

# Hygroscopic Materials versus Mechanical Ventilation

## 4.1 Matter and Material Science

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# Office Presentation – Ziegert | Roswag | Seiler Architekten Ingenieure

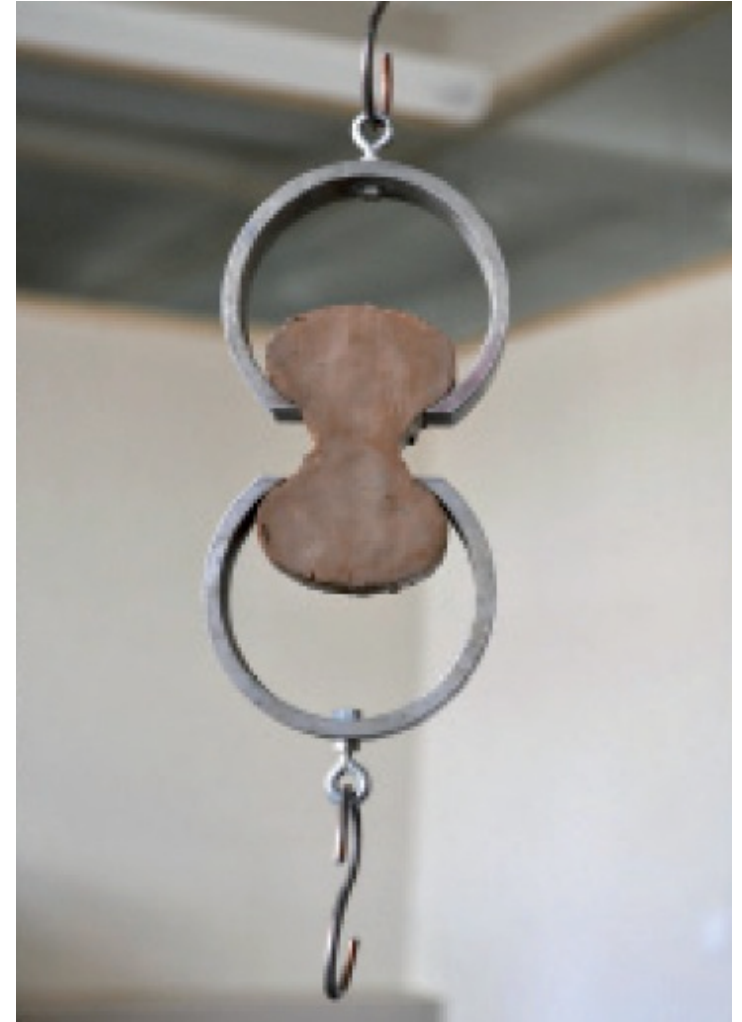
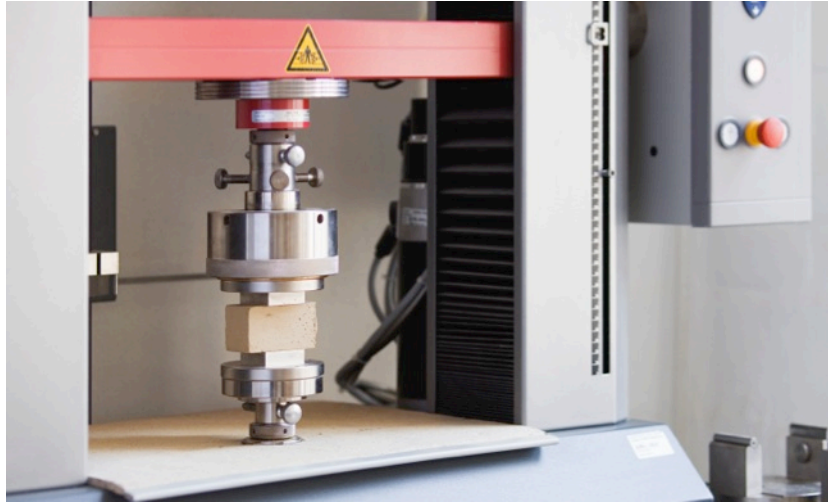
**Building with renewable resources in Germany and internationally**





# Office Presentation – Ziegert | Roswag | Seiler Architekten Ingenieure

Office lab for material testing and development for construction



# [H] house EU Research Project

## EU funded Research Project

### Project Aims & Objectives

- Indoor Environmental Quality (IEQ)

- > Relative humidity levels

- > Low emissions

- > Adsorption of airborne pollutants

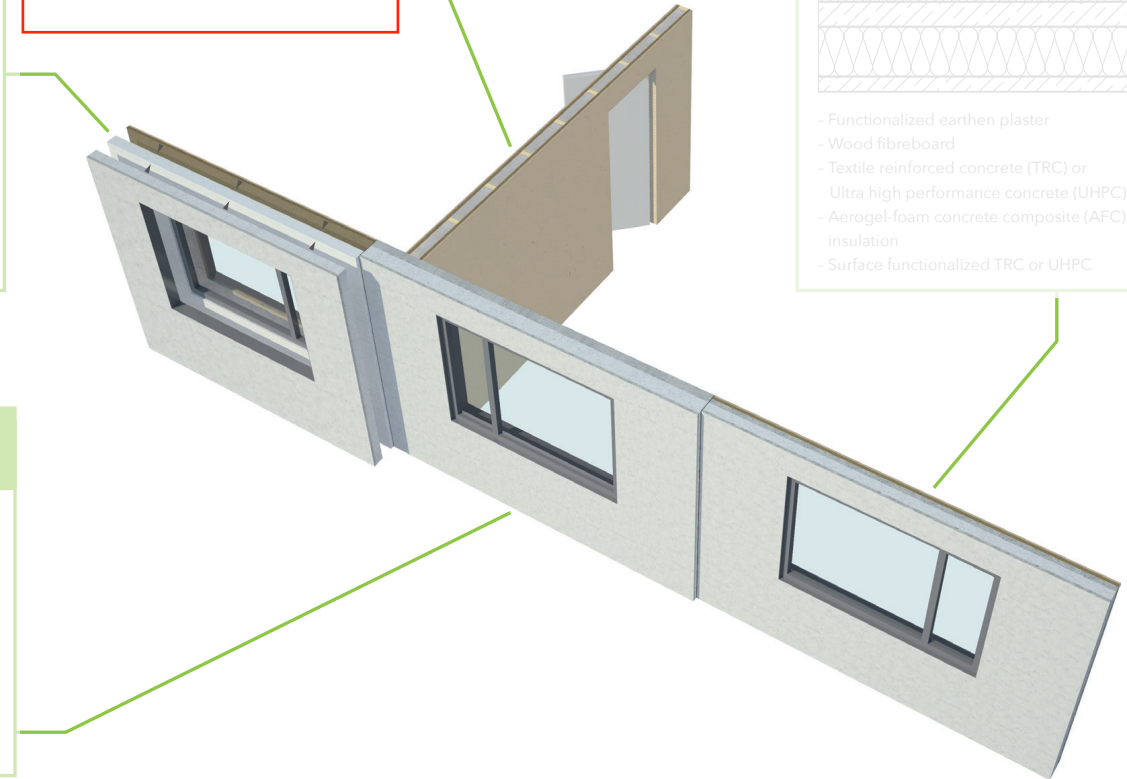
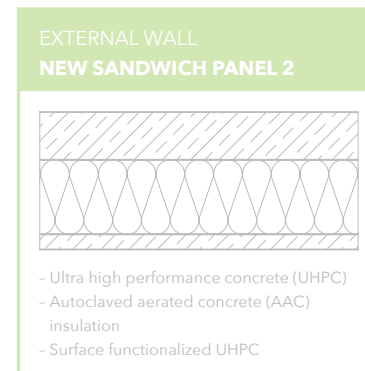
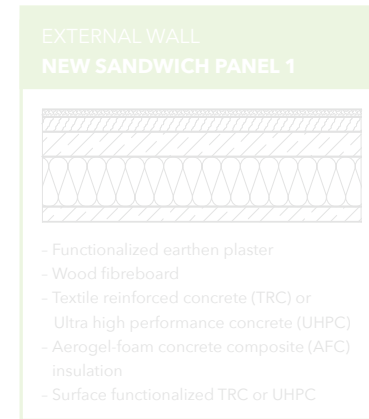
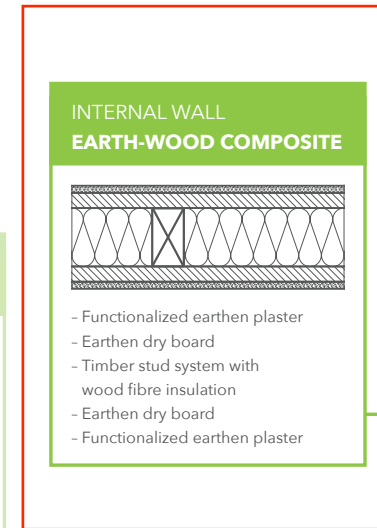
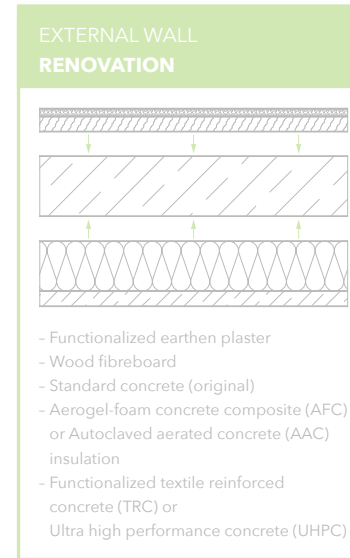
- > Noise protection and acoustics

- Sustainable construction

- LCA / LCC

- Durability

- Affordability





# [H] house Project Goals

## Improved Indoor Environment Quality (IEQ)

Address shortcomings associated with modern airtight buildings

- > increased or reduced relative humidity levels indoors
- > higher concentration of air pollutants and microorganism
- > damp problems and condensation, resulting in mould growth



Mould growth



Materials' emissions



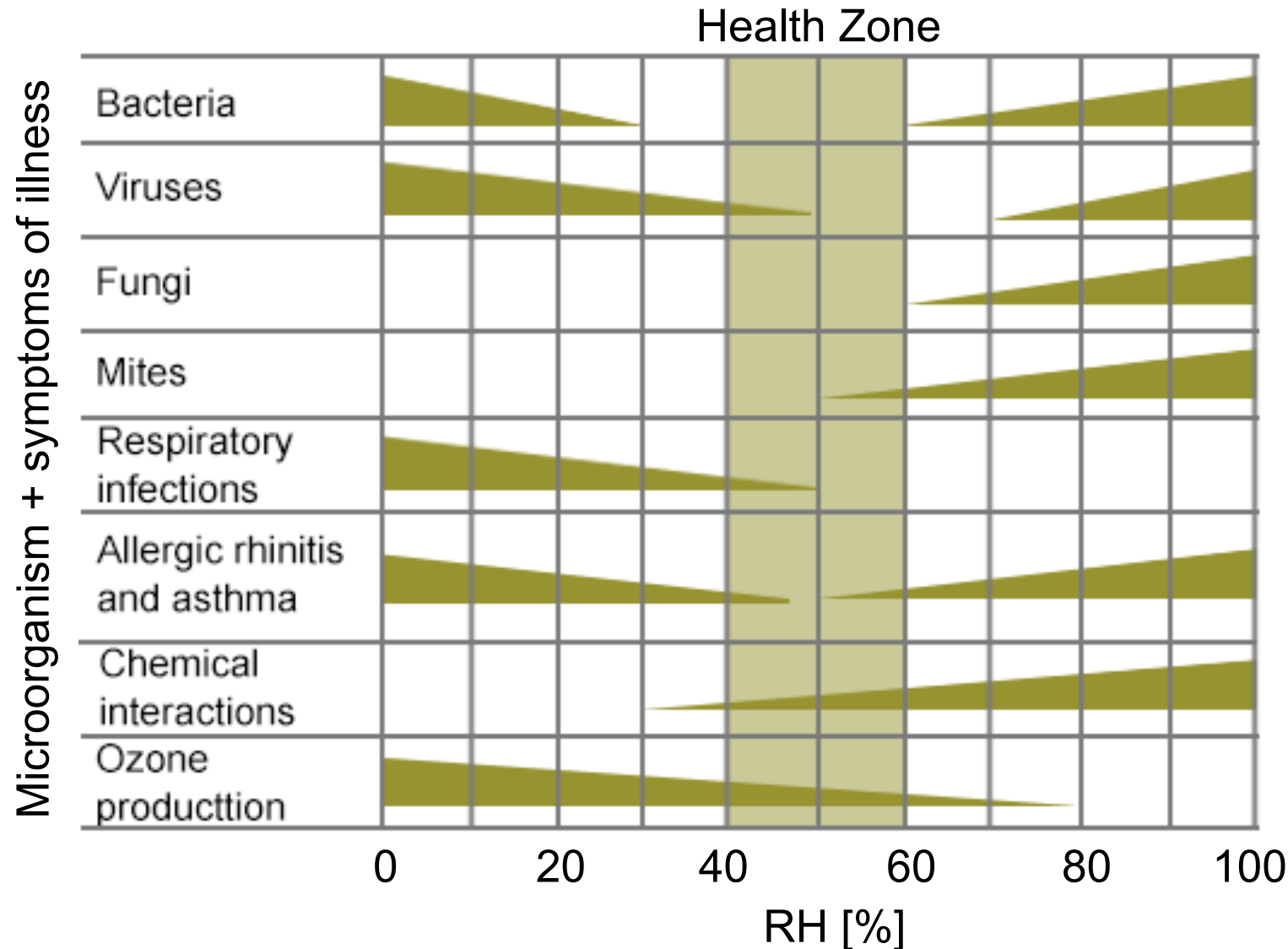
Evaporations



Occupants health

# [H] house Project Goals

## Improved Indoor Environment Quality (IEQ)



Scofield Sterling Diagram 1985

Decrease in bar width indicates decrease in effect

# [H] house Project Goals

## Improved Indoor Environment Quality (IEQ)

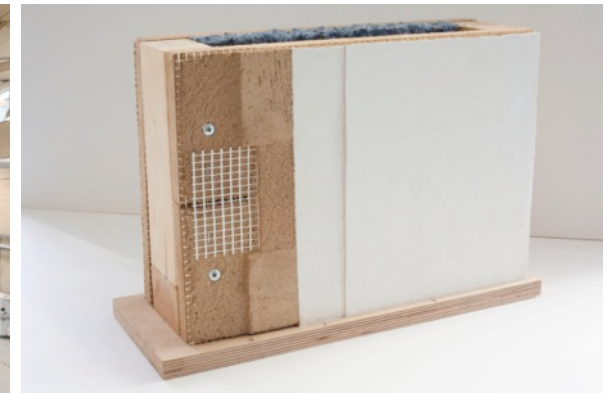
- Develop robust solutions that are able to react to reduced air exchange rates and reduce associated problems to improve occupants' health and well being
- Omission of mechanical ventilation
  - > importance of appropriate material selection
  - > vapour permeable construction, appropriate glazing ratio



Appropriate material selection



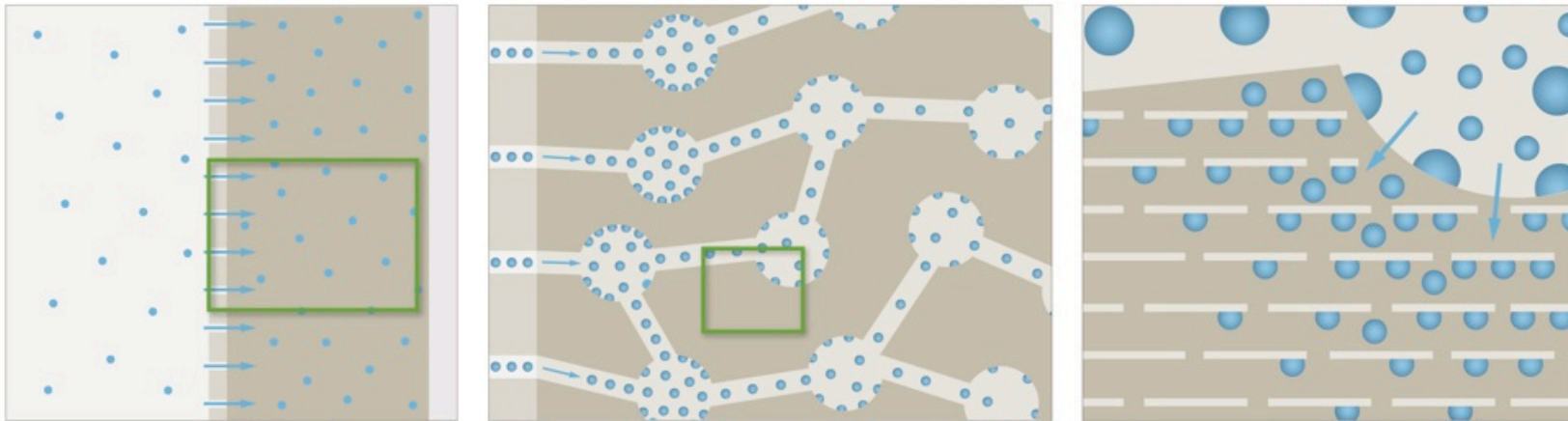
Increased moisture buffer through natural building materials, appropriate construction



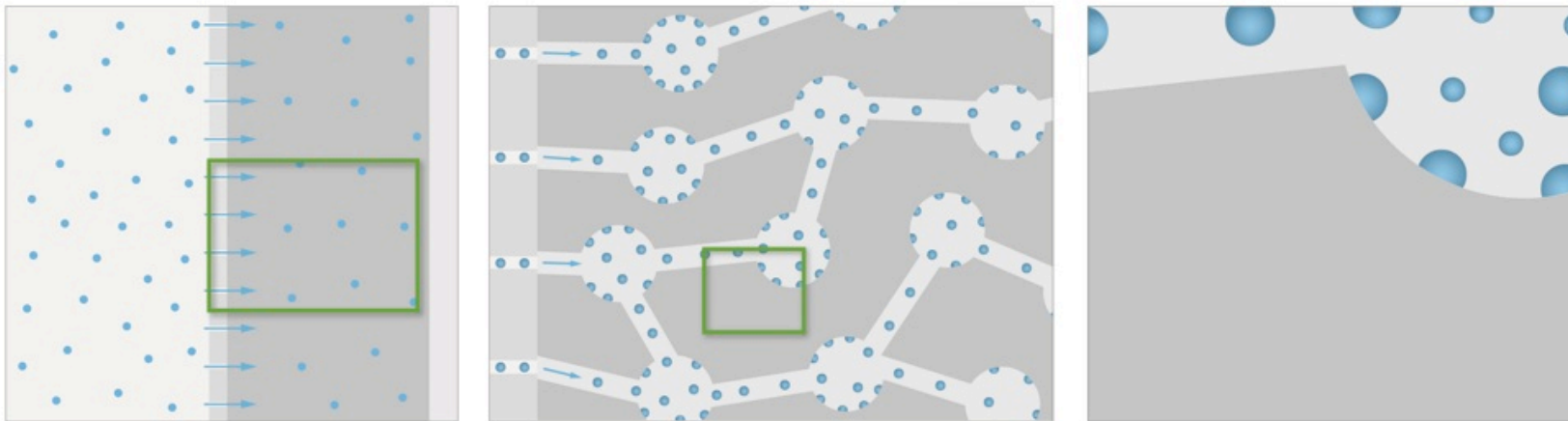
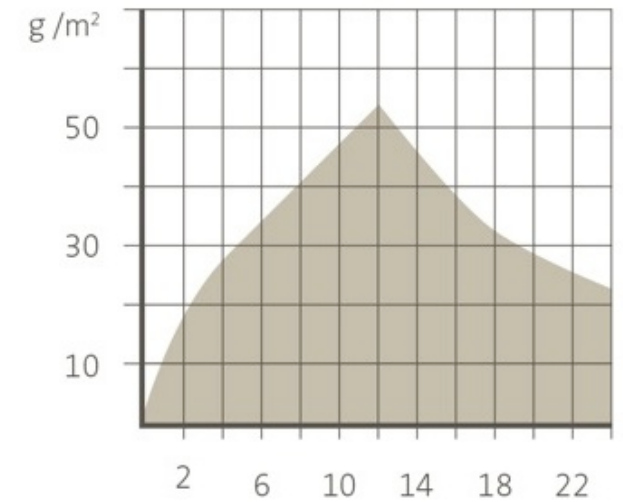


## [H] house Project Goals

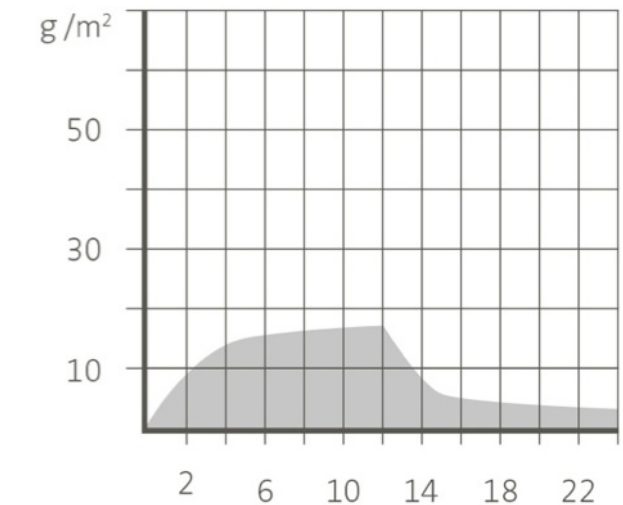
### Increased Moisture Buffer of Earth Plaster in comparison to Conventional Plaster



Texture and water vapour adsorption of earthen plaster



Texture and water vapour adsorption of NON earthen plaster

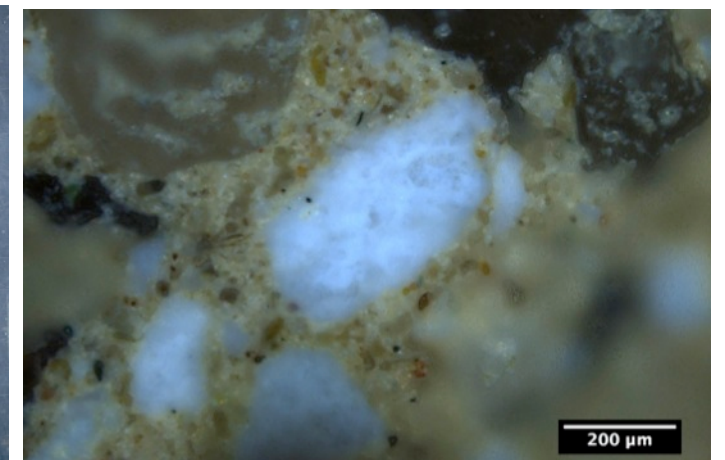
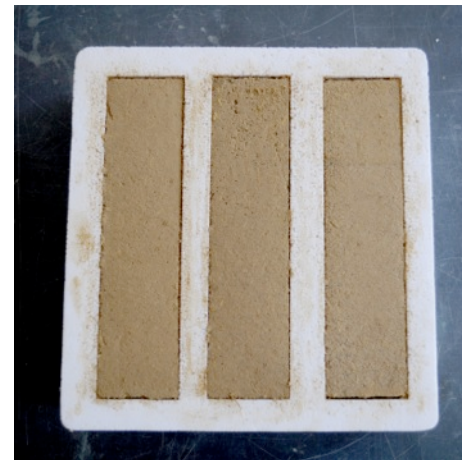
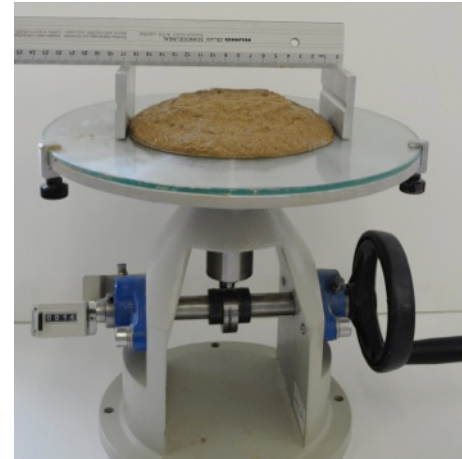




# [H] house Material Development – Indoor Environmental Quality (IEQ)

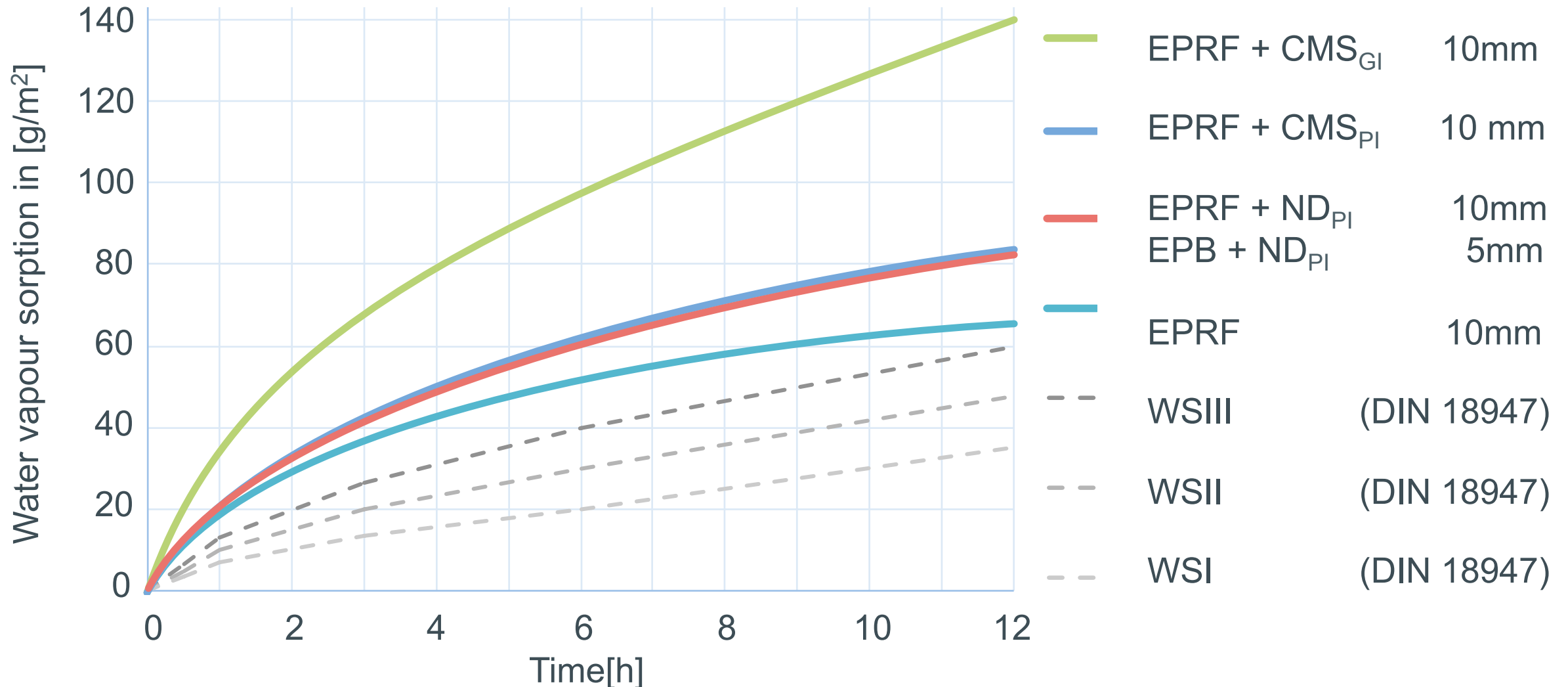
## Aerogel modified Earth Plasters

- Aerogel are highly porous solid objects on the basis of silicates
- Bulk density between 40-150 kg/m<sup>3</sup>
- Surface area 750 m<sup>2</sup> / g
- 3 different types of Aerogel (ND/CMS/E9)
- Spray dried powder, compacted granules
- Very cost efficient material production



# [H] house Material Development – Indoor Environmental Quality (IEQ)

## Water vapour adsorption test (DIN 18947 – Earth Plasters)



# [H] house Material Investigation

## Selection of Natural Building Materials for Internal Partition Walls



Earth plaster



Earth dry, earth cellulose board



Wood fibre board, sandwich board



Wood fibre, hemp and clothes insulation

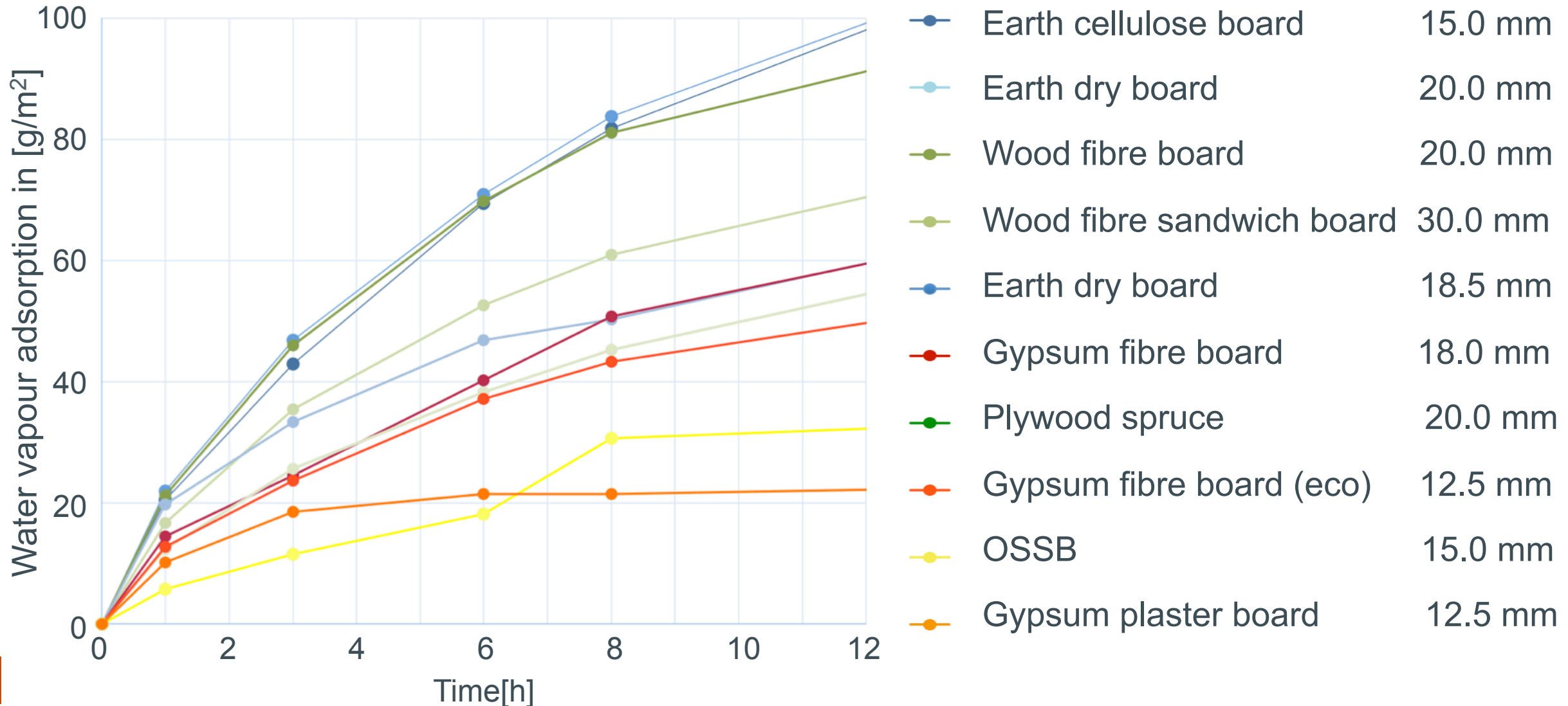


Wood fibre flax board, strawboard



# [H] house Material Investigation

## Water Vapour Adsorption Tests – Wall Lining Boards



# [H] house Material Investigation

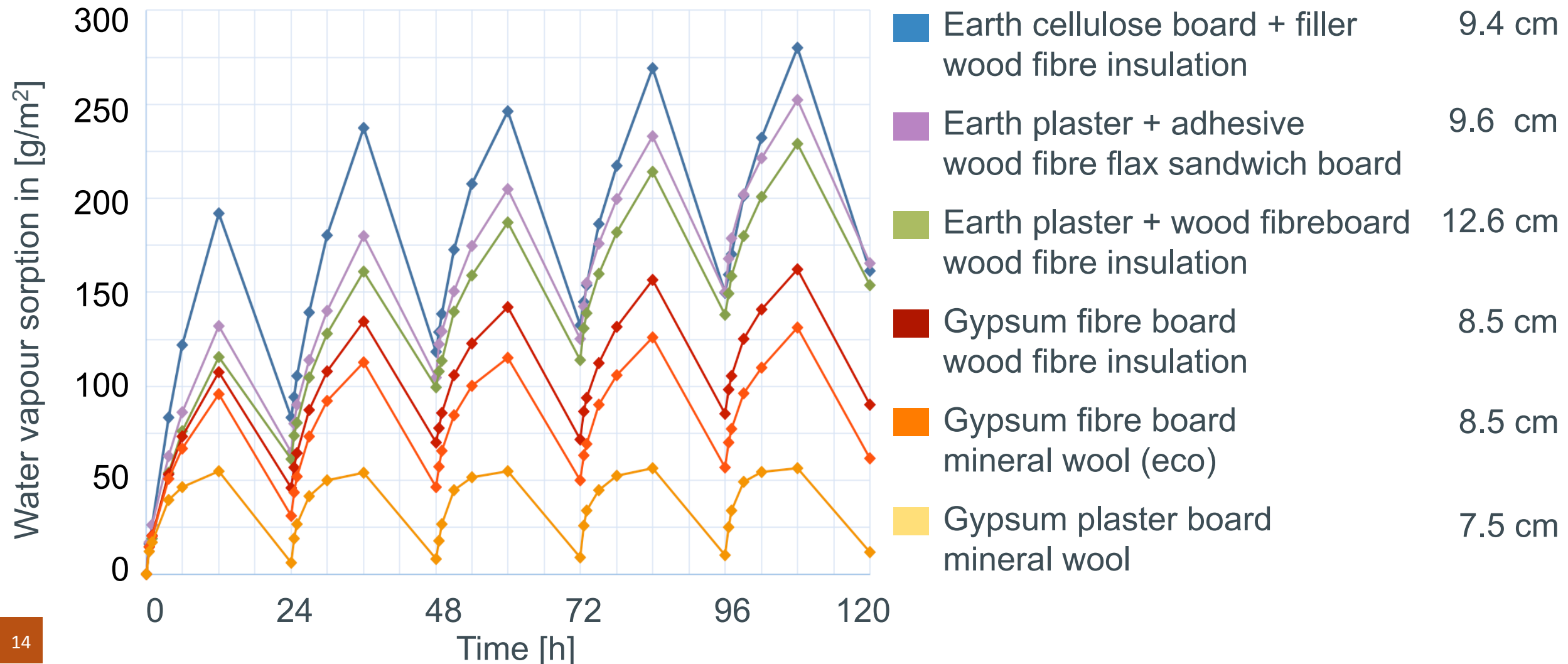
## Water Vapour Sorption Tests for Wall Build-Ups (Internal Partition Walls)



Wall build-up: earth plaster (straw) + earth adhesive + wood fibreboard + wood fibre insulation

# [H] house Material Investigation

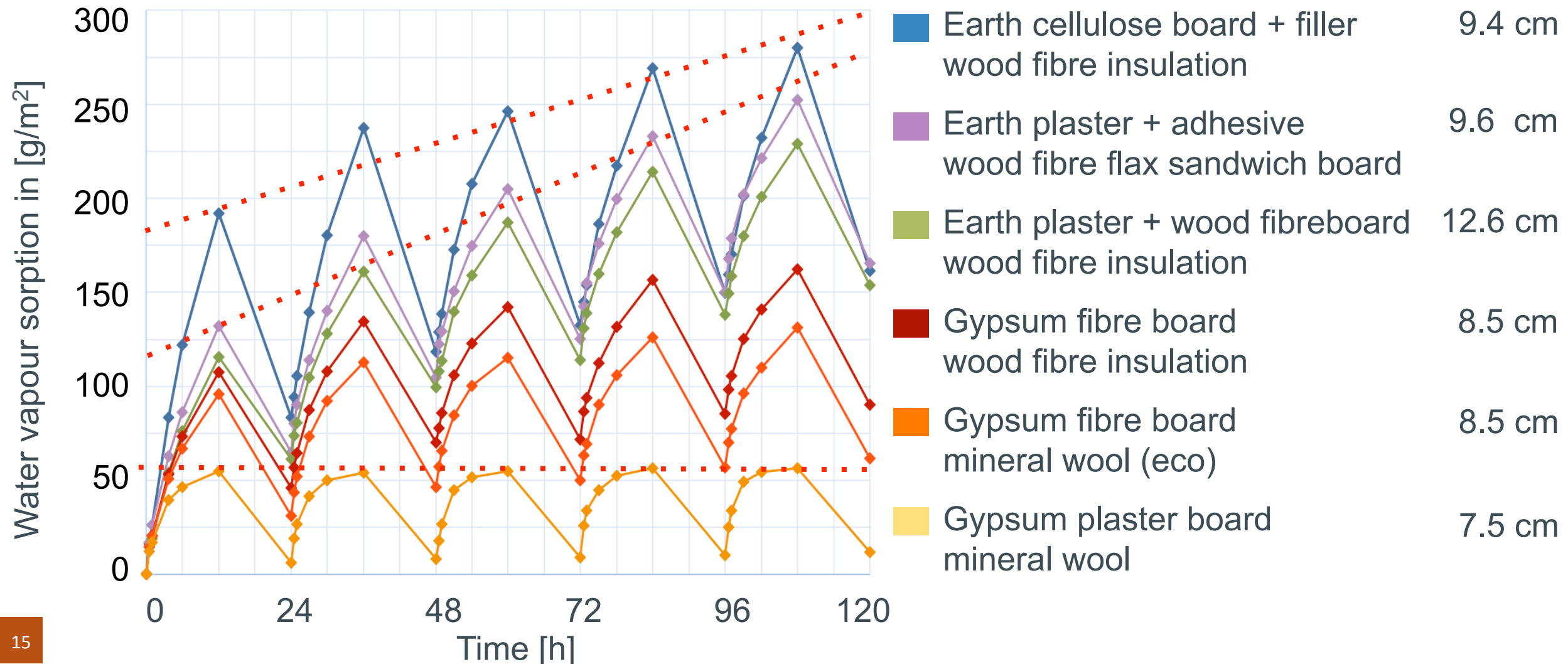
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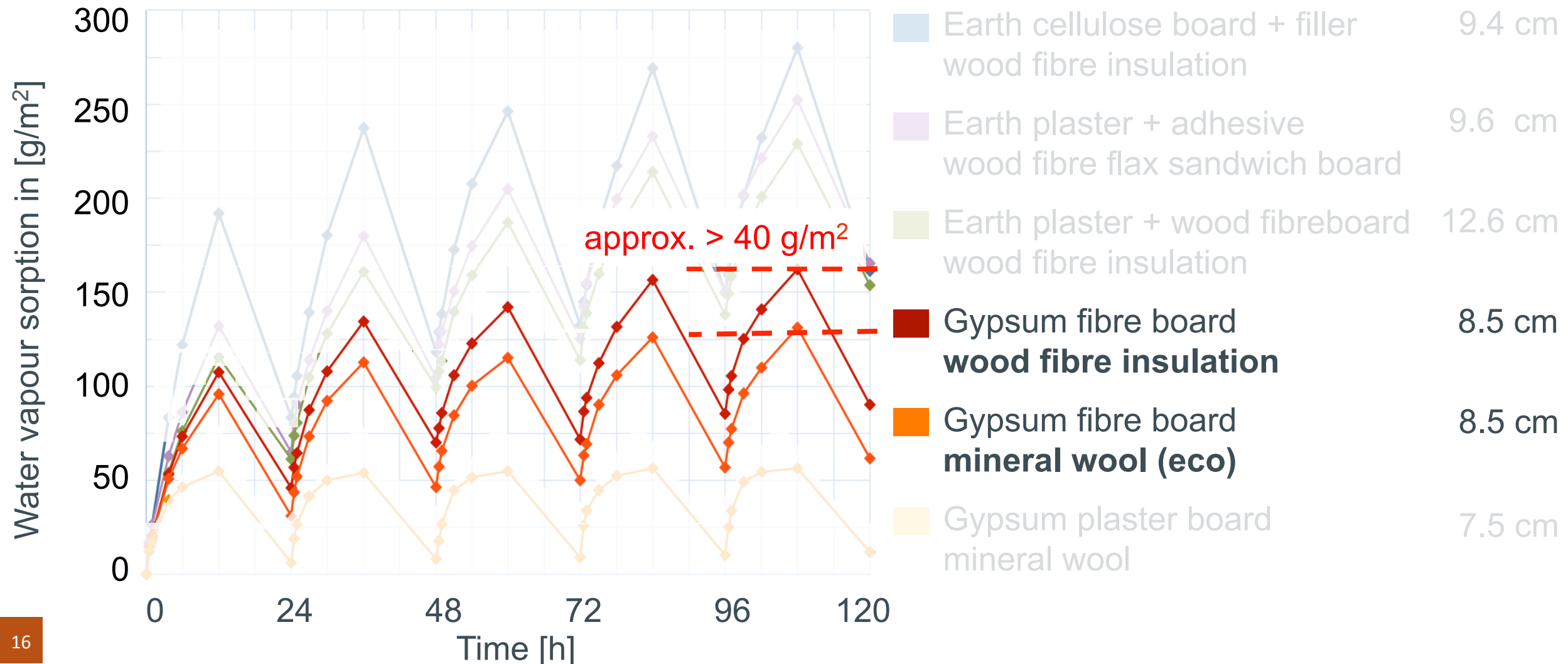
# [H] house Material Investigation

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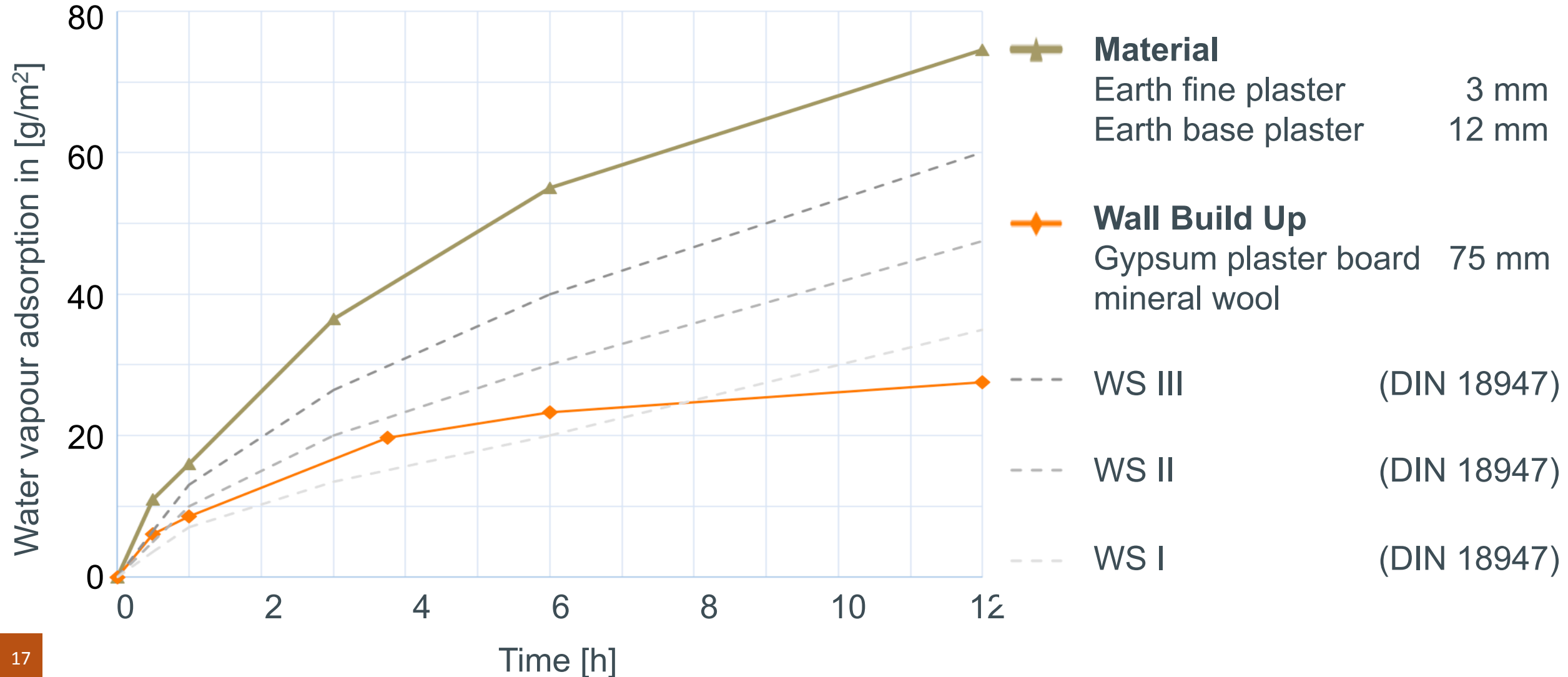
# [H] house Material Investigation

## Water Vapour Sorption Tests for Wall Build-Ups (Internal Partition Walls)



# [H] house Material Investigation

## Water Vapour Sorption Test - Earth Plaster and Gypsum Plaster Wall Build-Up





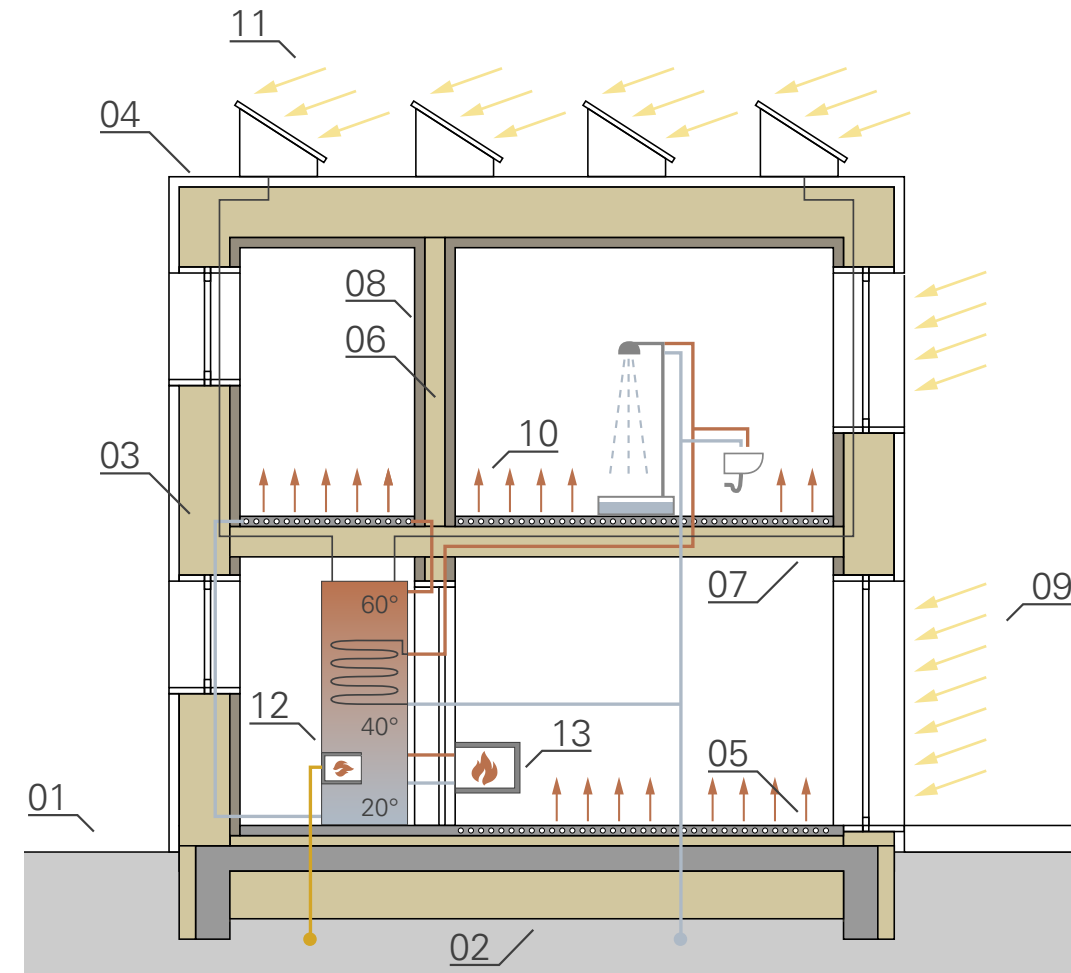
## [H] house – Conclusions and Outlook

- Hygrothermal simulations in WUFI run in parallel to assess the impact of proposed constructions on the indoor environmental quality with regards to temperature and relative humidity levels
- LCA Analysis to investigate the environmental impact of mechanical ventilation
  - > area assessment
  - > energy assessment
  - > cost assessment
- Monitoring of existing apartments fitted out with earth plasters to calibrate the simulation model and to generate data from real case scenarios

# Building Application

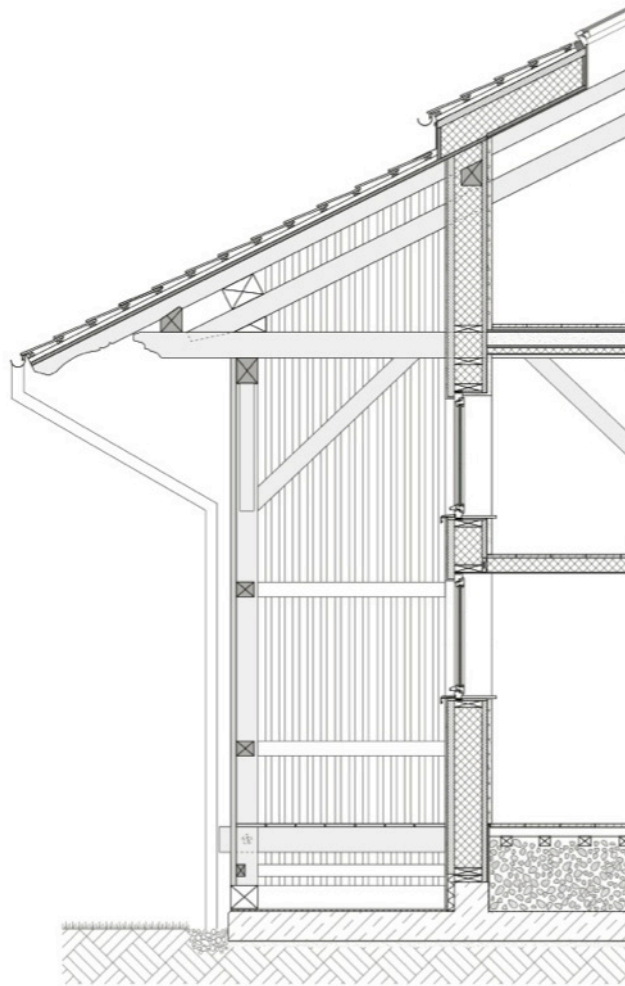
## Construction without mechanical ventilation

- External walls  
Vapour permeable construction through timber, cellulose and earth plasters
- Water vapour moisture buffer through application of earthen plasters and wood fibre boards for internal partitions
- Natural ventilation



# Building Application

## Reconstruction of a historic Barn with earth and timber







Thanks for your attention

# Roswag Architekten

Ziegert | Roswag | Seiler

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## Thanks all co-authors



BAM



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