Symposium

Renovation of Non-Residential Buildings towards Sustainable Standards


Subtask D: Environmental and Health Assessment
Sustainable Refurbishment of school Buildings

Sophie Trachte, Architecture et Climat, University of Louvain la Neuve, Belgium
What means Sustainable Development?

Sustainable Development = Development that meets present needs without compromising the ability of future generations to meet their
Building sector in Europe - **25 billions of square meters built**

- 25% are non residential buildings
- 40% were built before 1960 (old stock!)

Building sector in Europe – **Environmental impact**

- 40% of total natural resources depletion;
- 40% of total energy consumption;
- 35% of total waste production;
- 40% of total greenhouse gas emission;
- 15% of total water consumption;


Old buildings do not offer comfort and quality of life expected by users.

**Renovation is a real opportunity to improve comfort while lowering environmental impact of buildings and reducing fossil energy consumption**
To be considered as «sustainable», the renovation process must also correspond to the global concept defined by the Rio declaration (1992) and the 27 principles drafted in application of the definition of sustainable development proposed by Gro Harlem Brundtland.
To be considered as «sustainable», the refurbishment process must also interact strongly with the various contexts (environmental, social, economic, ...) in which it is integrated, while:

- Benefiting from the advantages of those contexts
- Protecting against aggressions from those contexts
- Giving the benefit of sustainable improvements to those contexts:
  - Protecting those contexts from the environmental, economical and social nuisances of the construction itself
Task 47: Renovation of Non-Residential Buildings towards Sustainable Standards

School Buildings in Europe

School = openness to the world, learning and knowledge socialization practices
To play this role, schools must offer quality and comfortable places of learning and teaching. This is not the case in Europe:

- Old or outdated buildings
- Poorly insulated
- No heating regulation
- Ventilation system: absent or not effective
- Outdoor spaces and playgrounds without real quality, too small, too noisy

This state of discomfort has negative consequences on pupils concentration and their learning process (20 to 30%)
School buildings have very different characteristics compared to office buildings or office buildings:

- **Occupancy rate relatively low**
  
  Schools are, most of the time, occupied 4 to 5 days per week, from 8:00 am to 15/16h00 pm. School buildings are used about 200 days per year with relatively long periods of non-occupancy.

- **Number of occupants relatively significant**
  
  According to the OECD report, the average number of students per class
  - in primary education is **22**
  - in secondary education is **24** but there may be large variations between countries.

  Average surface: 2.27 to 3.63m² per pupil (office building: 12/15 m²)

- **Diversity of occupants and needs**
  
  Adults and childrens
  Childrens from 2,5 to 18/19 years old
School buildings have very different characteristics compared to office buildings or office buildings:

- Diversity of rooms and spaces, large surface to be treated
- Importance of outdoor spaces
School = building with specificities

School buildings have very different characteristics compared to office buildings or office buildings:

- **Diversity of building types, construction methods and materials used**

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<thead>
<tr>
<th>Type</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Horizontal</td>
<td>Less than 4 floors</td>
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<td>Classrooms arranged either on one or both sides of the corridor</td>
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<td>Vertical</td>
<td>Up to 3-4 floors</td>
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<td>No clear preferential extension</td>
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<td>Classrooms are arranged around this “core”</td>
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<td>Contrary to horizontal lower buildings it needs differentiated attention due to fire precautions, escape routes and used materials</td>
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<td>In any case the vertical building category needs differentiated attention due to fire precautions, escape routes and used materials</td>
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- **School building, 1968, AT** (AEE INTEC)
- **School building, 1958, CH** (FHNW)
- **School building, 1930, BE** (Passiehuis-Platform view)
- **School building, 1970, DE** (Google street view)
Priorities for Sustainable Refurbishment of School Buildings

1. Increasing the comfort, the well-being and the quality of life

- **Improving thermal comfort, visual comfort, acoustical comfort, indoor air quality;**
  Envelope and building performances must be improved:
  - Optimising volume and compactness
  - Optimising insulation and airtightness
  - Reducing thermal bridges
  - Optimising glazed surfaces
  - Optimising solar protection
  - Limiting overheating – inertia
  - Limiting overheating – natural intensive ventilation
  - Optimising acoustic insulation and correction (classroom)
  - Limiting indoor pollution
  - Optimising ventilation system

- **Improving quality of life, especially in cities and urban context:**
  - Collective spaces, green spaces and playground
  - Soft mobility
  - Accessibility
  - Social diversity
  - Social interactions
2. Reducing the consumption of fossil energy resources

It is urgent to consume LESS WELL AND OTHERWISE taking into account of
- operation energy for the use of buildings
- embodied energy of building materials
- energy for transportation of occupants/users

- Improving the performances of the buildings envelope (priority 1);
  - Optimizing the systems (heating, ventilation, artificial lighting)
  - Optimising heating system
  - Optimising hot water production
  - Optimising ventilation system
  - Optimising artificial lighting
- Increasing the onsite renewable energy production
  - Hot water production by solar thermal
  - Electricity generation from renewable sources
  - Heat pump in renovation

Priorities for school buildings:
- Heating system + regulation
- Ventilation system + regulation
- Artificial Lighting + regulation/control
3. Enriching stocks of natural resources, including water

- **Enriching the "water" resource**
  - Reducing water consumption
  - Recovering and using rainwater if it is possible
  - Allowing the infiltration of rainwater into the ground;

- **Enriching land and raw materials resources**
  - Rational use of land and spaces
  - Rational use of building materials;

- **Enhancing biodiversity**
  - Protection, conservation and creation of green spaces
  - Creation of green roofs
4. Reducing waste production, including waste water

- **Recycling or purifying waste water**
  - Extensive techniques (by plants)
  - Intensive or mechanical techniques

- **Limiting and managing production of construction waste**
  - Preventive measures
  - Managing construction waste and exploiting stocks from recycling of waste;
  - Waste management on building site

- **Controlling and managing production of operation (domestic) waste**
  - Reducing waste at source – pedagogical choice
  - Managing and making rational use of operation waste
The integration of these four priorities in professional practice is a necessary step to achieve sustainable building renovation. These priorities are also the “red line” of the different environmental assessment methods such as BREEAM (England), LEED (US), HQE (France), DGNB (Germany), Total Quality Building (Austria)...

www.ibo.at  www.breeam.org  www.dgnb.de

BREEAM assessment methods

Table 21-1: BREEAM assessment issues by building type and their percentage contribution to BREEAM performance

<table>
<thead>
<tr>
<th>Management</th>
<th>Office</th>
<th>Retail</th>
<th>Industrial</th>
<th>Healthcare</th>
<th>Primary School</th>
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Subtask D focuses on school renovation

Task 47: Renovation of Non-Residential Buildings towards Sustainable Standards
### BREEAM assessment methods

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School renovation = common objective for European countries

Holistic approach based on environmental, urban infrastructure, comfort and health

Guidelines to be followed in the design phase and during renovation works

Sufficient knowledges and tools adapted to professional practice

Illustrated by exemplary projects from Subtask A

RESULT: A guidebook for designers and planners
RESULT: A guidebook for designers and planners

An introduction

4 priorities = 4 chapters

- Theoretical basics
- Proposals and tools to identify and evaluate problems met in buildings
- Solutions and recommendations
- Links with BREEAM certification
Thank you for your kind attention

Any questions?

Architecture et Climat
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sophie.trachte@uclouvain.be