Energy- and water-efficiency in buildings in the Luxembourg ‘Cité des Sciences’

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Overview

• The University of Luxembourg
• Planning and construction of the ‘Cité des Sciences’
• A statement on ‘Energy- and water-efficiency’:
  • A definition of ‘comfort’: the end-user assumes responsibility
  • Energy Grenzwert vs target value
  • Use of renewable energy
  • Watermanagement
  • Building materials
• Implementing recommendations in the planning and construction process?
The University of Luxembourg

• Creation of the University of Luxembourg by legal decree on 12.8.2003

• Controlled growth (figures reached on 31/12/2007):
  - Students: 4137
  - Doctorands: 186
  - Different nationalities: 89
  - Personnel: 549
  - Faculty: 157
    - Professors: 61
    - Assistant-Professours: 74
  - Different nationalities: 26

• 3 official languages: French, German, English
• Mobility requirement for Bachelor students
• Established a Group on ‘Sustainable Development’ in September 2006

The University of Luxembourg

• 3 campus sites:
  - Limpertsberg
  - Kirchberg
  - Wallerfangen

  • Recycling and cleaning products to comply with Luxembourg laws

• 3 faculties:
  - Faculty of Sciences, Technology and Communication
  - Faculty of Law, Economics and Finance
  - Faculty of Language and Literature, Humanities, Arts and Education

  - 11 Bachelor programmes
  - 16 Master programmes
  - Structures based on Bologna system
  - Innovative project-based teaching in some subjects
Research

- 12 Research Units
- The current 4-year plan (2005-2009) lists 9 priorities:
  1. Security and reliability in information technology;
  2. Material science;
  3. Life sciences;
  4. European law and commercial law;
  5. International finance;
  6. Educational Science;
  7. Luxembourg studies;
  8. Geodynamics and Seismology;
  9. Resources and technologies for the environment;
  10. Economy and Enterprise;
  11. Social Science

- Goal of the Sustainable Development Group for next 4-year plan (2010-2014): regroup more diverse topics under a new high research priority ‘Research and Education for Sustainable development’

Planning and construction of the ‘Cité des Sciences’ in Belval

- Brownfield redevelopment of a former steel production site from Arcelor-Mittal

- AGORA: private enterprise created by the state and the Arcelor group in 2000 ‘to redevelop [and sell] industrial wasteland, following the principles of sustainable development’

- The current urban design plan requires:
  - ~ 1 300 000 m² on 69 ha land for construction
  - 30% of the surface reserved for parkland and public spaces
  - Urban spaces, parc, mixed zones – walking distance
  - Organisation along railway line to Luxembourg, Metz, etc.

- Fonds Belval: a public organisation created by legal decree in 2002 to act as constructor of the site

- Target date for the move of the University: 2014
Urban design – the Masterplan

Running architectural competitions

The EU Directive 91/2002 is not as yet transposed for public buildings in Luxembourg

An integrated approach to energy considerations in building design is already a requirement for the competition and the evaluation in the préjury involves computermodelling (Büro Baseler).

The main selection criteria in the Préjury are:
• Building form
• Quality of the technology
• Use and comfort
• Fraction of energy consumption from renewable energy over total energy consumption
• Passive solar gain and building orientation
• Cost of technical installations compared to overall building cost
• % of translucid surfaces of the fassade
Statement on:
‘Energy- and water-management in buildings in Belval’

Objective: More visible target values and measures for energy- and water efficiency. A process for coordinated goal setting and improved communication between actors involved in planning and developing Belval.

Target audience: Constructors, architects, investors (e.g. European Investment Bank), public administration, and politicians.

Participants: ‘hand-picked’ experts from 3 organisations (UL, CRP HT, Agora) – with input from Fonds Belval.

Process: 3 meetings of the main expert group to achieve final product (18.1.; 11.3.; 6.5.2008) – (architectural competitions for first buildings already running – Rush!)

Structure and content

Structure:
- An accessible overview of all topics
- Topic annexes with more technical detail on implementation

Topics:
1. Definition of a standard of natural comfort
2. Target values for the end-energy of the district heating and consumption of electricity
3. Production and use of photovoltaic energy
4. Watermanagement
5. Building materials
### Summary of requirements for future buildings in the Cité des Sciences

<table>
<thead>
<tr>
<th>Theme</th>
<th>Requirement</th>
<th>Values*</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Comfort</td>
<td>Acceptable temperature range</td>
<td>20-26°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ 15 h &lt; 28°C</td>
</tr>
<tr>
<td></td>
<td>Isolation: average heat passage coefficient of the Fassade</td>
<td>U = 0.2-0.25 W/m²K</td>
</tr>
<tr>
<td></td>
<td>Aeration: Flow volume of external air</td>
<td>0.7 m³/h·m²</td>
</tr>
<tr>
<td></td>
<td>Illumination of offices</td>
<td>400 lux</td>
</tr>
</tbody>
</table>

*Zur Berechnung sind die neuesten Europäischen Normenpakete (EN und CEN) und die DIN Normen zulässig.

**Die Bezugsskala ist das Bruttogebäudevolumen.

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### Achieving energy efficiency

<table>
<thead>
<tr>
<th>Theme</th>
<th>Requirement</th>
<th>Values*</th>
</tr>
</thead>
<tbody>
<tr>
<td>B) Energy consumption</td>
<td>End-energy from district heating</td>
<td>14 kWh/(m³a)**</td>
</tr>
<tr>
<td></td>
<td>Target value:</td>
<td></td>
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<tr>
<td></td>
<td>Elektric current consumption – Target value:</td>
<td>8 kWh/(m³a)**</td>
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- Integration of Photovoltaïc cells in the roof and/or facade elements
## Water management

<table>
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<tr>
<th>Theme</th>
<th>Requirement</th>
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<tbody>
<tr>
<td>D) Watermanagement</td>
<td>- Watersaving and appliances</td>
</tr>
<tr>
<td></td>
<td>- Substitution of drinking water for toilet flushing or cooling</td>
</tr>
<tr>
<td></td>
<td>- Green roofs</td>
</tr>
<tr>
<td></td>
<td>- Avoidance of groundwater drainage to avoid moisture in buildings</td>
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</table>

## Building materials

<table>
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</thead>
<tbody>
<tr>
<td>E) Selection of building materials</td>
<td>Evaluation of building materials using the Oekobilanz method</td>
</tr>
</tbody>
</table>
Implementation

- **Selection process**: Distribution of position statement to all participants in the competitions. Evaluation of the criteria in the préjury phase and consideration in the préjury and the jury.

- **Planning and construction**: Definition of points at which actual values and measures are cross-checked with target values and measures.

- **Monitoring**: Public display of energy- and water-consumption for individual areas for awareness building, learning and improvement.

Challenges and open questions

- Information flow between FB, Agora and the UL still needs to be improved.

- Next steps: develop and carry out a dissemination and implementation strategy.
Participants

- Yves Biwer (Agora)
- Manfred Greger;
- Ariane König;
- Stefan Maas;
- Frank Minette (CRP-HT);
- Michael Scheuern;
- Jean-Jacques Scheuren;
- Paul Schosseler (CRP-HT);
- Susanne Siebentritt;
- Bianca Schmitt (CRP-HT);
- Andreas Thewes
- Daniele Waldmann
Diethmar Eberle the lead architect works on sustainability in building design since 1970's and teaches on it at the ETH Zuerich.

Main principles reflected in the Maison du Savoir include:
• Care in choice of building materials
• Use of natural ventilation and light is preferred
• Minimise structural elements that divide spaces in order to maximise flexibility of room use over the building's life time.