Sustainable Retrofit + EnerPhit Case Study

For REHIS
29.01.26

Chris Morgan
Architect + Director
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Sustainable Renovation

Pebble Trust / SEDA Guide:

Sustainable Renovation

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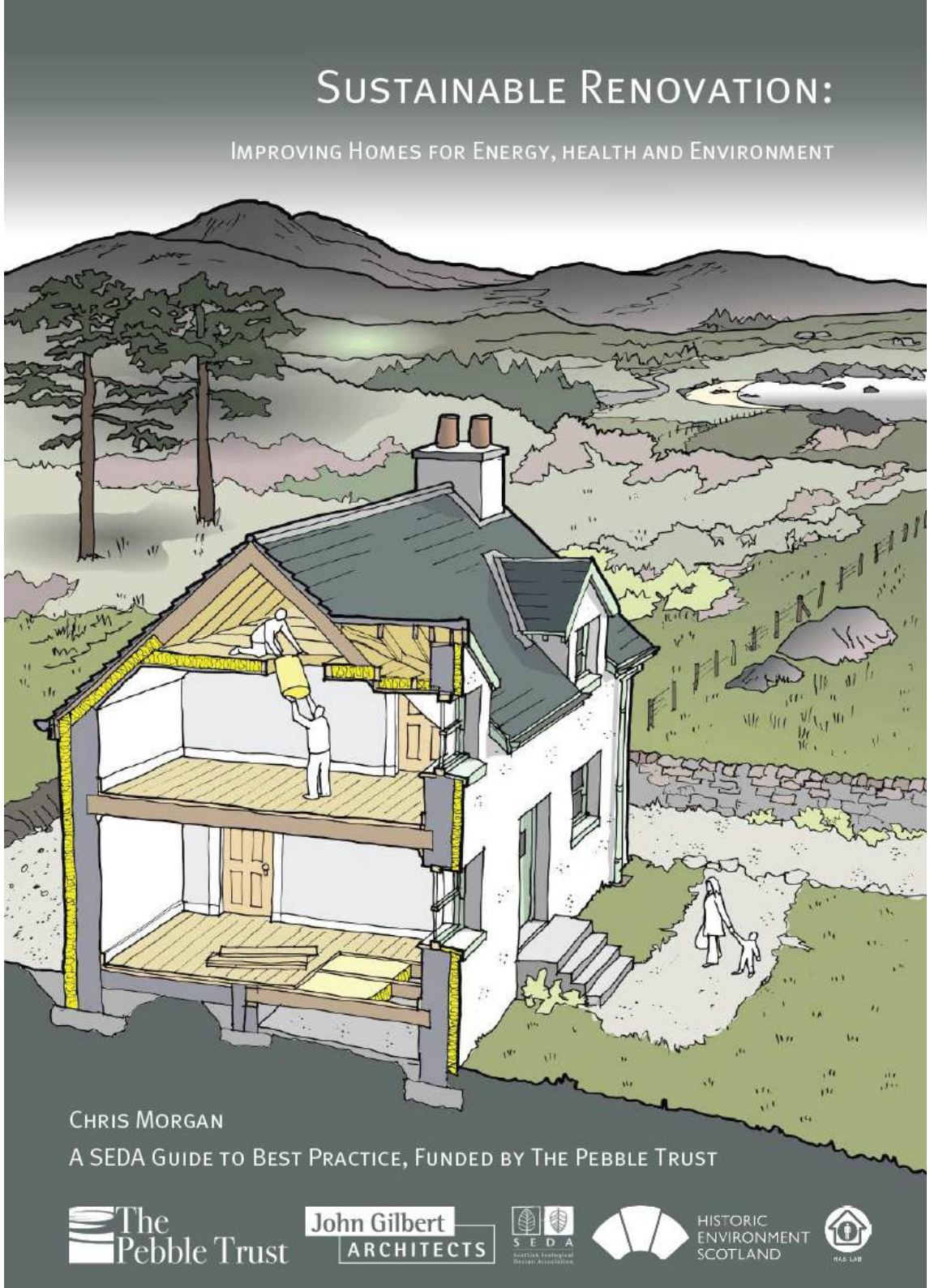

Building Performance Evaluation (BPE):

- Physical Testing
- Energy Monitoring
- Indoor Air Quality Monitoring
- People Engagement

Initially about energy performance, but broadened out to consider comfort, health, building fabric and people

HAB-LAB

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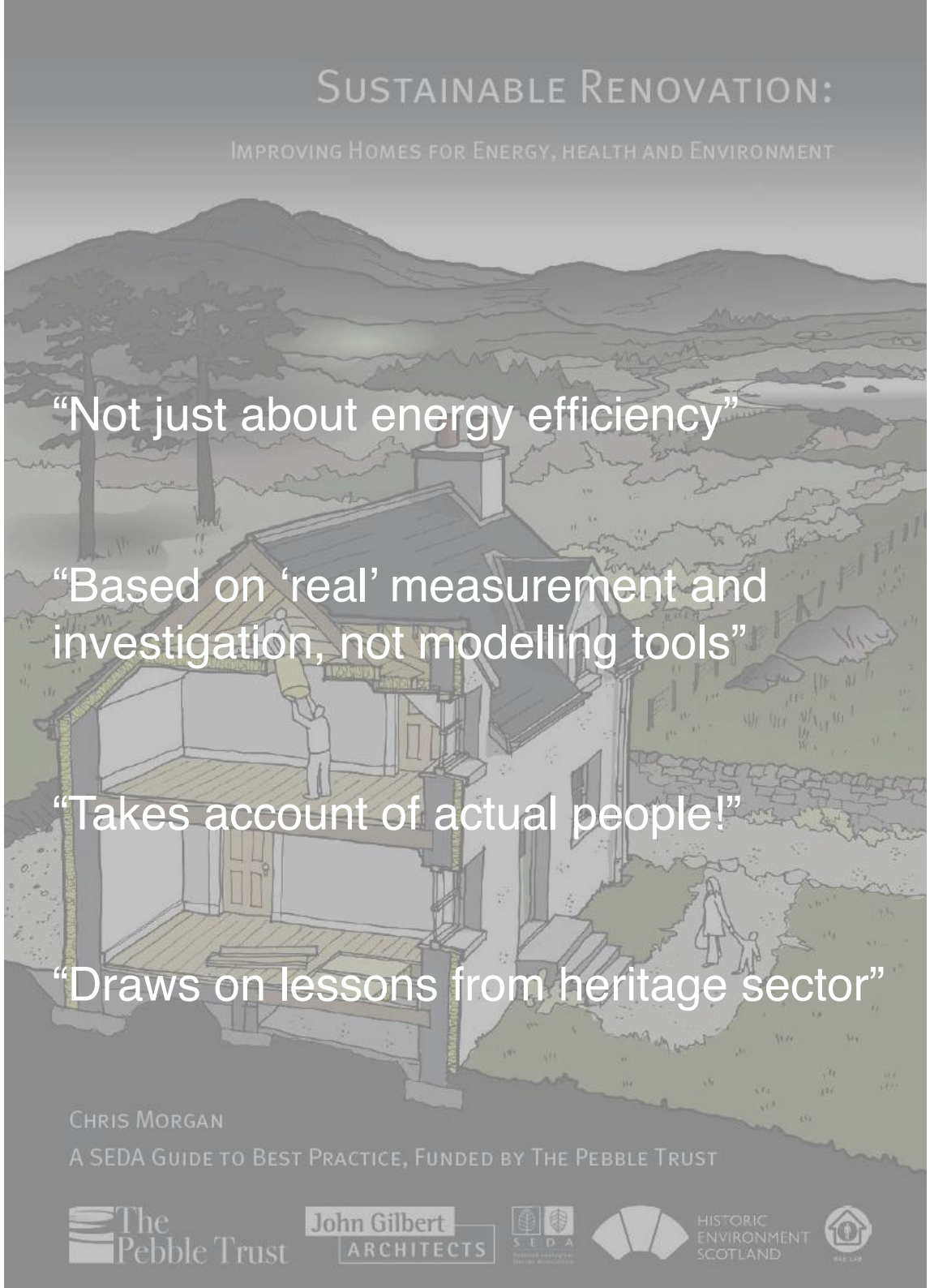
Our Guide and how it is different from other guidance

4 Principles

- Balance
- Reality
- People
- Heritage



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10 Issues:

Balance between:

1. Energy
2. Comfort & Health
3. Building fabric

Reality:

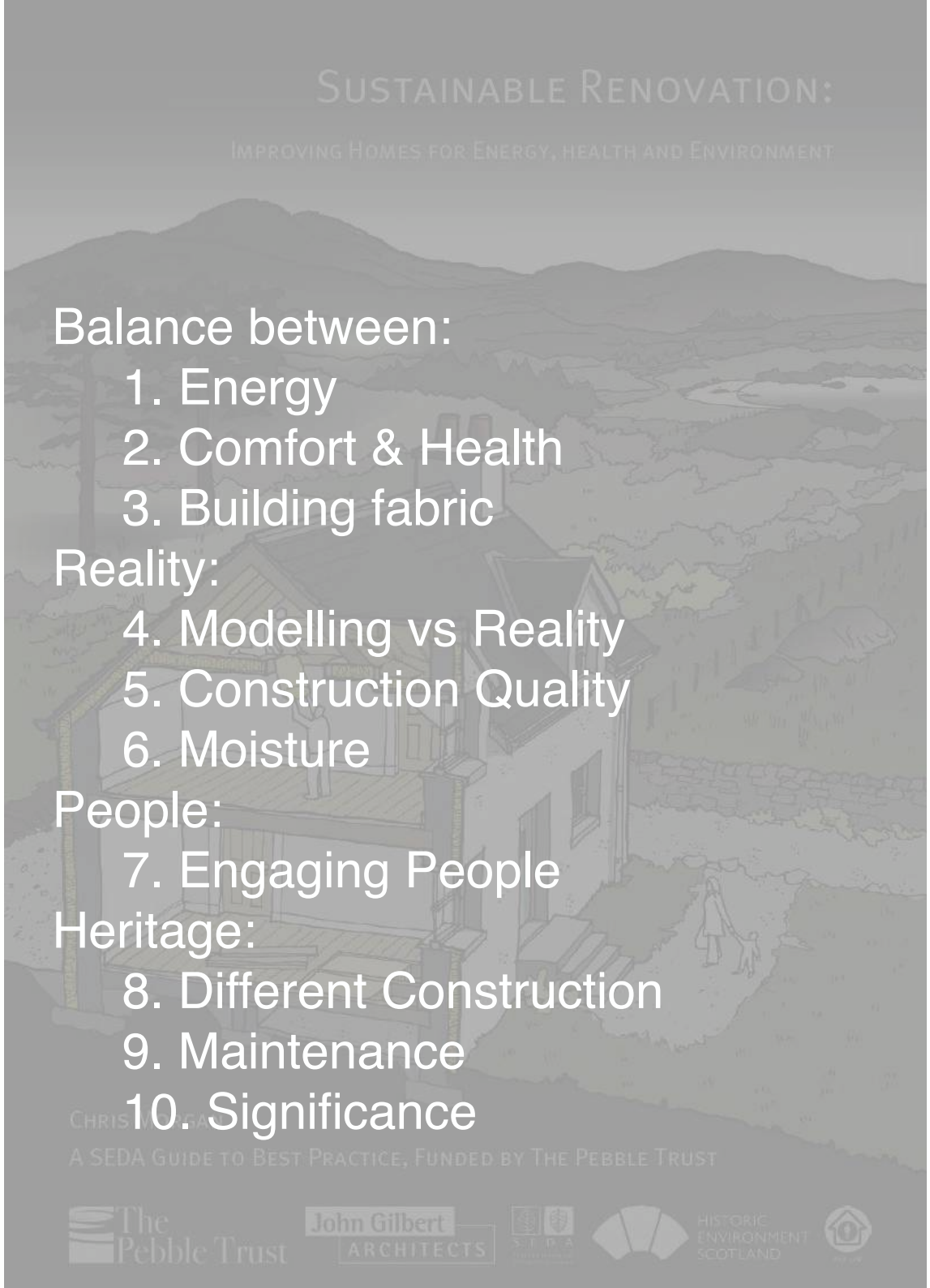
4. Modelling vs Reality
5. Construction Quality
6. Moisture

People:

7. Engaging People

Heritage:

8. Different Construction
9. Maintenance
10. Significance



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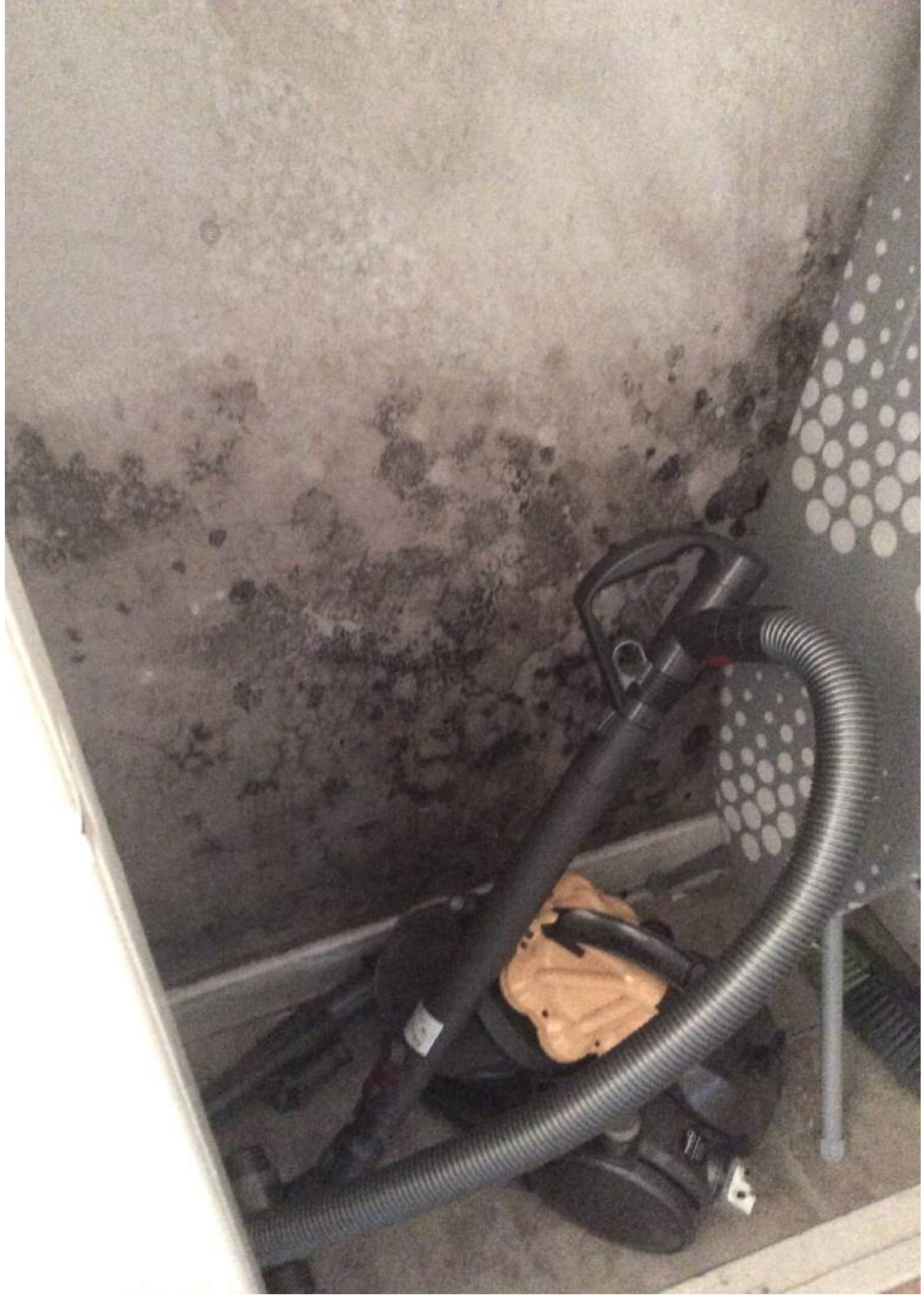
The Need for Balance:

- The current focus on energy efficiency creates ‘unintended consequences’:

- Energy Efficiency
- Comfort & Health
- Building Fabric

Balance



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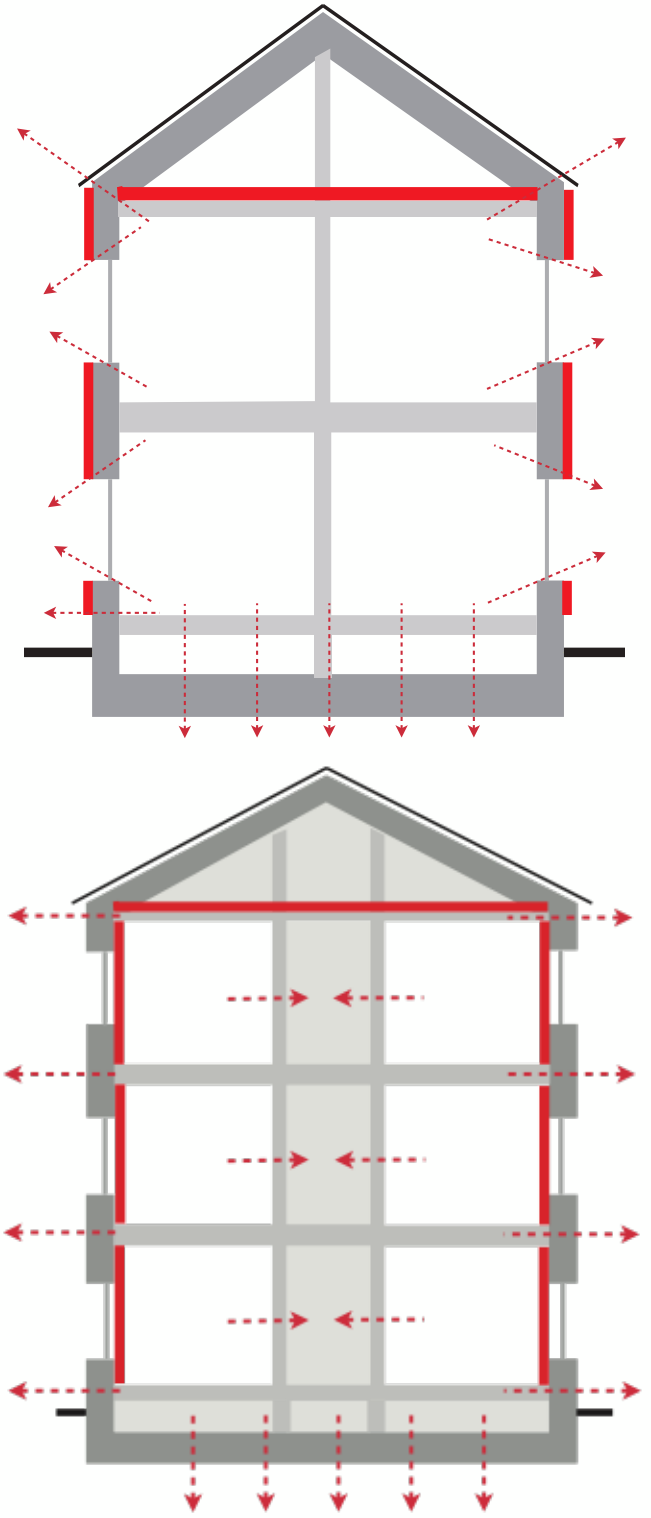
Energy Efficiency:

- … is not as good as anticipated
- Environmental impact and fuel poverty affected

- Mainly about closing gaps…
  - continuous insulation
  - thermal bridging
  - airtightness
  - thermal bypass



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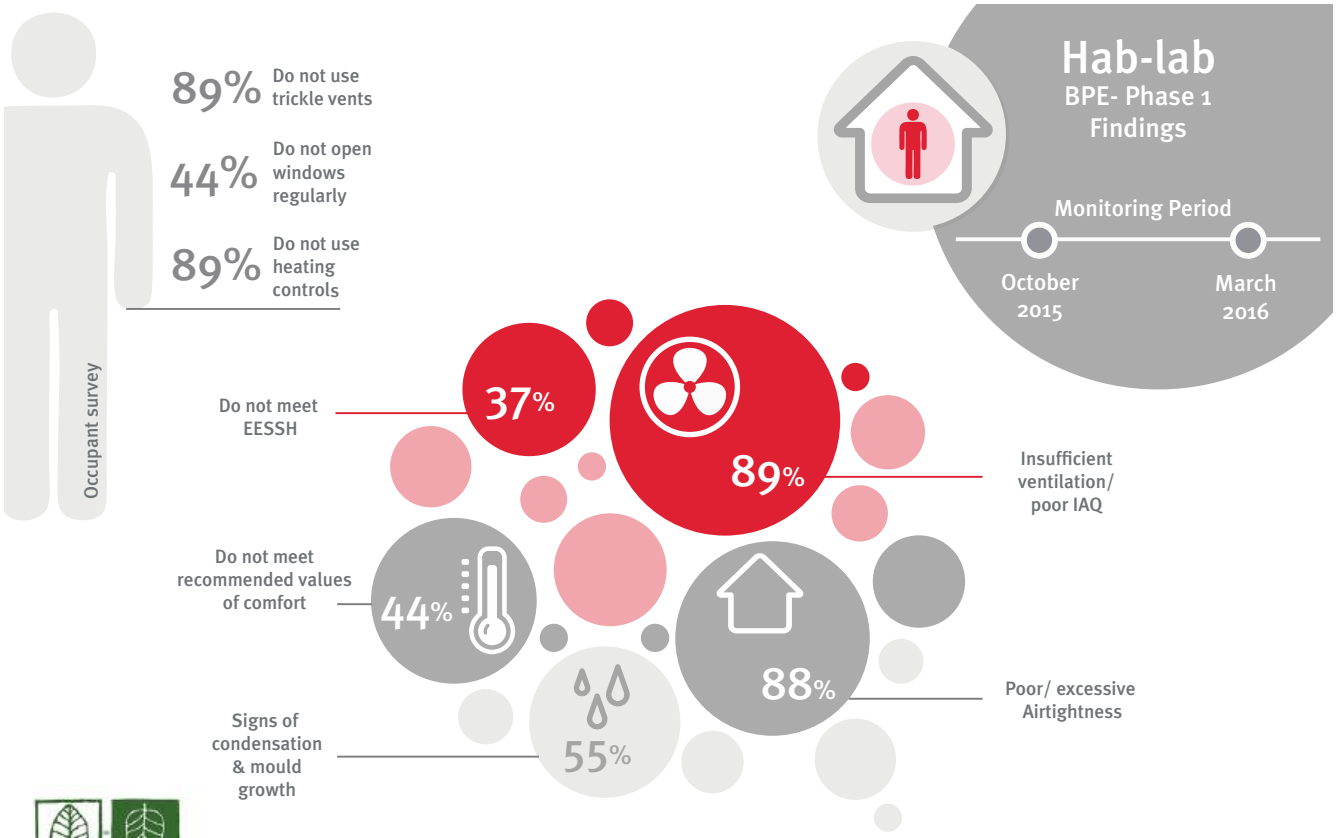
Comfort & Health:

- Overheating / too cold
- Surface condensation & mould
- Pollutants
- Poor Indoor Air Quality (IAQ)

- Source Control
  + Ventilation



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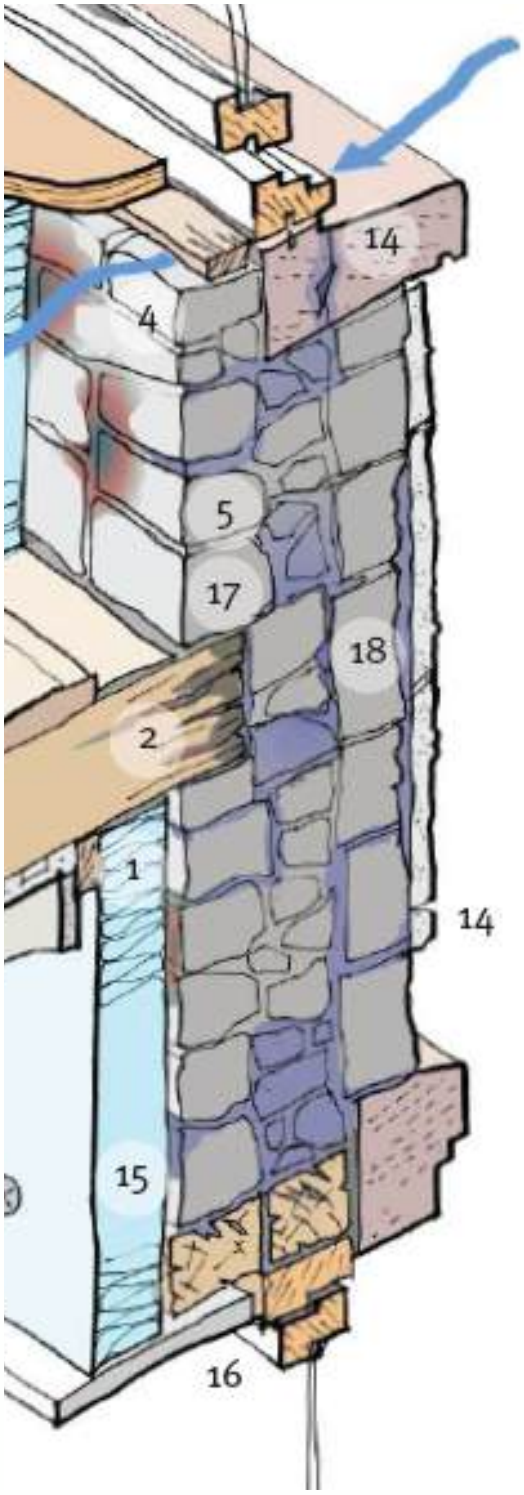
Building fabric:

- Building fabric decay
- Loss of external & internal heritage / appearance
- Inadequate ventilation



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Reality:

- Better Surveys
- Modelling vs Reality
- Construction Quality
- Moisture

Reality

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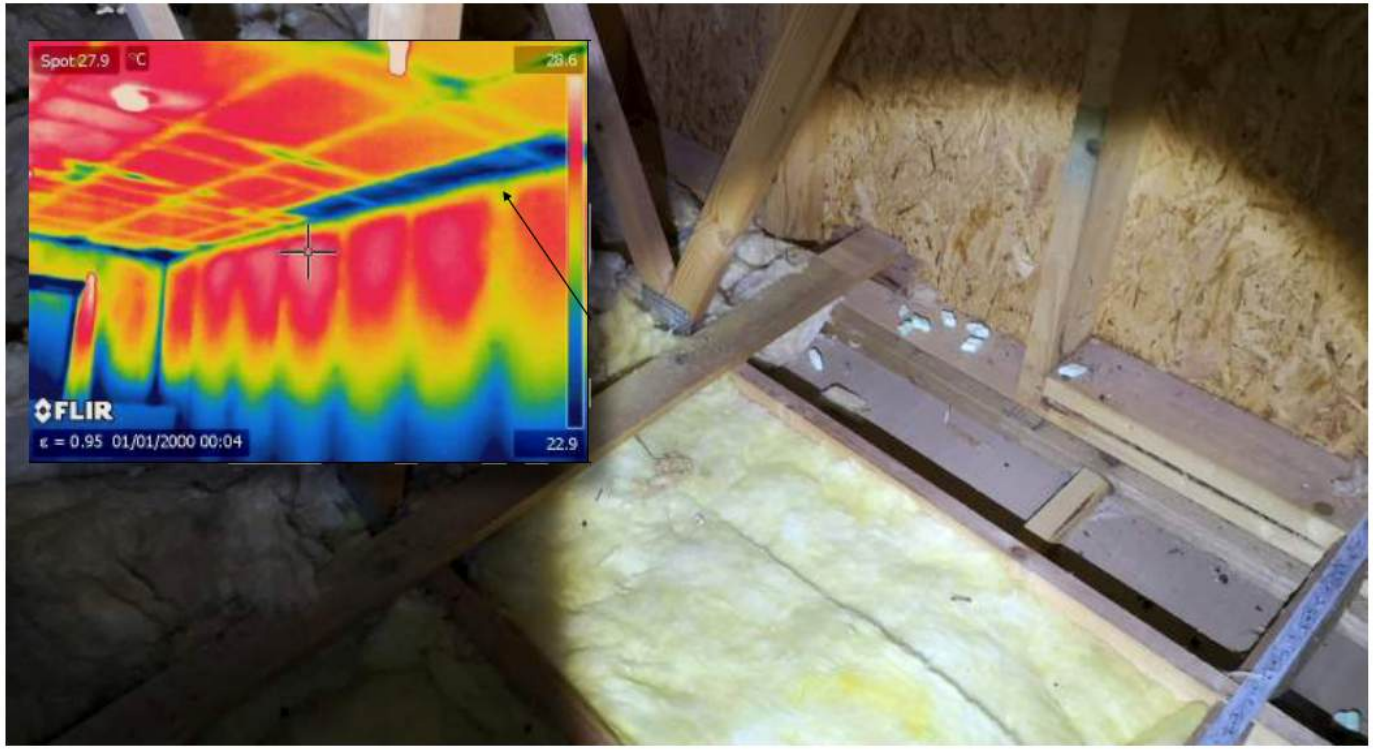
Modelling vs Reality:

- EPC Results are *presented and treated* as reality but they are not
- Defect blind

- BPE suggests different issues are more important
- Mainly about closing gaps, watching quality and managing moisture



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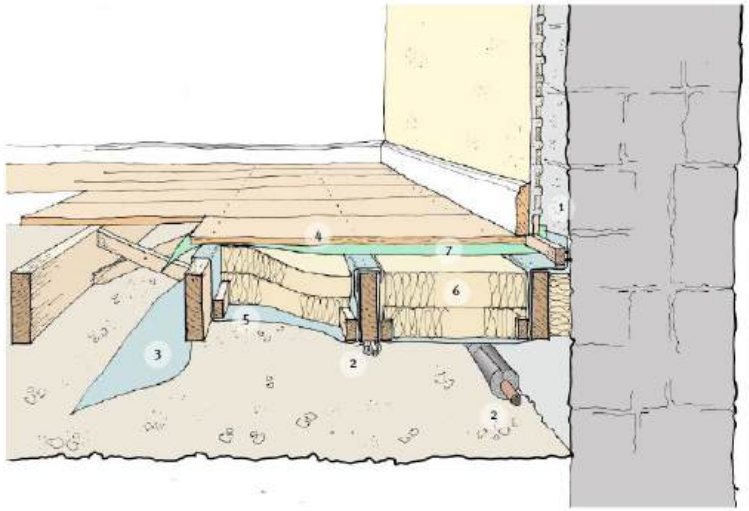
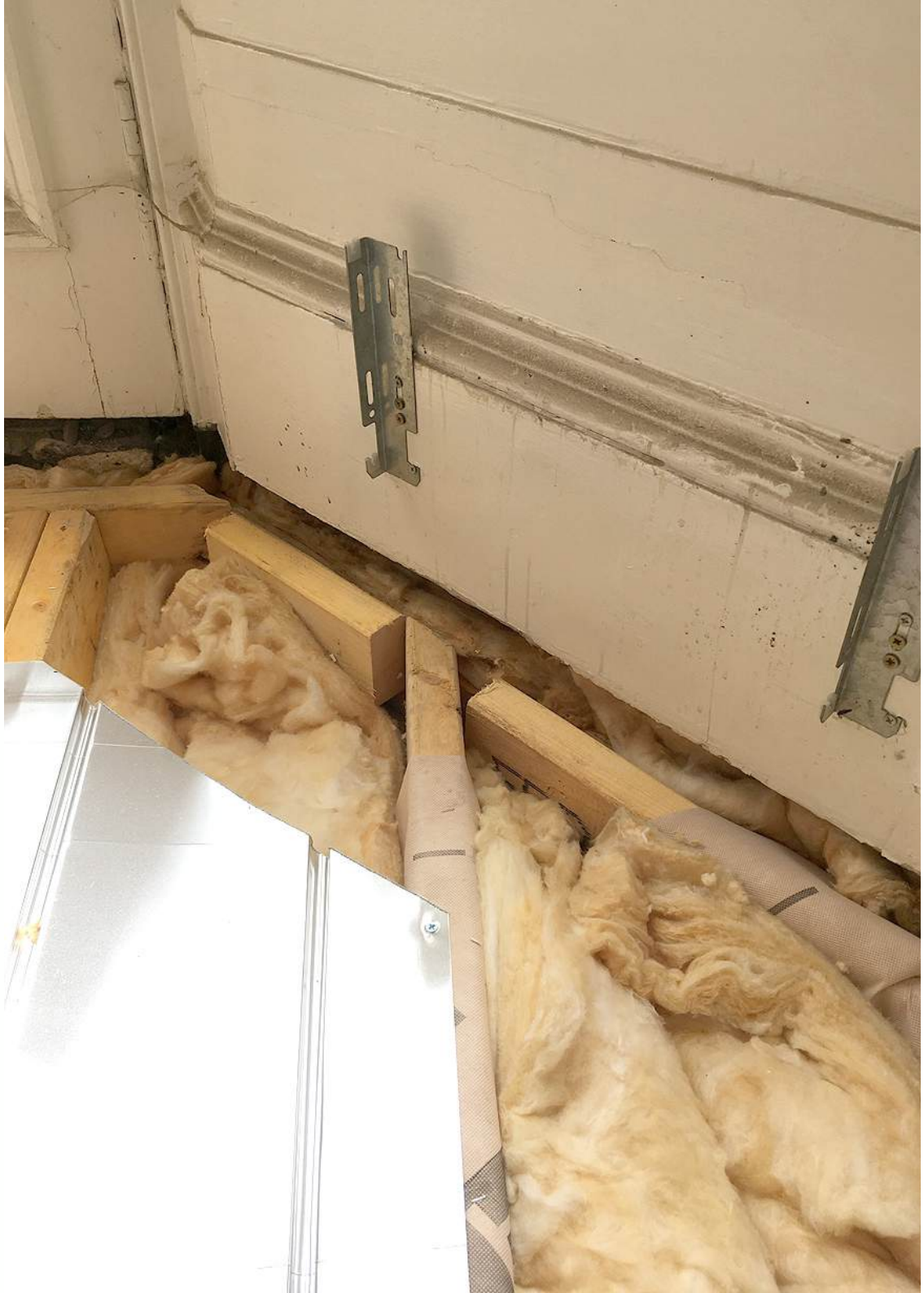
Construction Quality:

- Improving standards
- Two roles often missing on retrofit projects: Independent overview & Inspection of quality

- eg Architect / Building Control / Clerk of Works





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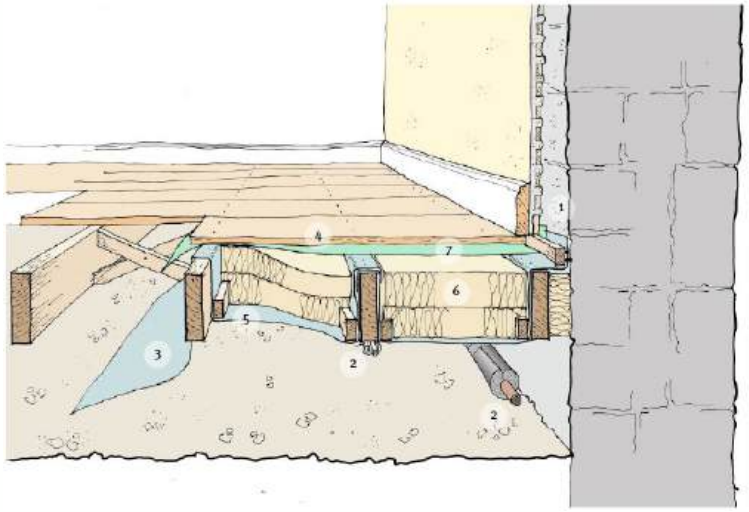

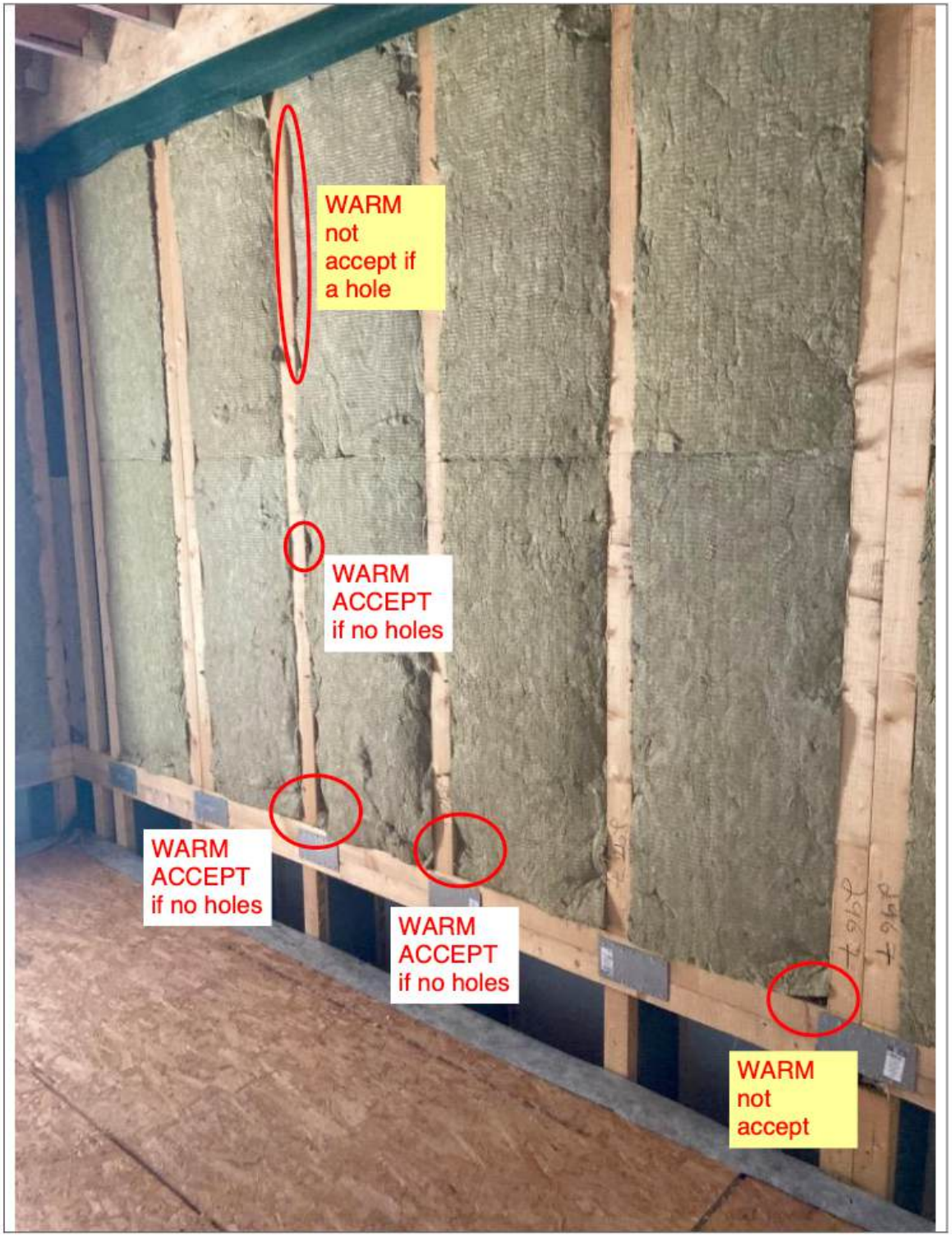

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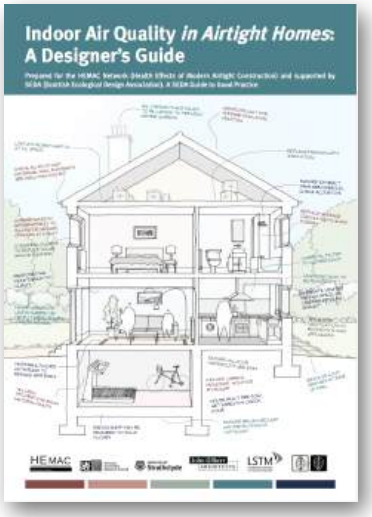
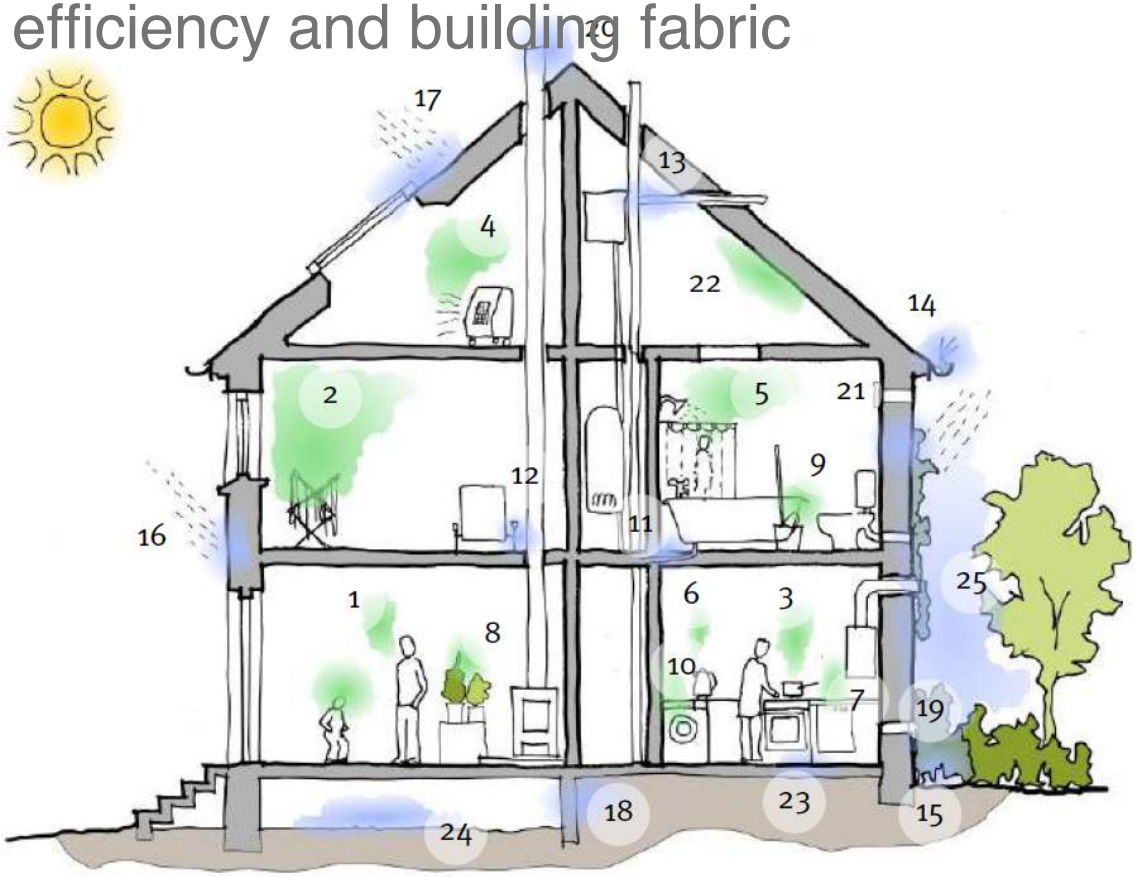
Moisture:

- Modern lifestyles often lead to greater internal moisture generation
- Greater airtightness increases risk of problems
- Ventilation in new-build, but not required in retrofit
- Impervious modern materials
- Affects comfort, health, energy efficiency and building fabric
- Expensive to model





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Engaging with People:

- Often the largest variable in building performance

- Better Controls
- Education
- Engagement

People

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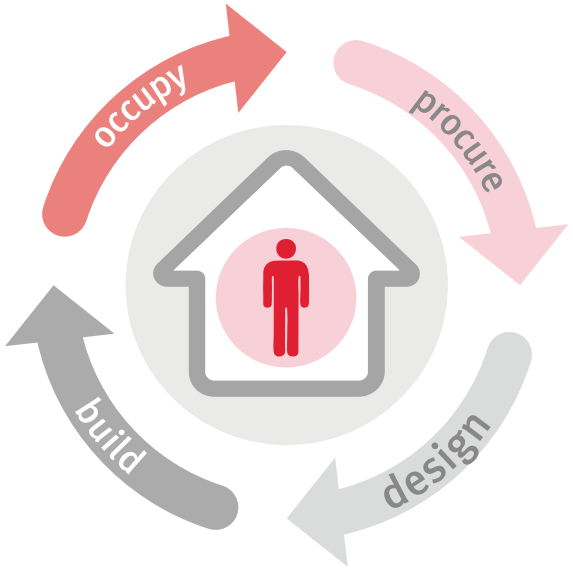
Engaging with People:

- Better Controls
- Education
- Engagement



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Heritage Considerations:

- Drawing on the lessons of the conservation sector to improve the retrofit sector

- Different construction
- Maintenance
- Significance

Heritage

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Different Construction:

- Fewer key components
- Limited palette of natural materials
- Managing moisture
- Flexibility & movement
- Assumed maintenance

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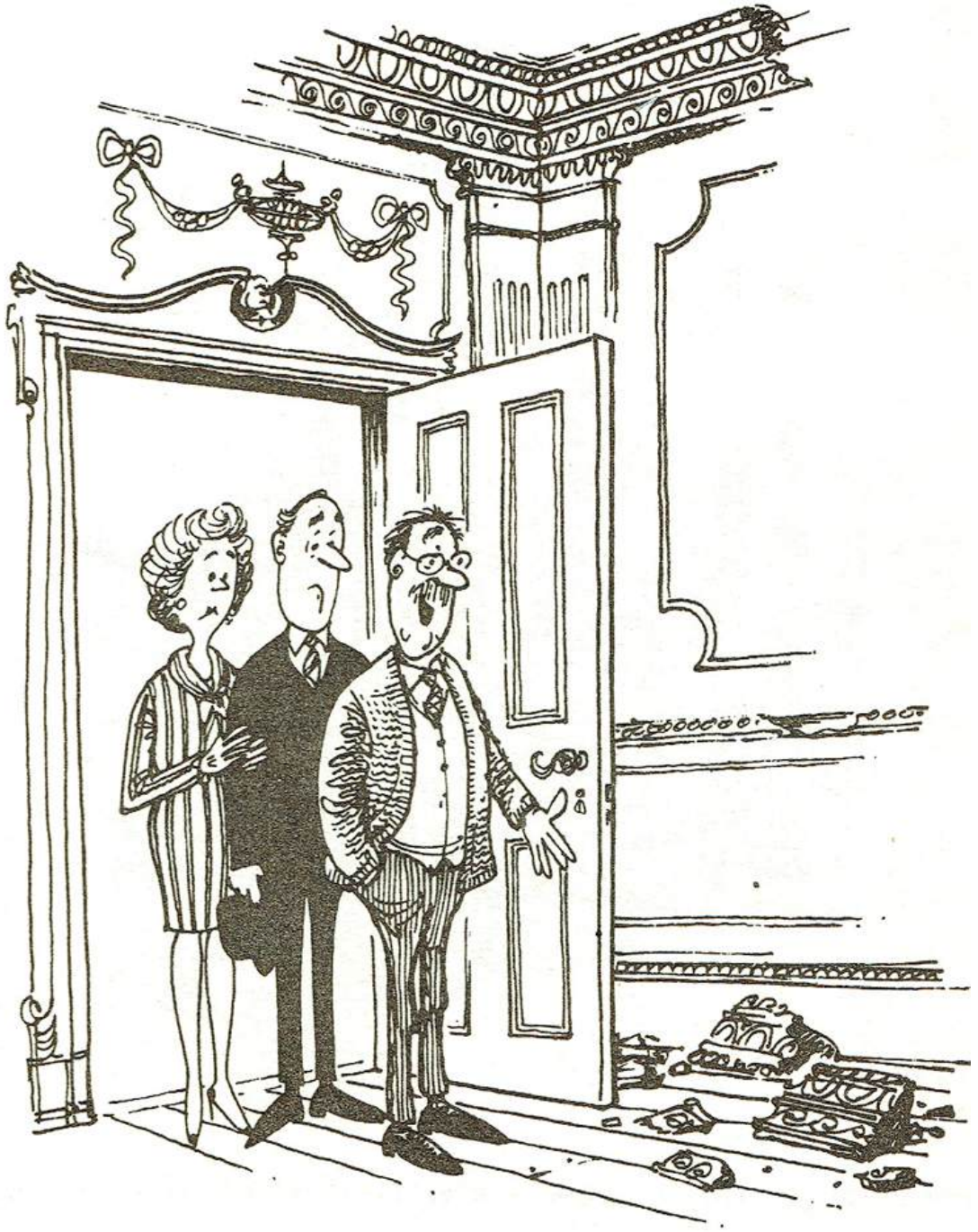
Maintenance:

- ‘Maintenance-free’ vs planned maintenance
- Should be factored into retrofit projects
- Benefits:
  - Correspondence with original intentions
  - Lower cost in long term
  - Lower waste / resource use



"THEY DON'T MAKE CEILINGS LIKE THAT ANY MORE."

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Significance:

- ‘Significance’ is an important part of conservation, but plays no role in energy efficiency surveys
- But it IS important, visually and culturally
- Links to SG Placemaking agenda

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Details & Specification:

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Works:

Maintenance
Airtightness
Space and Time

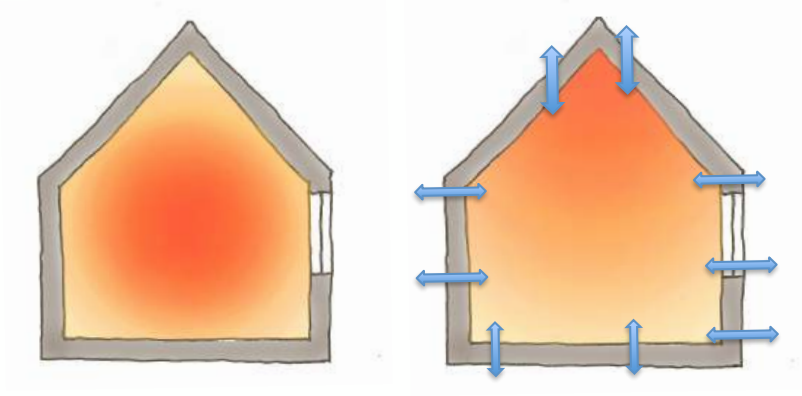
Roofs & Ceilings
Walls
Windows & Doors
Ground Floors

Heating
Ventilation
Lighting & Appliances

(Resources & Glossary)

Roofs: Attics

1. Most Important after maintenance
2. Most cost effective even if hassle to arrange
3. Fewest risks / easiest to solve
4. But the devil is in the details…



	Conventional Guidance	Our Guidance	
	300mm insulation. Lay cross-ways.	300mm insulation. No gaps. Lay cross-ways. Existing poorly laid insulation to be re-laid. Insulate over hoods at lights etc. Create access above to avoid later compaction of insulation. Use 'soft' rolls to fit snugly. Use a 'breather membrane' over. Natural insulation reduces embodied energy.	ENERGY
	-	Effective insulation reduces mould risk internally & improves comfort. Use of natural insulation reduces respiratory health risk (mainly when installing)	HEALTH
	Maintain air flow above, and at eaves.	Measures noted for Energy, Health, Maintenance and Moisture will all serve to protect building fabric from long-term problems.	FABRIC
	-	As Energy above – emphasis on little details in practice.	MODELLING
QUALITY	-	As Energy above.	
MOISTURE	(Air flow above.)	Air flow above insulation removes moisture safely. Hygroscopic insulation helps protect timber. Insulation to water pipes to be vapour-proof avoids condensation problems.	
PEOPLE	-	Separate effort required to remove / replace items stored in lofts. Invest in upgrading services etc. before installing insulation (less cost and disruption later). Walkway created allows for use of the space for storage etc.	
CONSTRUCTION	-	Soft insulation works better between timbers. Hygroscopic material helps protect timber from moisture problems.	
MAINTENANCE	Electrics above insulation. Plumbing insulated	Ensure all external maintenance carried out first. Review existing services / condition before starting. Electrics above insulation (or in conduit). Plumbing insulated. Walkway provides safe access in the future.	
SIGNIFICANCE	-	Unlikely to be relevant. Otherwise, as Fabric above.	

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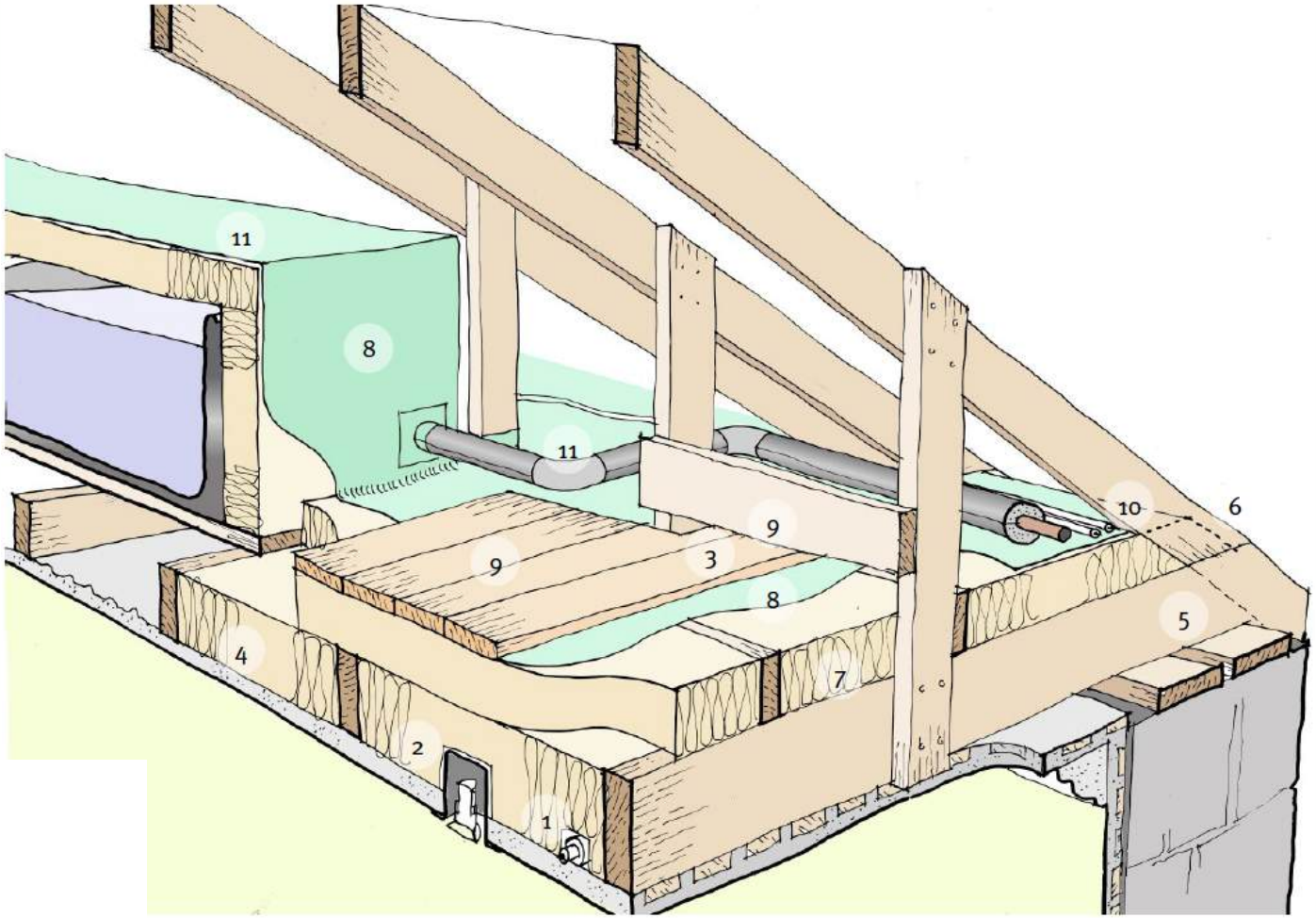
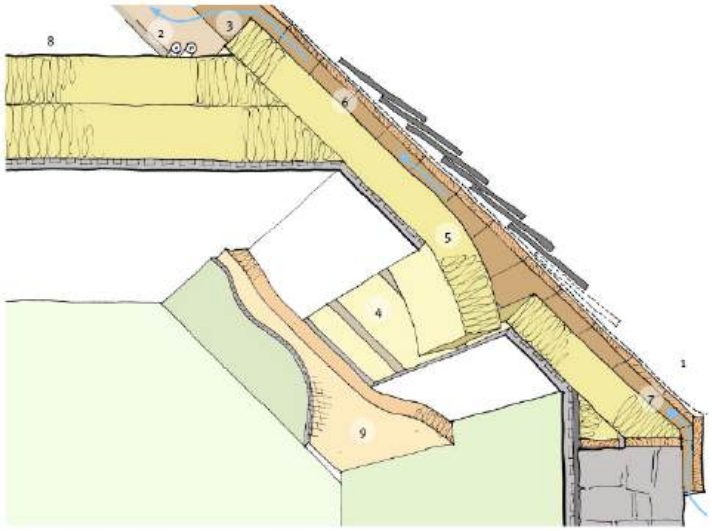
Roofs: Attics

1. Electrics + Plumbing
2. No gaps AT ALL!
3. Windtight membrane over
4. Raised deck…
5. Ventilation over

… and coombes





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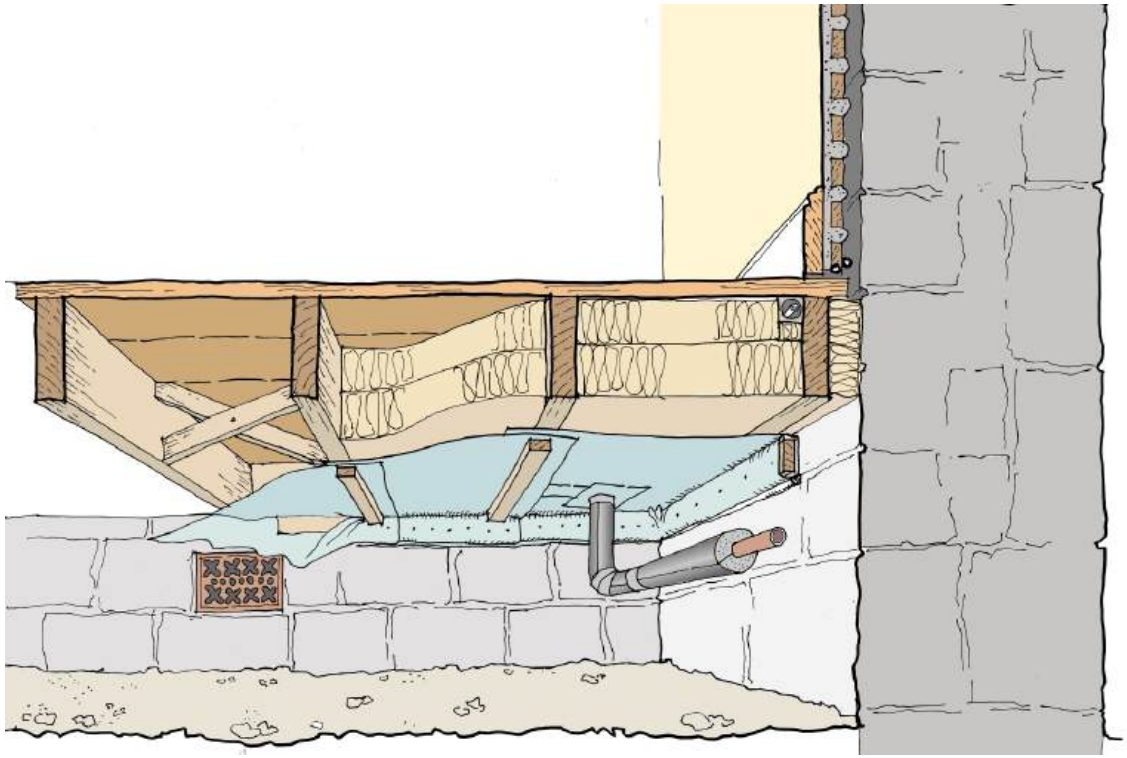
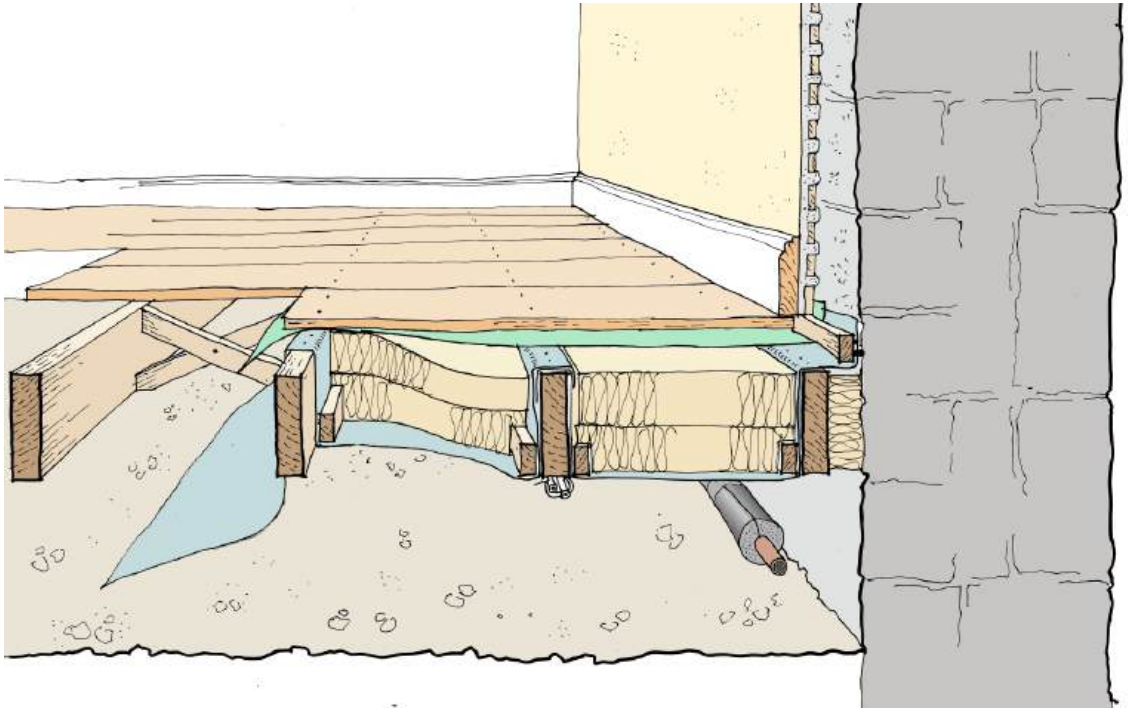
Ground Floors:

- MUCH more important than most people think

- U value
- Air leakage
- Warm feet, cool heads
- Like roofs, cost effective with less risks
- Edges difficult but important

(also solid floors)





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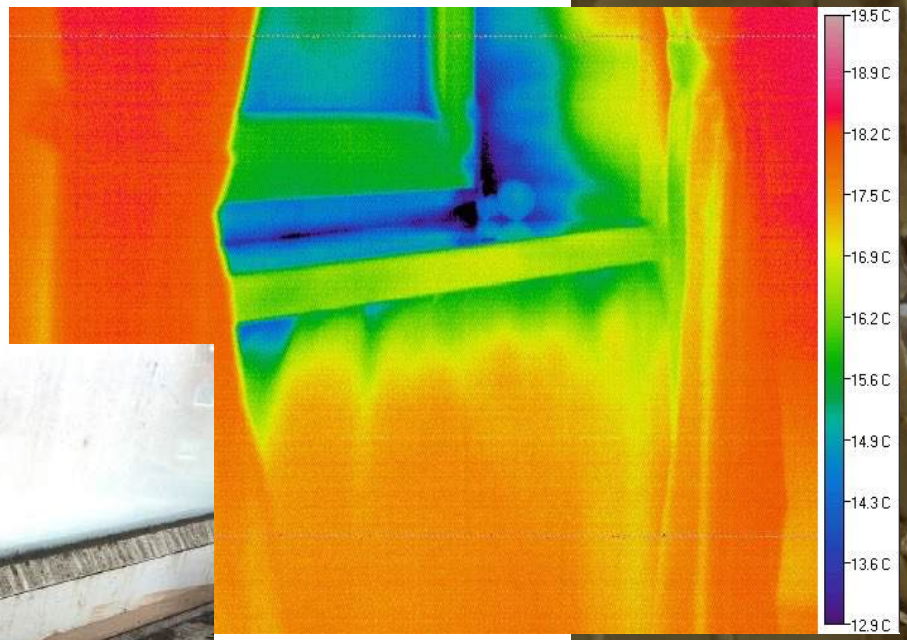
Windows (1):

- New windows - better U values…
- … but poor installation



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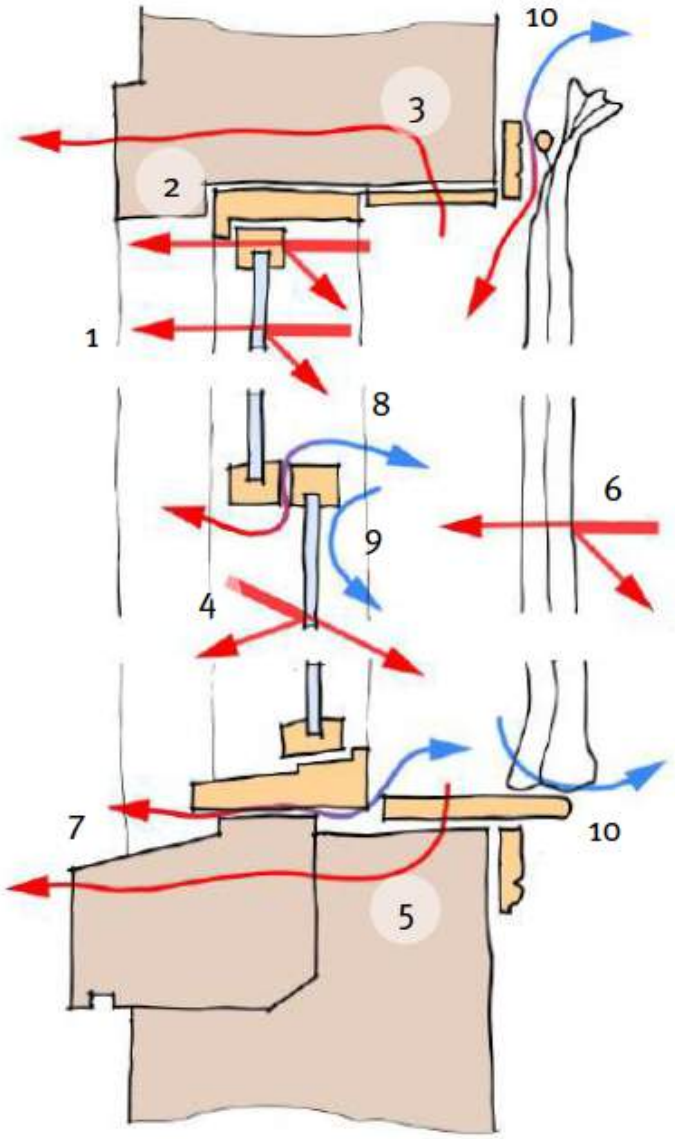
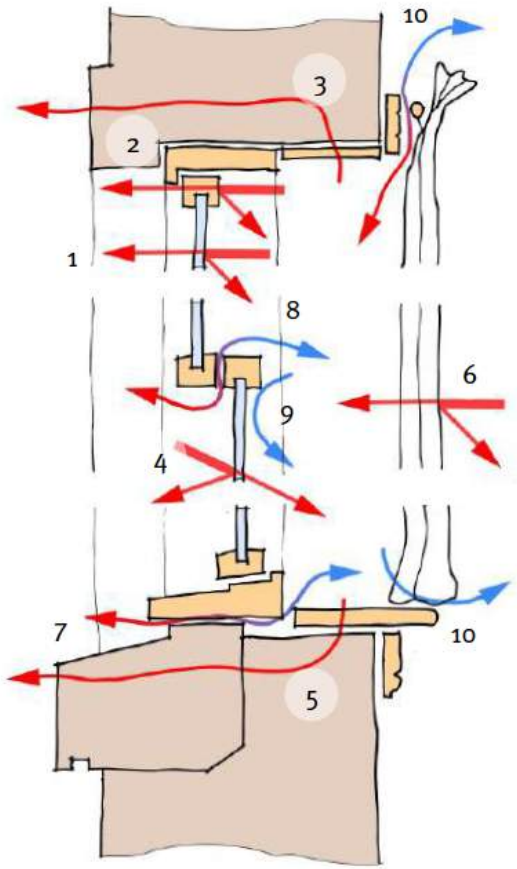
Windows (2):



1. mainly radiant losses through the glazing, better U-values will reflect more back into the room
2. conductive losses through the frame (timber frames better than PVCu and metal, but can be improved)
3. mainly conductive losses through the surrounding construction and materials used to fill the installation gap (if any)
4. mainly radiant gains from sunshine, better U-value glazing will reflect more, preventing heat gain
5. like 3, but water running off glazing can saturate the wall beneath a window if the cill is not effective and cause greater heat loss
6. curtains (but also blinds, shutters, secondary glazing) will reduce radiant losses from the room
7. convective losses from draughts between the window and the surrounding walls – a common problem
8. convective losses from inadequately airtight windows
9. downdraughts caused by cold glazing can lead to cold air running at low level into the room – discomfort
10. downdraughts caused by inadequate seal top and bottom to curtain, or whatever is placed in front of the window at night

Windows (3):

- Client support, better details, greater care on site, no problems long-term



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Walls: Solid Walls - IWI vs EWI

IWI Best?

1. Cheaper?
2. No external alterations (planning etc.)
3. No restrictions on timing
4. No restriction related to height
5 Not specialist / DIY possible

But…

6. Decant occupants
7. Loss in internal space
8. Cornicing, historic linings, servicing
9. Heavy fixing loads
10 Thermal bridging (internal structure)

Less well known:

11. Lack of protection from weather
12. Interstitial condensation / wall is cold
13. Impermeable materials
14. Separating thermal mass
15. Above means limited (60mm?)

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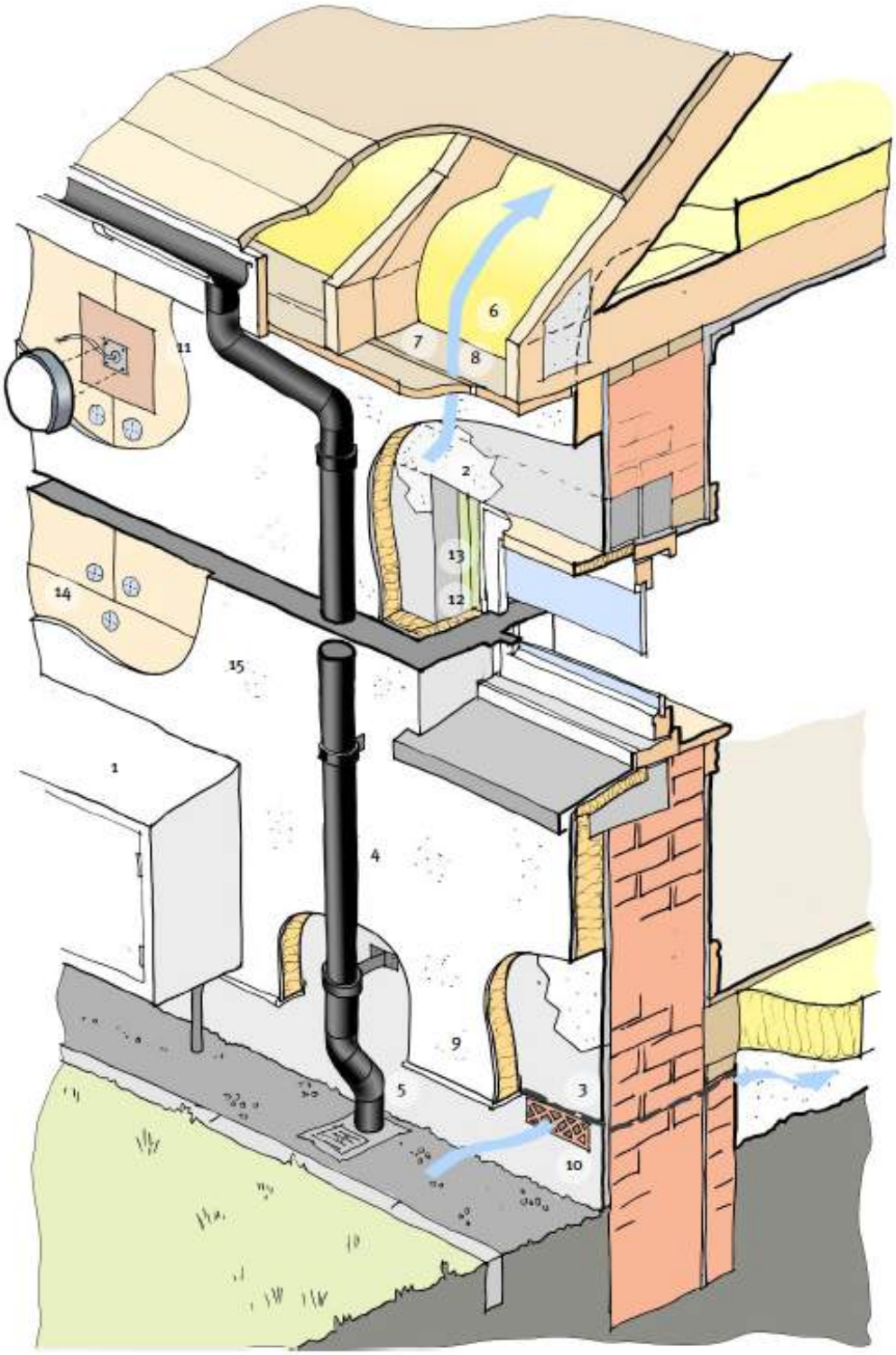
Walls: EWI

1. Avoid Gaps at all costs
2. Connect to roof insulation
3. Must be vapour permeable
4. Preparation, liaison with gas etc.



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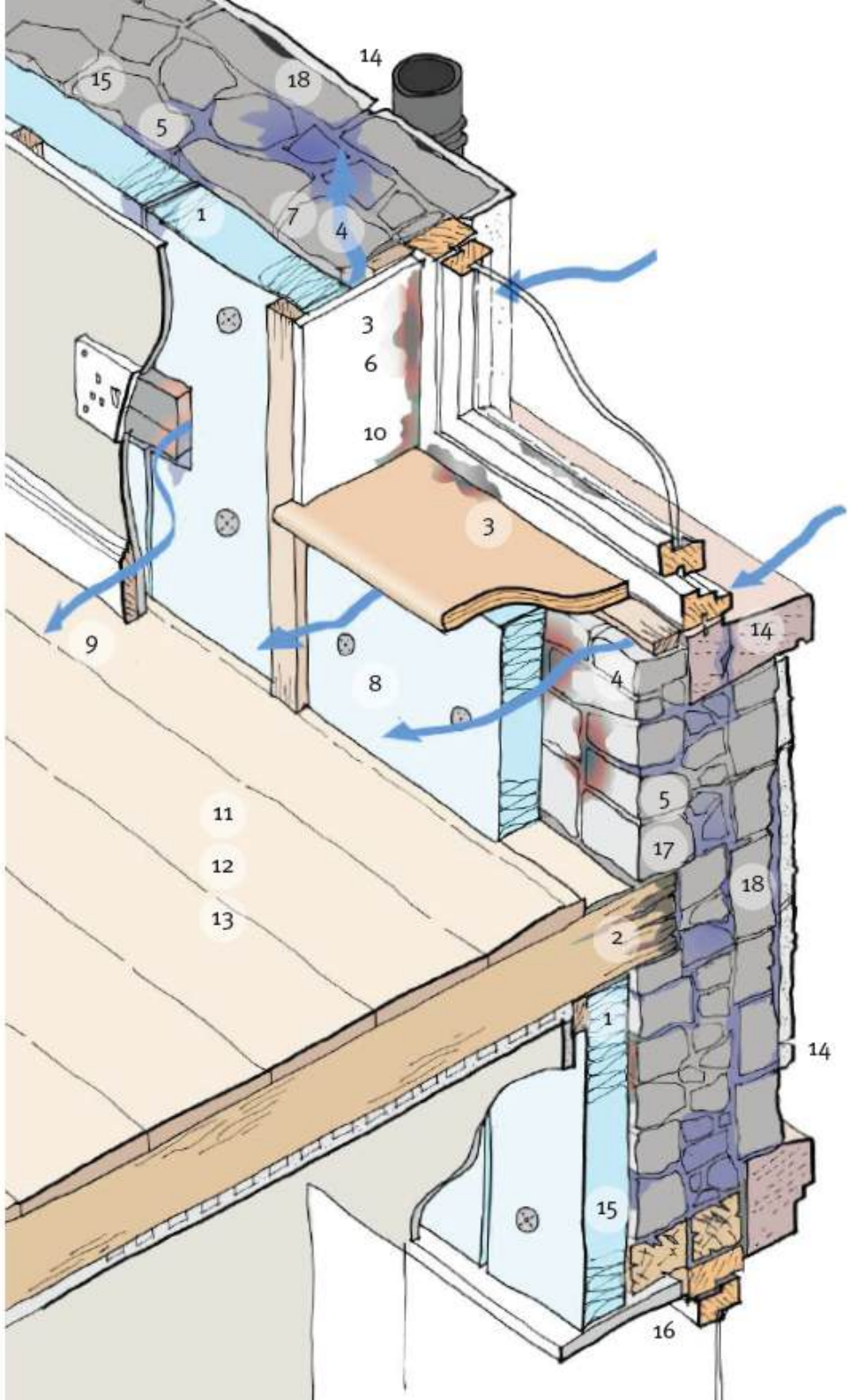
Walls: IWI

Energy: Unfulfilled Potential

1. Heat loss - gaps in the insulation
2. Heat loss - lack of insulation at floor joists
3. Heat loss - no insulation to reveals
4. Air leakage around window
5. Increased heat loss - saturated wall
6. Cold air flowing behind plasterboard cools internal surfaces increasing radiant heat loss
7. Cold air behind plasterboard ‘wicks away’ heat within fabric to outside
8. High embodied energy in insulation



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Walls: IWI

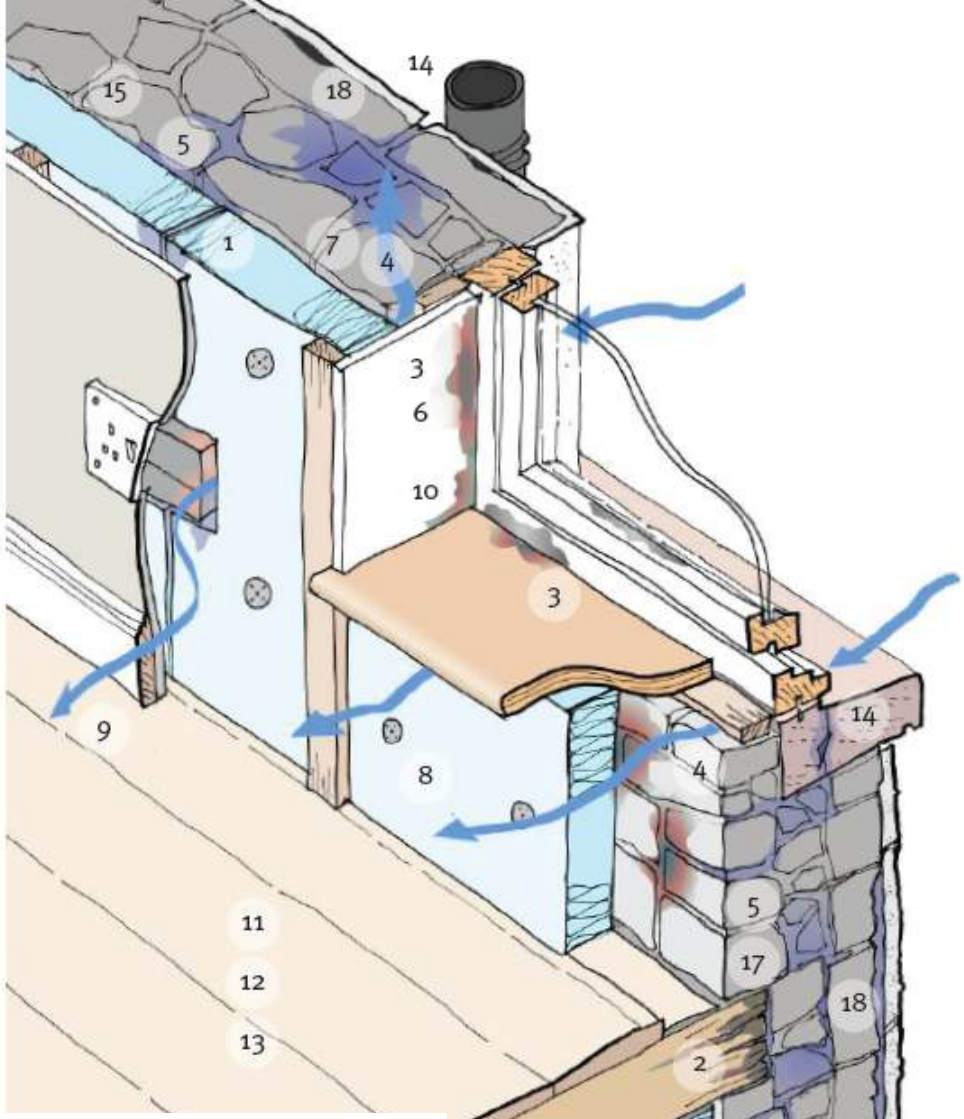
Health & Comfort Issues

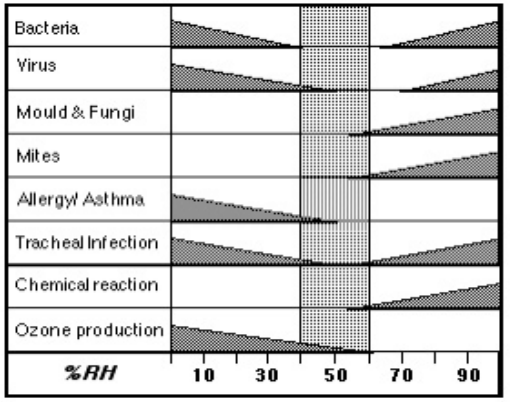
9. Discomfort due to draughts

10. Condensation and mould forming on cold surfaces, mould spores in air

11. Internal insulation reduces access to thermally massive / hygroscopic surfaces: increased fluctuation of temperature and humidity

12. Reduced internal air quality due to VOCs etc from synthetic materials (insulation), new paint etc.





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Walls: IWI

Building Fabric / Conservation

13. Loss of original cornicing etc.

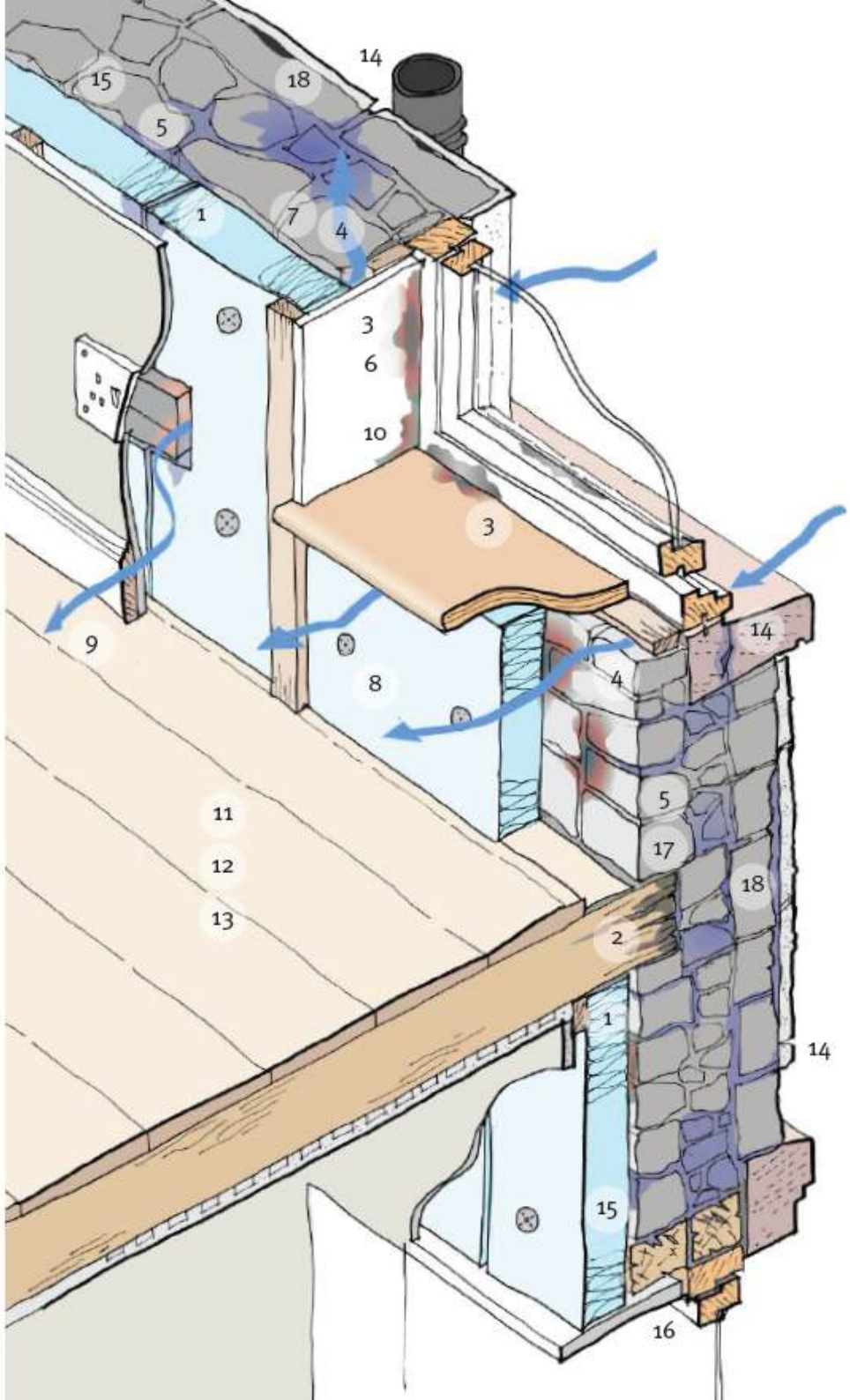
14. No maintenance - downpipe / water, cill crack, missing render

15. Interstitial condensation / gaps in insulation, external water penetration / lack of breathability / capillary action - moisture spread between insulation and wall - conditions for rot spread

16. Risk of rot / insect attack of lintols

17. Risk of rot / insect attack at joist ends

18. Saturation of wall - leaching of salts, spalling of masonry



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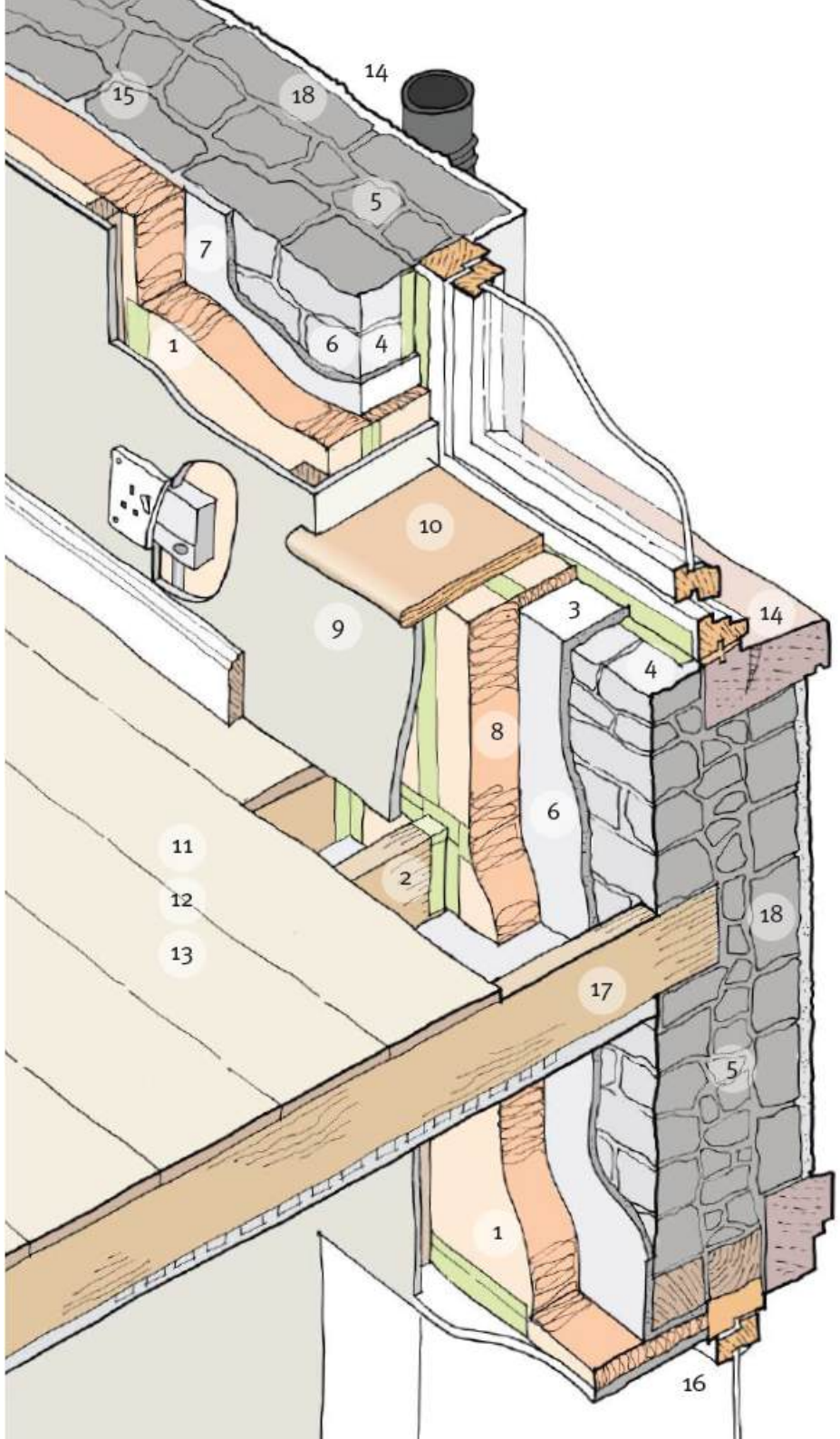
Walls: IWI

Energy: Optimised performance

1. No gaps in the insulation (and sealed)
2. Insulation extends into floor joists…
3. … and into reveals
4. No air leakage around window
5. Wall maintained and dry
6. No cold air behind plasterboard, surfaces warm
7. No cold air movement, no ‘wicked’ heat
8. Low embodied energy in insulation



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Walls: IWI

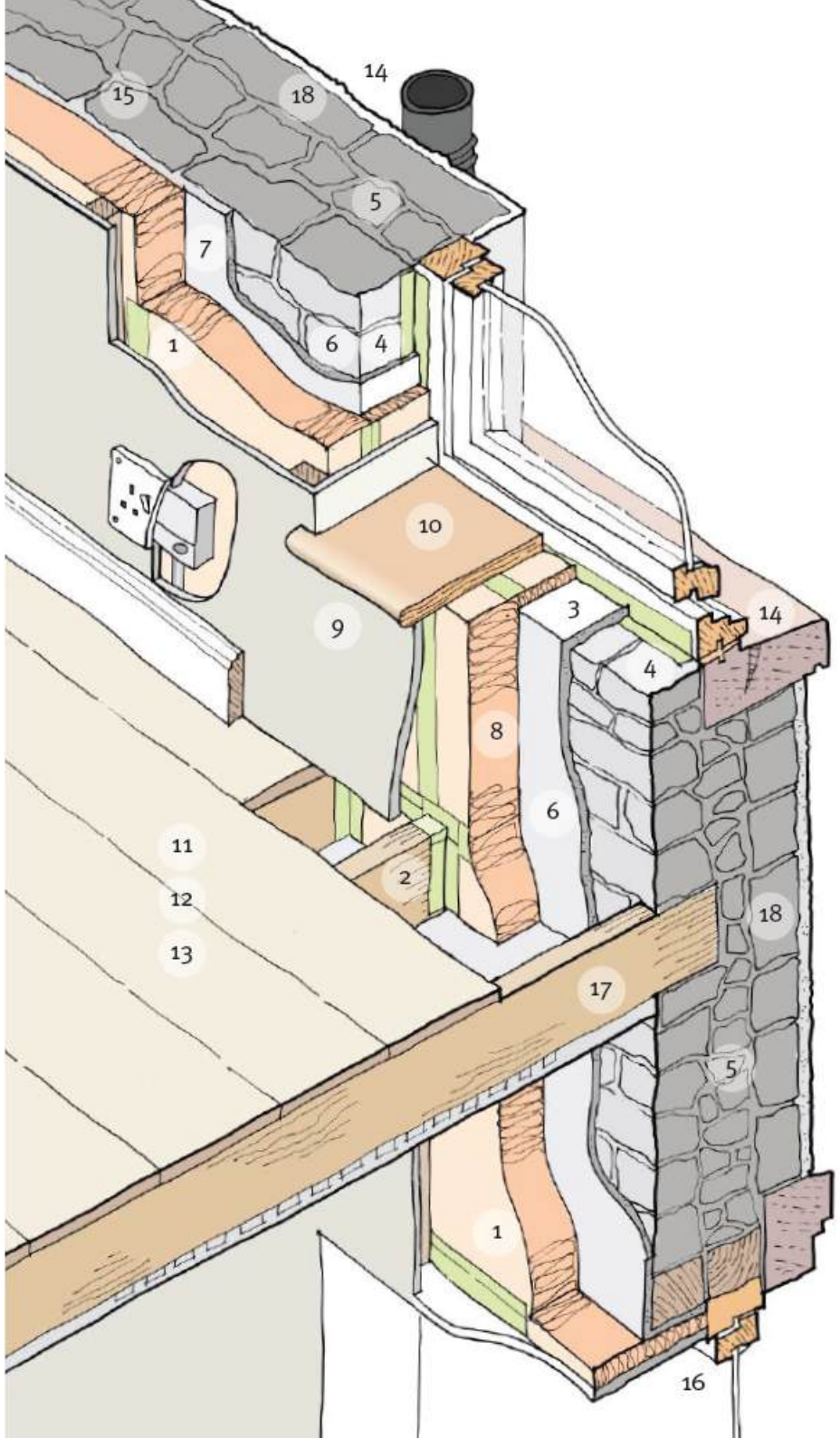
Comfortable and Healthy

9. No draughts cooling occupants

10. Warm surfaces mean nowhere for condensation to form, no mould (+ better ventilation)

11. Thermal mass access reduced, but insulation has much more thermal capacity and is hygroscopic so temperature and RH swings reduced

12. Air quality improved, no toxins / offgassing, no excess moisture / humidity



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Walls: IWI

Building Fabric / Conservation

13. Loss of original components still

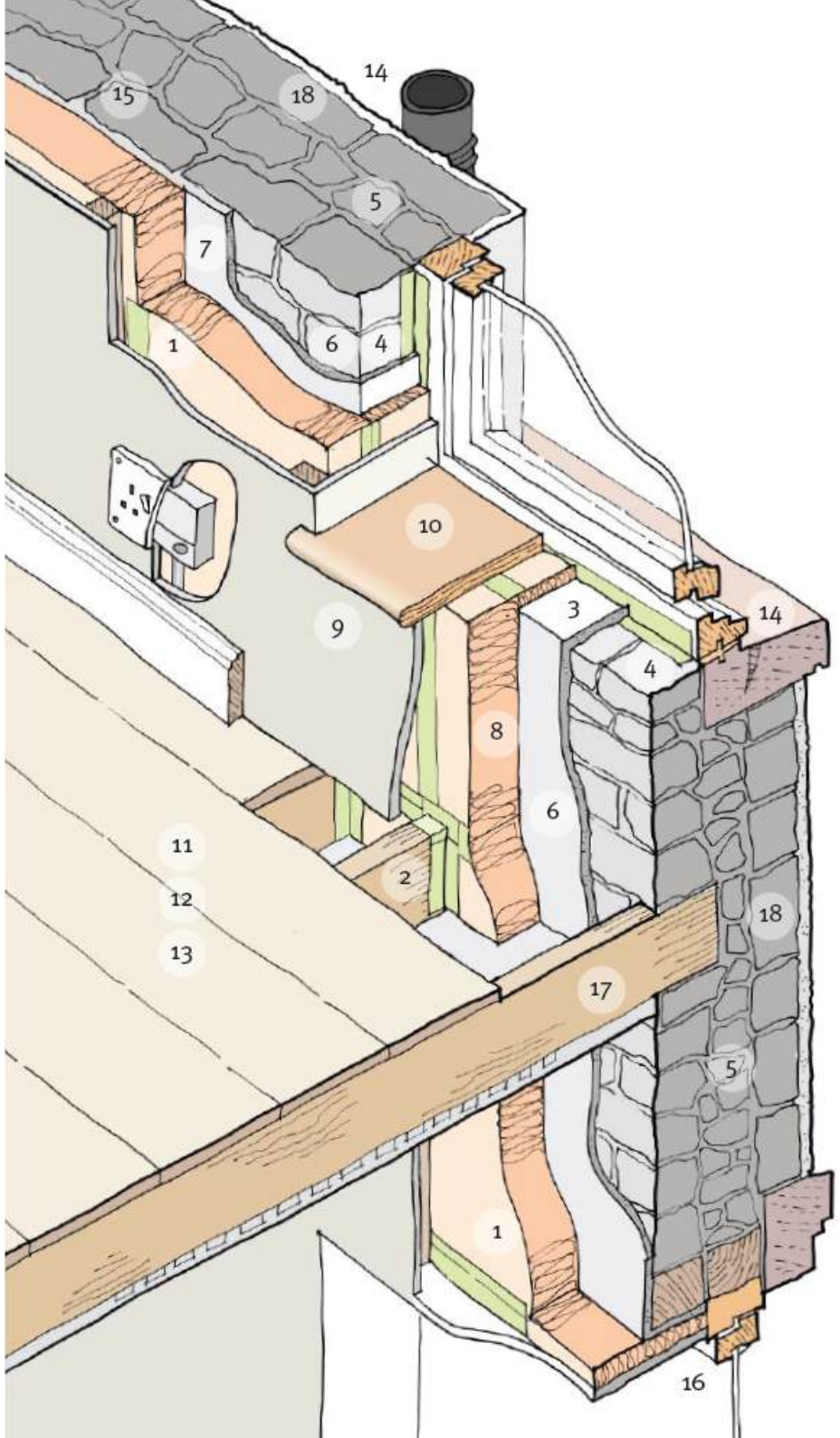
14. Maintenance carried out, many problems solved, value retained, insurance / H&S issues OK

15. Vapour permeable insulation + equalising coat reduces risks of IC, condensation can be diffused safely through fabric and back into room

16. Safe lintols remain dry

17. Floor joists remain dry

18. Stone wall remains dry, or at least capable of drying out, so less risk of damage long-term



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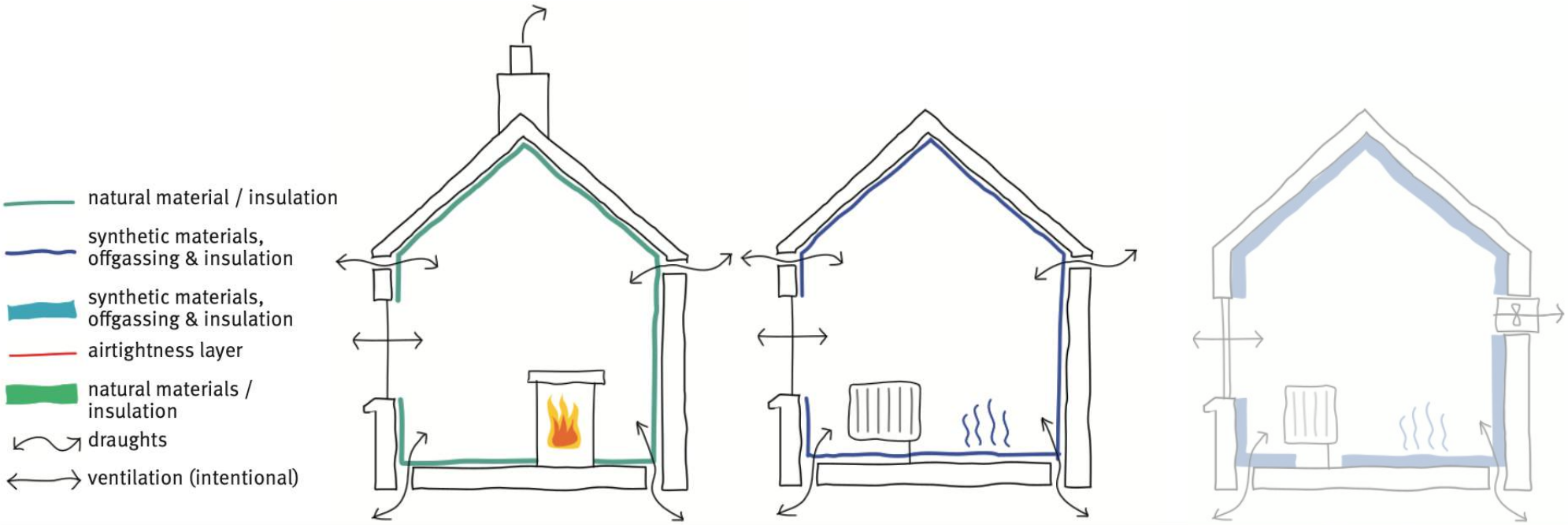
Building Defects

History



	› 1945	› 1970s + synthetics	1980s–2000s + insulation
TEMPERATURE	Cold	Cold	Warmer
AIR MOVEMENT	Draughty	Draughty	Still draughty
AIR QUALITY	Good IAQ	Poor IAQ	Poor IAQ
COST TO HEAT	£££	£££	££
MATERIALS / FINISHES	Natural	Synthetic	Synthetic
DURABILTY	Robust	Less robust	Less robust

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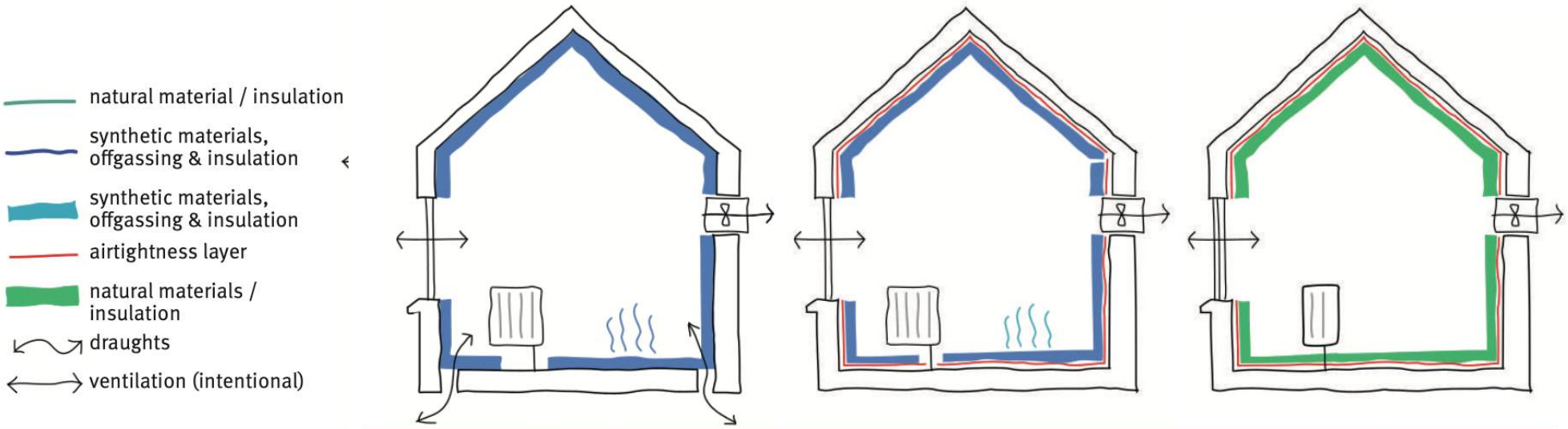
History



	1980s–2000s + insulation	2000–2020 + airtightness	2020 › + ventilation – toxicity
TEMPERATURE	Warmer	Warm	Warm
AIR MOVEMENT	Still draughty	Airtight	Airtight
AIR QUALITY	Poor IAQ	Poor IAQ	Good IAQ
COST TO HEAT	££	£	£
MATERIALS / FINISHES	Synthetic	Synthetic	Natural
DURABILTY	Less robust	Not Robust	Robust

The Pebble Trust

John Gilbert ARCHITECTS

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Priorities

1. Maintenance / Keep dry / manage dampness

2. Insulation: (ceilings and ground floors first, walls and windows last) (reduce thermal bridging and thermal bypass)

3. Good airtightness

4. Good ventilation

5. Natural / non-toxic materials

6. Guard against overheating

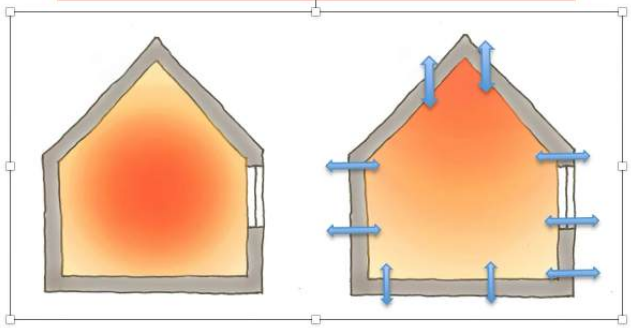
7. Occupants engaged / understand services / monitoring

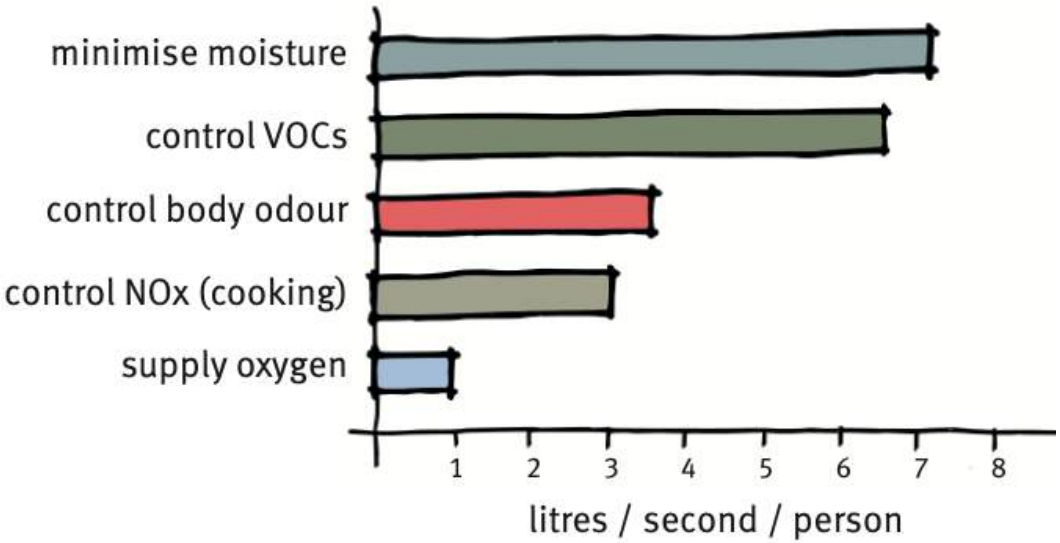
BPE suggests that priorities are (usually):

1. Roof / Attic
2. Floor
3. Airtightness
4. Windows
5. Walls

lower cost, few conservation issues, few technical problems

higher cost, more conservation issues, more technical problems





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Questions -

what is the best way to deal with dampness caused by condensation?

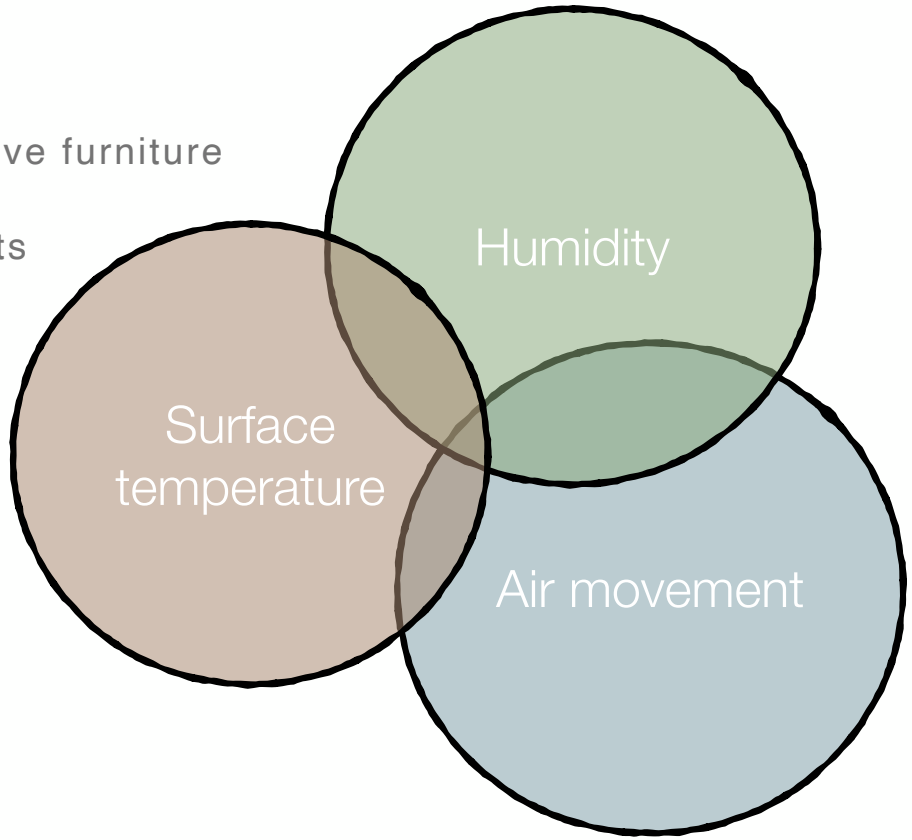
details into the issues that has been caused by improper retrofitted insulation to older houses?

how the introduction of Awaabs law will effect enforcement action in Scotland?

Humidity - reduce sources, wipe down, fix leaks

Ventilation - improve airflow (ingress + egress), move furniture

Temperature - heating regime, insulation, cold spots



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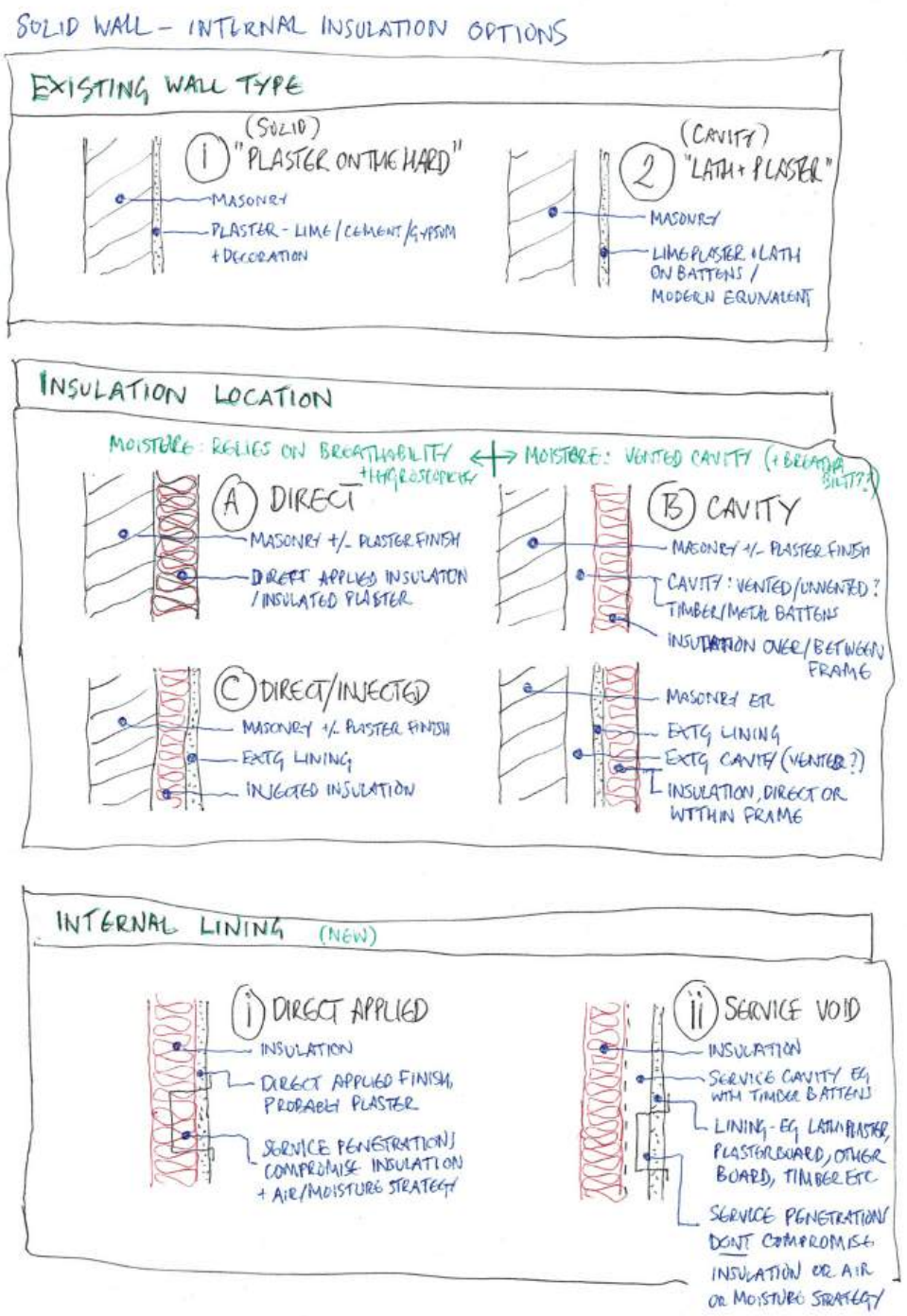
Questions -

For a traditional built house, with thick walls that are battered by the rain. What method would you use inside to add insulation to the walls inside the home if renovating the home? Would it be a wooden stud partition with glass wool insulation or a more modern approach of Kingspan sheeting? What method would you recommend to improve the energy of this typical type of home, e.g. air source heat pump / underfloor heating / wood burning stove.

In relation to the roof in such a house, what method would you use for air circulation in the loft space if using Kingspan between the roof joist for a warm roof construction. Would you be looking for an air gap in between the Kingspan and the roof.

Lastly, what are you thoughts on using traditional lime mortar on the outside of a traditional Skye built house?



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