Flourentzos Flourentzou: Innovation park EPFL Lausanne, Switzerland
F. Flourentzou  Lefkosia new townhall – passive bioclimatic Minergie design

Cyprus Energy Agency – Serpente seminar – October 2013
• 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
This bioclimatic building does not use some passive technics. It uses all the necessary passive technics to reduce its primary energy consumption under 38 kWh/m² and get the Minergie® label.
• thermal insulation

Perfect thermal insulation with minimum thermal bridges and double glazing of U value 1.3, reduces heating demand from 21 to 8 kWh/m²y (factor 2.6 compared to a standard building complying to regulations)
• Thermal energy demand for heating and cooling

- Buildings before the energy law need a lot of energy for heating
- The new Lefkosia townhall reduce energy demand by a factor of 4
The energy revolution in Europe and in Cyprus

- The new Lefkosia townhall has to invent its own solutions
- effect of reinforced thermal insulation and passive shading

10 cm of thermal insulation instead of 5 and window U value of 1.3 instead of 3.5 reduces heat demand from 21 to 8 kWh/m²y (factor 2.6)
F. Flourentzou

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Permanent solar protection and glazing g-39%, TL-70%
• almost perfect solar shading

Permanent solar protection and glazing g-39%, TL-70%
almost perfect solar shading

Shaded patios, buildings shading each-other, protecting circulations and auxiliary buildings, offices avoid unprotected east and west, trees.
• effect of solar protection

→ Solar shading and reduced g glazing value saves 37% of energy
• apparent thermal mass

→ Unhydrid screed for the floor, apparent claded concrete slab.
• apparent thermal mass

→ Without thermal mass temperature would rise to 37° C instead of 30
• Opening dimensioning

- 0% east and west, 1X140X300 south, 2X140X300 north.
- Enough passive heat gains in winter (~30 W/m²), enough natural lighting autonomy (>65%), low heat gains in summer (<20W/m²)
- **Natural lighting (60-85% autonomy)**

  → **Opening dimensions and position, light color walls, roof and ceiling.**
Inside – outside in the Mediterranean climate

682 m² (75%) within the thermal envelope out of a total of 900 m²
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682 m² (75%) within the thermal envelope out of a total of 900 m²
• night ventilation design

⇒ safe, protected, flexible openings, dissociation of air from light path
natural ventilation design

<table>
<thead>
<tr>
<th>Opening possibilities 40X300</th>
<th>m³/h</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>40X300</td>
<td>610</td>
<td>100</td>
</tr>
<tr>
<td>40X300 grille</td>
<td>366</td>
<td>60%</td>
</tr>
<tr>
<td>40X122</td>
<td>158</td>
<td>26%</td>
</tr>
<tr>
<td>40X122 + 40X122</td>
<td>499</td>
<td>82%</td>
</tr>
<tr>
<td>15X122 à la française</td>
<td>59</td>
<td>10%</td>
</tr>
<tr>
<td>7X122</td>
<td>28</td>
<td>5%</td>
</tr>
<tr>
<td>15X122 + 15X122 à la Fr</td>
<td>187</td>
<td>31%</td>
</tr>
<tr>
<td>15 cm à l’italienne (6°)</td>
<td>49</td>
<td>8%</td>
</tr>
<tr>
<td>10 cm à l’italienne (4°)</td>
<td>30</td>
<td>5%</td>
</tr>
</tbody>
</table>

A window offering 30 to 366 m³/h stack effect 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
Systematic and well thought use of ceiling fans
• 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 load
Technical sobriety: these are all the building technical installations
• Need of correct cooling load dimensionning.

→ 50 W/m² of simulated sensible cooling load needed, 135 installed

→ Static dimensionning 24-42° C is not adapted for low energy buildings

→ 220 fan electric Watts to distribute 2500 thermal Watts is to match
• Monitoring: outside 45°C – inside 30°C, winter heating 15’ in the morning

outside

Cooled occupied office Unoccupied office

simulated occupied office

→ The concept works, simulations are valid
Green materials: no paint, no glue, no silicone
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An almost zero energy office building

- Good thermal envelope and reasonable solar gains (cooling demand < 40 kWh/m²y, heating demand < 10 kWh/m²y)
- Perfect solar shading and reduction of internal gains
- Natural light
- Controlled natural ventilation and natural cooling
- High performance cooling systems (global COP production + distribution > 3)

- Renewable energy
• Hybrid ventilation of the hall

→ Light building, sporadic use, high stack height, special shading
• Hybrid ventilation of the hall – natural ventilation path

→ Cooling storing under the plenum, stratification, intelligent strategy
• Hybrid ventilation of the hall – mechanical with heat recovery

→ Use only when it is needed