Sustainability and quality of buildings

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What is quality?

- J.M. Juran defines quality as satisfaction of a costumer and a suitability for exploitation
- Satisfaction of a customer and suitability for exploitation are the characteristics of a product
- The product is software, goods, service or buildings
Quality of completed product

- Connections can be depicted with the quality circle:
DGNB (German sustainable building scheme)

<table>
<thead>
<tr>
<th>DGNB criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecological quality of the building</td>
<td>mostly based on <em>life cycle analysis (LCA)</em> of the building products used in the construction</td>
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<tr>
<td>Economical quality</td>
<td>particularly viewed not through the up-front cost of the building but through a <em>life cycle costing</em> and expected impact of different choices on the long-term value of the building</td>
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<tr>
<td>Socio-cultural aspects and functionality,</td>
<td>in particular the <em>health and comfort aspects of a building</em> as well as how it impacts its local environment</td>
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<tr>
<td>Technical quality,</td>
<td>especially regarding the <em>thermal performance</em> of the building but also other key issues such as fire safety</td>
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<tr>
<td>Process quality,</td>
<td>a focus on ensuring a <em>good planning process</em> and a high level of quality as built</td>
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</table>
Improving the quality of buildings

Meeting the goal of sustainable development

Improving architectural quality

Creating excellent buildings with a healthy indoor climate
Why to look after the quality of process and product?

- Process and product are **inextricably linked**, so that consideration of one in isolation from the other is a recipe for failure.

- There have been **many attempts at bringing change** in the way buildings are “produced”, only to fall by the wayside because they **ignored the product** and **what it meant to occupants** (those who have to use buildings).
Many examples of failed projects

- Unskilled construction of thermal insulation – often leads to construction damage!

- Ulica Domovinskog rata – Vukovar
- 150 m² facade destructed after a storm
Dear architect, sir...

My husband would like for you to stop by, to have a coup of coffee...

Where did I put those bullets?
Receipt for good quality buildings

- Continuous improvement
- Learning
- Organization
- Communication

- Customer focused design
- Integrated design and production
- Industrialized production methods
- Customer use and satisfaction
Whole building approach
Voluntary sustainability (quality) control

- Green Building Rating Systems are voluntary
  - LEED
  - BREEAM
  - DGNB German sustainable building scheme
  - …
LEED

- LEED loosely defines green structures as those that are “healthier, more environmentally responsible and more profitable”
- The rating system is based on an assessment of attributes and an evaluation of the use of applied standards.
Is it possible to enhance quality and remain sustainable?

- **YES! Through some principles:**
  - **Eco-design**
    - Set of rules and principles which is intended to eliminate harmful influence through correct choices in design phase.

- **Eco-Efficiency**
  - Through the delivery of competitively priced goods and services that satisfy human needs, while progressively reducing ecological impacts throughout the life cycle.
Factors determining sustainable qualities of a material

With growing awareness about sustainable design other qualities of materials besides mechanical properties became important:

- Energy required to produce the material
- CO₂ emissions resulting from the material’s manufacture
- Impact on the local environment resulting from the extraction of resources
- Toxicity of the material
- Transportation of the material during its manufacture and delivery to site
- Degree of pollution resulting from the material at the end of its useful life
Life cycle approach

• Life-cycle chain:
  • extraction
  • production
  • consumption
  • waste
Life cycle approach

- Waste recycling (and waste prevention) is closely linked to material use.
- Depending on material used in construction you will influence sustainability of the building
  - much of the material is sooner or later turned into waste
Waste materials or resources?

- Waste is increasingly seen as a production resource and a source of energy.
- Use of recycled materials with post-consumer content that originates from a previous use, that would otherwise be diverted to landfills.
Energy efficiency

- Energy efficiency and environmental stewardship complement each other

- No matter how you look at it, permanently reducing the volume of fuels and kWh used reduces the total raw fuel inputs

- Reducing fossil fuel combustion ultimately reduces air pollution.
Reducing energy-in-use requirements

- **Buildings and energy: impossible to ignore!**

- Whilst supporting non-fossil based energy is important, the **huge saving potential from buildings** needs to be recognized and acted upon.
Reducing energy-in-use requirements

- Since buildings consume so much, the savings opportunities are huge!
  - equivalent of 3.3 million barrels of oil a day could be saved for the European Union alone or
  - the equivalent energy that would be saved by taking 230 million cars off the roads in Europe.
Insulation of building elements

- The cost of reducing energy use is low and the benefits are extensive.
- Simple solutions such as insulation exist today and are simply waiting on the shelf to be deployed.
  - Insulation can cut energy use and thus carbon dioxide emissions from existing buildings by a third and more…
Details – Leakages

• Especially important is conducting testing during the construction process, before its completion
• Proving the absence of leakages through building elements
Air permeability

- By sealing, reduce the unwanted heat losses and optimize technical system
Air permeability

- Calculation nomogram for air flow through leakages

1-m Leak, width: 2 mm

Airflow throughput 15 m³/h
Water transport 75 g/h
Air permeability

- Unsealed doors…
Air permeability of buildings - motivation:

Source: PassNet
Infrared thermography

- “A picture is worth a thousand words”
Use of IR testing in buildings

- Thermal bridges
- Insufficient or poor insulation

- Cold air infiltration
- Moisture
The benefits of "green building" - sustainable building
Conclusion

- In order to sustain:
  - untouched nature,
  - vivid history and
  - cultural identity,

- As one of the most beautiful countries in the world.
Thank You for Your attention!

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