

# Moisture accumulation in building materials and growth of fungi

COST Action FP 1303

30-31 August 2016

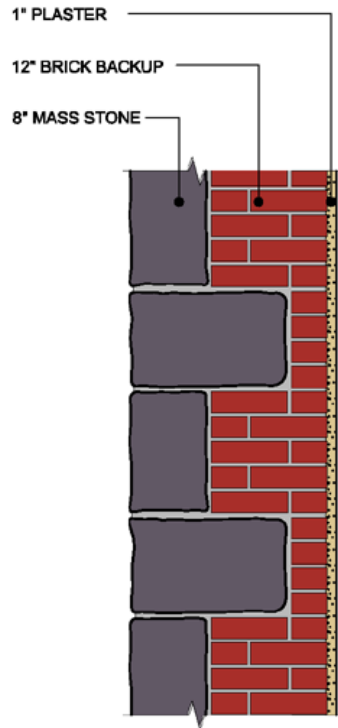
Poznan, Poland

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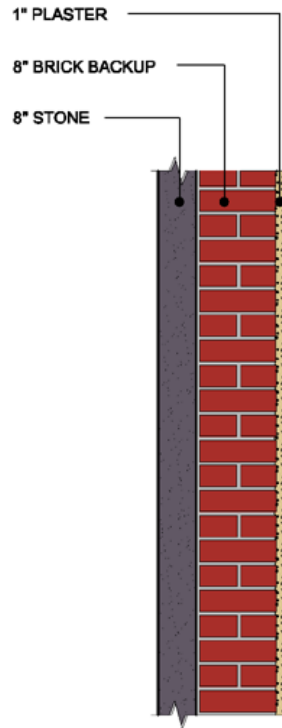
# Introduction

- Distinct characteristics of a building play an important role in how much energy it uses
  - Building structure/type, building materials.
  - Ventilation performance.
  - Poor maintenance and improper operation of buildings.
  - Poor structural or system design.
  - Age of the structure.
- The need for comfort together with the increased time spent inside buildings have elevated building energy consumption.
- In recent times, there has been attempts to improve building performance and minimize energy usage
  - Improved insulation → Reduce heat loss
  - Improved ventilation systems → Thermal comfort.

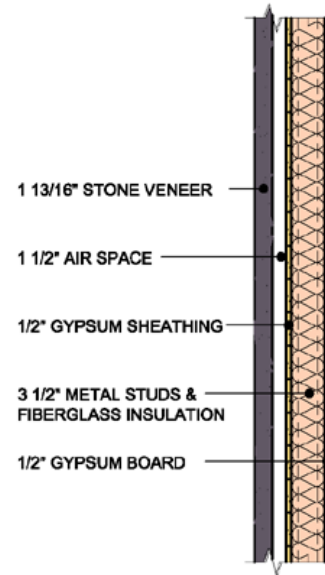
# Changes in building structure



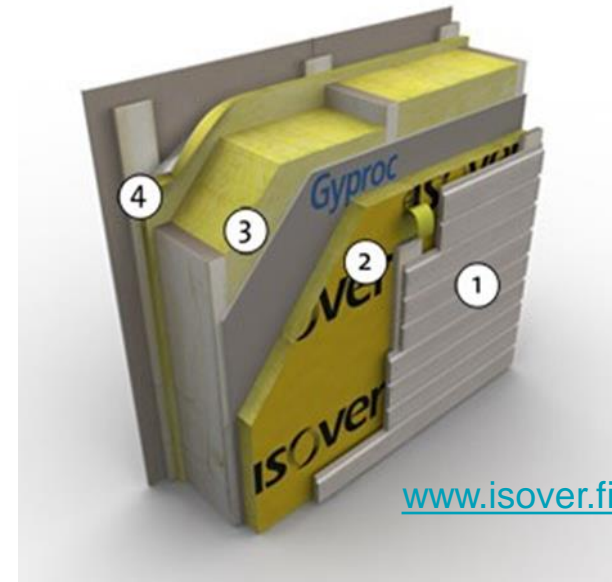
**STONE BEARING WALL 1800**



**STONE CURTAIN WALL 1932**



**STONE VENEER CURTAIN WALL 2004**



[www.isover.fi](http://www.isover.fi)

1. Outer wall
2. Air space
3. Glass fibre insulations
4. Inner wall

*(Morse and Acker, 2009, the Whole Building Design Guide and the National Institute of Building Sciences)*

# Intro cont'd

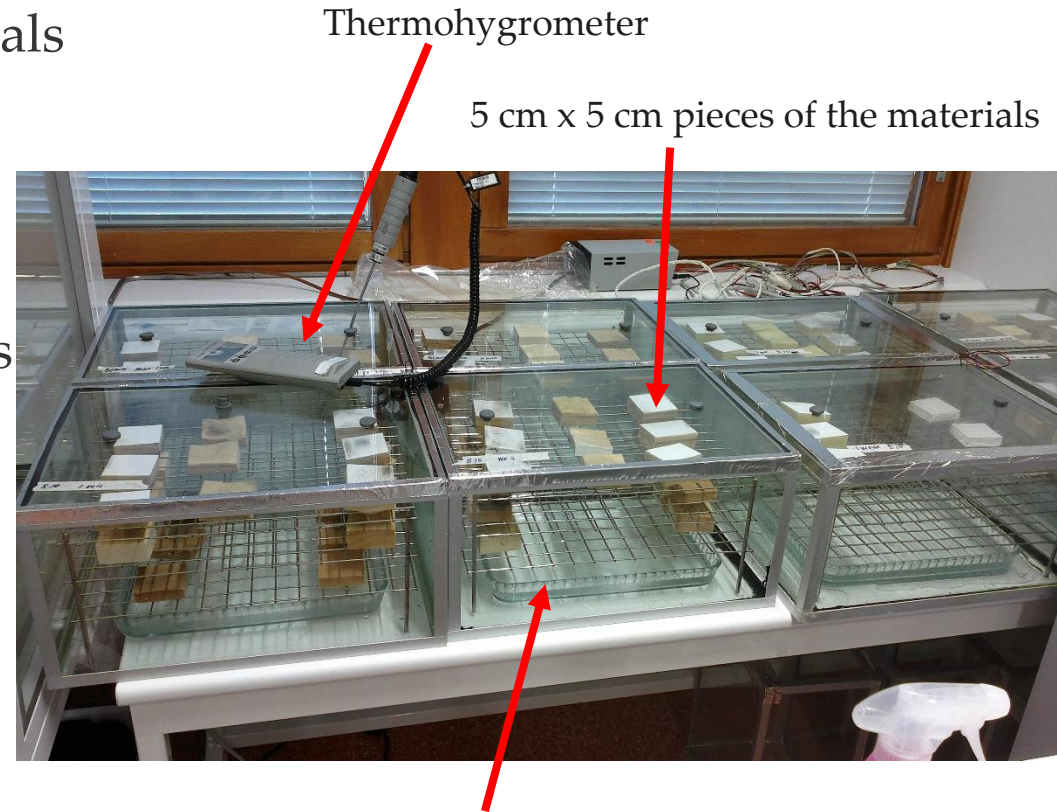
- A reduction in the ventilation rate is one way to achieve potential energy savings.
- On the other hand, continued running of the system at lower flow rates decreases the efficiency of the air exchange and this can allow moisture to accumulate, creating conditions favorable for microbes, especially fungi, to grow in the structures and indoors.
- Damage to the building materials.

# Aim

- To determine the water sorption capacity of different building materials and how the accumulation of moisture influences fungal growth.

# Materials and Methods

- Two types of building materials
- Green building materials
  - Acoustic board (ABD)
  - Haltex
- Non-green building materials
  - Acoustic board (ABY)
  - Gypsum board
- Wood
- Three fungal species
  - *Aspergillus versicolor*
  - *Cladosporium cladosporioides*
  - *Penicillium brevicompactum*



# Moisture content estimation

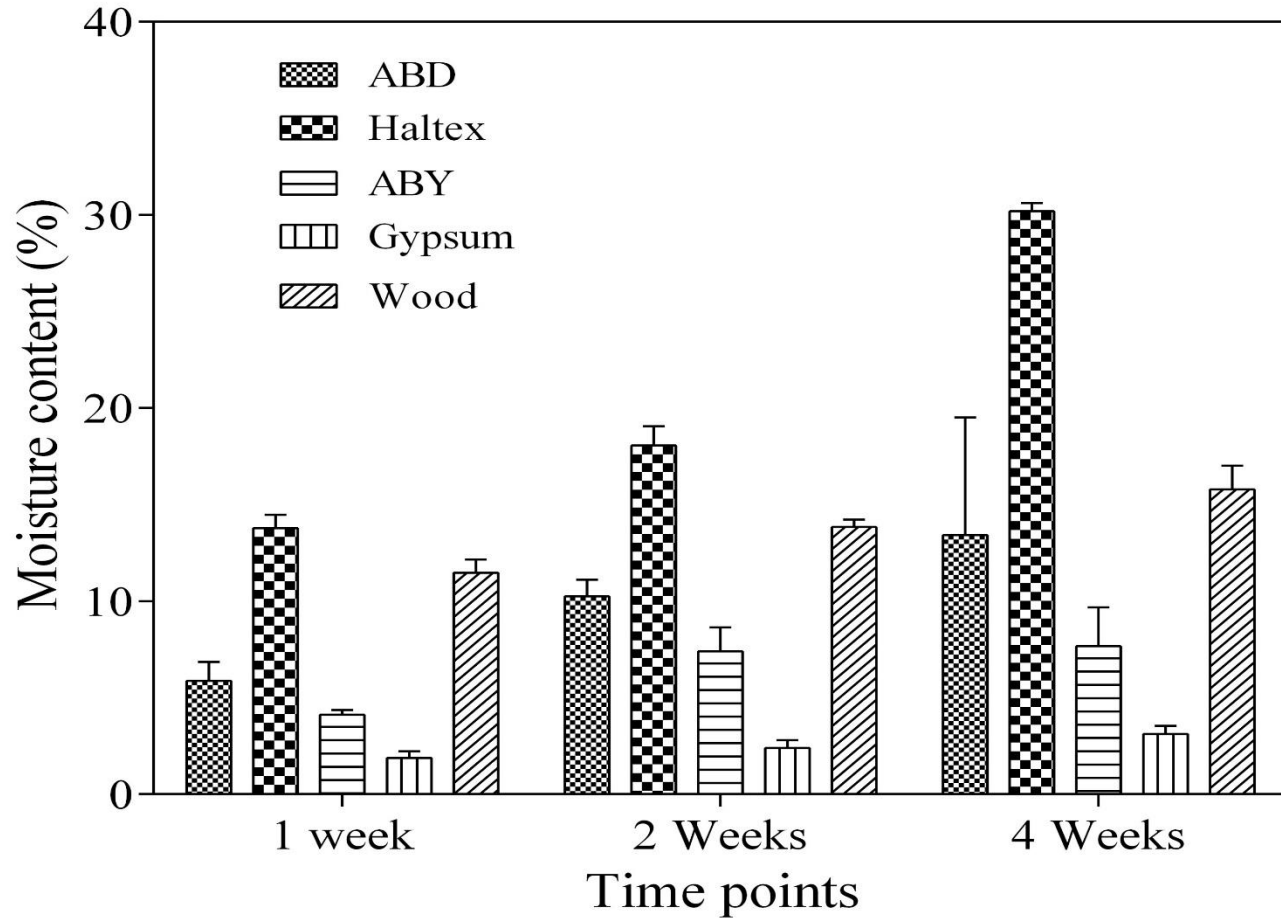
- Initial weights of blank building material pieces were measured ( $M_{initial}$ ).
- Building material pieces were kept in conditioned chambers for 1, 2 and 4 weeks.
- The building material pieces were weighed at the end of each time point to determine the amount of moisture the materials had absorbed ( $M_{final}$ ).
- Estimate of the moisture content of the materials was calculated as follows:
  - $MC = \frac{M_{final} - M_{initial}}{M_{initial}} \times 100$

# Fungal growth measurements

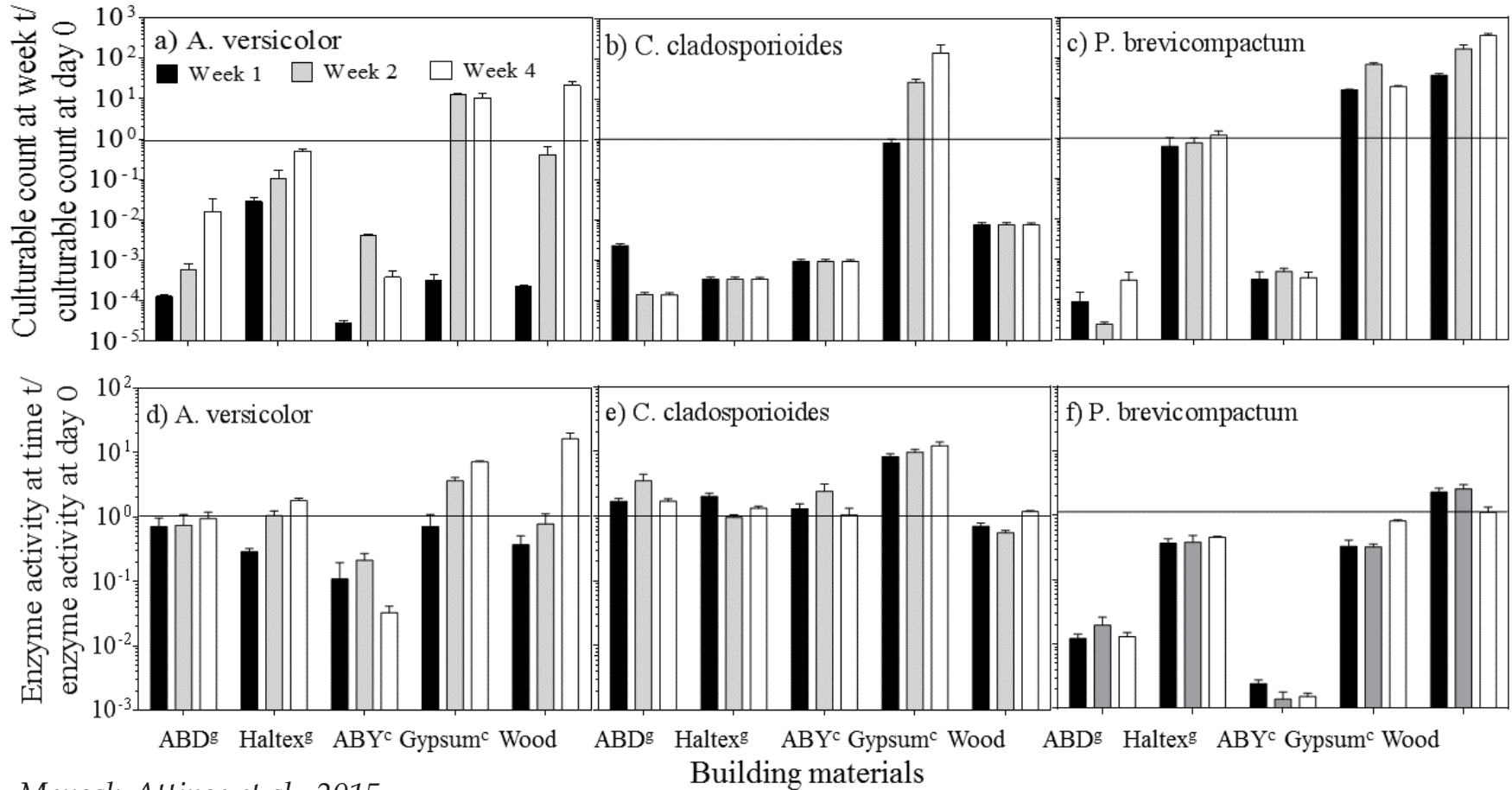
- Cultivation method (viable counts) and N-acetylhexosaminidase (NAHA) enzyme activity (total biomass) were used to determine fungal growth.
- Fungal growth was assessed at three time points (Weeks 1, 2 and 4).
- Concentration at Day 0 was also determined.
- Normalized concentration = fungal concentration with respect to day 0.
- $$\text{Normalized conc} = \frac{\text{Concentration at time } t}{\text{Concentration at day 0}}$$
- Values above 1 → growth
- Values below 1 → "survival"



# Results



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Mensah-Attipoe et al., 2015

# Conclusions

- Growth was diverse and depended on the type of fungi and material substrate.
- Fungal growth increased with increase in moisture content of building materials.
- In situations where moisture accumulation cannot be minimized, building materials that are less susceptible to fungal growth should be used in order to protect the building structures.

*Thank you!*



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Supported by the Finnish Distinguished Professor (FiDiPro) program for the Development of Bioaerosol Testing Facilities (BiTeFa) project through TEKES (1391/31/2011).