Moisture transfer in internally insulated buildings

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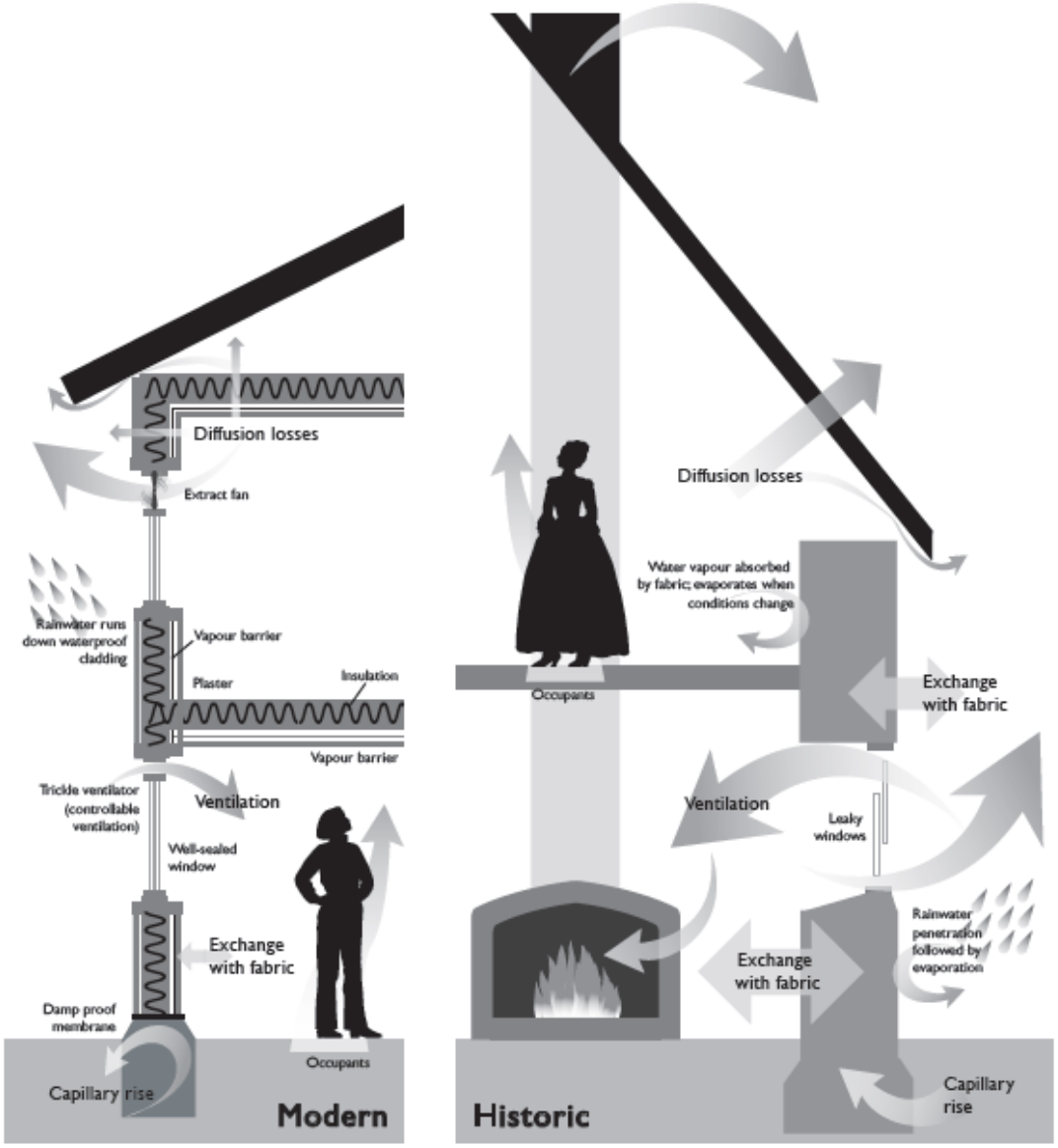

(English Heritage, 2011)

Liquid transfer and sources

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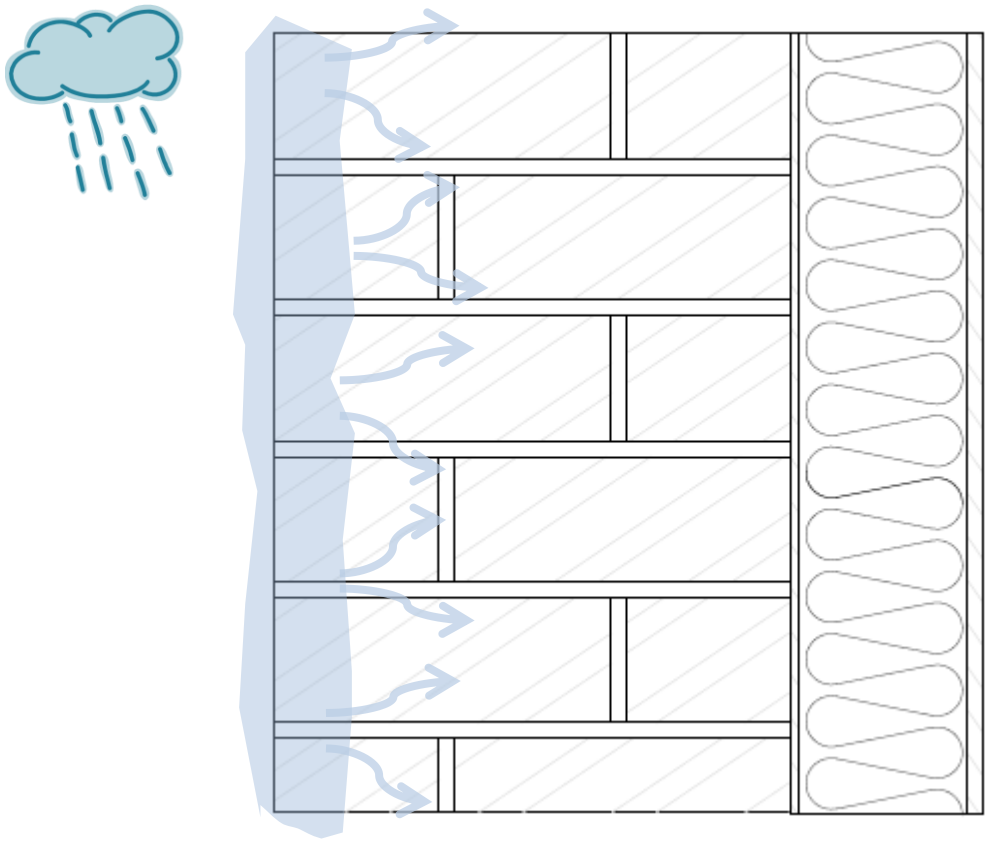
RAIN

- Flow through pores
- Gravitational flow



Liquid transfer and sources

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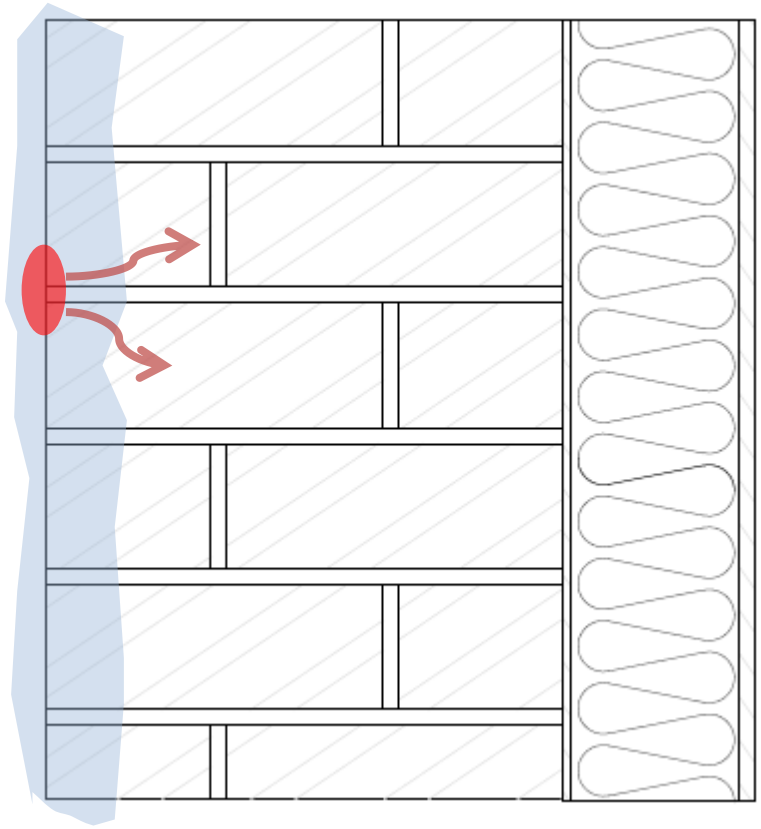
RAIN – LEAKS
(window details, cracks..)

- Flow through pores

- Gravitational flow



Liquid transfer and sources

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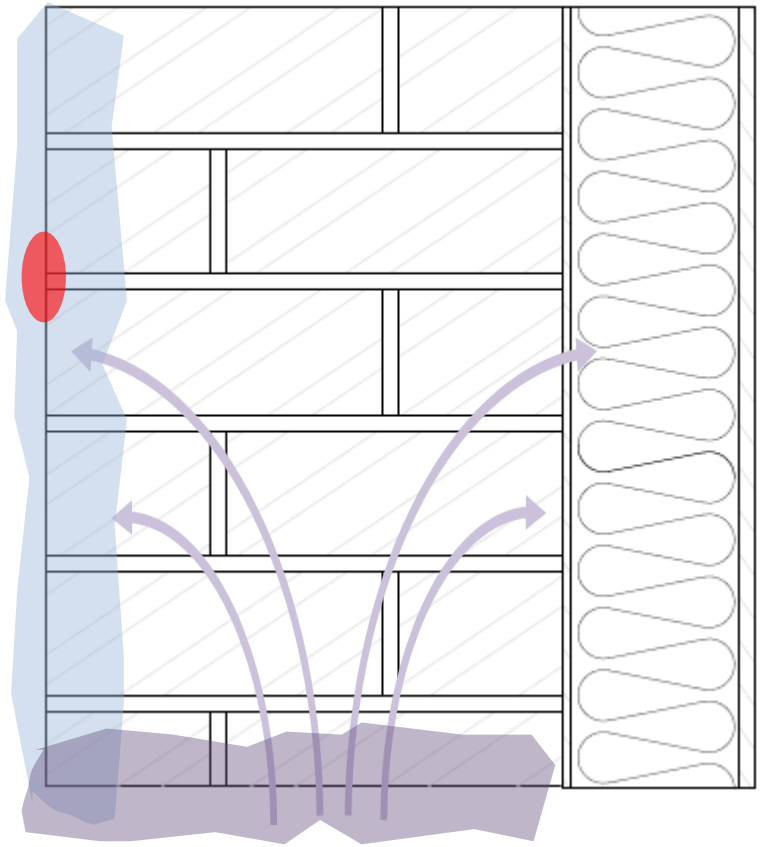
RISING DAMP

- Flow through pores



Vapour transfer and sources

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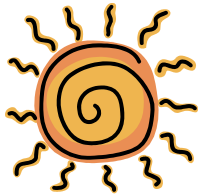
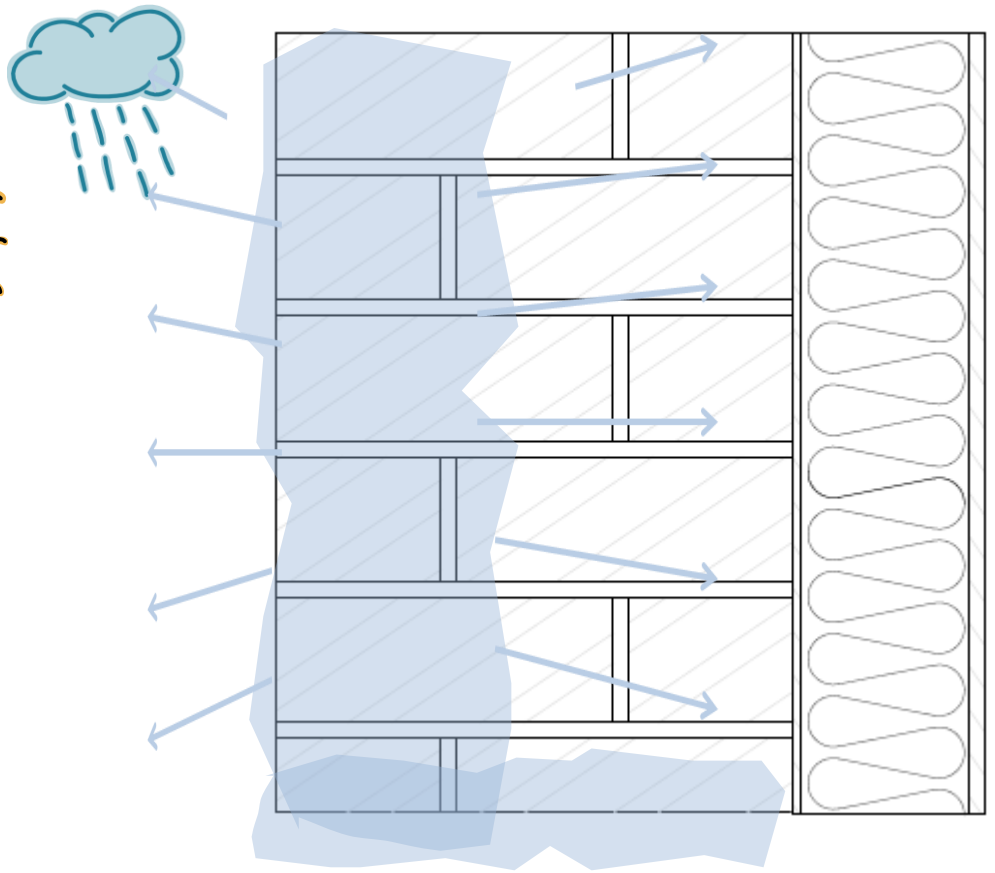
SOLAR RADIATION

- Vapour diffusion





Vapour transfer and sources

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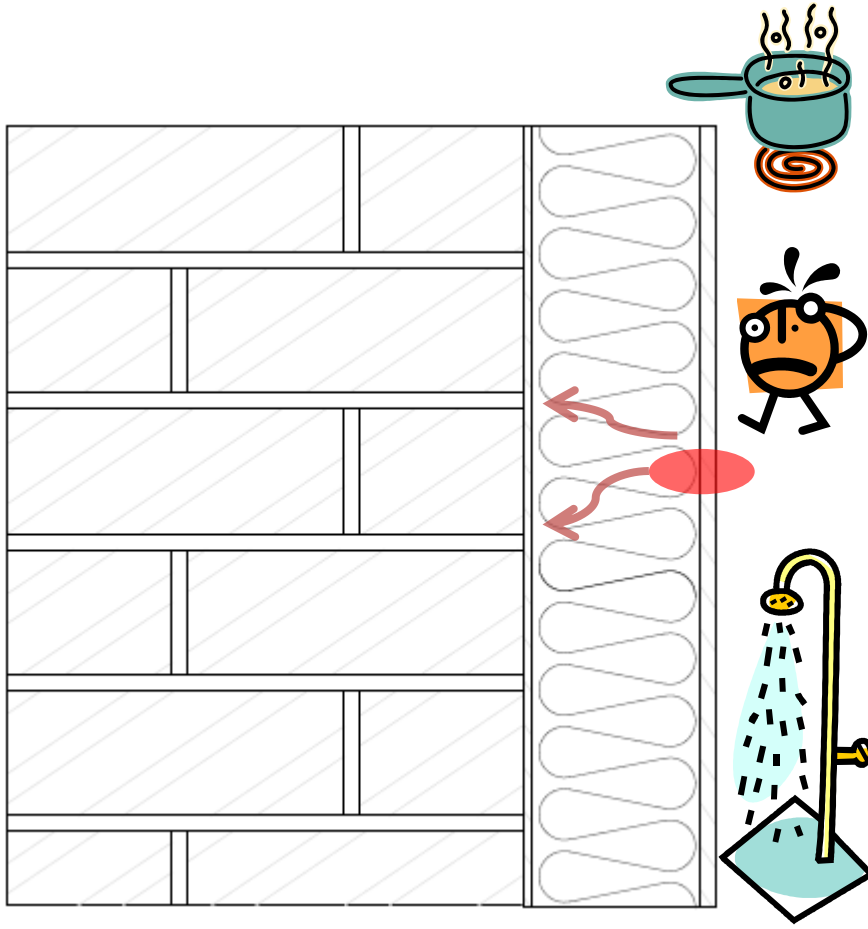
INDOOR VAPOUR - LEAKS THROUGH INSULATION and VAPOUR BARRIERS (Radiators fixings, services penetrations..)

- Flow of moist air



Vapour transfer and sources

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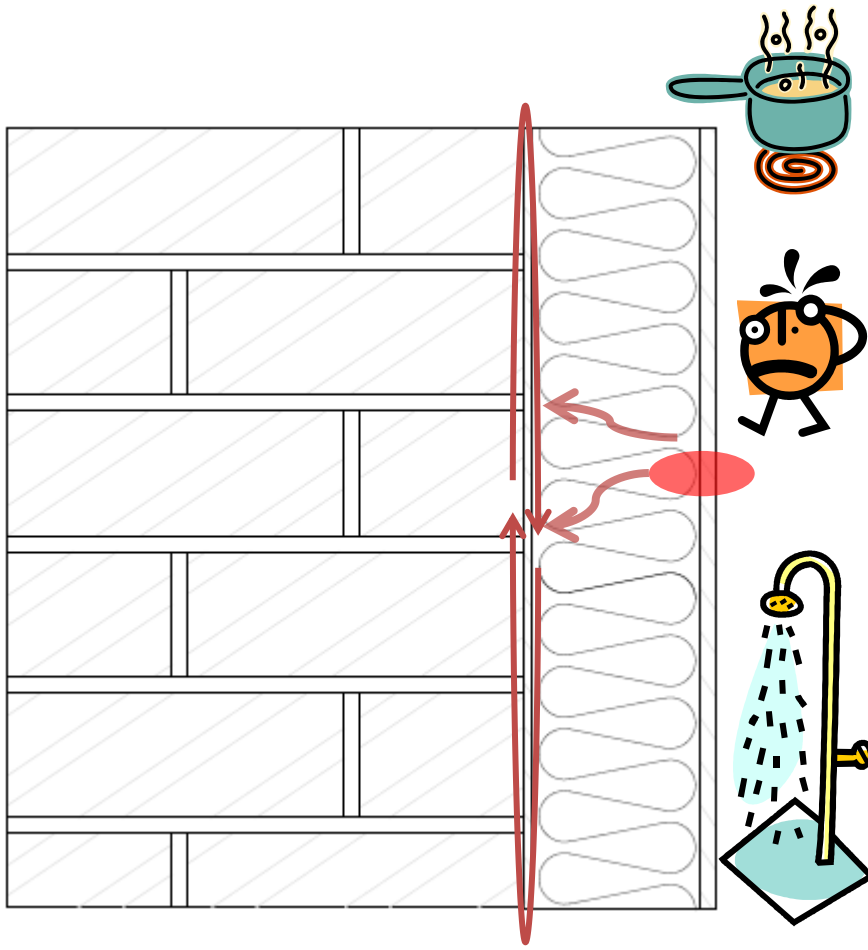

Vapour transfer and sources

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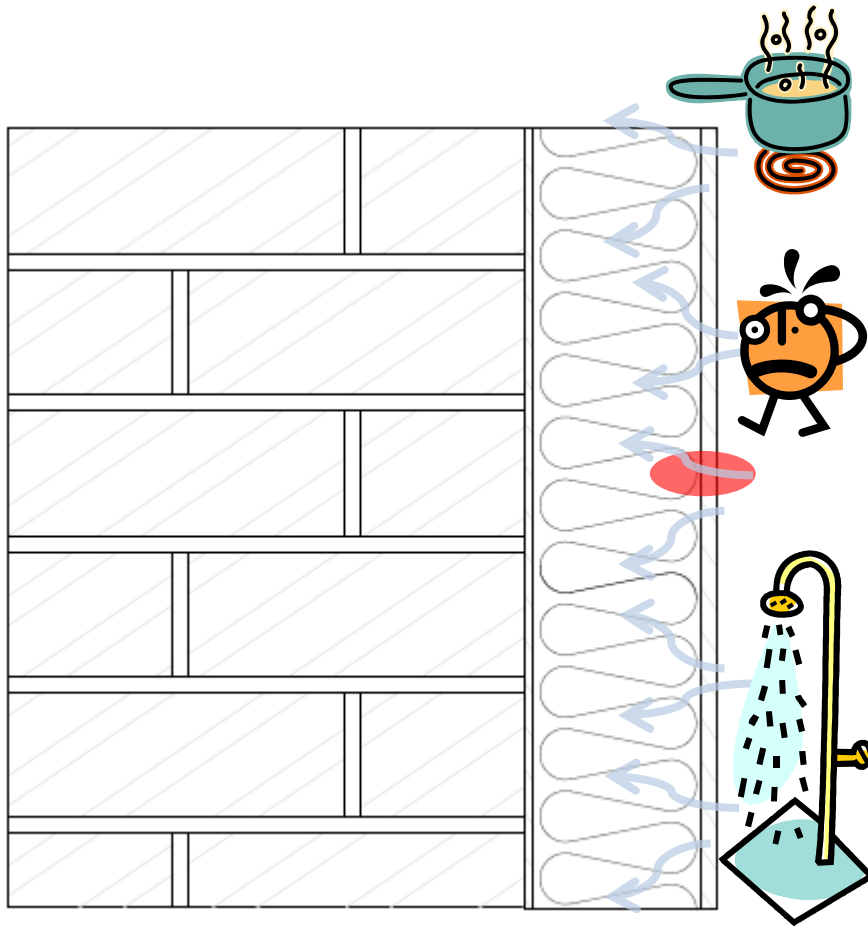
INDOOR VAPOUR

- Vapour diffusion



Moisture control

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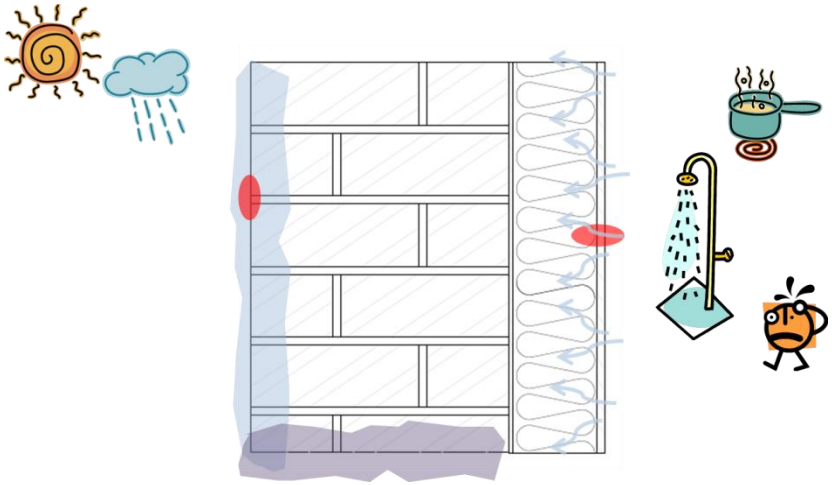
MOISTURE SOURCES (RANKED BY RISK):

1) Water ingress as liquid
2) Air flow from the room
3) Water ingress as vapour (diffusion)

IF ANY MOISTURE GETS IN THE BUILDING FABRIC, WE NEED TO ALLOW DRYING



Moisture control

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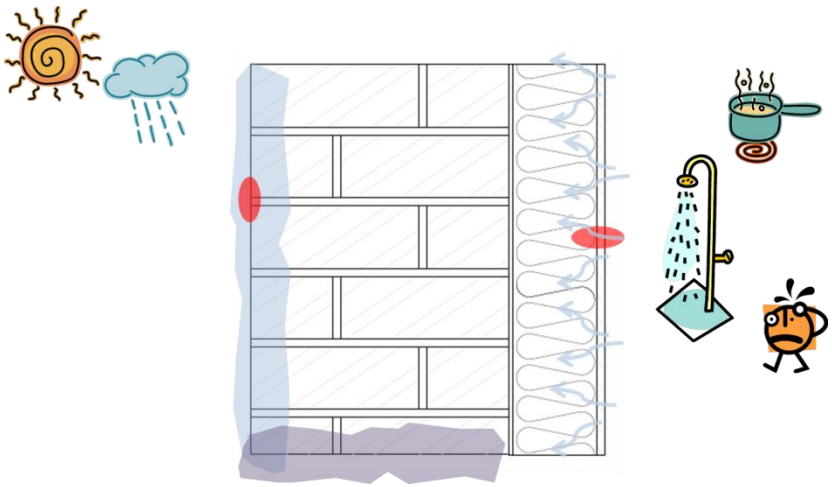
MOISTURE SOURCES (RANKED BY RISK):

1) ~~Water ingress as liquid~~

2) ~~Air flow from the room~~

3) Water ingress as vapour (diffusion) → Dew point calculation



Dew point calculation?

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?

Moisture control

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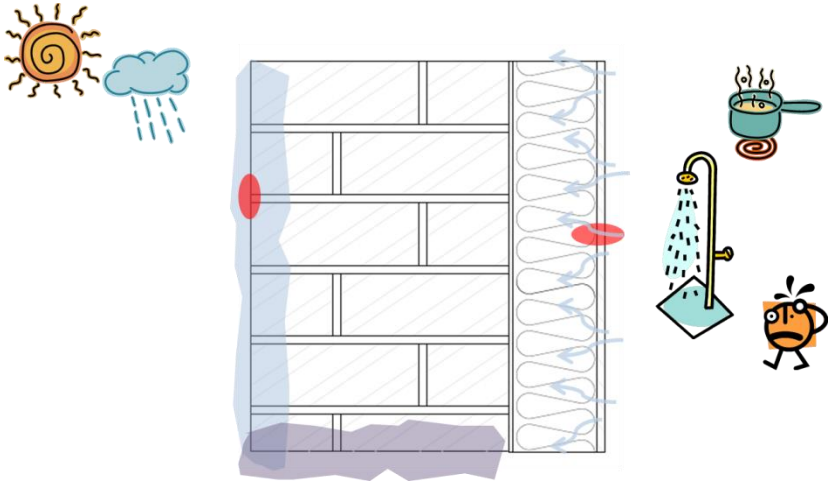
MOISTURE SOURCES (RANKED BY RISK):

1) Water ingress as liquid
2) Air flow from the room
3) Water ingress as vapour (diffusion)

Hygrothermal simulations (Heat, Air and Moisture)

IF ANY MOISTURE GETS IN THE BUILDING FABRIC, WE NEED TO ALLOW DRYING



Hygrothermal simulations

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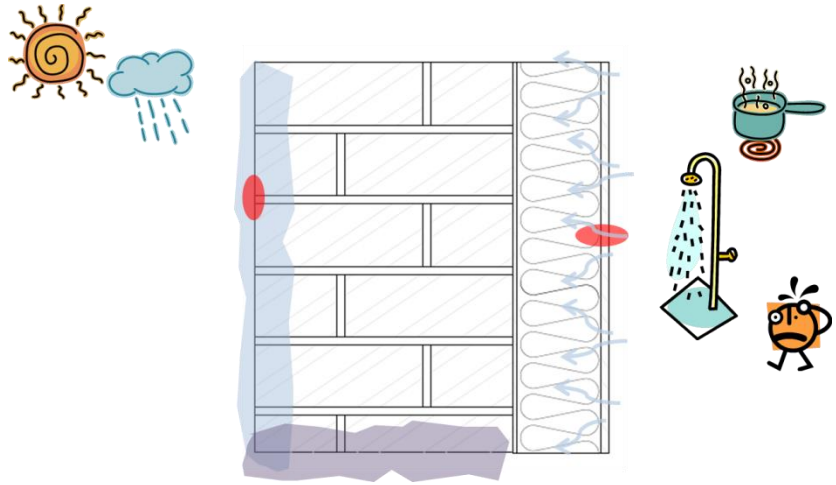
- Described in BS EN 15026
- Most moisture sources and transfer mechanisms included
- Software: WUFI® Pro (Fraunhofer IBP), Delphin (TU Dresden)



Aims of the work

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What is the response of internal wall insulation to moisture loads?

What is the response of internal wall insulation to real climate loads?

Are the simulation tools accurate enough to estimate moisture transfer within building elements?

Laboratory work

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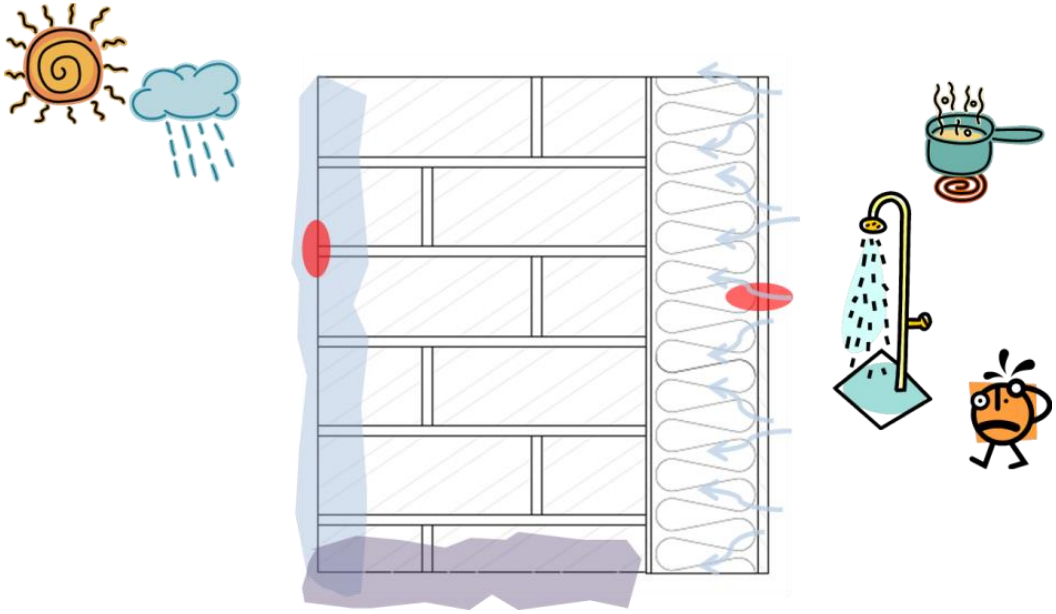

Methodology – test wall

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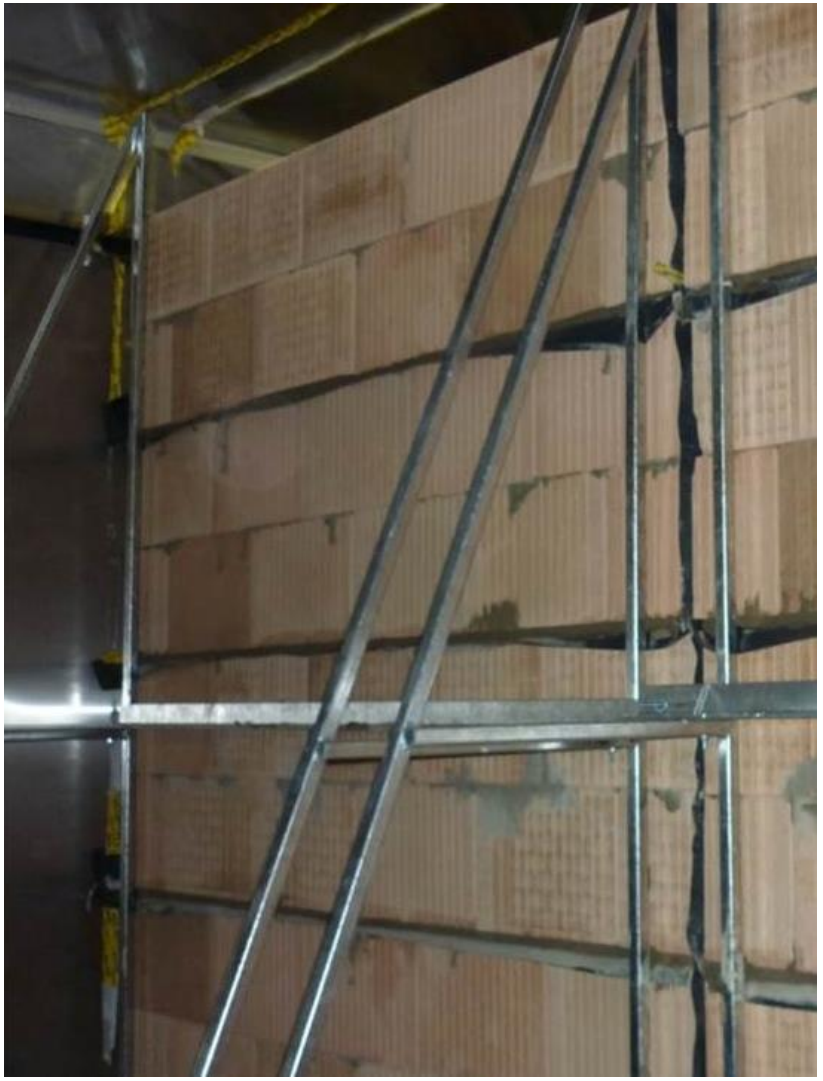

Results

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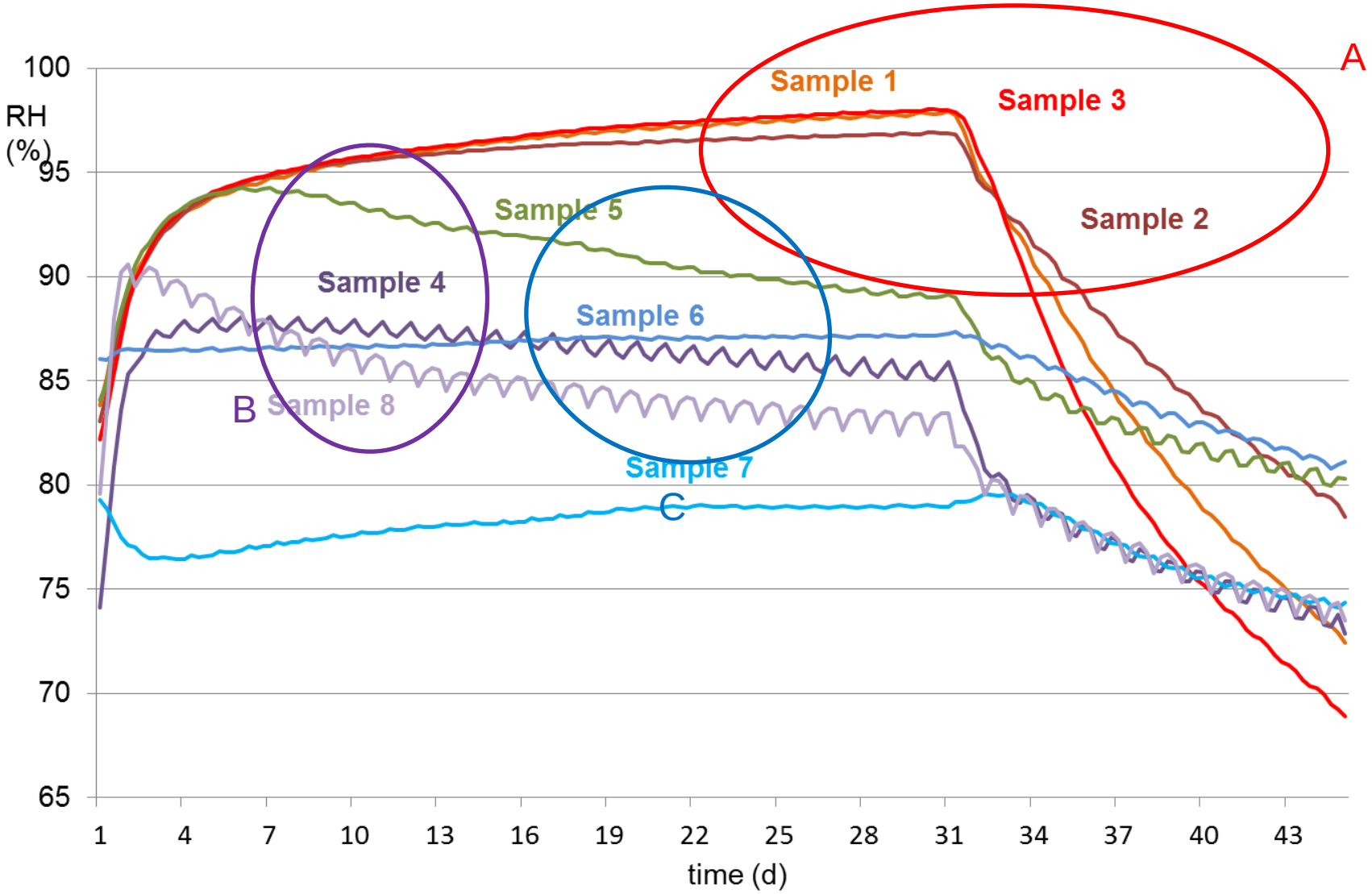

In-situ monitoring

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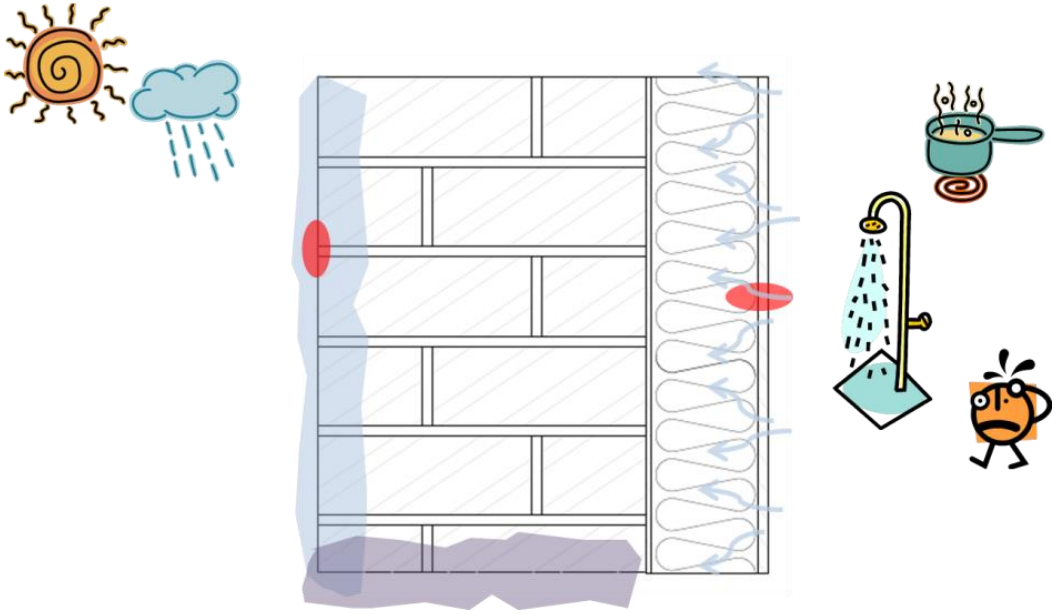

Methodology – building

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Methodology – climate

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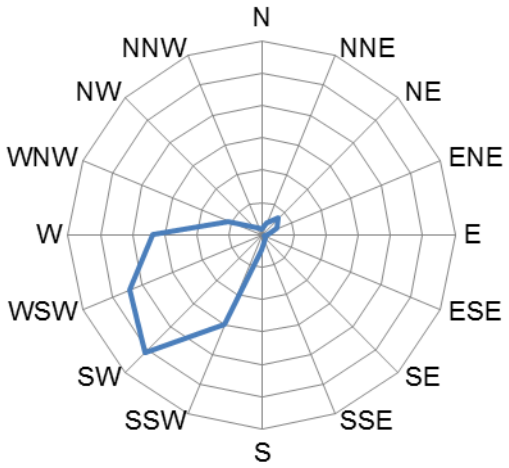
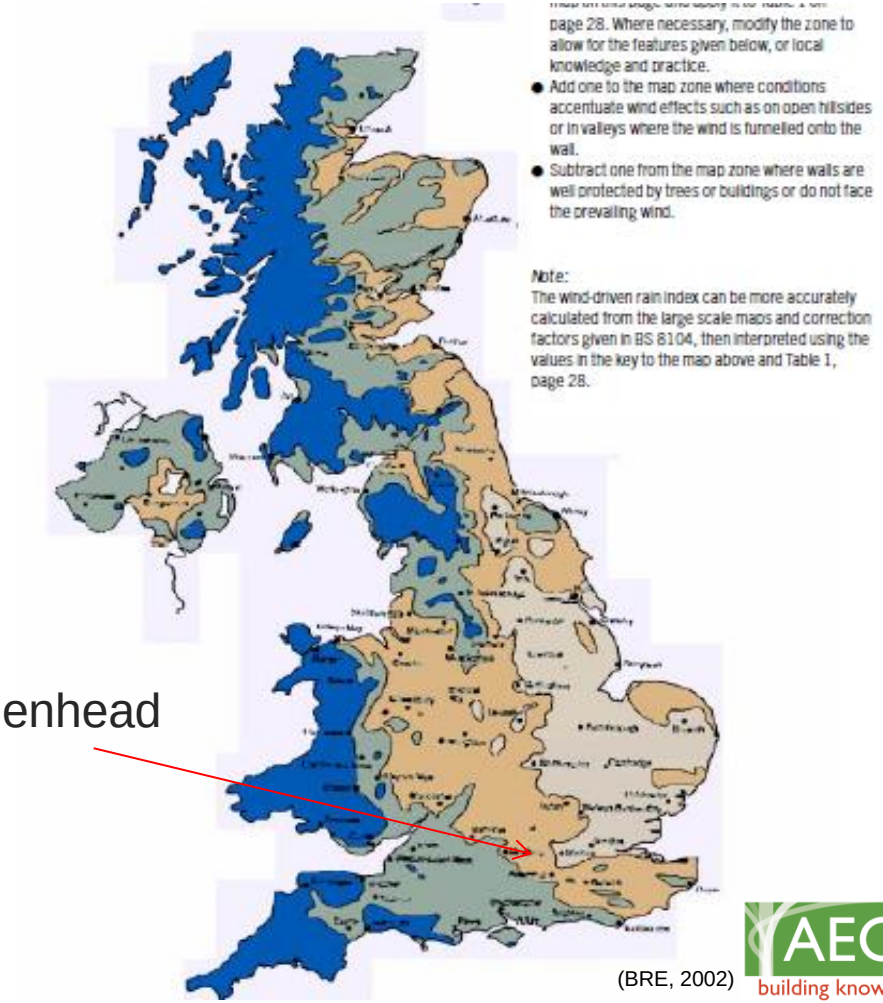
Wind direction





(BRE, 2002)

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Methodology – the wall

Low T → high RH → “interstitial condensation”

Low T→ low drying potential

Higher vapour diffusion resistance (μ) → low drying potential

Methodology – the wall

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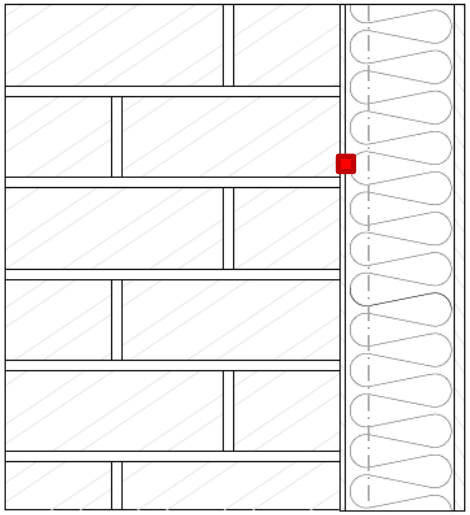

Wall construction (outside to inside)		Thickness (mm)
Brick		330
Levelling coat (3:1 NHL and sand)		0 to 6
Bonding coat (Lime plaster)		5
Pavadentro (composite insulation)	woodfibre board	20
	mineral layer	1
	woodfibre board	80
Internal finish (Lime plaster)		8

Results

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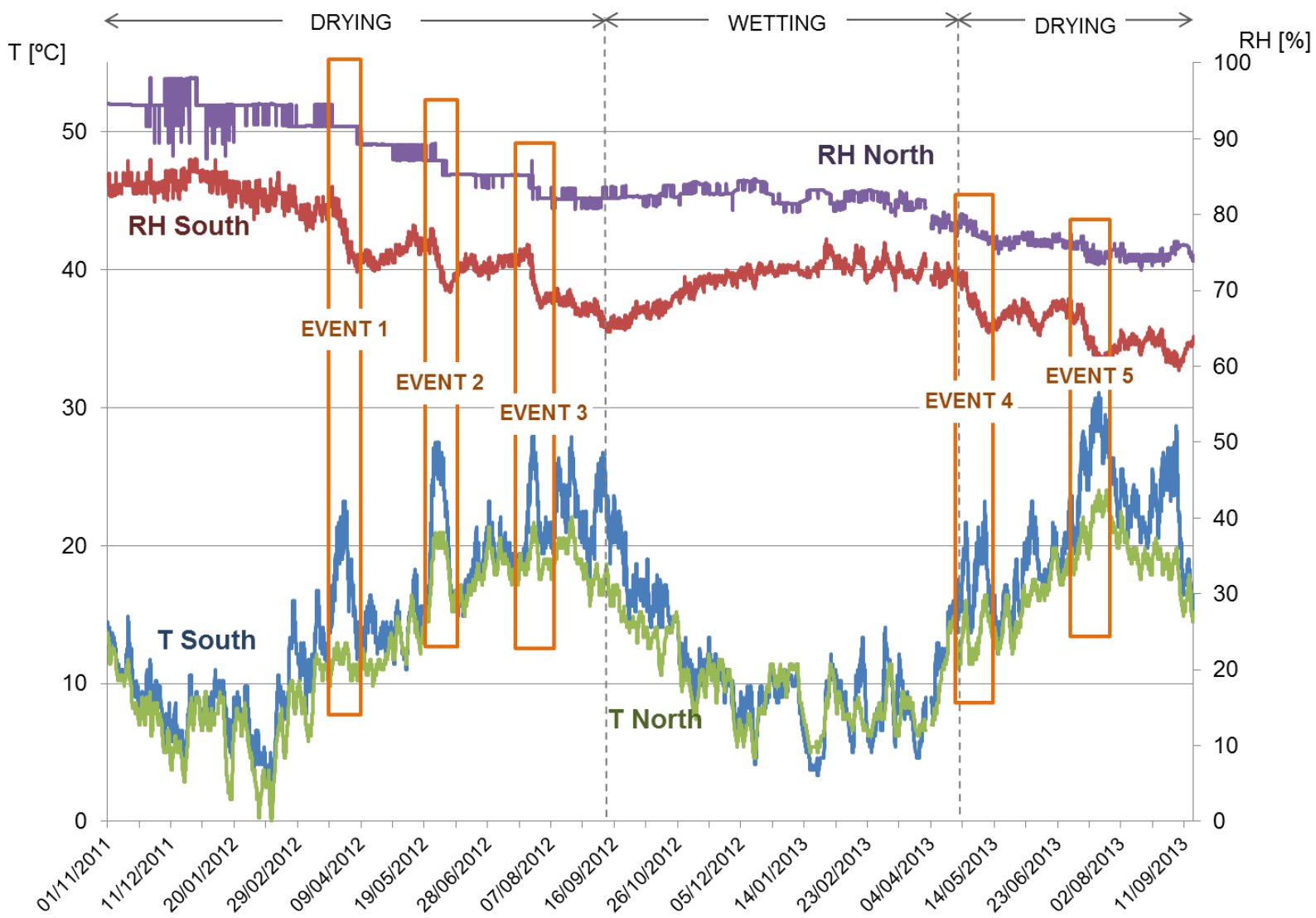
Results



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Results

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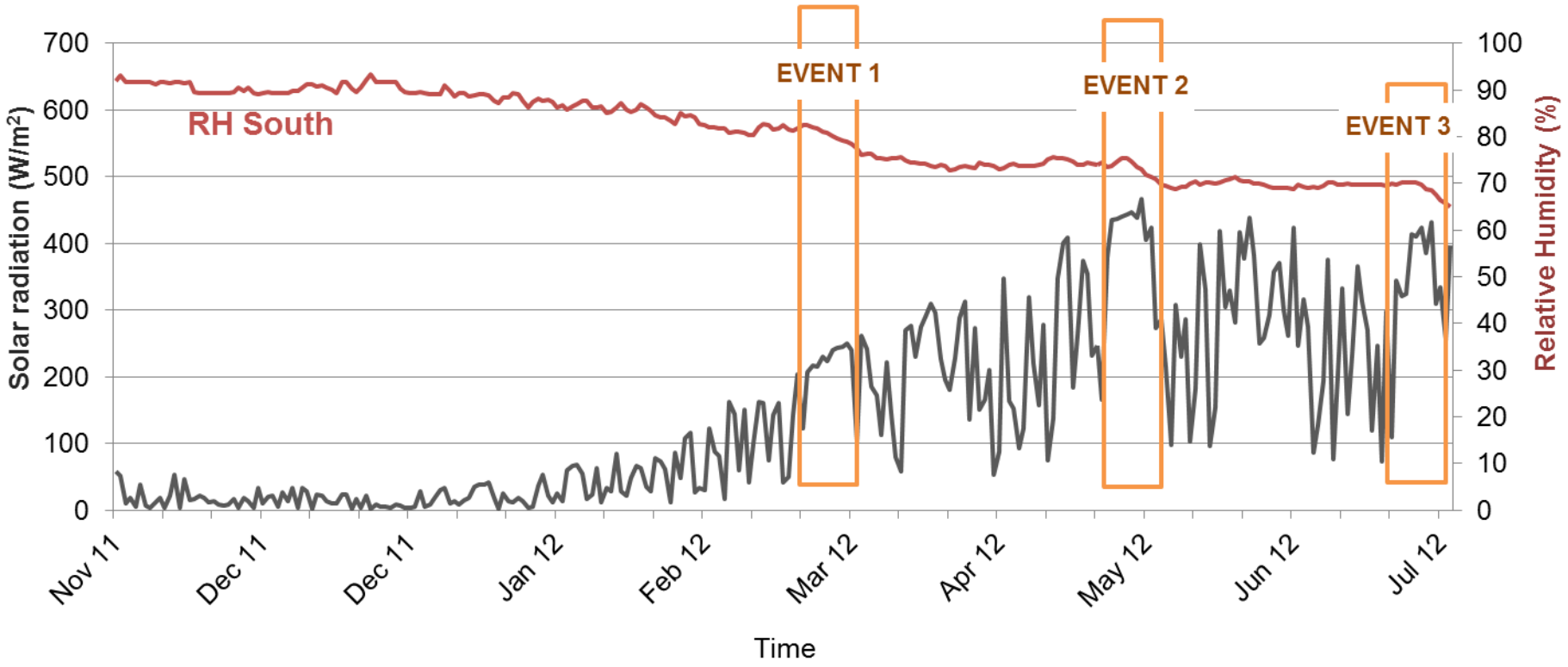
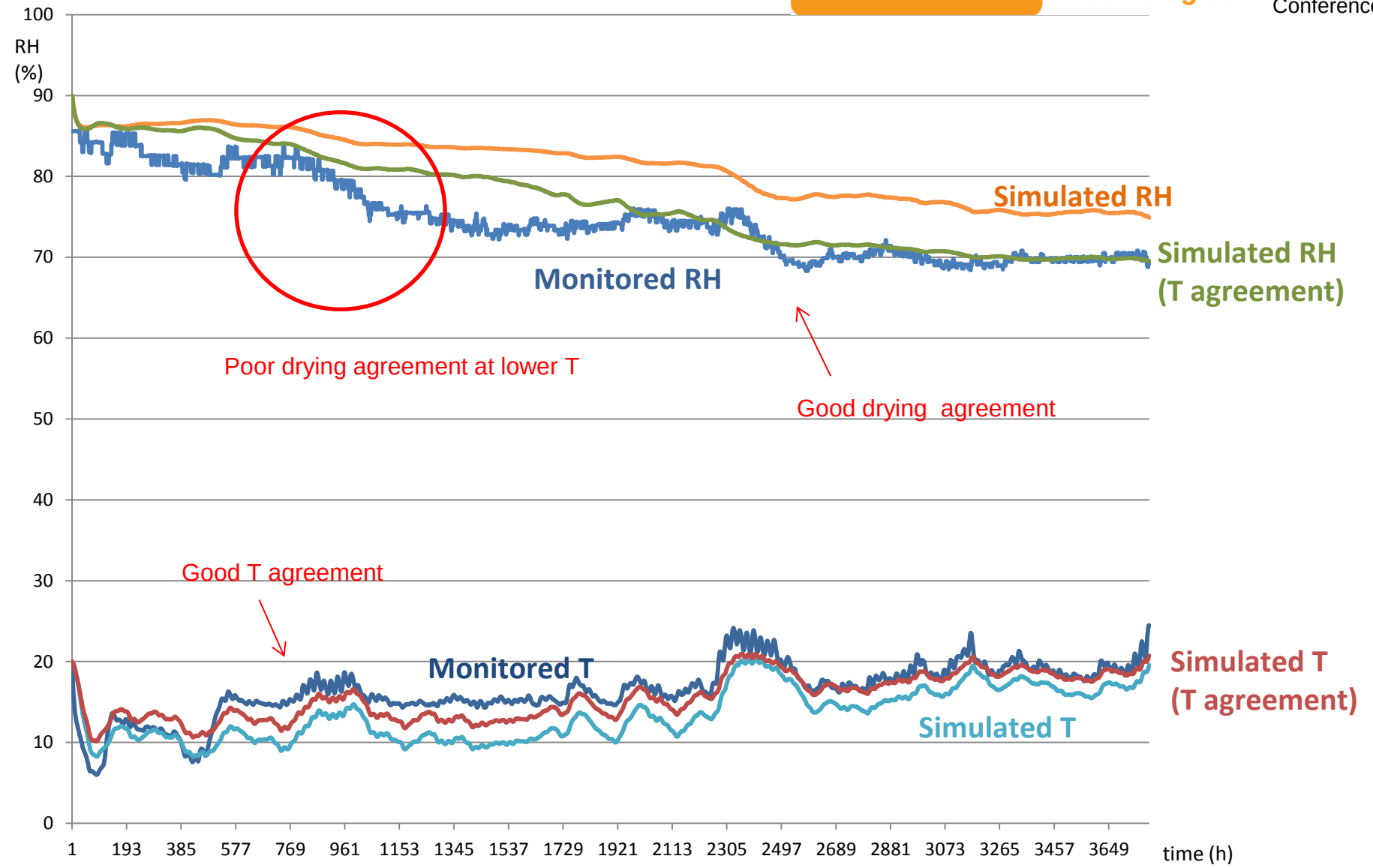


Results – simulations



Way forward for moisture control in buildings?

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- We must take into account faults and failures both short and long term
  - Maintenance
  - Workmanship
- We need to know our building
  - Building fabric
  - Occupants
  - Climate

More questions..

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- How can we assess the worst case scenario for mould growth risk / wood rot?
  - Poor workmanship
  - Worst case climate file
  - Variability of material properties
- Can we identify the main principles for retrofit and robust building fabric solutions?

Thank you!

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Marincioni V., Altamirano-medina H. (2014) Effect of orientation on the hygrothermal behaviour of a capillary active internal wall insulation system, 10th Nordic Symposium of Building Physics, 15-19 June 2014, Lund

Marincioni V., Altamirano-medina H., Ridley I. (2014) Performance of internal wall insulation systems - experimental test for the validation of a hygrothermal simulation tool, 10th Nordic Symposium of Building Physics, 15-19 June 2014, Lund