Methodological Improvements in the Assessment of the Resistance against Moulds of Bio-based Insulation Materials

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BIOBASED Insulation materials

Reed fibers

Cotton wool

Cork

Linen wool

Duck feathers

Wood fibers

Cellulose

Coconut fibers

Straw

Hemp

http://www.developpementdurable.com/diapos/2011/01/D5723/E1097/habitat-les-differents-isolants-ecologiques.html

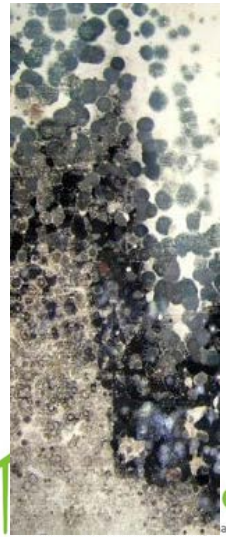
In-door use, dry environment = insulation material at its initial state

If abnormal moisture conditions (weathering, condensation, leaky buildings …)
And insulation material not treated and not resistant to biological threat

Development of moulds and decay fungi

Degradation by subterranean termites

Toxicity (indoor air quality)
Altered thermal performance



Possible mould growth on biobased insulation materials

Reliable characterization of the resistance against moulds of insulation materials ?
Limit mould growth conditions of temperature and relative humidity ?

- **French project supported by the Ministry of Ecology**
- **Optimization of the mold resistance criteria of biobased insulation materials according to their end use**

1 – Development of a laboratory test protocol for the assessment of the resistance against mould growth of biobased insulation materials

2 – Study of the impact of temperature and relative humidity conditions on mould growth and water uptake of insulation materials

1 – Development of a laboratory test protocol for the assessment of the resistance against mould growth of biobased insulation materials

EN 15101-1 (2013) Thermal insulation products for buildings - In-situ formed loose fill cellulose (LFCI) products - Part 1: Specification for the products before installation

Annex F Method for determining mould fungi resistance

ASSESSMENT CRITERIA: only qualitative (visual rating)

Mold growth rating	Evaluation
0	No mould growth (microscope observation x50)
1	Moulds hardly visible to the naked eye, but clearly visible through light microscope (magnification x50)
2	Moulds visible to the naked eye – less mould growth on the test material compared to the reference material
3	Moulds visible to the naked eye – mould growth equal or higher on the test material compared to the reference material

Visual rating of mould growth on loose fill insulation materials is subjective and not very accurate

High risk of interpretation mistakes

1 – Development of a laboratory test protocol for the assessment of the resistance against mould growth of biobased insulation materials

Chance of having false negative test

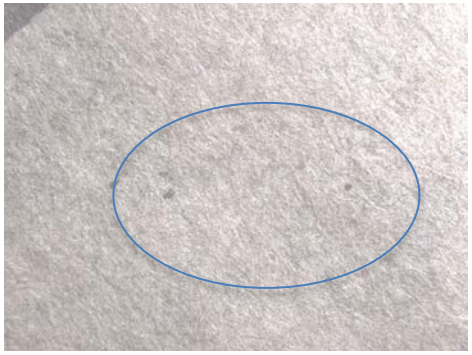
Impossible to see the whole surface of loose fill insulation materials by naked eye / light microscopy due to its size and heterogeneity

	Observation		Conclusion
	Average visual rating= 0	→	**RESISTANT**
	Number of spores at the end of the test = x40 number of spores initially inoculated to the material	→	**NON RESISTANT**

→ **Importance of qualitative AND quantitative assessment of mould growth**

Chance of having false positive test

Stains on insulation materials can be confused with molds or insulation materials might have been contaminated with moulds prior to testing

Observation		Conclusion
	→ Average visual rating = 2	→ **NON RESISTANT**
	→ Number of spores at the end of the test < number of spores initially inoculated to the material	→ **RESISTANT**

→ **Importance of qualitative AND quantitative assessment of mould growth**

Other test parameters also need improvement (i.e. sterilization of the test samples …)

1 – Development of a laboratory test protocol for the assessment of the resistance against mould growth of biobased insulation materials

INPUT TO FRENCH AND EUROPEAN (CEN TC 88) STANDARDIZATION

Set up of a new test protocol: test methodology and analytical criteria

Draft standard in preparation (French mirror commitee of CEN TC 88)

Proposition of an amendement to the standard EN 15101 (CEN TC 88 / WG15)

Experts discussions
Round-robin tests
Validations

Revision of the standard EN 15101

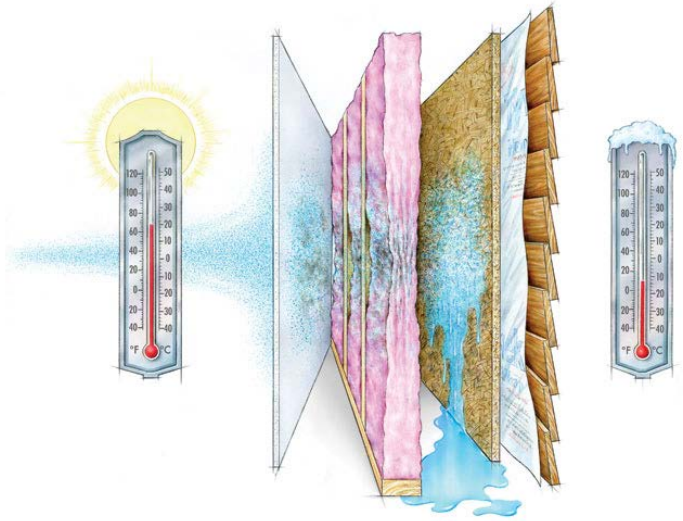
2 – Study of the impact of temperature and relative humidity conditions on mould growth and water uptake of insulation materials

Moisture risk for insulation materials

When, why ?
How often ?
Associated risk of degradation?

Modelling of climatic conditions (T/MC) in wooden frames

Vary along the year,
depend on geographical areas, climate



OBJECTIVE : Use Classes for biobased insulation materials based on the risk of mould growth

2 – Study of the impact of temperature and relative humidity conditions on mould growth and water uptake of insulation materials

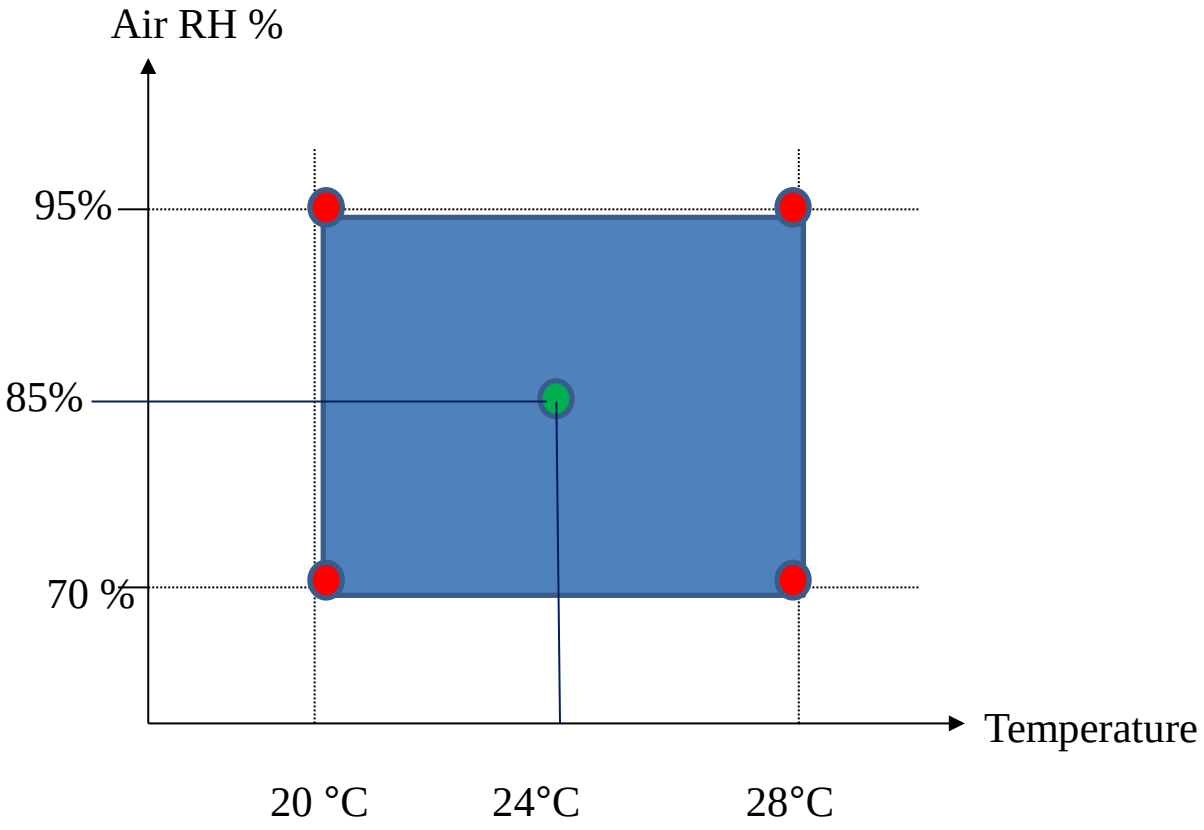
METHOD: mould resistance of cellulose based insulation material

Study of 2 factors: temperature and air relative humidity

5 couples of tested parameters
4 replicates

↳ 20 tests

+ 1 test done at
12° C and 95% HR



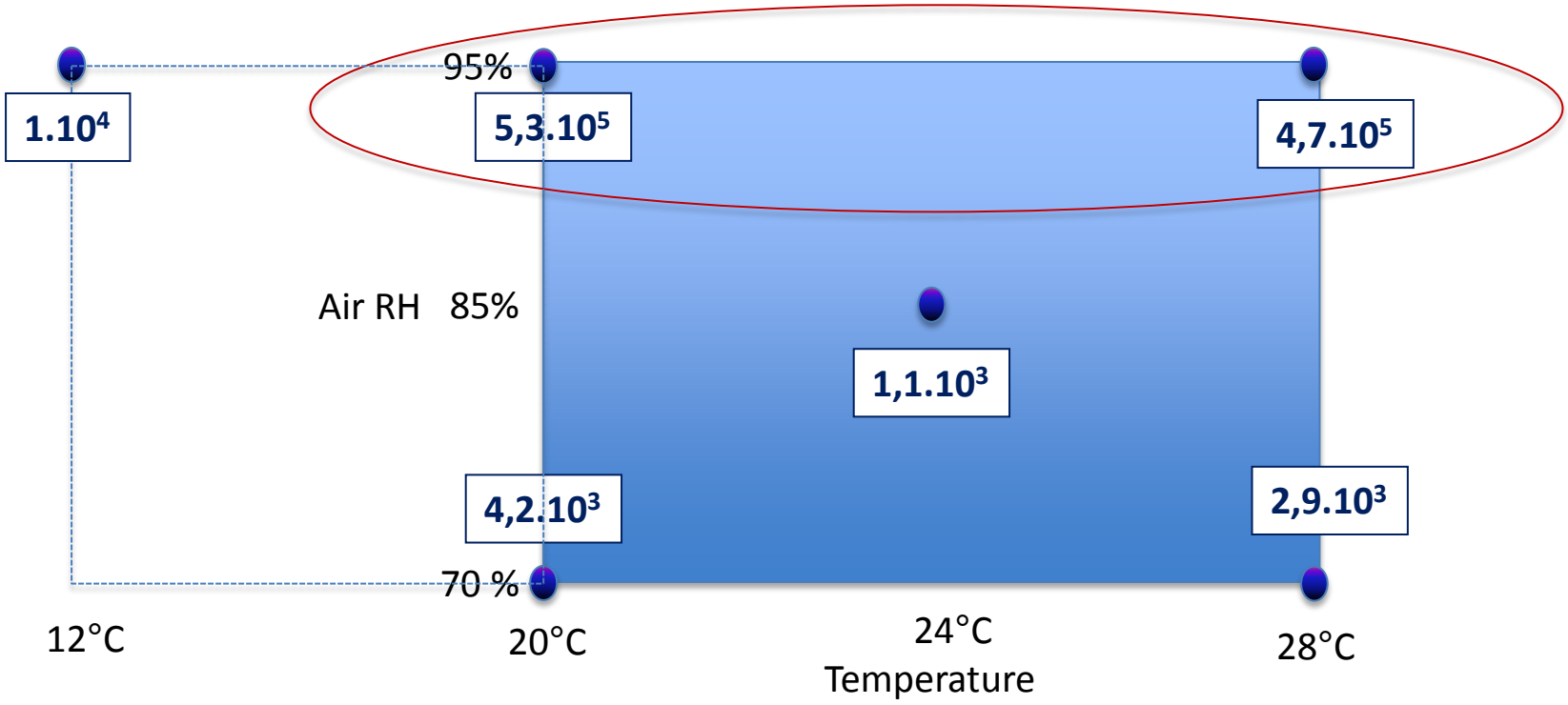
2 types of assessment: spores counting and measures of the material MC after 28 days

2 – Study of the impact of temperature and relative humidity conditions on mould growth and water uptake of insulation materials

RESULTS: mould spores counting

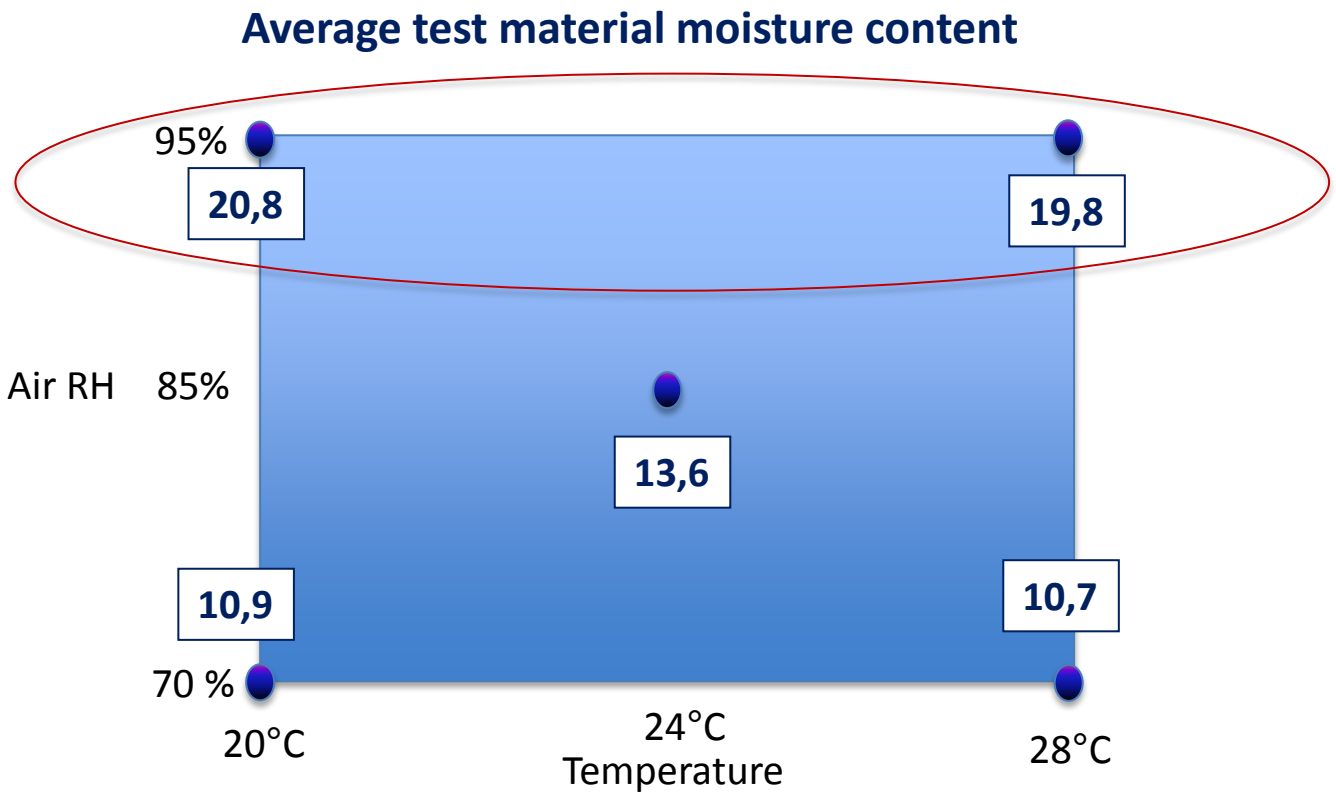
Number of spores initially inoculated (sp/test specimen) = 2.10^5

Average number of spores counted after 28 days (sp/test specimen)



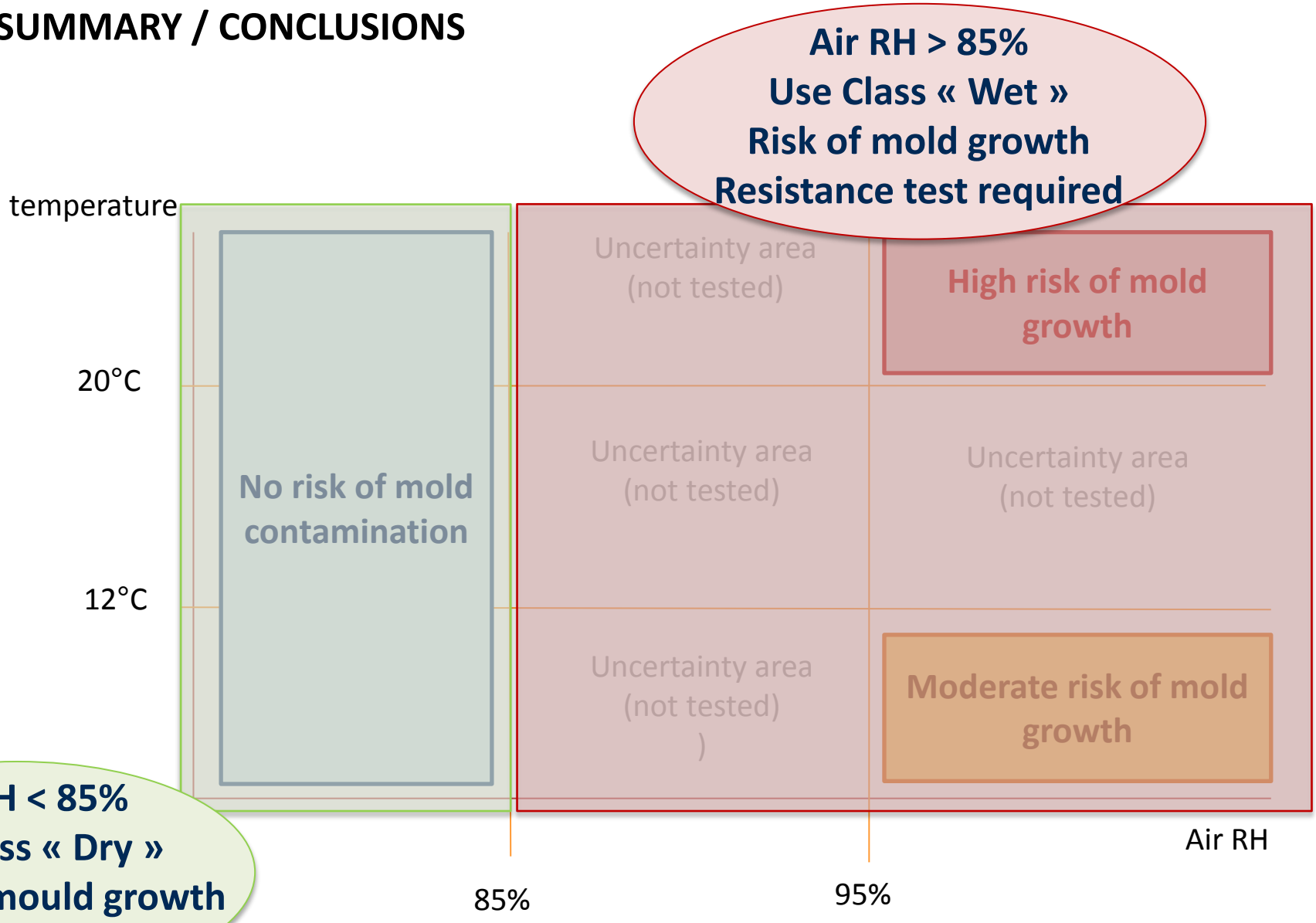
1) Between 20°and 28°C, no influence of the temperature on the intensity of mould growth
2) At 12°C, the growth is lowered
3) Maximum mould growth at 95% air RH
4) No/less mold growth at 70% and 85% air RH

RESULTS: test material moisture content



1) Test material MC increase with air RH
2) Between 20°and 28°C, no influence of the temperature on the test material MC
3) At 95% air MC, the test material reaches 20% MC

SUMMARY / CONCLUSIONS



2 – Study of the impact of temperature and relative humidity conditions on mould growth and water uptake of insulation materials

PROPOSITION OF USE CLASSES FOR INSULATION MATERIALS: practical use

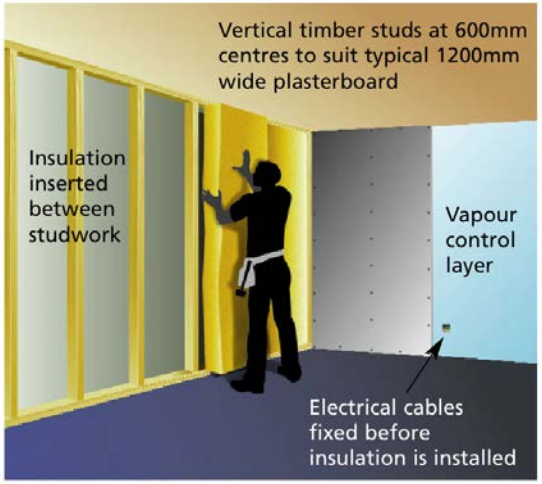
Walls

Internal insulation of walls, **with** vapour barrier: **UC « DRY »**

Internal insulation of walls, **without** vapour barrier: **UC « WET »**

External insulation of walls **: to be discussed**

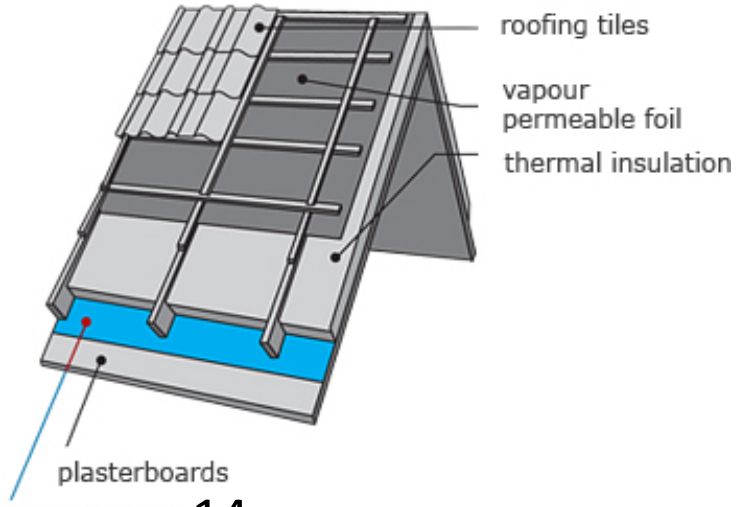
Wooden frames filled with straw / inside and outside rendering: **UC « DRY »**



Roofs and floors

Inaccessible roof attics, **with** vapour barrier: **UC « DRY »**

Inaccessible roof attics, **without** vapour barrier: **UC « WET »**



Discussions about the UC classification are still ongoing…

THANK YOU FOR YOUR ATTENTION !