Sveučilište u Zagrebu
Arhitektonski fakultet
University of Zagreb
Faculty of Architecture

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TRADITION, CREATIVITY & SUSTAINABILITY

Sustainability and quality – EU Projects Croskills and Eco-Sandwich

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SVEUČILIŠTE U ZAGREBU
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FACULTY OF CIVIL ENGINEERING

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:

The importance of thermal and sound insulation

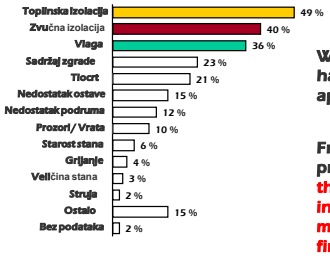
The results of a poll on the situation in housing in Germany,
Information center, Köln 1994

2600 ispitanih domaćinstava

Which criteria is important for You when purchasing new apartment?

From 16 criteria, thermal and sound insulation were rated as 11th according to importance.

The importance of thermal and sound insulation



550 ispitanih domaćinstava

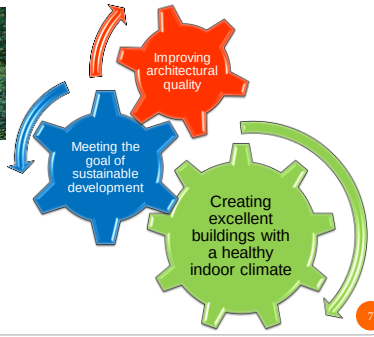
Which problems do You have with Your apartment?

From 12 criteria offered, problems related to thermal and sound insulation, together with moisture problems took first 3 places.

DGNB (German sustainable building scheme)

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

Improving the quality of buildings



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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).

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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

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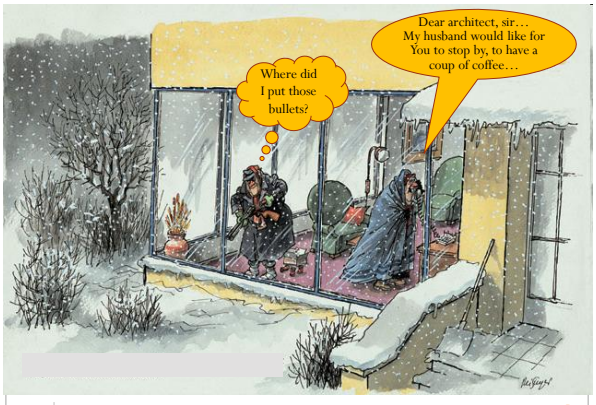

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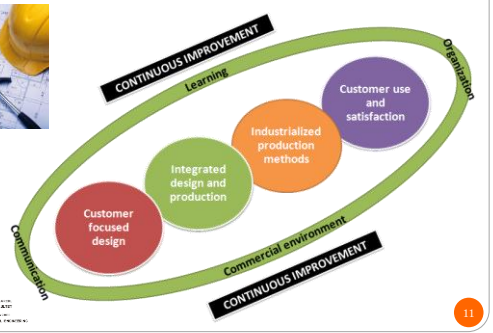
Receipt for good quality buildings



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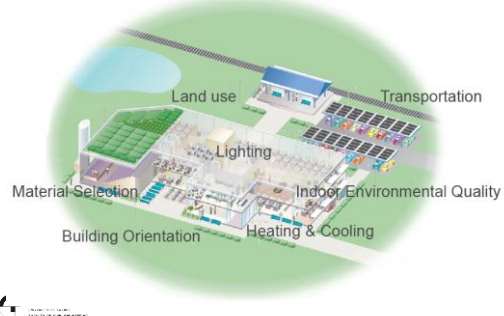
Whole building approach



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Voluntary sustainability (quality) control

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

BREEAM

LEED GREEN ASSOCIATE

U.S. GREEN BUILDING COUNCIL LEED USGBC

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e.g. 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.

Sustainable Sites	**SS**	Materials and Resources	**MR**
Water Efficiency	**WE**	Indoor Environmental Quality	**IEQ**
Energy and Atmosphere	**EA**	Innovation and Design	**ID**
		Regional Priorities	**RD**

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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.

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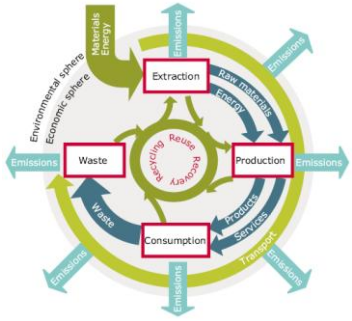
Factors determining sustainable qualities of a material

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

- energy required to produce the material
- CO_2 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

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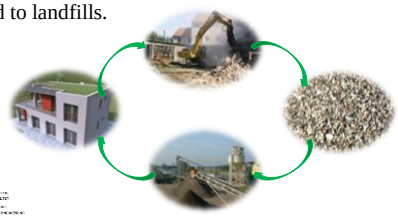
Waste materials or resources?

- 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.



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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.

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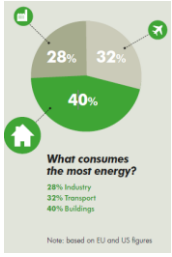
Reducing energy-in-use requirements

- ***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.



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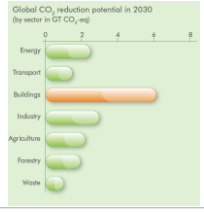
Reducing energy-in-use requirements

- 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.



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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…

The best energy is saved energy

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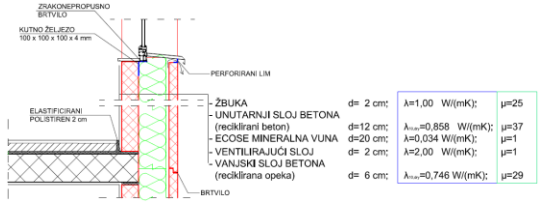
ECO-SANDWICH

- Innovative prefabricated concrete wall panel system



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ECO-SANDWICH

- 50 % of the total aggregate quantity needed
  - replaced with recycled aggregate obtained from construction and demolition waste (CDW).
- Newly developed mineral wool manufactured using Ecose® Technology used as thermal insulation material.
- The wall system reduces the effect of thermal bridges to a minimum due to its connection to load bearing structure

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Partners

- ECO-SANDWICH
  - Energy Efficient, Recycled Concrete Sandwich Facade Panel
- CIP Eco-innovation
  - First Application and market replication projects Call 2011
- Partners:
  - Faculty of Civil Engineering, University of Zagreb
  - Beton Lučko Inc.
  - Faculty of Architecture, University of Zagreb
  - Knauf Insulation Inc.
  - Eurco Ltd.

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LCA results

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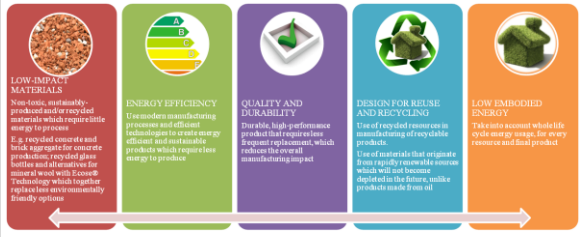
ECO-SANDWICH

- Principles of sustainability



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Possible application – housing

- Three layer facade elements

Beton Lučko – POS Rab

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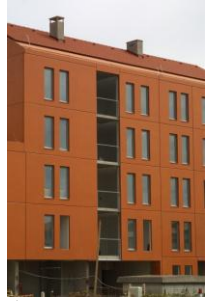
Possible application – housing



Beton Lučko – POS Rab

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Possible application – housing

Family house Ukrainczyk
Beton Lučko

Possible application – industrial facilities

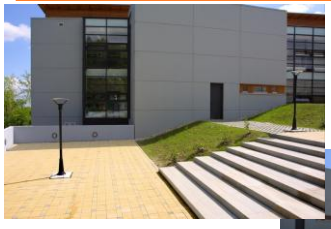
Possible application – sports facilities

- Sports hall Bale

Beton Lučko

- 1. nagrada u kategoriji sportskih objekata
- 1. World Architecture Festival
  - Barcelona 2008

Possible application – double walls



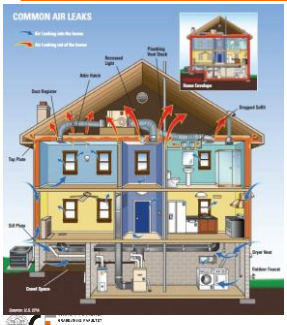
Finishing possibilities

- Natural concrete
- Colored concrete
- Natural stone
- Washed concrete finish
- …

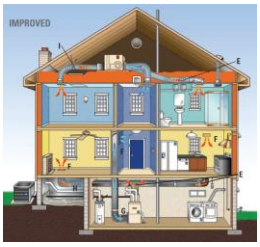
Details – Leakages

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

Air permeability

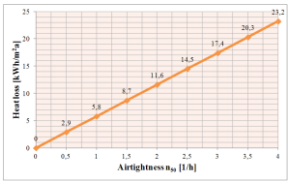


- By sealing, reduce the unwanted heat losses and optimize technical system



Gubici energije putem eksfiltracije zraka kroz vanjsku ovojnicu

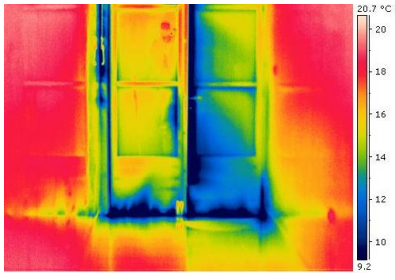
- **Belgija i Njemačka**
  - Zrakopropusnost vanjske ovojnice odgovorna za 10% toplinskih gubitaka u zgradi, odgovara instalaciji fotonaponskih panela.
- **Francuska**
  - Udio je procijenjen na 2 do 5 kWh/m²a za jediničnu promjenu broja izmjena zraka u prostoriji (n_{50}) energije potrebne za grijanje prostora.
- **Skandinavija**
  - Udio je procijenjen na približno 10 kWh/m² a za jediničnu promjenu broja izmjena zraka u prostoriji n_{50}.



Source: IEE Passnet project

Air permeability

- Unsealed doors…



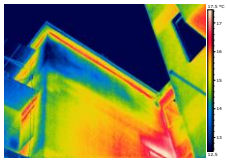
Infrared thermography

- **"A *picture is worth a thousand words*"**

Use of IR testing in buildings

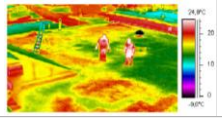
- Thermal bridges

- Insufficient or poor insulation



- Cold air infiltration

- Moisture



BUILD UP Skills

BUILD UP SKILLS
ENERGY TRAINING FOR BUILDERS

- The EU Sustainable Building Workforce Initiative in the field of energy efficiency and renewable energy
- BUILD UP Skills focuses on education and training of blue collor workers (construction workers and installers) for low energy building construction .
- BUILD UP Skills PILLAR I: National Qualification and roadmaps
  - 30 European countries involved
  - CroSkills 8 partners (GF, MGiPU, HOK, REC, AF, KI, GSC, UNDP)
    - 19 institutions supported

Objectives and scope

- Bring all stakeholders together
- Modernise the education system
- Qualify the building workforce
- Deliver high performing buildings

- On-site work-force
- Further education
- All buildings types

Conclusions

- The benefits of "green building" - **sustainable building**

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Conclusion

- In order to sustain:
  - untouched nature,
  - vivid history and
  - cultural identity,
- As one of the most beautiful countries in the world.

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Thank You for Your attention!

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