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Panel 10

**Breathing Walls:**  
**A Challenge for New Sustainable Building  
Techniques in Hungary**

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# Precedents

## In Hungary (and other East-European countries):

- transition from the state-controlled East –European economy to the market economy with consequences in the whole construction sector
- emerging new problem of ecologically more friendly, energy efficient and healthy building
- traditional brick (and adobe) constructions are still dominant
- new housing programs

# Focus

**possibilities of combining energy efficiency with “breathing qualities” in building envelopes in residential construction**

## The problem

- The performance of the external building envelopes is a critical issue in housing
- Applying energy saving measures alone can result in sealed internal environments and too closed buildings
- A risk of too little ventilation and natural light, and too much retention of moisture and toxic internal emissions

## The answer

- mechanical ventilation systems
- “breathing walls” using Building Biology principles:  
“buildings as our third skin” (e.g. UK, Norway, Germany)

# Introduction

- Traditional brick masonry or adobe structures: healthy and good breathing qualities, though not sufficient insulation
- New demands in housing: functional flexibility, rapid and economical construction, convertibility, energy efficiency.
- Simultaneously with the developments in energy-efficiency, an achievement to preserve the breathing quality, the heat storage capacity, the good acoustic behavior and the fire safety characteristics of traditional structures would be necessary criteria for a social acceptance of new techniques.

## Proposed directions of developments:

- keeping the “breathing quality” when improving the energy efficiency of the traditional wall structures
- application of wooden-frame breathing walls with modifications to the local preconditions (not traditionally used in the country)

# R&D program

- how to adopt the “breathing wall” concept and construction on local climatic and cultural condition
- to convert the concept in the building techniques traditionally used in Central and East-Europe
- to use the term “breathing constructions” in a wider sense: a more active connection and “communication” between the building’s interior and the external environment (physical & psychical aspects)

## **New “communicative building envelopes”:**

**connect the internal and external environments in a healthier and more natural way.**

## **Aim:**

to develop **prototype constructions** addressing different building techniques

# The concept of breathing walls – state of the art I.

## The problem:

Increasing use of synthetic materials + tightly sealed buildings (energy-efficiency)



- too sealed constructions without breathing qualities
- limited natural storage and transmission processes (heat, solar energy, air, moisture, light)
- increased emission level of pollutants (vapours from timber treatments, paints, vinyl and formaldehyde glues, radon decomposition products, etc.), harmful radiation and electro-pollution



“**sick buildings**” , serious effect on the occupants' health

## The answer:

- air-conditioning or integrated and optimized ventilation design
- building envelopes with porous membranes to allow „breathing” through the building fabric

# The concept of breathing walls – state of the art II.

## **The simplest concept:**

refers rather to diffusion of water vapour than air through the fabric.

## **Breathing wall:**

“a particular timber-frame construction that has higher vapour permeability than conventional designs and hence increased moisture migration from inside to outside of the structure”

## **Dynamic insulation:**

relates also to air-breathing (depressurisation of the internal air through active and passive extraction, filtering).

## **Diffusive insulation:**

a special case of dynamic insulation where the air-flow is zero

# The timeliness of the problem I.

Continuous and **intensive house-building** activity throughout Europe.

The **competitiveness** of new housing with refurbishments will increasingly be determined by two major factors:

- affordability
- the provision of a **new type of quality** (exceeding the limits of refurbishments)

Housing quality is strongly related to **building envelopes**:

- the **most durable** building components (whole lifetime)
- the **most problematic** building components (~ 80% of building failures)
- the **greatest influence on indoor air quality, comfort, architecture and environment**, all essential factors in the **quality of the urban life**.

**Complexity** of the problem  
(health, ecology, energy and architecture  
should be brought together)



**holistic, integrated approach**



**Widened definition of  
breathing construction**



**“communicative building envelopes”**

# The timeliness of the problem II.

## Challenges in Hungary and in Europe:

- new emerging housing programs (H)
- sustainable construction techniques and their affordability
- creating a real market for “sustainable building”
- raising the public’s awareness of sustainable and healthier life
- to make the residents aware of the quality of the house and district they live in

## Breathing constructions’ contribution to European policies:

- optimizing the use of resources, reducing the use of primary raw materials and primary energy consumption in buildings
- minimizing the production of pollutants
- improving the indoor health and comfort of the built environment
- preventing “sick building syndrome” and decreasing risks of health related to the environment
- increasing the level of recycling
- reducing the life cycle cost of the construction process

# Developments I.

## Aims:

- applying healthier and more natural materials
- optimizing ventilation and filtering
- improving communication (contact) between inside and outside
- to determine the necessary minimum envelope
- a change from technical and “conceptual” architecture to a more philanthropic and environmentally friendly architecture

## Addressed constructions to use “breathing wall principles”:

1. Adopting **wood and wooden-like light constructions** with various ecological heat insulations
  - Special application field:  
built-in attics also in case of traditional masonry construction
  - Special consideration: possibilities of prefabrication (low-cost quality)
2. Sustainable silicate-base products used in **masonry constructions**
3. **Other green building techniques** using local or locally available materials (like adobe, straw, wood, hemp, cellulose, etc.)
  - Special consideration: possibilities of using self-built or industrialized techniques

# Developments II.

**The principle of breathing is aimed to widen to several levels**

## **physical measures:**

- to use solar energy
- controlled heat and vapour storage and transmission, airflow and filtering
- to reduce the level of indoor pollutants
- the transmission of useful radiation, filtering of harmful radiation
- light transparency and protection,
- noise and vibration protection
- all other essential requirements (safety in case of fire, structural stability, etc.)

## **psychical measures:**

- good day-lighting (window/wall ratio, skylights, greenhouses, orientation),
- optimal view out from the interior and the protection against the view in
- architectural appearance

# Testing and performance monitoring

## Circumstances:

- in laboratory;
- in outdoor test-cells;
- in a full-scale model building;
- in new housing estates in real urban context.

## Related aims:

- to minimize ventilation heat losses by increased air tightness;
- lower fabric heat loss, thus energy saving through the whole life-cycle;
- healthy indoor climate with low pollutant emissions and optimal indoor relative humidity.

## Conditions:

- testing in all seasons of the year;
- control tests of traditional constructions.

# Conclusion

## **Breathing constructions:**

- towards a more healthy, ecological and energy efficient building practice;
- minimize toxic impact load on indoor spaces;
- minimize impact load on the environment.

## **Proposal:**

To widen the common term of breathing constructions and convert their basic principles to various building techniques, climates, cultures and environments. A holistic, integrated approach is suggested.

## **in Central and Eastern Europe:**

- to introduce breathing constructions on a wider sense;
- to convert the main principles to traditional brick or adobe constructions.

## **In large-scale housing programs in urban context:**

- affordability is a major factor of competitiveness;
- special climatic and cultural conditions (attitudes);
- to test physical issues in a context, where the surface of the envelopes are limited and factors like day-lighting, orientation and architectural appearance should be also strongly considered.