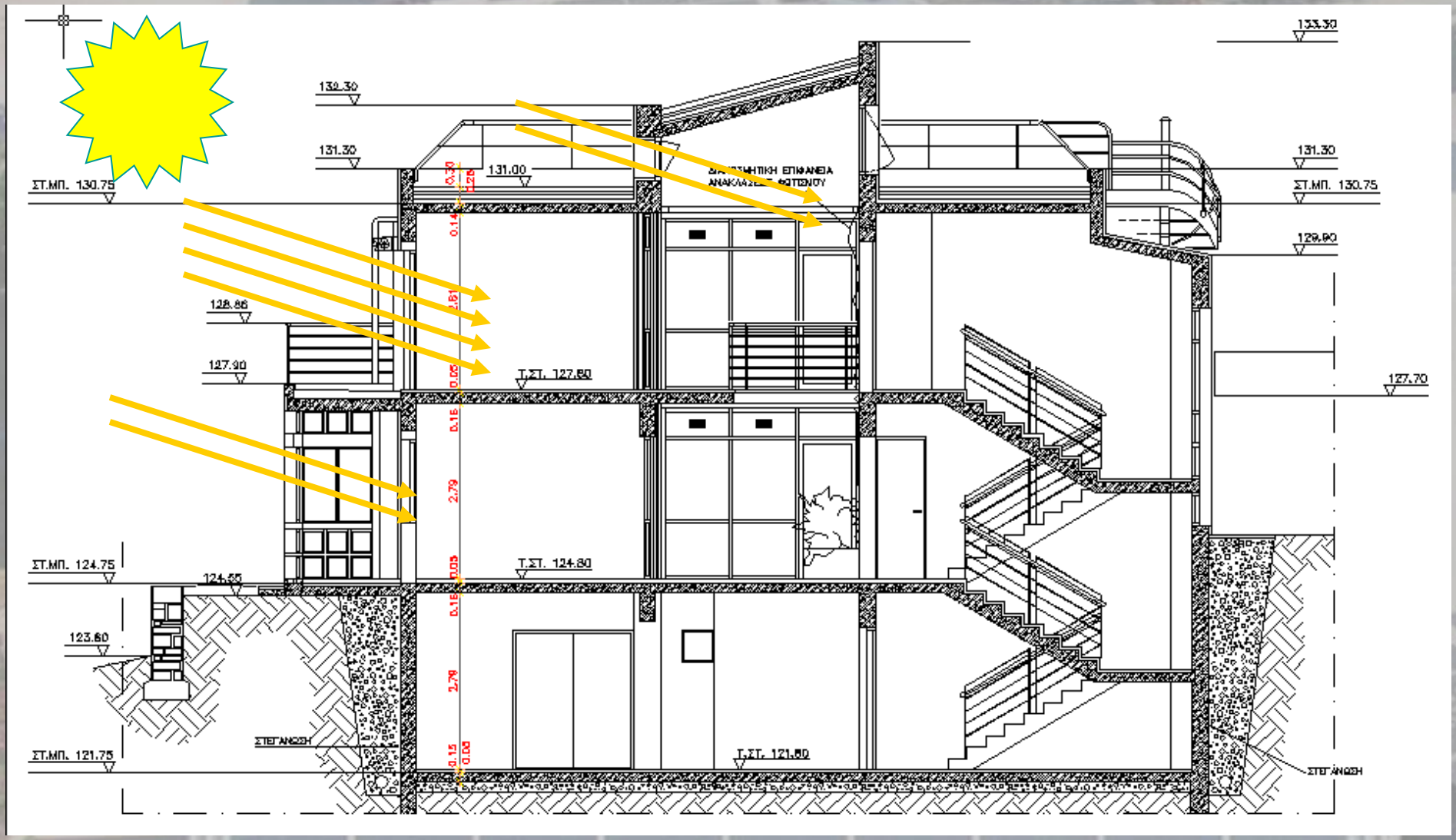
Transparent insulation with a total area of 8m2

Greenhouse with an area of 8.25m² added to the south face of the building, with openings of 12m²

Direct gain systems (openings with a total area of 17 m²)


2001/ 5/16

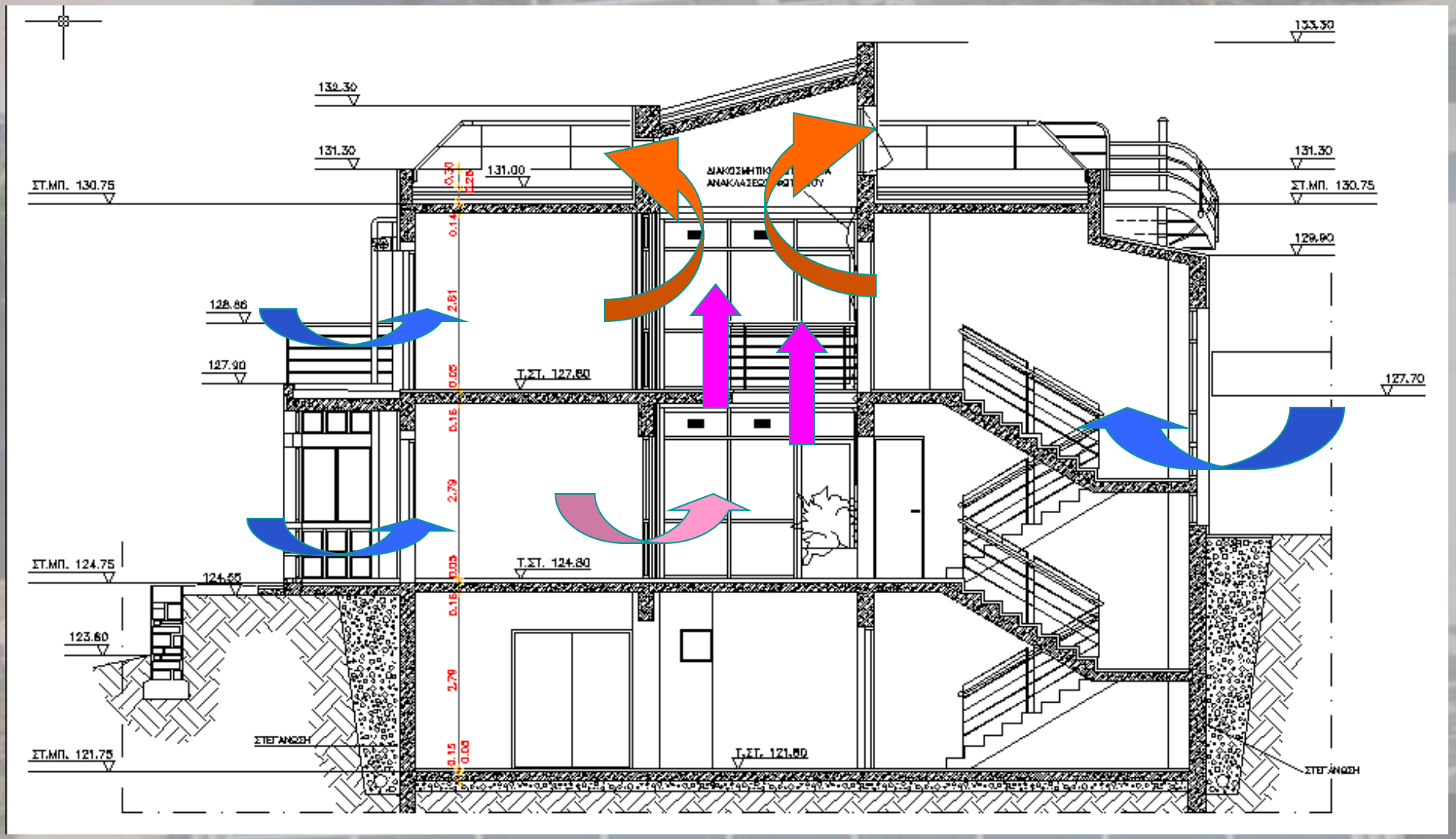
Transparent
Insulation



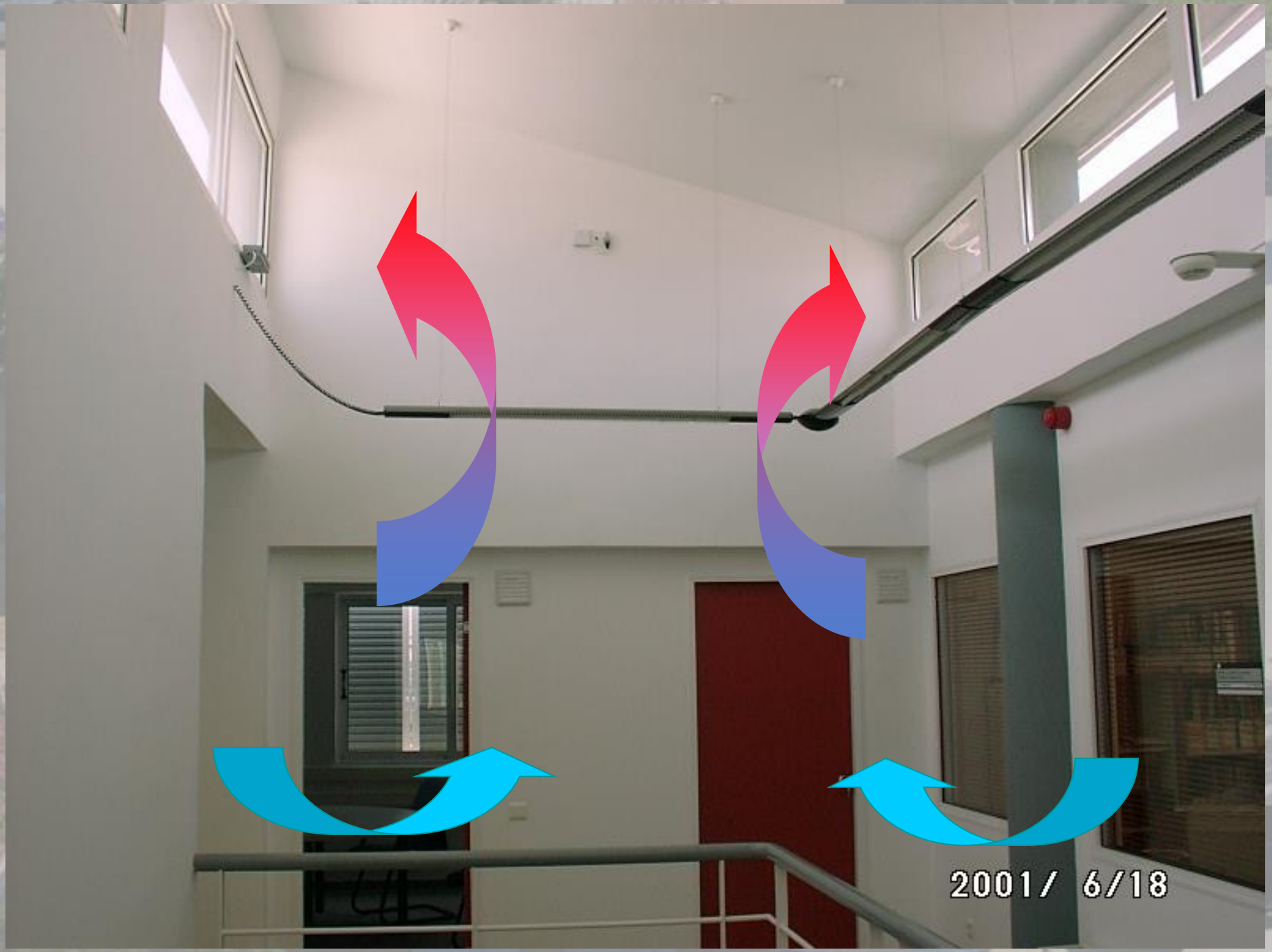
Daylighting techniques

Sun protection system on the south facade

Sun protection system on the east & west facades



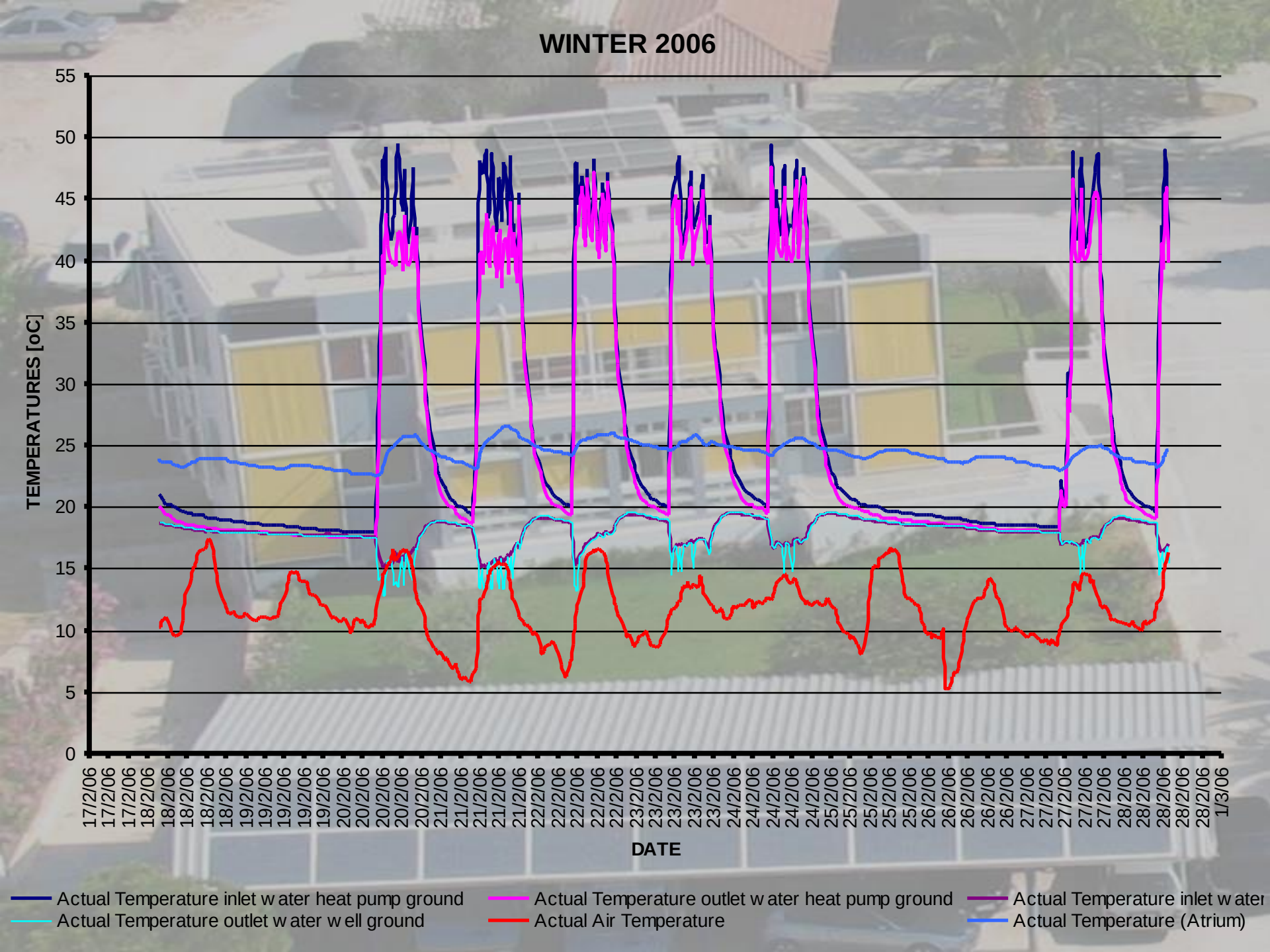
The solar atrium is used as a passive cooling system


2001/ 6/18

Geothermal water to water heat pump

TECHNICAL CHARACRTERISTICS OF GEOTHERMAL HEAT PUMP

Power for heating…… 17,50 kWth
Power for cooling…… 16,00 kWc
COP…… 3,12
Temperature of water from aquifer … 12 ^{o}C
Temperature of reinjection water to aquifer … 8 ^{o}C
Temperature of water to fan coils unit…45 ^{o}C (heating)
Temperature of water to fan coils unit…7 ^{o}C (cooling)
Heat pump type ..... electric heat pump
Year of installation 2001
Purpose ..... heating and cooling
Heat source/sink ..... water/water
Heat source system ..... aquifer/wells
Distribution system ..... fan coil units
Operation mode ..... bivalent
Refrigerant R22


WINTER 2006
TEMPERATURES [oC]
55
50
45
40
35
30
25
20
15
10
5
0
17/2/06
17/2/06
17/2/06
18/2/06
18/2/06
18/2/06
18/2/06
19/2/06
19/2/06
19/2/06
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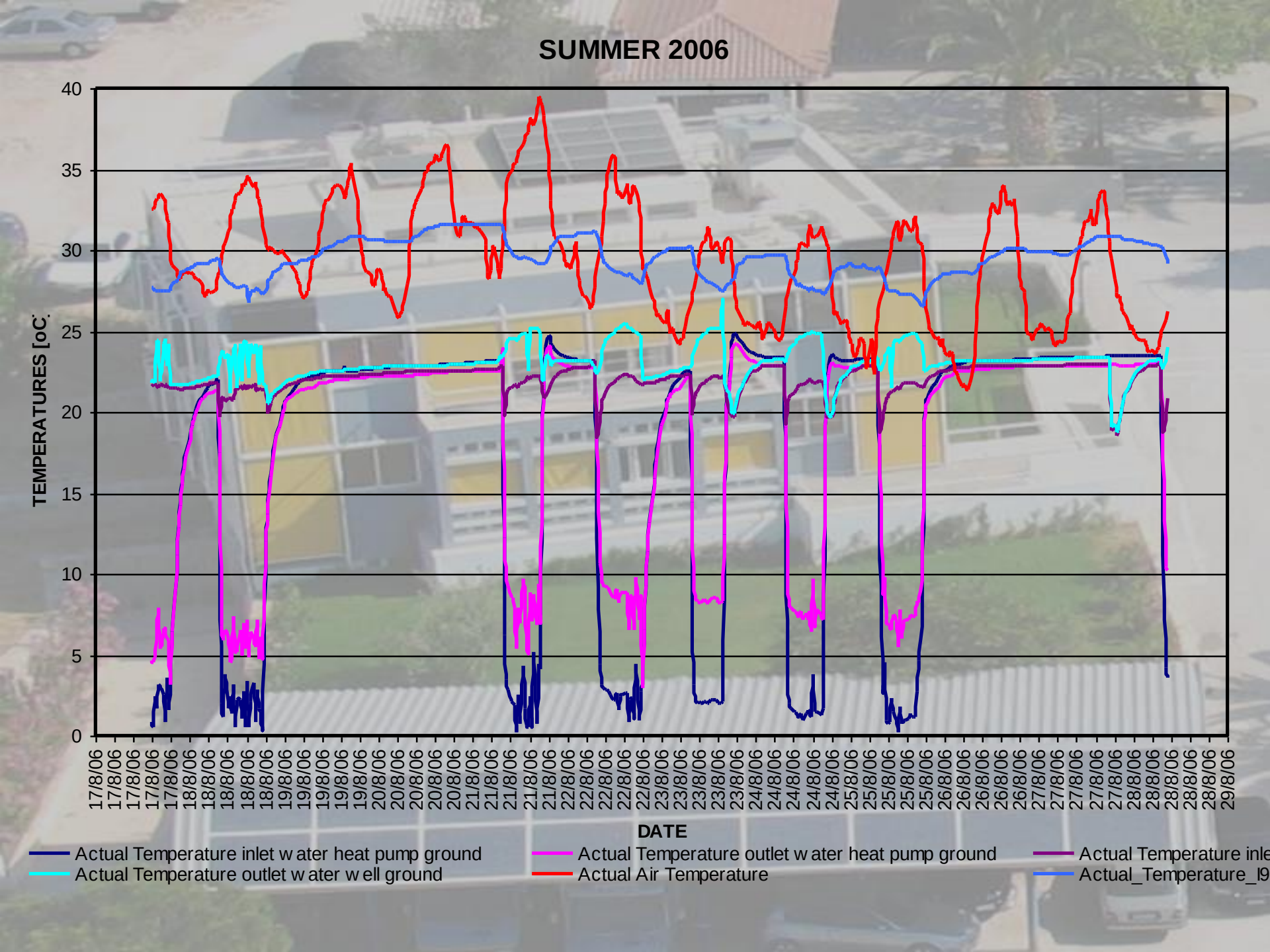
27/2/06
27/2/06
27/2/06
27/2/06
28/2/06
28/2/06
28/2/06
28/2/06
1/3/06
DATE
Actual Temperature inlet w ater heat pump ground
Actual Temperature outlet w ater heat pump ground
Actual Temperature inlet w ater
Actual Temperature outlet w ater w ell ground
Actual Air Temperature
Actual Temperature (Atrium)


SUMMER 2006
TEMPERATURES [oC]
40
35
30
25
20
15
10
5
0
17/8/06
18/8/06
19/8/06
20/8/06
21/8/06
22/8/06
23/8/06
24/8/06
25/8/06
26/8/06
27/8/06
28/8/06
29/8/06
DATE
Actual Temperature inlet w ater heat pump ground
Actual Temperature outlet w ater heat pump ground
Actual Temperature inle
Actual Temperature outlet w ater w ell ground
Actual Air Temperature
Actual_Temperature_I9

Solar assisted water-air heat pump


TRANE
2001/ 6/21

The central control unit and the 1st floor control board.

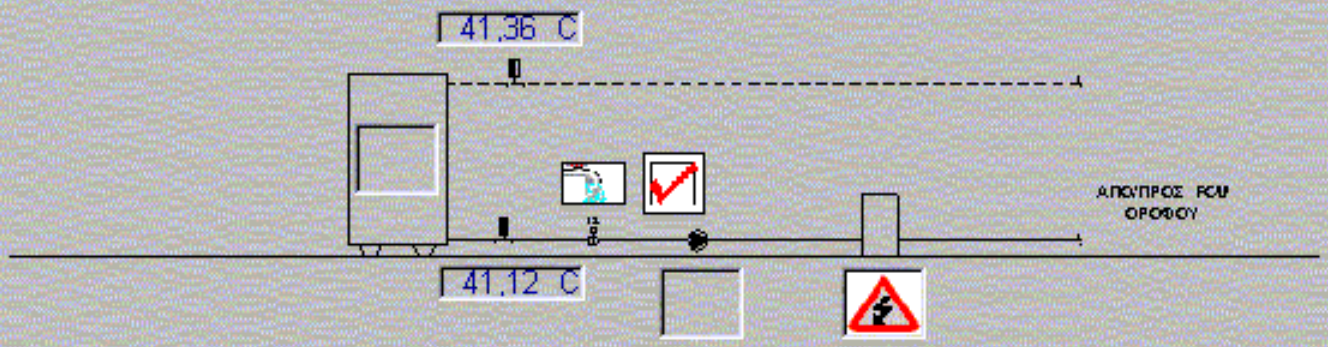
Room thermostat, occupancy sensor and eight function switch installed throughout the building’s rooms.

Σύστημα κλιμ_θέρμ - Elvis

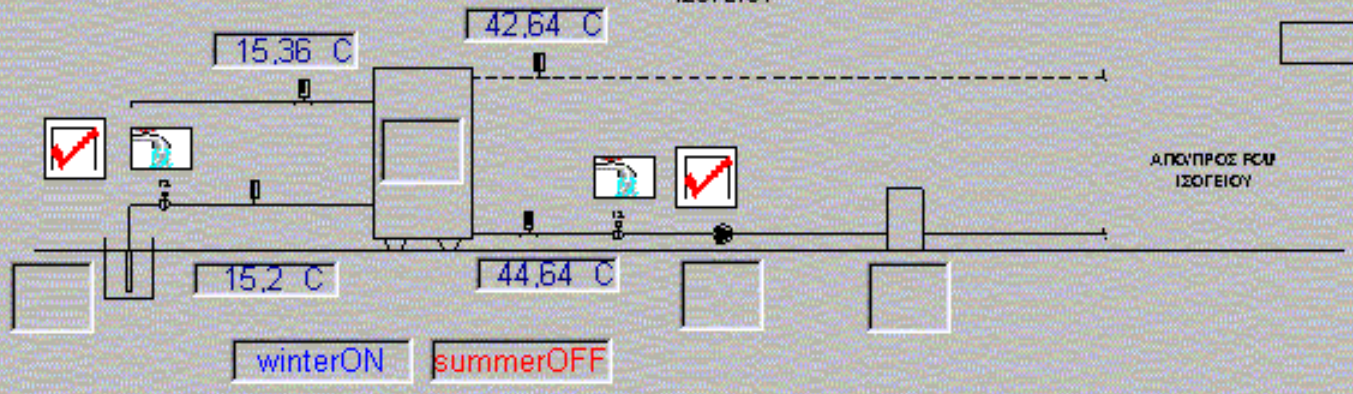
File View Help

>Πρώτη σελίδα

ΕΓΚ. ΠΑΡΑΓΩΓΗΣ ΨΥΧΡΟΥ - ΘΕΡΜΟΥ ΝΕΡΟΥ ΟΡΟΦΟΥ



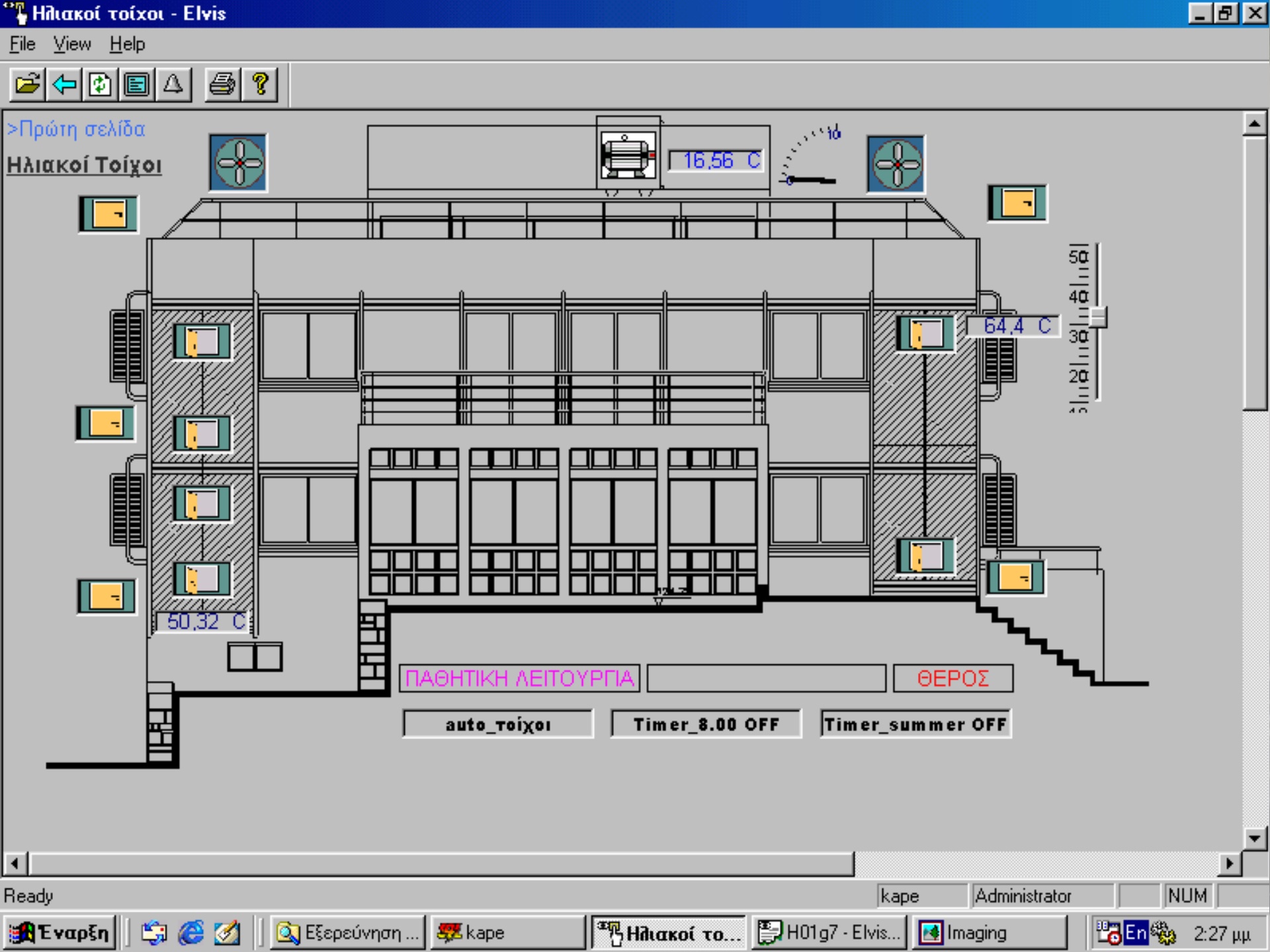
ΕΓΚ. ΠΑΡΑΓΩΓΗΣ ΨΥΧΡΟΥ - ΘΕΡΜΟΥ ΝΕΡΟΥ ΙΣΟΓΕΙΟΥ

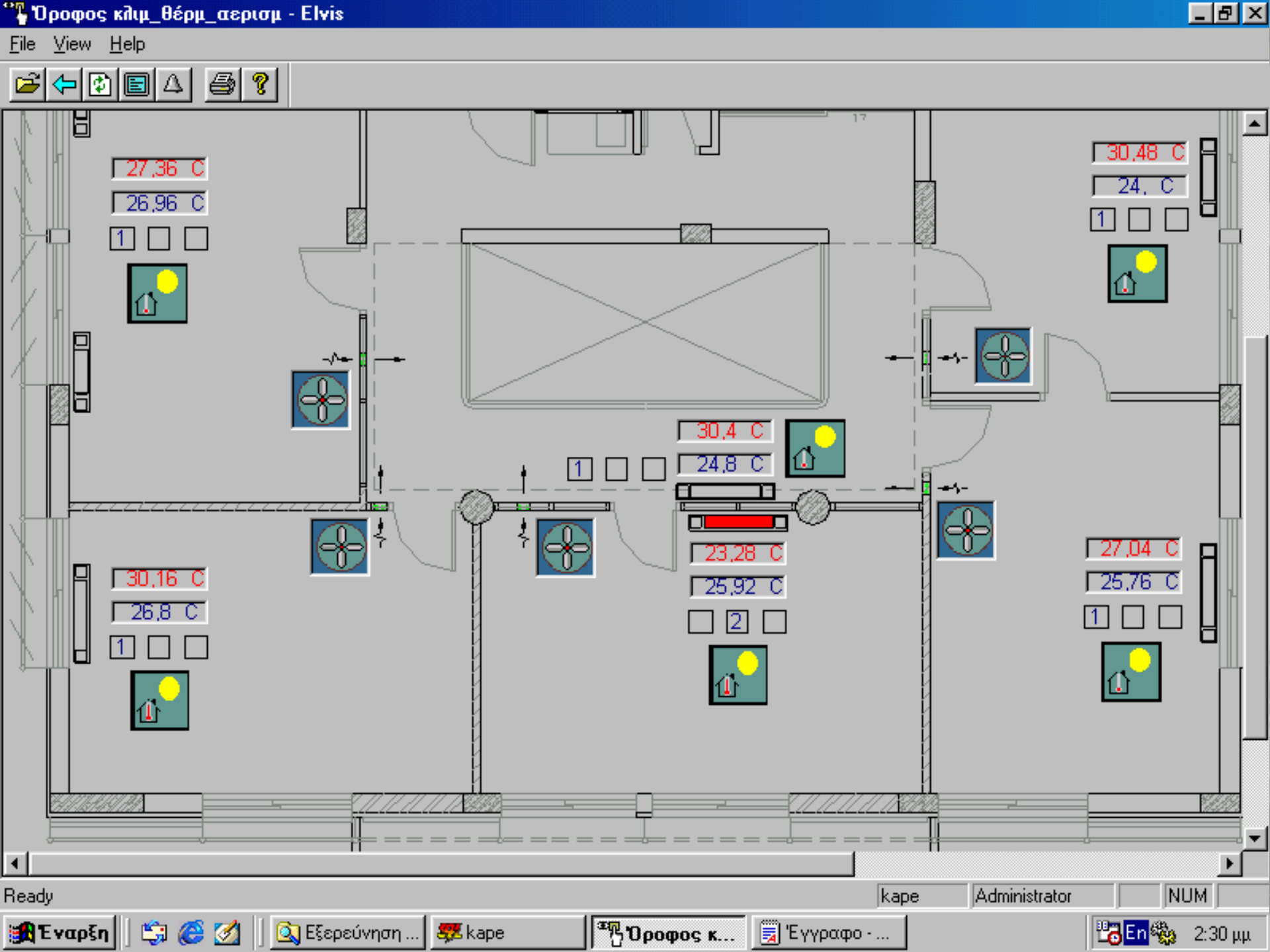


Ready

kape | administrator | CAP | NUM

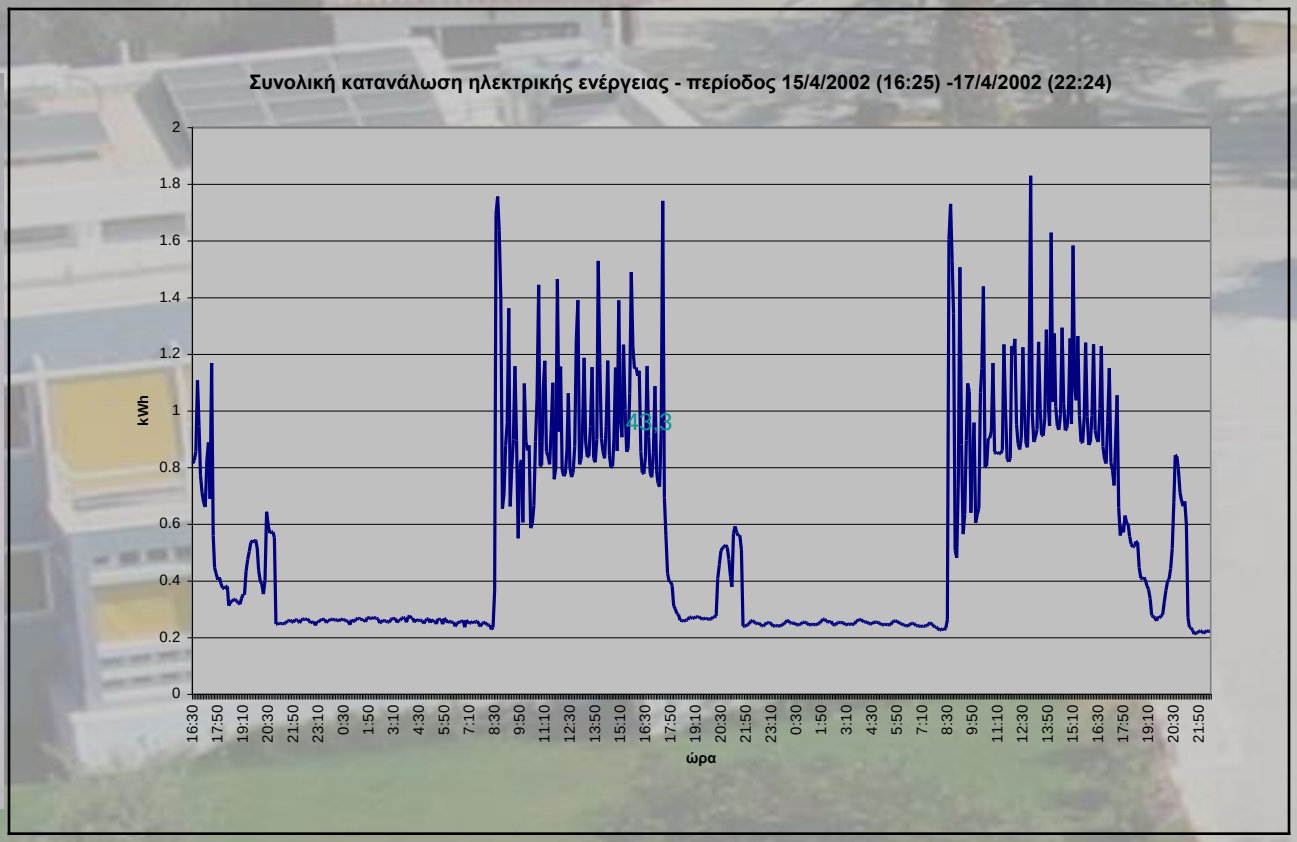
Έναρξη | kape | Σύστημα κλιμ_... | Log | Microsoft Photo Editor | En | 10:40 πμ


Ηλιακοί τοίχοι - Elvis
File View Help
>Πρώτη σελίδα
Ηλιακοί Τοίχοι
16,56 C
64,4 C
50,32 C
ΠΑΘΗΤΙΚΗ ΛΕΙΤΟΥΡΓΙΑ
ΘΕΡΟΣ
auto_τοίχοι
Timer_8.00 OFF
Timer_summer OFF
Ready
kape
Administrator
NUM
Έναρξη
Εξερεύνηση ...
kape
Ηλιακοί το...
H01g7 - Elvis...
Imaging
2:27 μμ

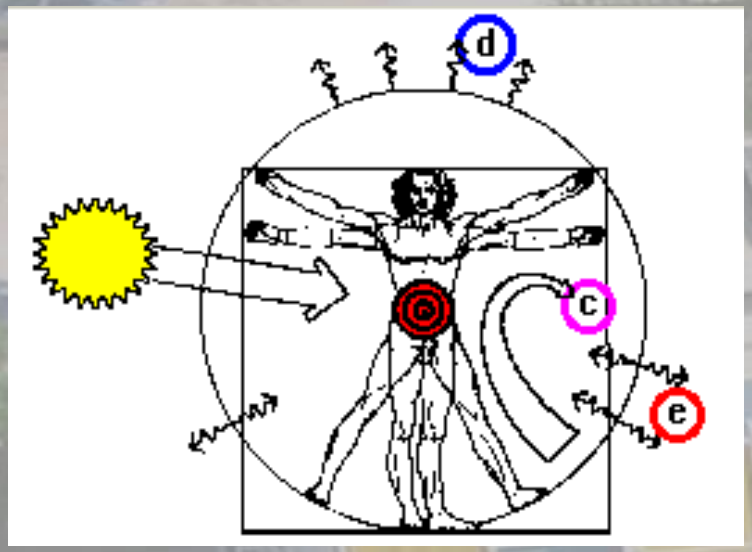

Όροφος κλιμ_θέρμ_αερισμ - Elvis
File View Help
27,36 C
26,96 C
1
30,48 C
24, C
1
30,4 C
24,8 C
1
23,28 C
25,92 C
2
30,16 C
26,8 C
1
27,04 C
25,76 C
1
Ready
kape
Administrator
NUM
Έναρξη
Εξερεύνηση ...
kape
Όροφος κ...
Έγγραφο - ...
En
2:30 μμ

P/V 600W on the sloping part of the roof.

Electrical consumption of the building

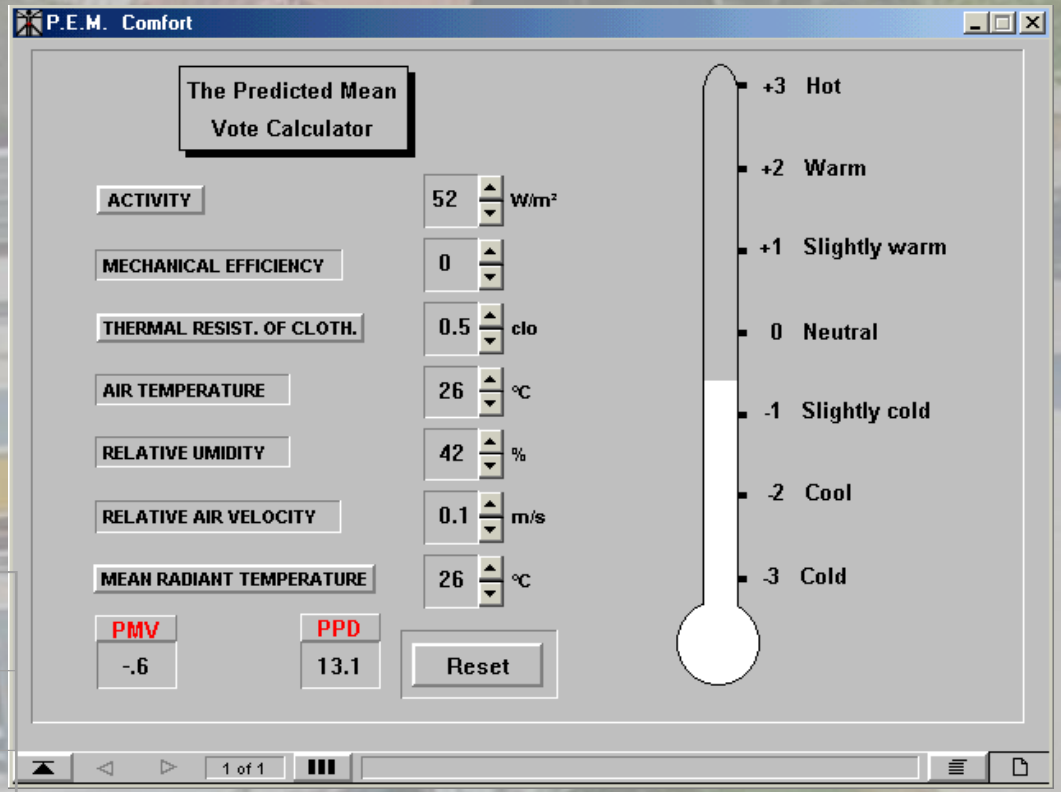


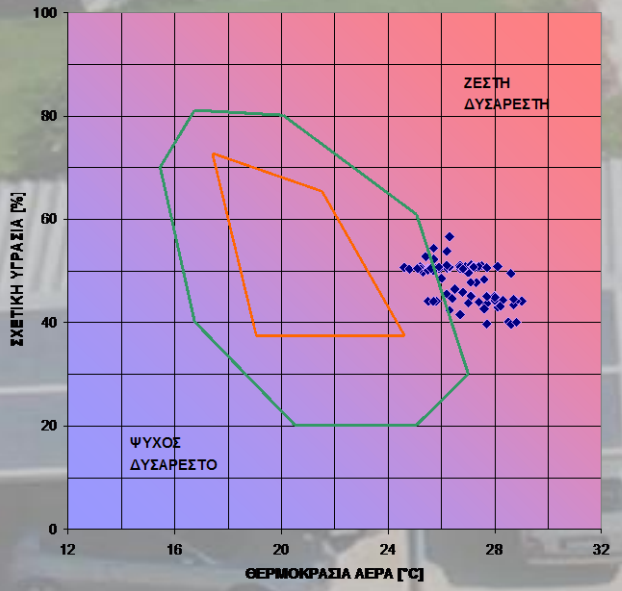
	COOLING	HEATING	LIGHTING	ELECT. APPLIANCES	TOTAL	PVS
	kWh/m2	*kWh/m2*	*kWh/m2*	*kWh/m2*	***kWh/m2***	
Conventional Office Building	**33.0**	**101.3**	**20.0**	**48.0**	**202.3**	
Bioclimatic Office building	**41.8**	**27.1**	**10.6**	**25.5**	**107.1**	**1.7**



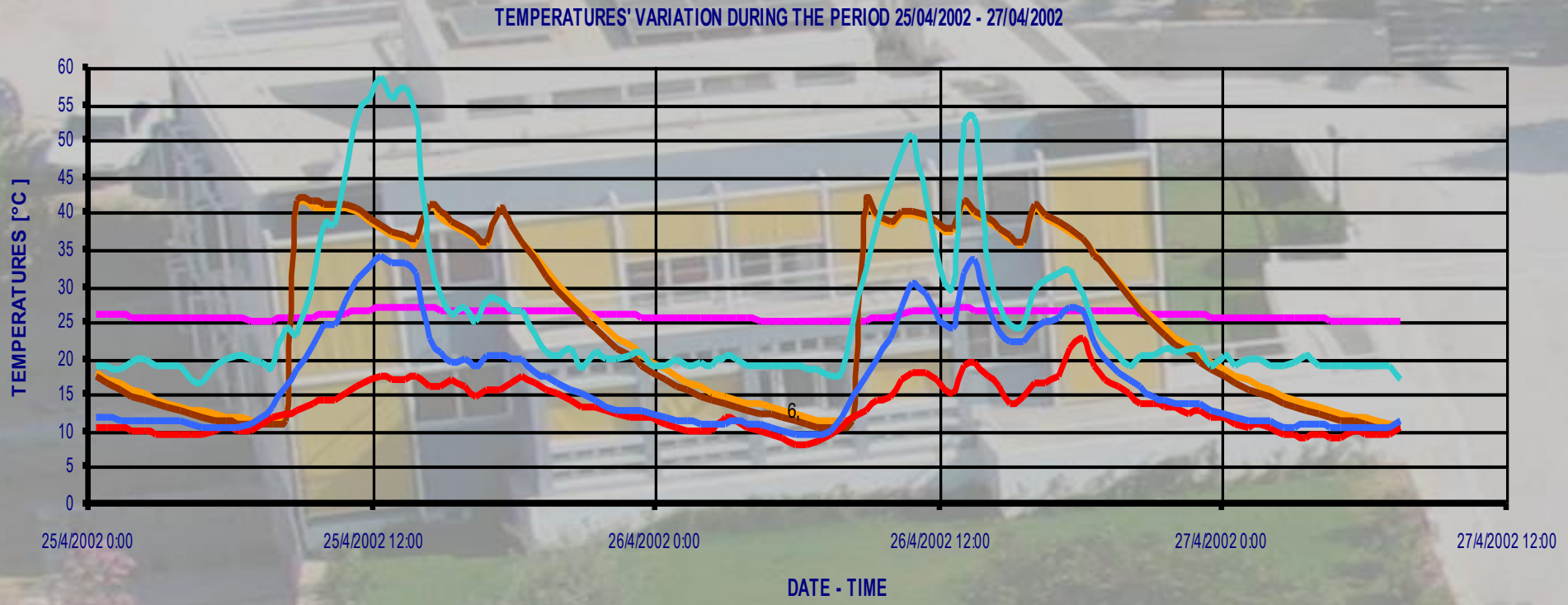
PRESENTAGE OF THERMAL COMFORT (table II)

CONDITION	%
NEUTRAL [±0.5]	61.9
SLIGHTLY WARM [+1]	4.8
SLIGHTLY COLD [-1]	31
WARM [+2]	0
COOL [-2]	2.4
HOT [+3]	0
COLD [-3]	0
TOTAL	100

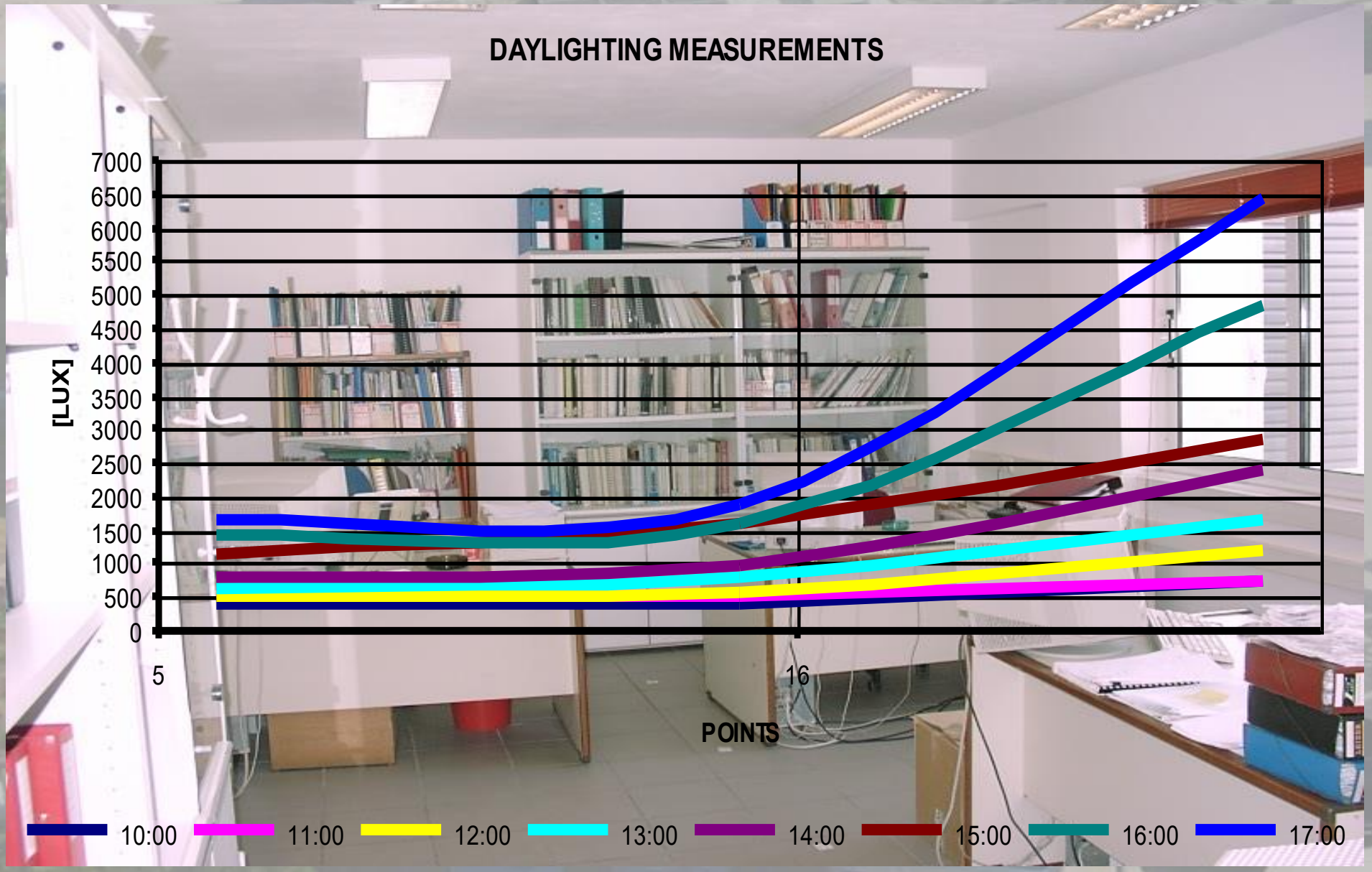




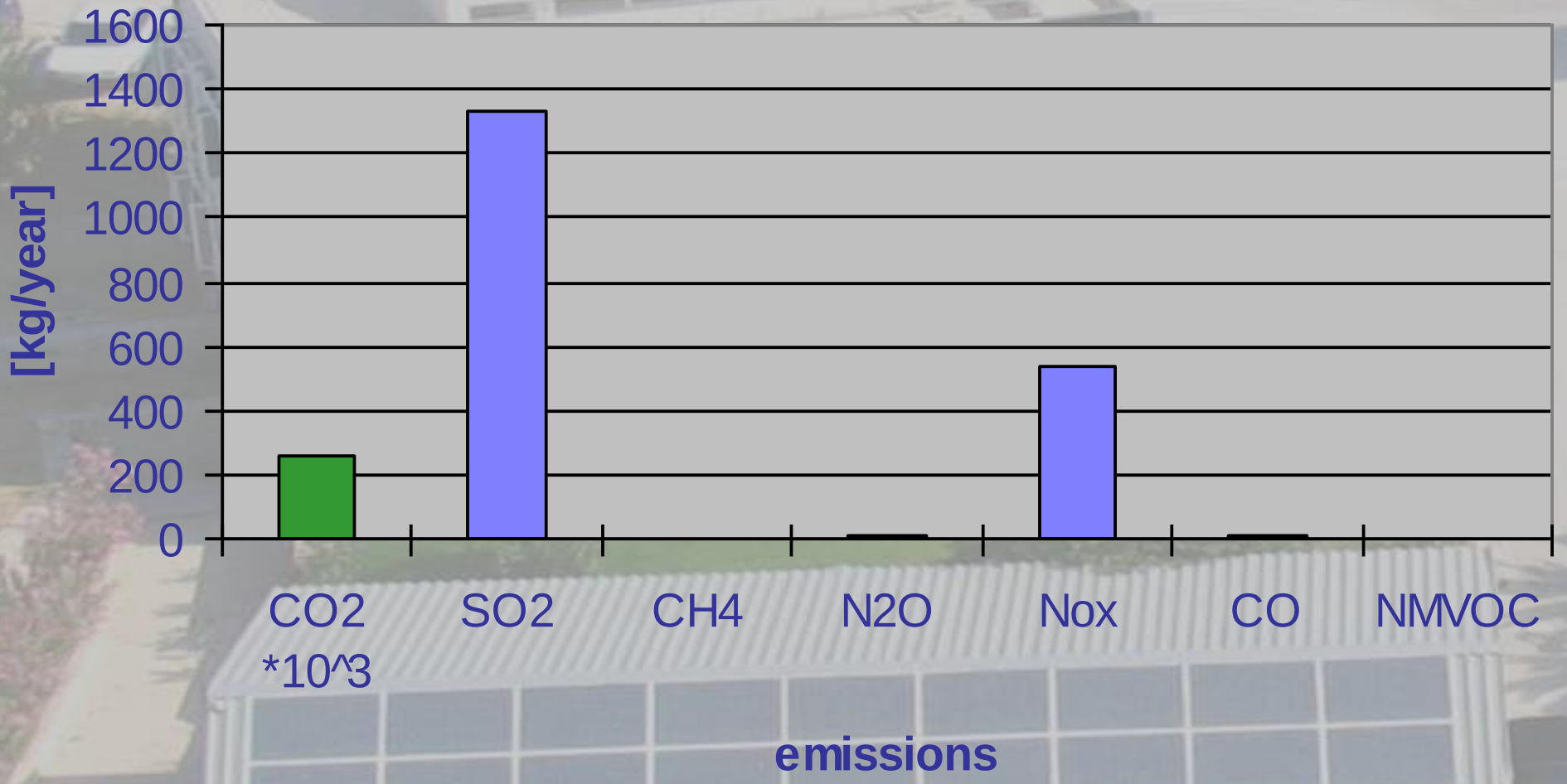
Air solar walls (thermosyphoning air panels)


TEMPERATURES' VARIATION DURING THE PERIOD 25/04/2002 - 27/04/2002
TEMPERATURES [°C]
60
55
50
45
40
35
30
25
20
15
10
5
0
25/4/2002 0:00
25/4/2002 12:00
26/4/2002 0:00
26/4/2002 12:00
27/4/2002 0:00
27/4/2002 12:00
DATE - TIME
AIR TEMPERATURES IN AREA A4
WATER TEMPERATURES WHEN RETURNING TO THE HEAT PUMP
INDUCTION WATER TEMPERATURES TO THE FCU
AMBIENT TEMPERATURE
AIR TEMPERATURES IN A HIGH LEVEL OF SOLAR AIR COLLECTOR
AIR TEMPERATURES IN A LOW LEVEL OF SOLAR AIR COLLECTOR

Average measurements of Daylighting (10:00 – 17:00)



Reduction of annual of gas emissions



CONCLUTIONS

- ☑ The energy technologies and systems installed in the building cost, in 1999 prices, 11% (39.780 Euro) of the total cost of the building
- ☑ Based on the results of the six-year energy measurements in the building and on the calculated energy saving (50354Kwh/year or 47%).
- ☑ compared with similar “conventional” buildings, there is a simple payback period of 11 years
- ☑ Respectable decrease CO_2 emissions (255 ton CO_2)
- ☑ High levels of thermal and visual comfort