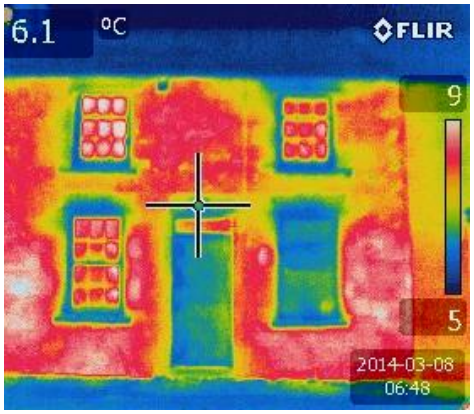
Older Building Retrofit Essentials





A Practical Perspective

John Edwards

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Professor in Practice: University in Wales Trinity St David

Chartered Building Surveyor, Chartered Construction Manager, Building Pathologist, Chartered Environmentalist, RICS Certified Historic Building Professional

Director of Edwards Hart:

1. Building Conservation.
2. Surveys.
3. Dampness & defects analysis
4. Retrofit / energy efficiency
5. Standard setting & guidance
6. Training – development & delivery

Previously - Cadw & English Heritage

Other activities include:

1. UK Green Construction Panel
2. STBA Expert Panel & Co-Founder
3. Advisor to the National Trust
4. IHBC Tech Panel & Educ Committee

1. Lead author of new BS for conservation
2. Co author of European Standard for condition surveys of historic buildings
3. Co author of the revised BS for stone & brick masonry cleaning and repair
4. Co author of RICS building conservation guide
5. Co author of CIOB retrofit & refurbishment guidance

Content

1. Introduction
2. Difference between older and newer buildings
3. Wider issues – its not just retrofit & getting a building ready for retrofit
4. Planning retrofit
5. Technical issues – need for condition surveys and proper understanding of moisture
6. Significance issues
7. Measuring the impact of retrofit – ‘Impact Assessments’
8. Choosing the retrofit measures and tools that can help
9. Managing quality

Climate change – what it means

Predictions by Defra

- Hotter drier summers
- Warmer wetter winters
- Rise in sea levels
- Increase in extreme weather

Buildings must be retrofitted, refurbished and properly maintained to cope with the changes

Retrofit – defined!

"add (a component or accessory) to something that did not have it when manufactured"

Oxford dictionary on-line

But its not just retrofit!

National Trust Going Green

Fit for the Future "The way to get started is to quit talking and begin doing." Walt Disney

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INSPIRE WALES AWARDS 2014

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Good Energy Working with National Trust

The need to take an holistic approach to sustainability and energy efficiency

Why older buildings?

Why older buildings?

Because there are so many of them…
Percentage Built pre 1919

Republic of Ireland 10%

Northern Ireland 16%

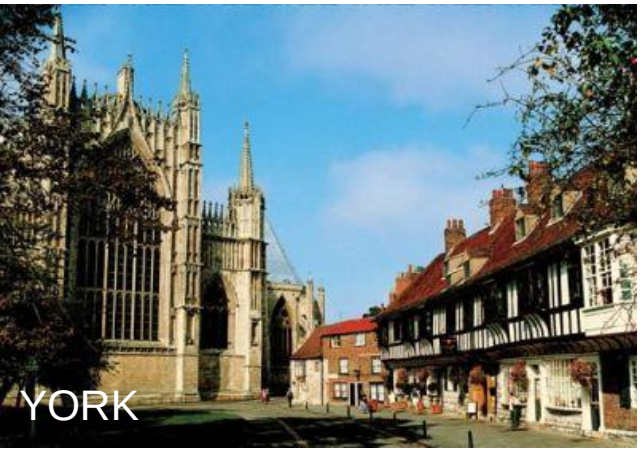
Scotland 20%

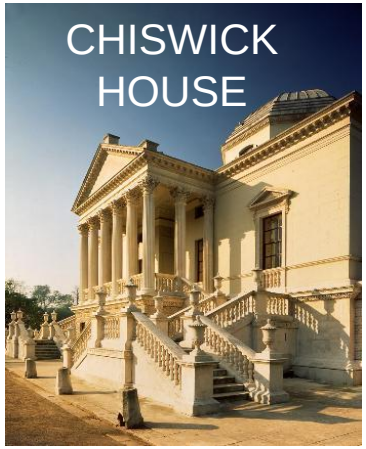
England 22%

Wales 34%

Not just about Listed Buildings and Scheduled Monuments

Listed Buildings and Monuments ~ 570,000 approx

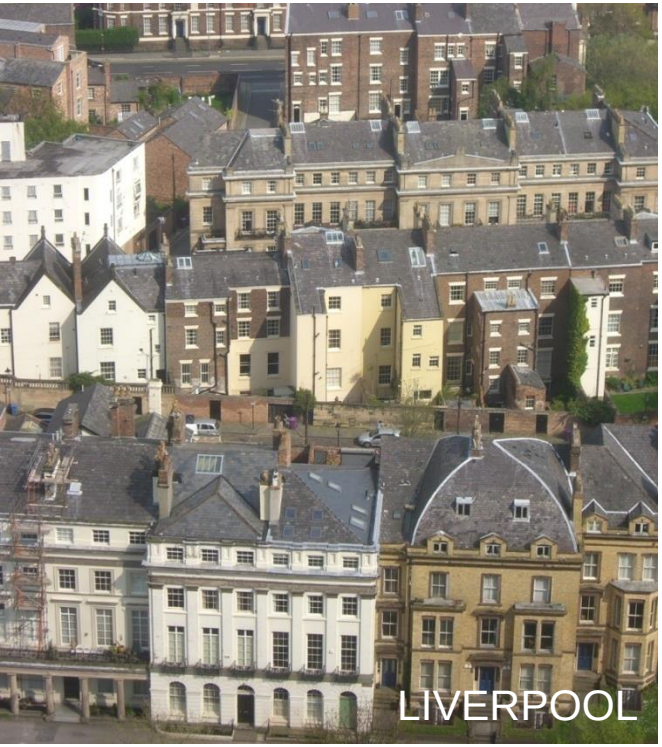




UK

2%

Traditional Buildings (pre 1919) ~ 6 Million approx


LIVERPOOL

TRURO


MANCHESTER


EDINBURGH


CHELTENHAM


CARDIFF

UK

25%

Cared for by conservation experts…

Will mainstream properly care for these?

Cared for by conservation experts…

- **Listed Building /Scheduled Monument Consents**
- **Building Regulation exemptions**
- **More likely to have proper expertise**
- **Energy Efficiency/ Retrofit– more expert approach**

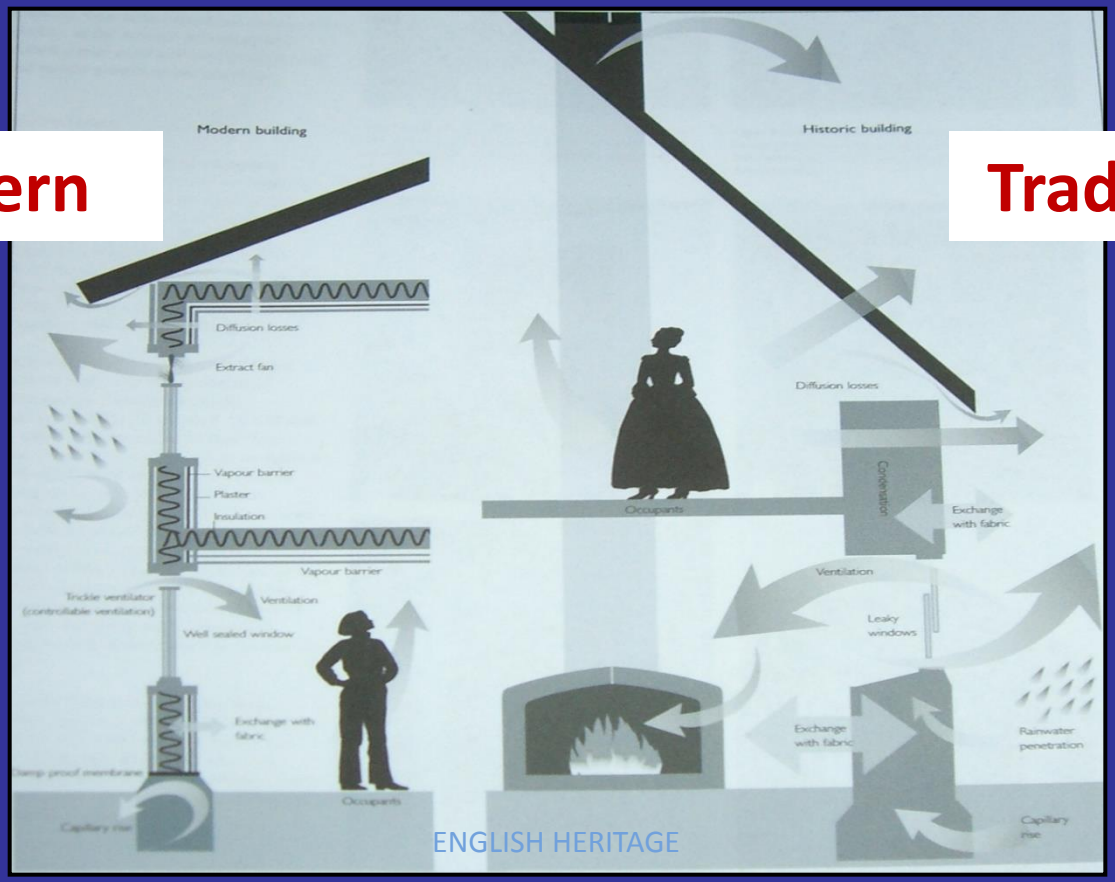
Will mainstream properly care for these?

- No planning consents for most works
- Building Regulations – 'Special Considerations' – but will they be applied for or granted?
- Much less likely to have proper expertise – from 'mainstream'
- Energy Efficiency / Retrofit – risks to buildings, paybacks. Unlikely to receive traditional building 'expertise' from Energy Advisors
- Many BS's /EN's, etc. contrary to good practice

The MOST IMPORTANT thing to understand…

These buildings are the different

Modern



Traditional

They perform differently

Main issue….

Treated the same –
when it should be different

Treated differently –
when it should be the same

Main issue….

Treated the same –
when it should be different

Treated differently –
when it should be the same

What is an historic building?

DOES IT MATTER?

- Similar design~
- Similar Construction ~
- Similar performance
- Requires Similar Repairs
- Same understanding!
- Significance

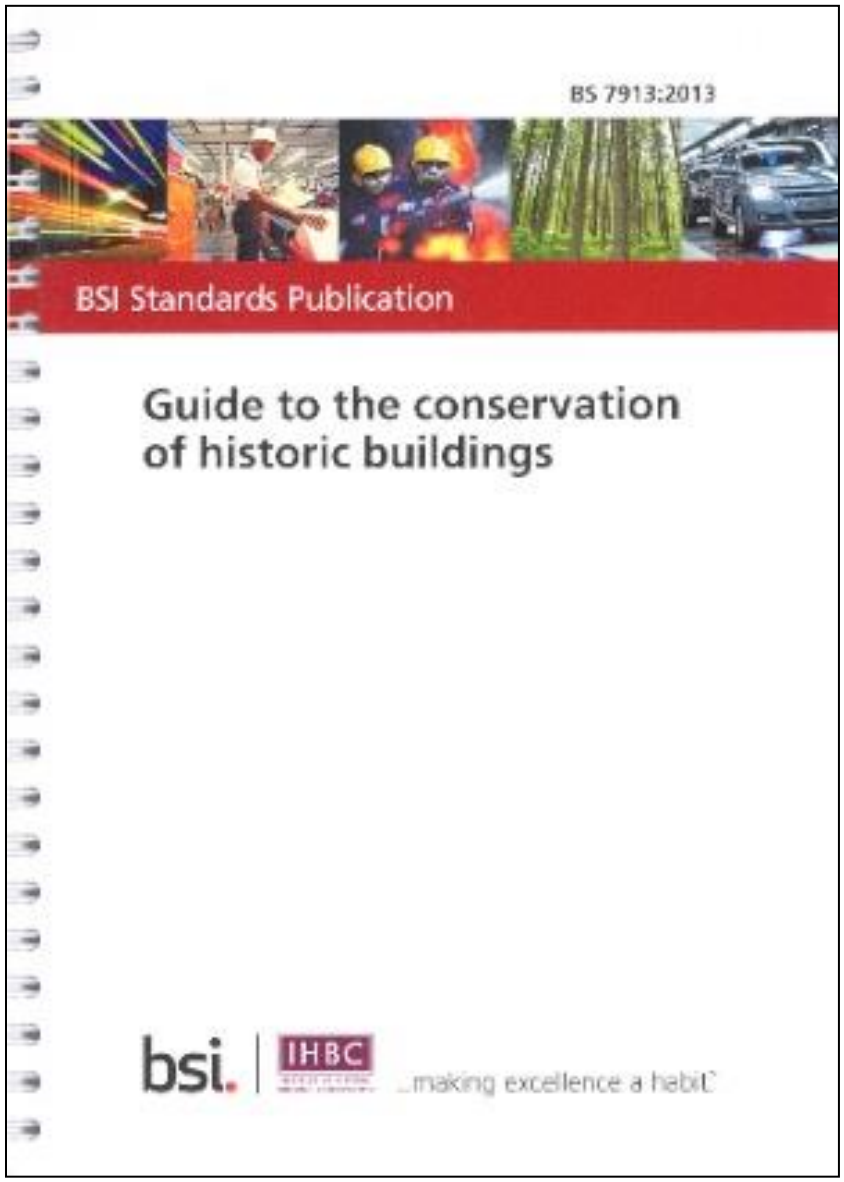
Un-designated

Common Victorian Terraced House

Grade 1 Listed

Castell Coch Victorian

What can guide us?

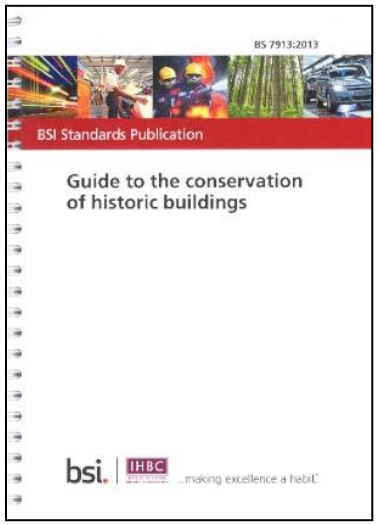


BS 7913: 2013

Wide ranging authoritative guidance for all old buildings…

The most authoritative UK wide….guidance according to the IHBC – a ‘must have’.

What can guide us?



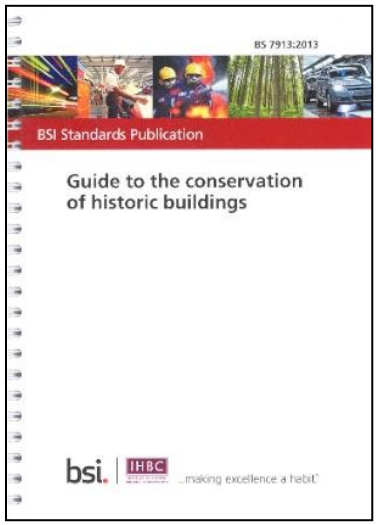
BS 7913: 2013

0 Introduction

0.1 General

(2) Requires judgement based on an understanding of principles informed by experience and knowledge. "**British Standards that are applicable to newer buildings <u>might be inappropriate</u>".**

What can guide us?



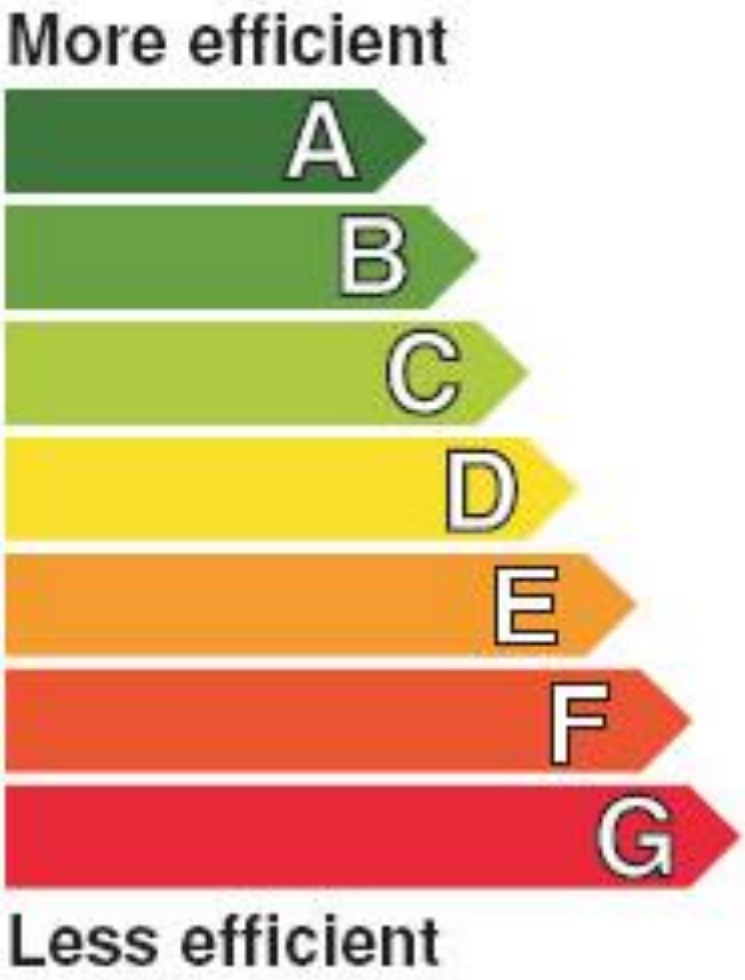
BS 7913: 2013

1 Scope

(1) …. *"**best practice in the management and treatment of historic buildings**. It is **applicable to historic buildings with and without statutory protection**. It is not applicable to below ground archaeology or any other type of heritage asset such as movable objects or vehicles".*

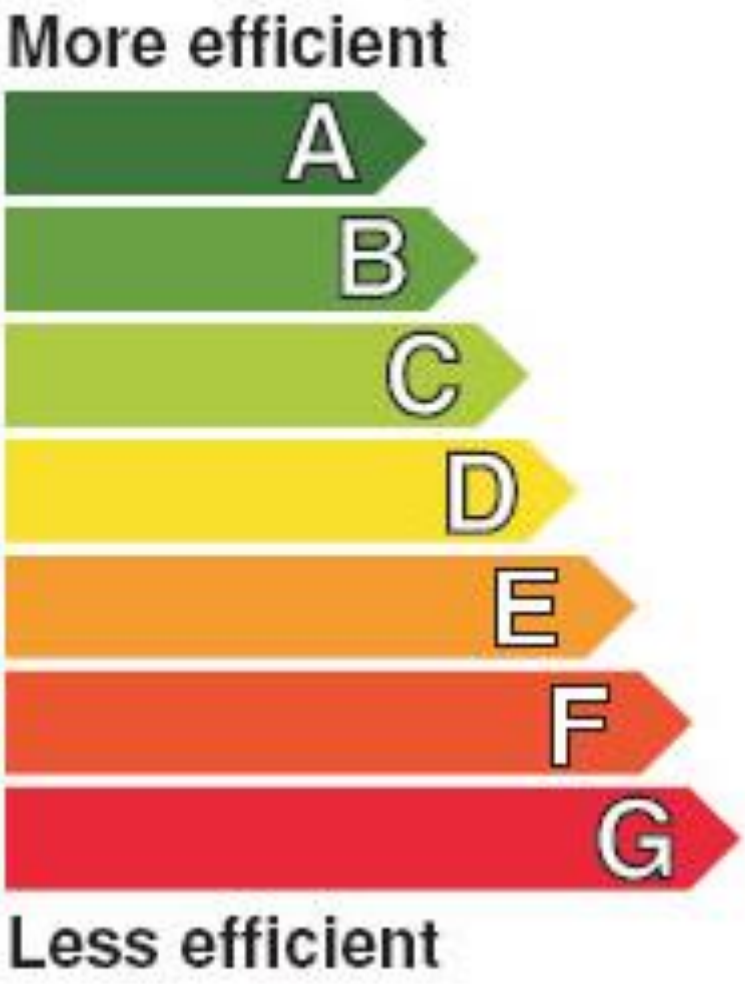
Energy performance assessment

The basics…



Energy performance assessment

The basics…

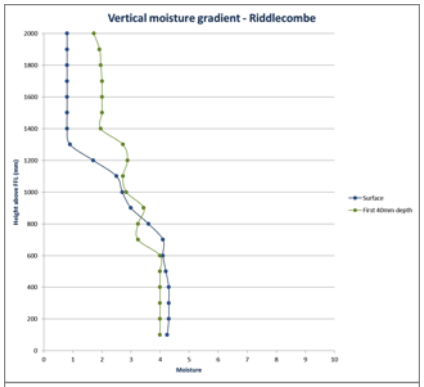


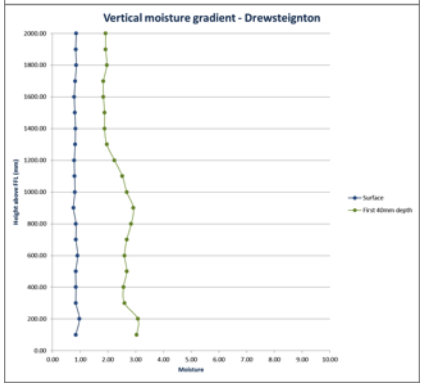
and what we REALLY need to understand…

1. **Design and construction**
2. **Performance of the building at present**
3. **Performance of the building after retrofit**
4. **Is the condition of the building affecting its performance?**

One Critical issue!

Relationship between wall moisture and U - Values





0.76 W/m²K @ 1790 mm above ffl

1.05 W/m²K @ 630 mm above ffl

1.24 W/m²K @ 1800 mm above ffl

1.50 W/m²K @ 800 mm above ffl

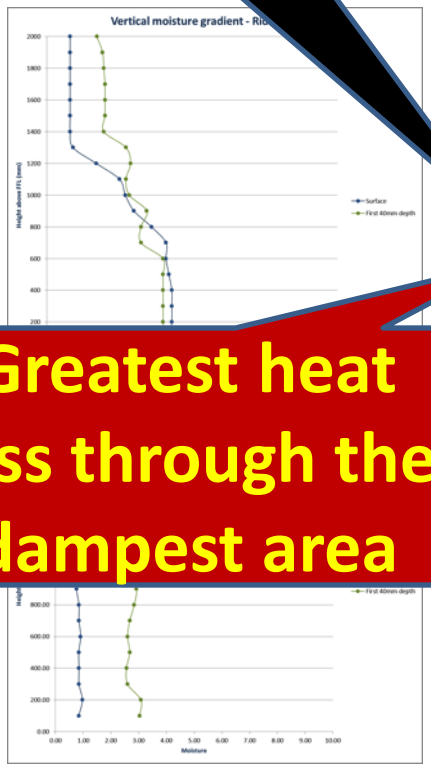
Courtesy Caroline Rye / SPAB

One Critical issue!

Relationship between wall moisture and U - Values

DAMP

DRY



Greatest heat loss through the dampest area

0.76 W/m²K @ 1790 mm above ffl

1.05 W/m²K @ 630 mm above ffl

1.24 W/m²K @ 1800 mm above ffl

1.50 W/m²K @ 800 mm above ffl

Courtesy Caroline Rye / SPAB

and what this means…

BS 7913: 2013: Section: 5.31 Sustainability

…….“Elements such as walls can be over a third less energy efficient if damp. Some energy efficient measures can have an adverse effect on sustainability. The actual energy efficiency of historic buildings and their potential energy efficiency with the addition of energy efficient measures should be taken in account at the outset (see 6.3). The need for energy efficiency and low carbon might also influence the selection of materials and work methods as they can impact on thermal performance and weather resistance. Building materials and products should be sourced and procured in a sustainable manner”……

and what this means… in practice…

High wall moisture and high U - Values

1. The correct materials and tools required for re-pointing stone / brick joints in traditional buildings.

2. The implications of not re-pointing joints properly.

Energy Efficiency of Building Fabric

Keep walls in good condition for good thermal performance….

Pointing irons

Which tools should be used?

Pointing trowels

Energy Efficiency of Building Fabric

Re-pointing stone/brickwork properly

Which tools should be used?

Pointing irons

TRADITIONAL BUILDINGS

These are the same – treat them the same!

Pointing trowels

Wrong tools = inferior work = energy inefficiency

Energy Efficiency of Building Fabric

Re-pointing stone/brickwork properly

Pointing irons

Pointing trowels

Use the CORRECT tools

Energy Efficiency of Building Fabric

Re-pointing stone/brickwork properly for good thermal performance and sustainability

Repairs to Stone Wall		
Repair Type	**Durability – well executed**	**Durability – sub standard**
Stone indent / piecing in	100+ yrs	10-20 yrs
Mortar repairs in sheltered locations	30-60 yrs	5-15 yrs
Mortar repairs in exposed locations	Avoid	< 10 yrs
Mortar joint re-pointing	60-120 yrs	5-15 yrs
Stone replacement	100+ yrs	< 30 yrs
Brick replacement	100+ yrs	< 30 yrs

Energy Efficiency of Building Fabric

BS 7913: 2013: Section: 5.31 Sustainability

……**“The most effective way of ensuring energy efficiency and sustainability is to keep historic buildings in good repair** so that they last as long as possible, do not need replacement and **do not suffer from avoidable decay that would require energy and carbon to rectify.** They should provide occupancy in an efficient manner, involving minimal production of carbon and use of energy without harming significance or the physical performance of the historic fabric. Using natural ventilation and light, and proper temperature and humidity control for individual rooms are ways of minimizing energy usage that respect the building’s material characteristics”…….

Energy Efficiency of Building Fabric

BS 7913: 2013: Section: 5.31 Sustainability

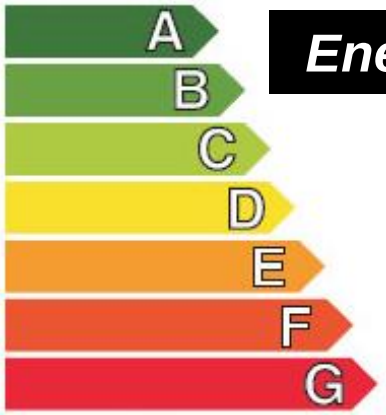
…….“Elements such as walls can be over a third less energy efficient if damp. **Some energy efficient measures can have an adverse effect on sustainability.** The actual energy efficiency of historic buildings and their potential energy efficiency with the addition of energy efficient measures should be taken in account at the outset (see 6.3). The need for energy efficiency and low carbon might also influence the selection of materials and work methods as they can impact on thermal performance and weather resistance. Building materials and products should be sourced and procured in a sustainable manner”……

But how do we solve this problem?

Treated the SAME –
when it should be different

Treated DIFFERENTLY –
when it should be the same

By linking all these things together…



Energy efficiency

Climate Change

Retrofit

Appropriate skills

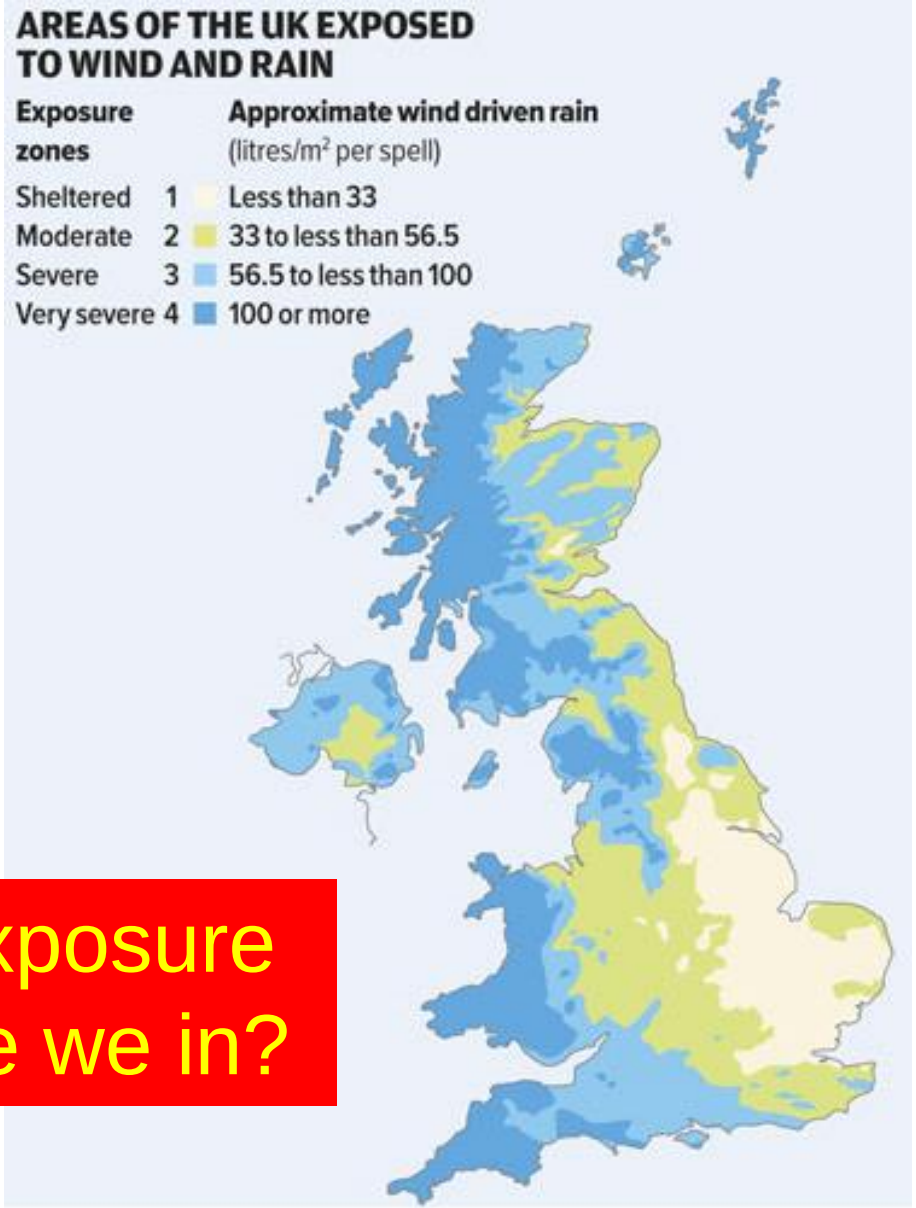
Sustainability

Building Pathology

Appropriate Knowledge

Understand - Location & Environment

UK Weather Exposure Zones



What exposure zone are we in?

Understand - Location & Environment

UK Weather Exposure Zones

Most of Wales is in exposure zone 4

What exposure zone are we in?

Understand - Location & Environment

UK Weather

Exposure Zones

Most of Wales is in exposure zone 4 And large areas of England & Scotland plus NI

What exposure zone are we in?

and remembering its not just retrofit….

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Good Energy Working with National Trust

The need to take an holistic approach to sustainability and energy efficiency

The way we live & the Energy Hierarchy

FIRST STAGE: Reduce need for energy:

- **Wear additional clothing and turn heating down in the winter.**
- **Quicker showers and no long baths.**
- **No tumble drier – using a washing line.**
- **Turn off radiators in room not/seldom used and close door.**
- **Keep a smaller fridge – use a larder / cool room.**

The way we live & the Energy Hierarchy

SECOND STAGE: Reduce energy use via Life Style:

- **Use heating controls properly – turn off when not needed.**
- **Close curtains / shutters in winter when practicable.**
- **Only boil just enough water that is needed in a kettle.**
- **Turn off appliances at wall socket when not in use.**
- **Close doors to rooms – protecting heat in rooms that are used most.**

The way we live & the Energy Hierarchy

THIRD STAGE: Reduce energy use via Low Cost relatively easy improvements:

- **Low energy lighting.**
- **Insulate hot water cylinder.**
- **Loft insulation.**
- **Draught proof doors and windows.**
- **Thermostat valves to radiators.**
- **Secondary glazing.**
- **Replacement appliances - energy efficient models**

The way we live & the Energy Hierarchy

FOURTH STAGE: Reduce energy use via Higher Cost improvements:

- Energy efficient boiler.
- Floor insulation.
- Shutters to windows.
- Upgrade windows.
- Wall insulation
- Solar thermal panels.
- Solar photovoltaic panels.
- Wood burner – if wood is easily accessible.
- Ground/ Air source heat pump.

The way we live & the Energy Hierarchy

FOURTH STAGE: Reduce energy use via Higher Cost improvements:

- Energy efficient boiler.
- Floor insulation.
- Shutters to windows.
- Upgrade windows.
- Wall insulation
- Solar thermal panels.
- Solar photovoltaic panels.
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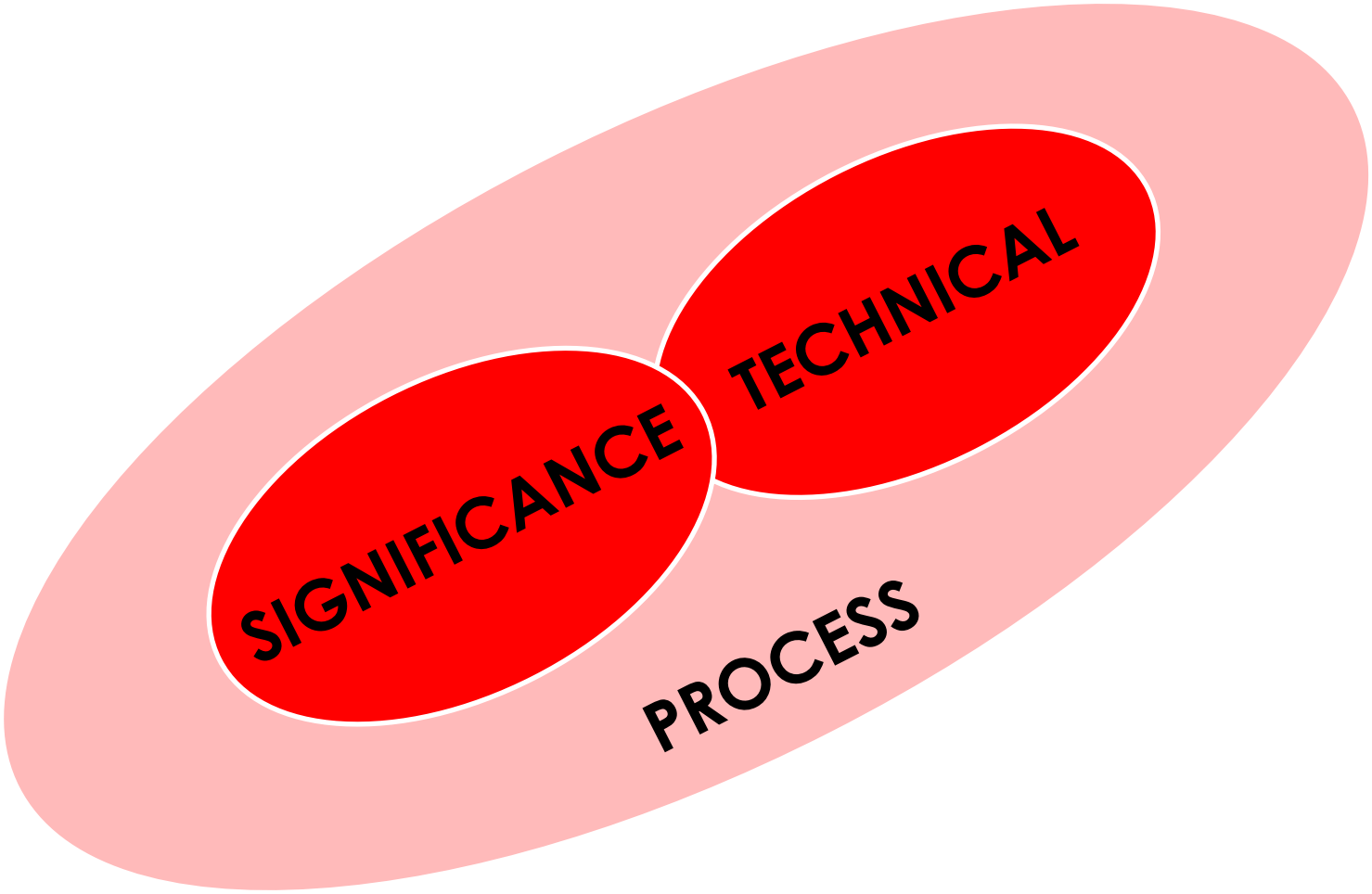
- Ground/ Air source heat pump.

But its not just about energy!

Planning Retrofit

Use BS 7913: 2013

Which is based on three elements…



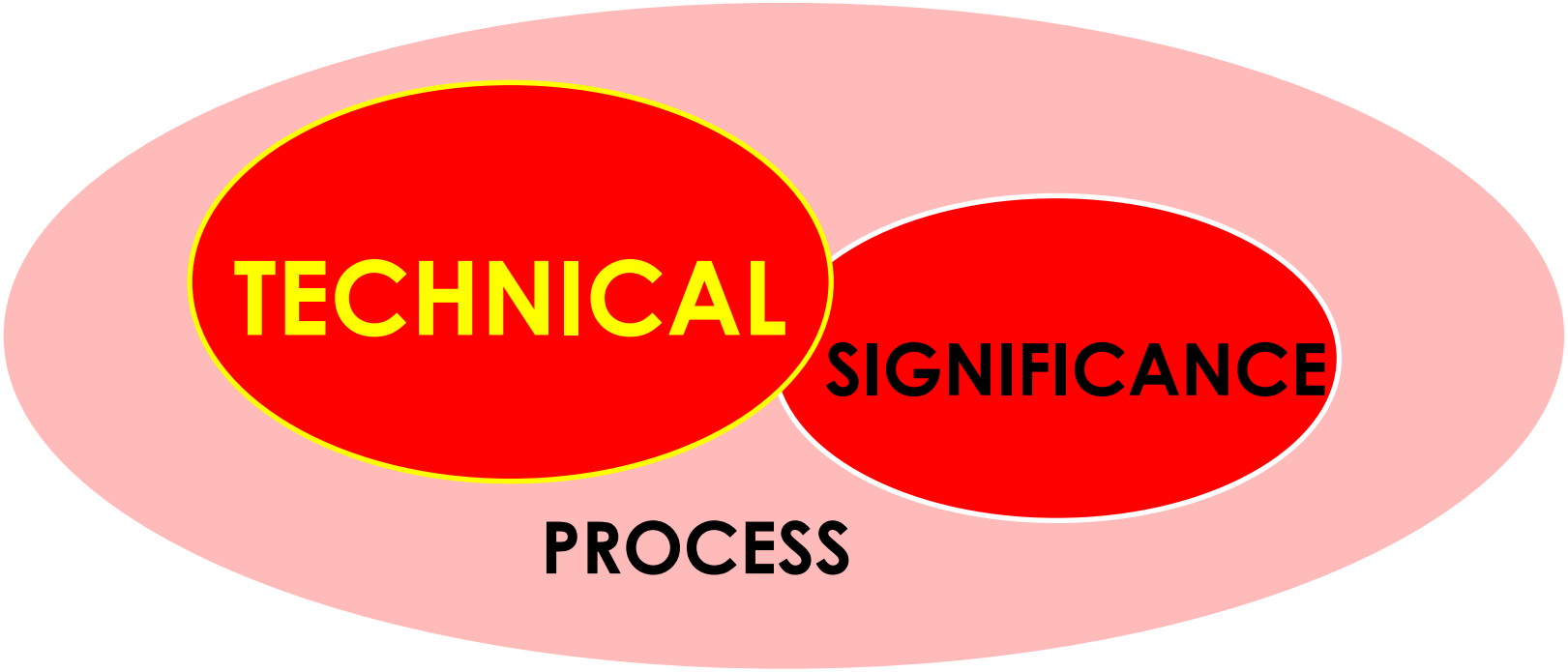
Planning Retrofit

1. Our understanding must go beyond energy assessment methods.
2. Need to look at the way buildings are used – Energy Hierarchy.
3. Need to understand the REAL performance of buildings - How they work.
4. Look for good knowledge – not <u>just</u> from manufacturers.
5. Maintenance & Repair to be the first energy efficiency measure.
6. Remember the dangers of getting it wrong and take a risk management approach.
7. All traditional buildings have some significance – understand it and measure proposals against it.
8. Refer to BS 7913: 2013 even when using other ‘authoritative’ guidance.

Planning Retrofit

Use BS 7913: 2013

Which is based on three elements…



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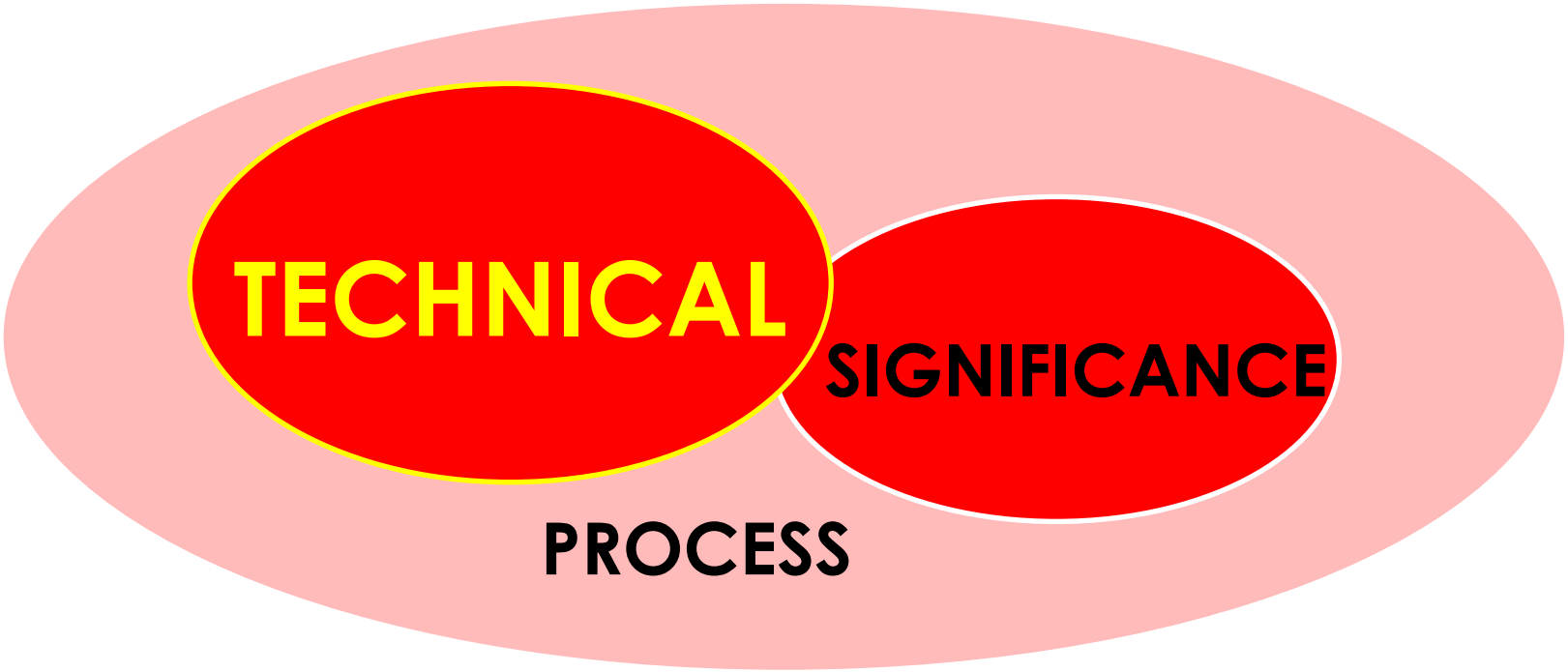
Which is based on three elements…



We must properly understand the building and properly deal with 'technical' problems

A Condition Survey is Essential…

BS 7913: 2013: Section 6.2 Condition surveys and inspections

(5)Programmed surveys and inspections - to monitor condition, help determine priorities and programme work - an essential part of properly managing historic buildings (see 6.1).

(6) Carried out by **competent persons** with knowledge of traditional materials, construction techniques and decay processes.

NOTE Conservation Accreditation schemes.

A Condition Survey is Essential…

BS 7913: 2013: Section 6.2 Condition surveys and inspections

(7) Reference to a site plan and other suitable templates to reference locations, areas and components.

(8) Photographs and drawings may be included, and these should be annotated with reference points and areas consistent with the written and graphic data.

A Condition Survey is Essential…

BS 7913: 2013: Section 6.2 Condition surveys and inspections

(9) Process - inspection with recording of a narrative, sometimes with detailed analysis and identification of defects and the related causes (see 6.3) to determine remedial works and priority timescales, measuring and quantifying works and estimating costs in a report and work schedules.

(10) **There should be a consistent and logical process** for the inspection, recording and reporting (see Annex B for further information).

A Condition Survey is Essential…

BS 7913: 2013: Section 6.2 Condition surveys and inspections

(11) Surveys and inspections can conclude with the need for more detailed analysis, often termed **"targeted specialist investigations"** (TSI). Examples include architectural paint and plaster analysis, timber decay assessment, structural movement monitoring and environmental monitoring for dampness and humidity.

NOTE TSI's usually go beyond a visual inspection - involve destructive and non-destructive equipment and processes, involving data collection and assessment over a period in time. Can lead to a reconsideration of the ongoing use…

Building Pathology is Essential…

BS 7913: 2013: Section 6.3 Assessments of performance and pathology

6.3.1 General

Cause of problems and not just the symptoms.

"Knowledge of the pathology of materials and the agents of decay should be sought so that corrective, preventative and remedial measures can be taken that allow the retention of original historic fabric and ensure its longevity".

Building Pathology is Essential…

BS 7913: 2013: Section 6.3.2 Core principles and dynamics

"Pathology is broader than the decay of materials. It also encompasses the way the components interact and, how the spaces are used".

Ventilation is important - chimney flues, sub floor vents and cupolas. Disruptions and consequences identified.

*"**Some decorative** features are also functional, for example over sailing eaves, string courses and hood mouldings. Reinstatement of such features can fulfil a repair need".*

Dampness is the biggest issue…

BS 7913: 2013: Sections 6.10 Some common repair issues and 6.10.1 Dampness (see 6.3.6.2)

"Dampness is often caused by:
a) ***the external ground levels being higher than the internal floor level****; or*
b) the insertion of modern non-porous materials.

It might be possible to remedy a) ***by improving the draining of the ground by a French drain or by creating a dry area or open trench****. It might be possible to remedy b) by the selective removal of these materials where possible."*

The right approach to dampness…

The right approach to dampness…

The right approach to dampness…

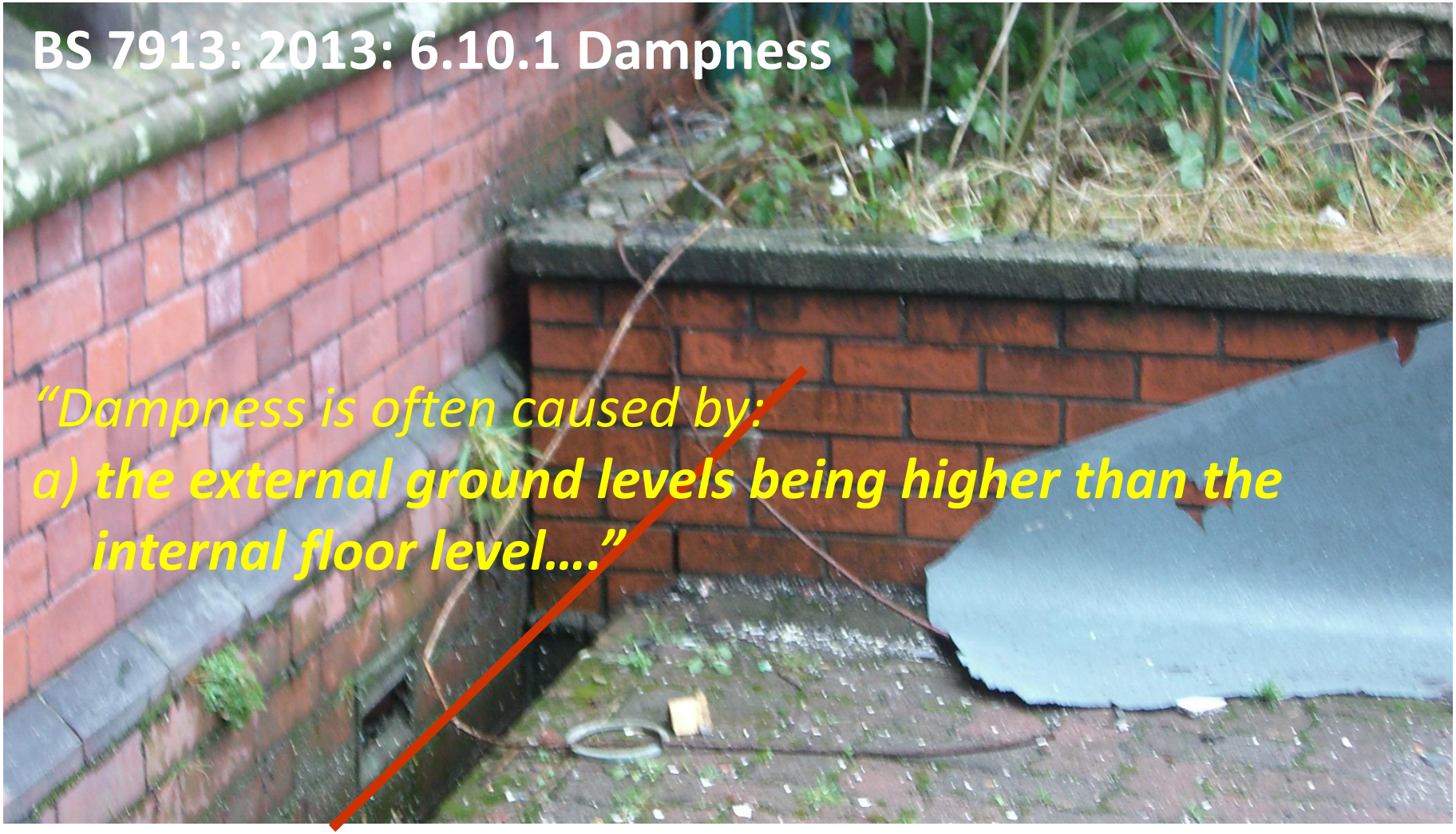
OR
THIS?

The right approach to dampness…

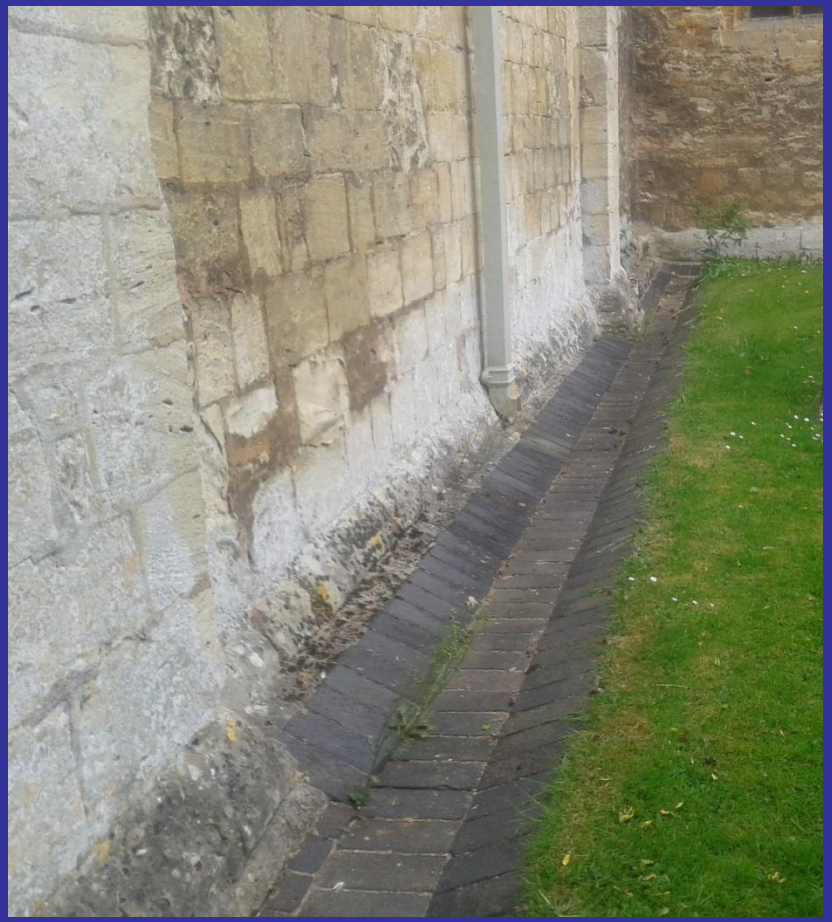
Is a retrofitted dpc required?

The right approach to dampness…

Is a retrofitted dpc required?



The right approach to dampness…



The right approach to dampness…

Properly understanding and dealing with dampness is essential before we start retrofitting…

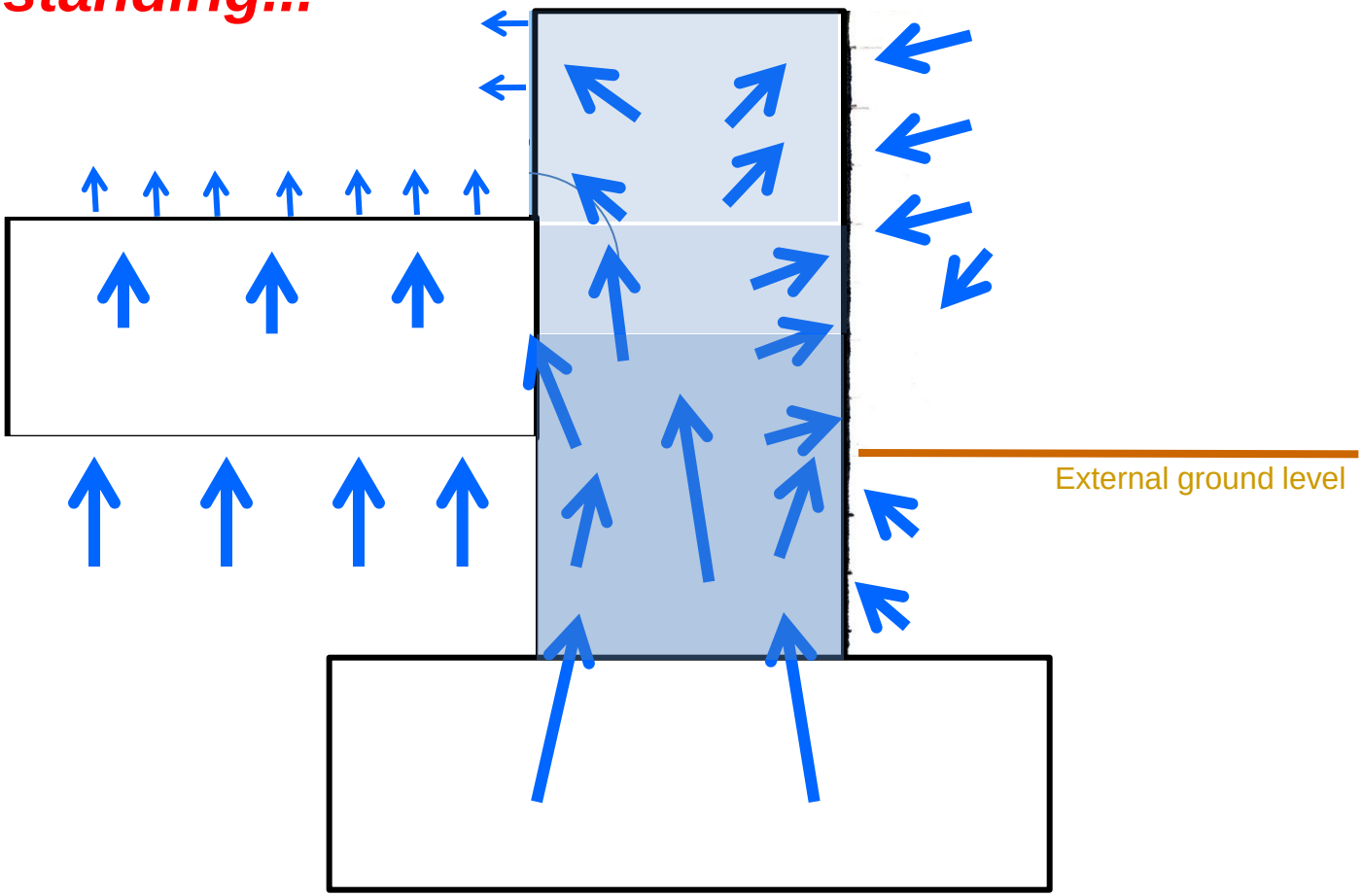
BS 7913: 2013: Sections 6.3 Assessments of performance and pathology 6.3.1 General

Cause of problems and not just the symptoms

"Knowledge of the pathology of materials and the agents of decay should be sought so that corrective, preventative and remedial measures can be taken that allow the retention of original historic fabric and ensure its longevity".

The right approach to dampness…

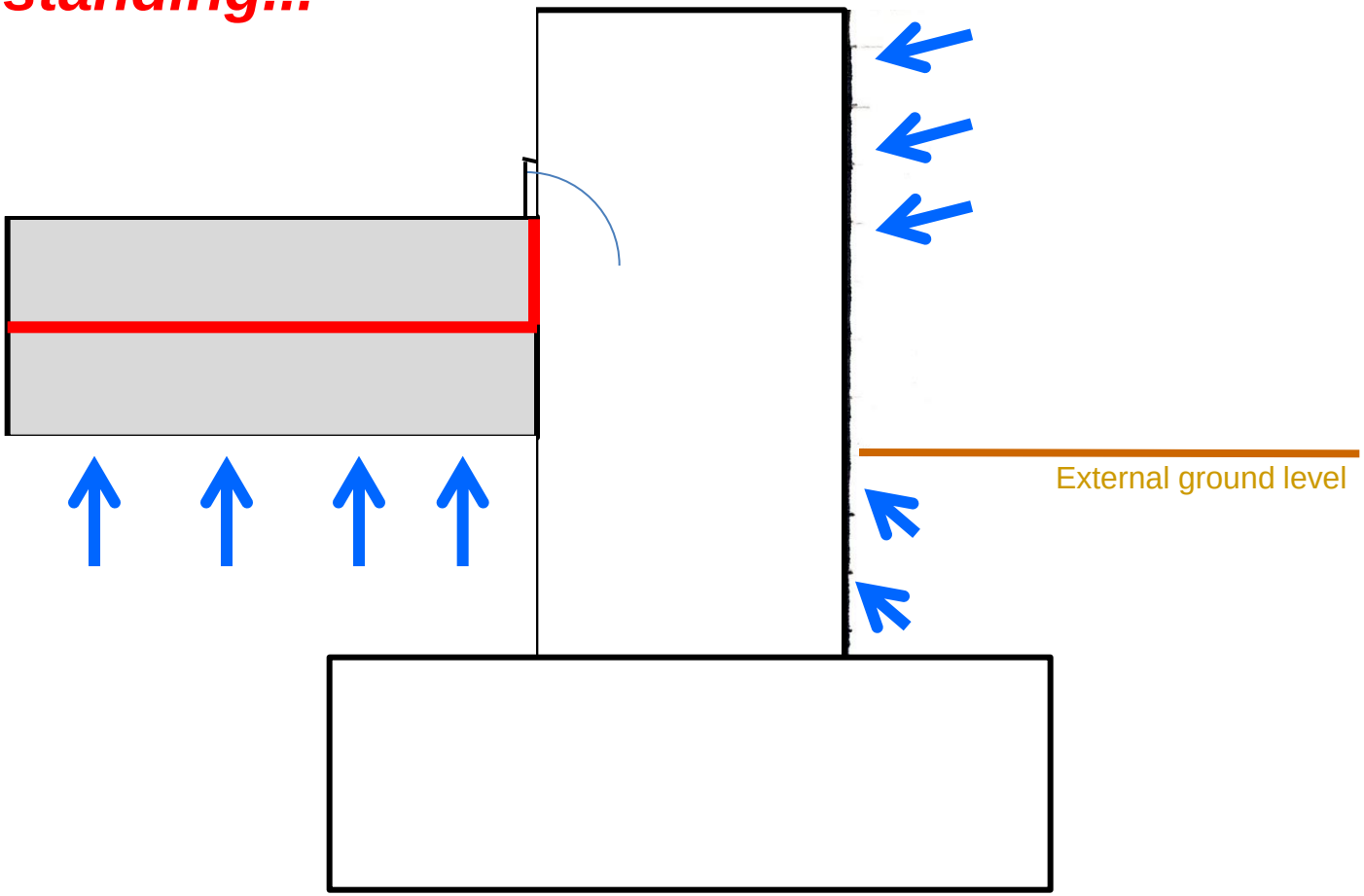
and its understanding...



How they are meant to perform!

The right approach to dampness…

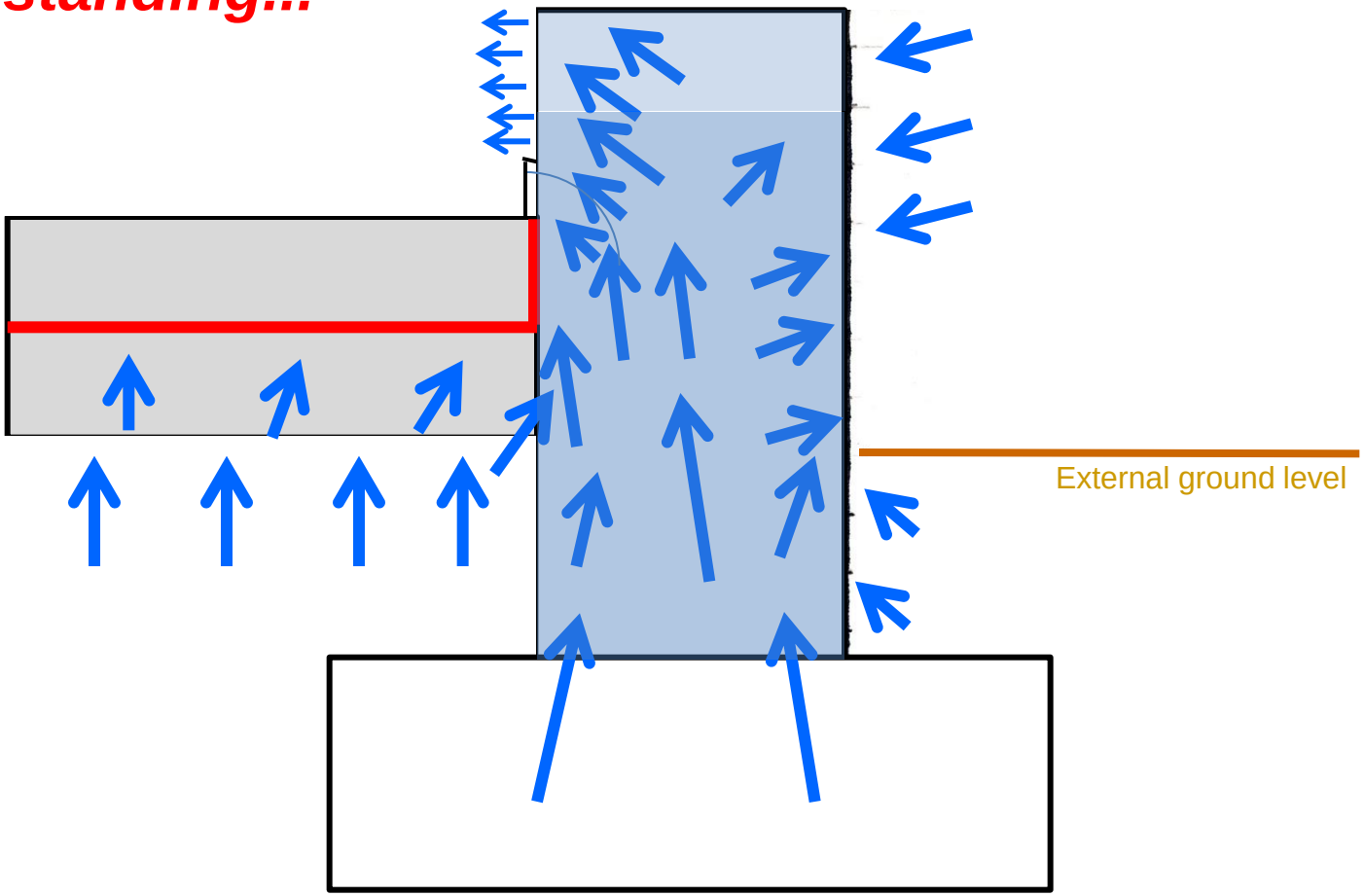
and its understanding...



What happens now?

The right approach to dampness…

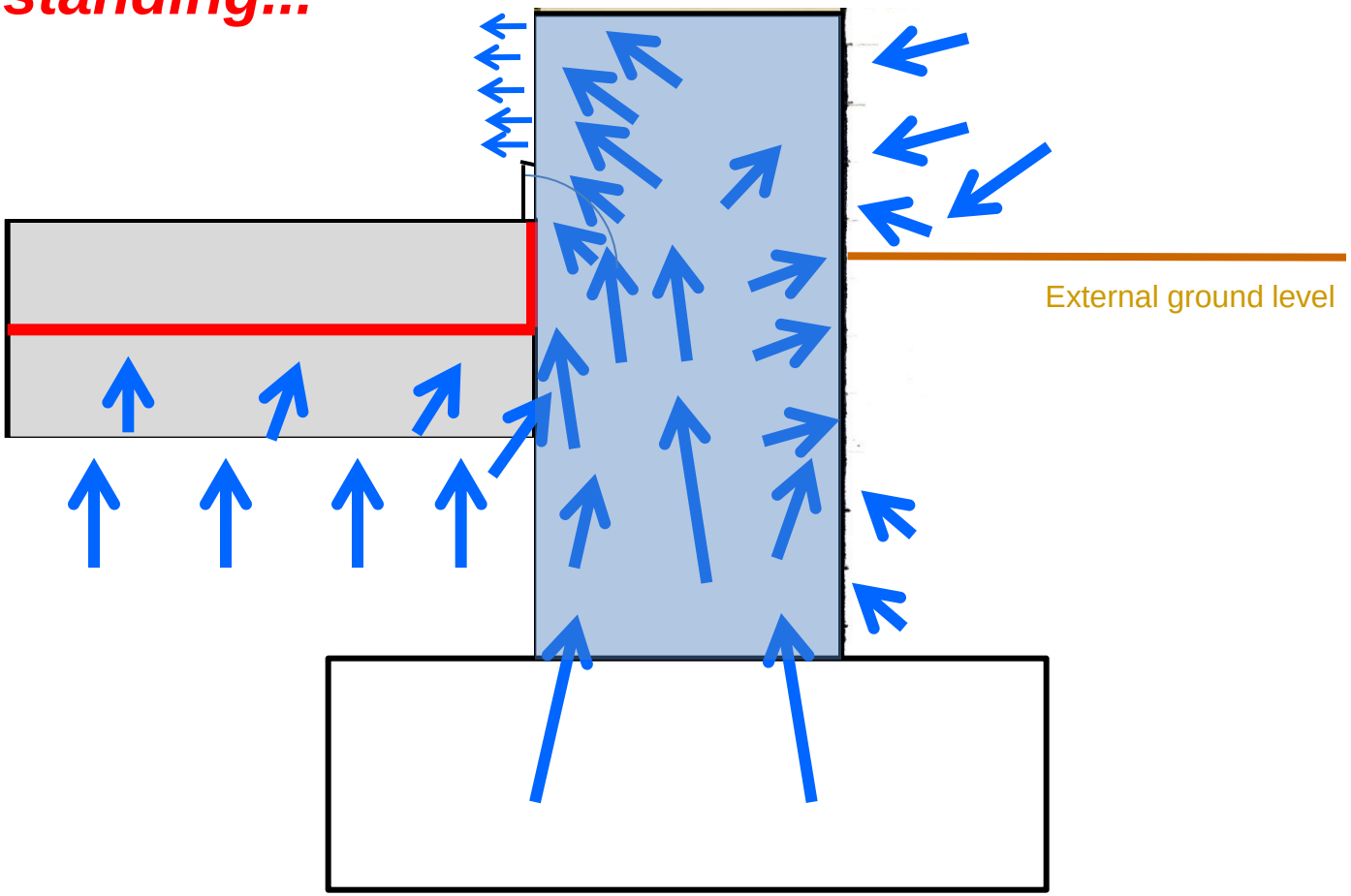
and its understanding...



This happens…..

The right approach to dampness…

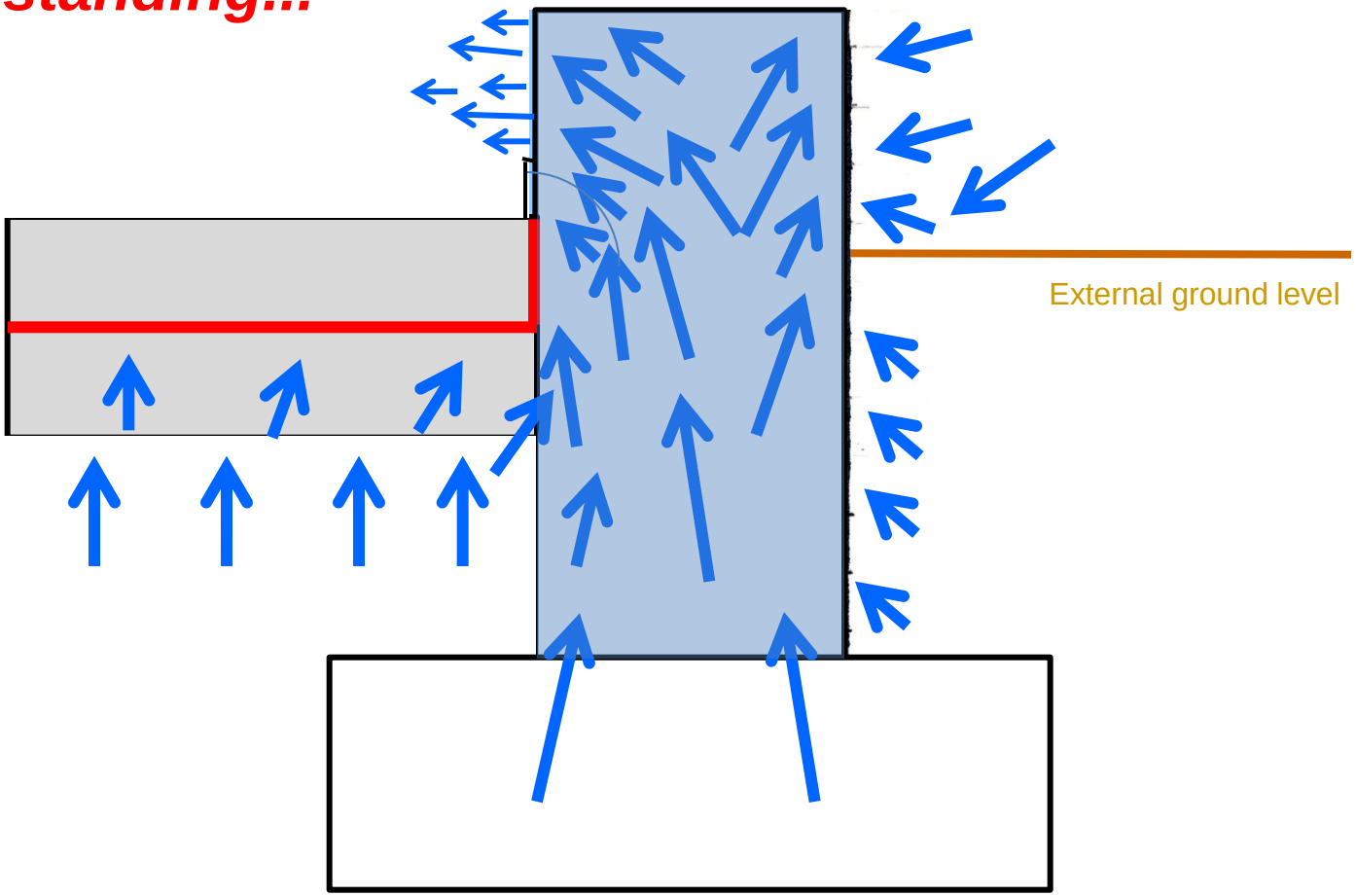
and its understanding...



Increase of external ground levels – next?

The right approach to dampness…

and its understanding...



This happens….. increased moisture…..

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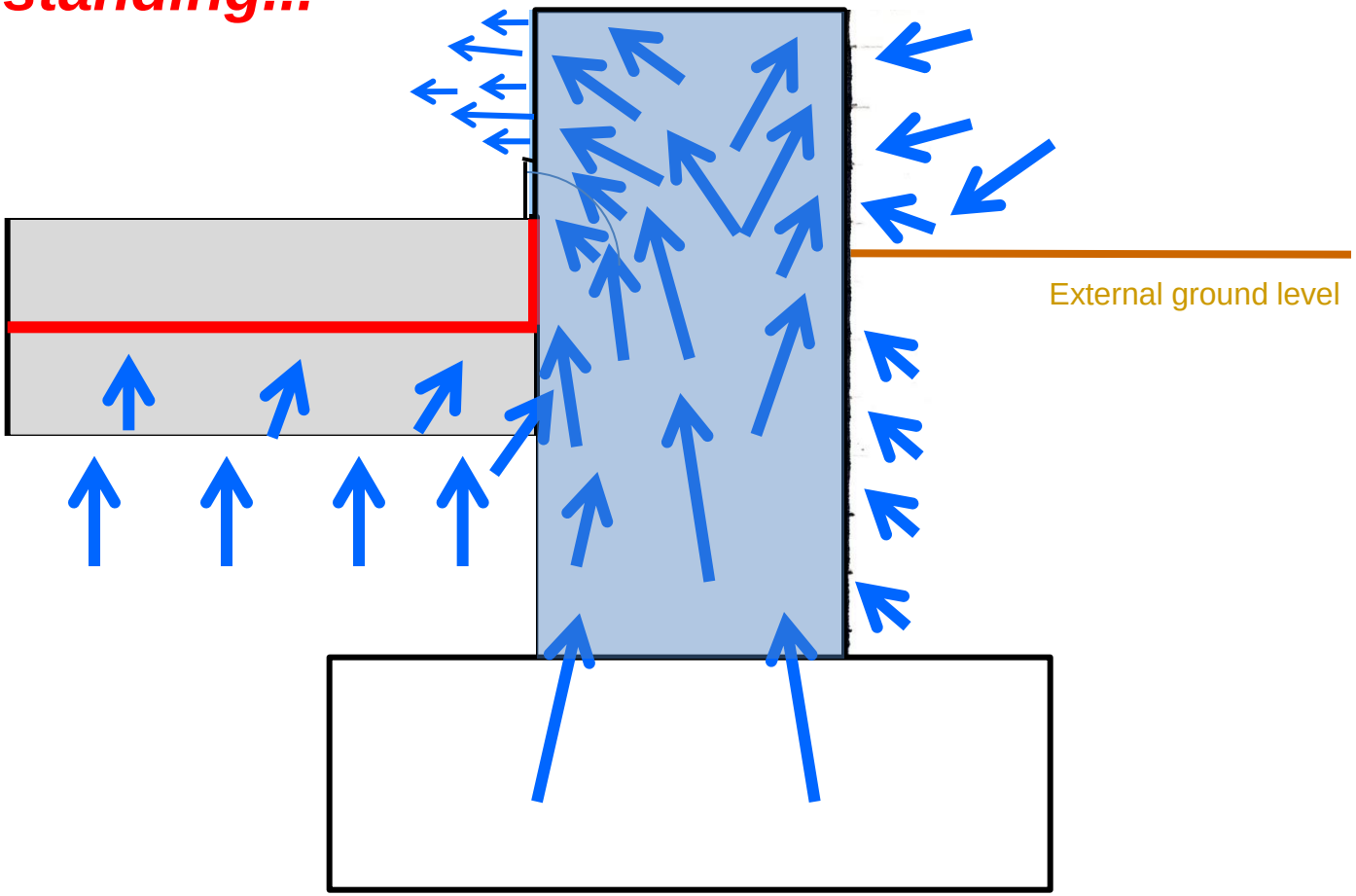

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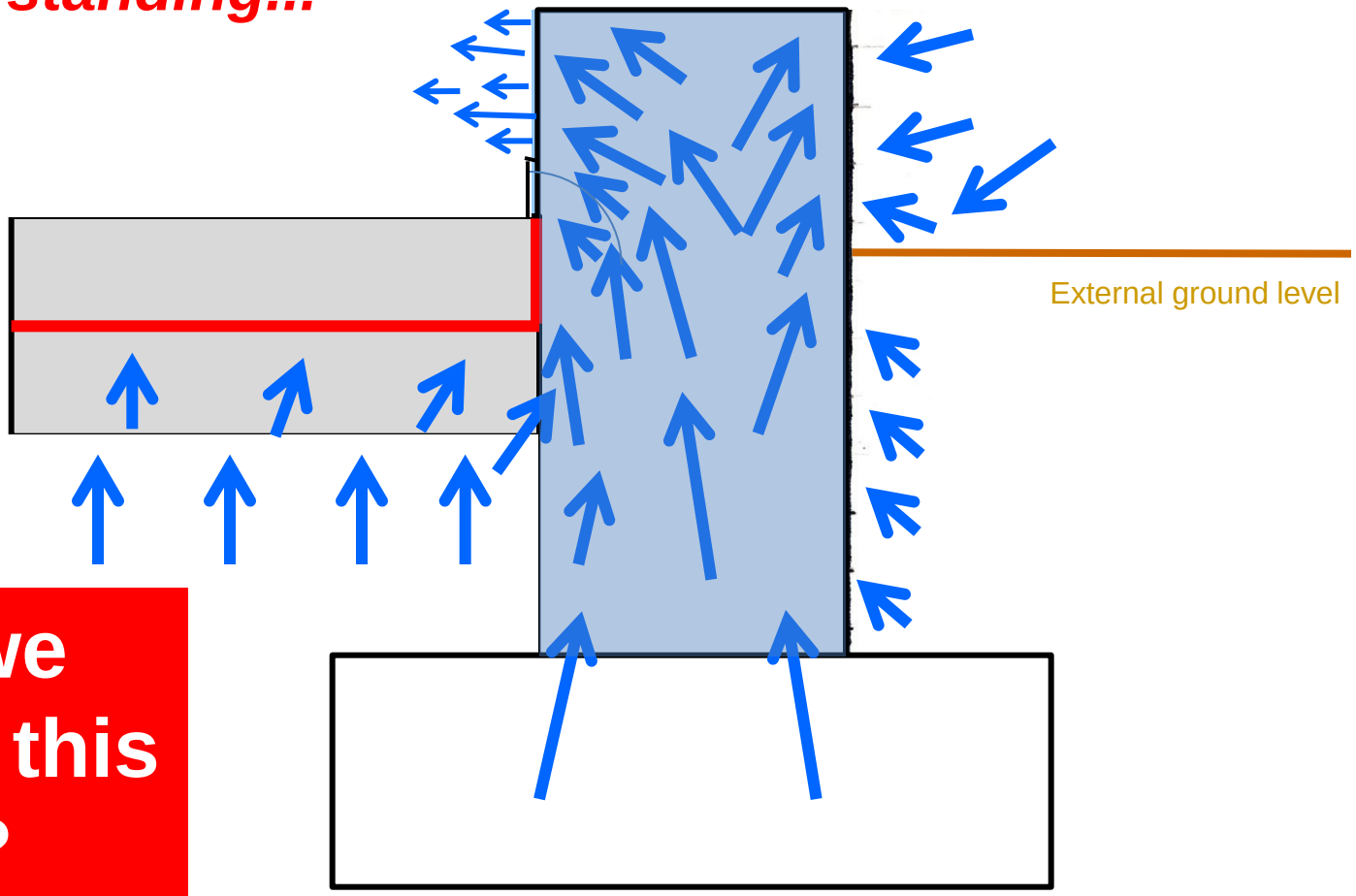
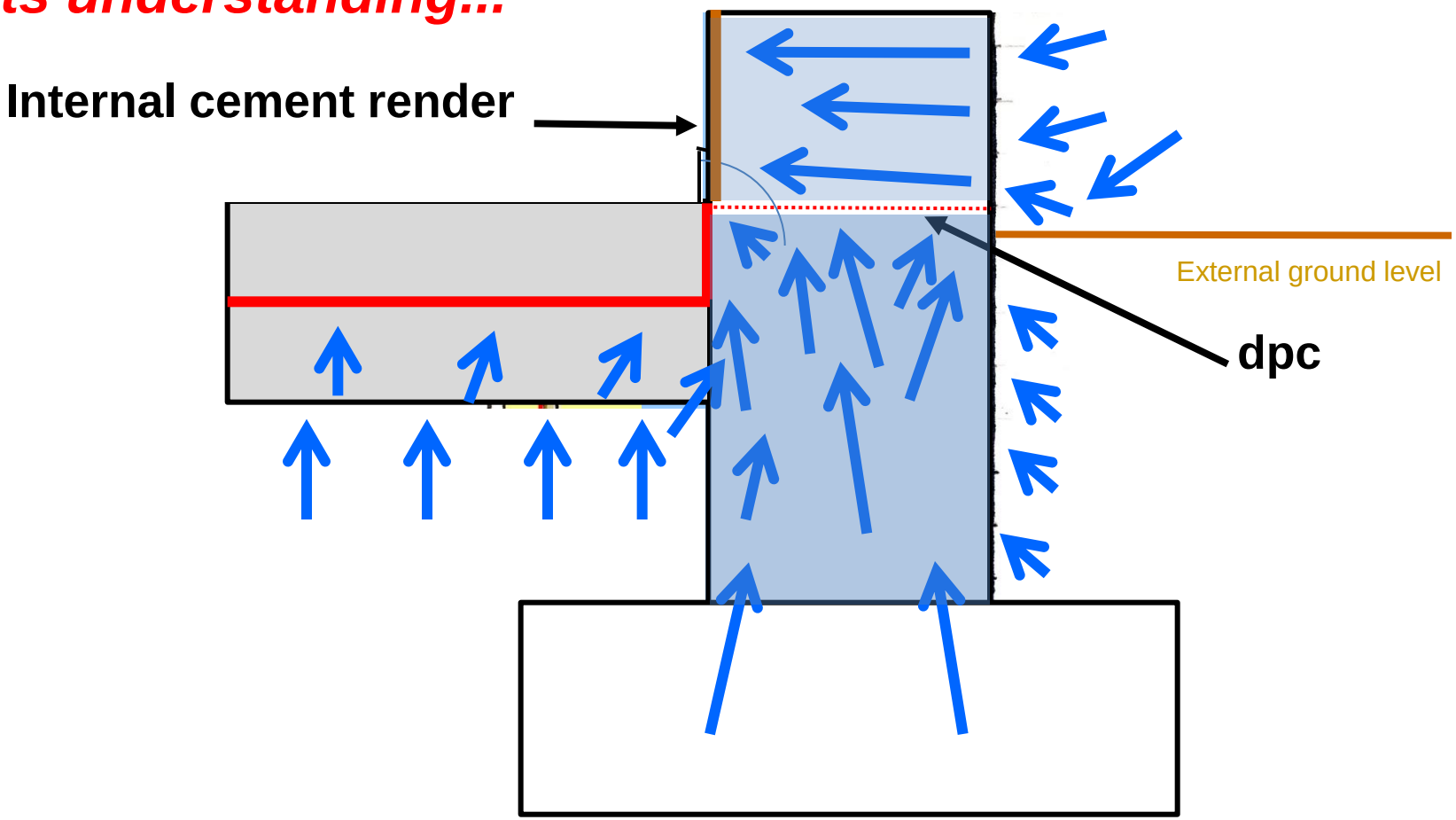


How do we deal with this problem?

The right approach to dampness…

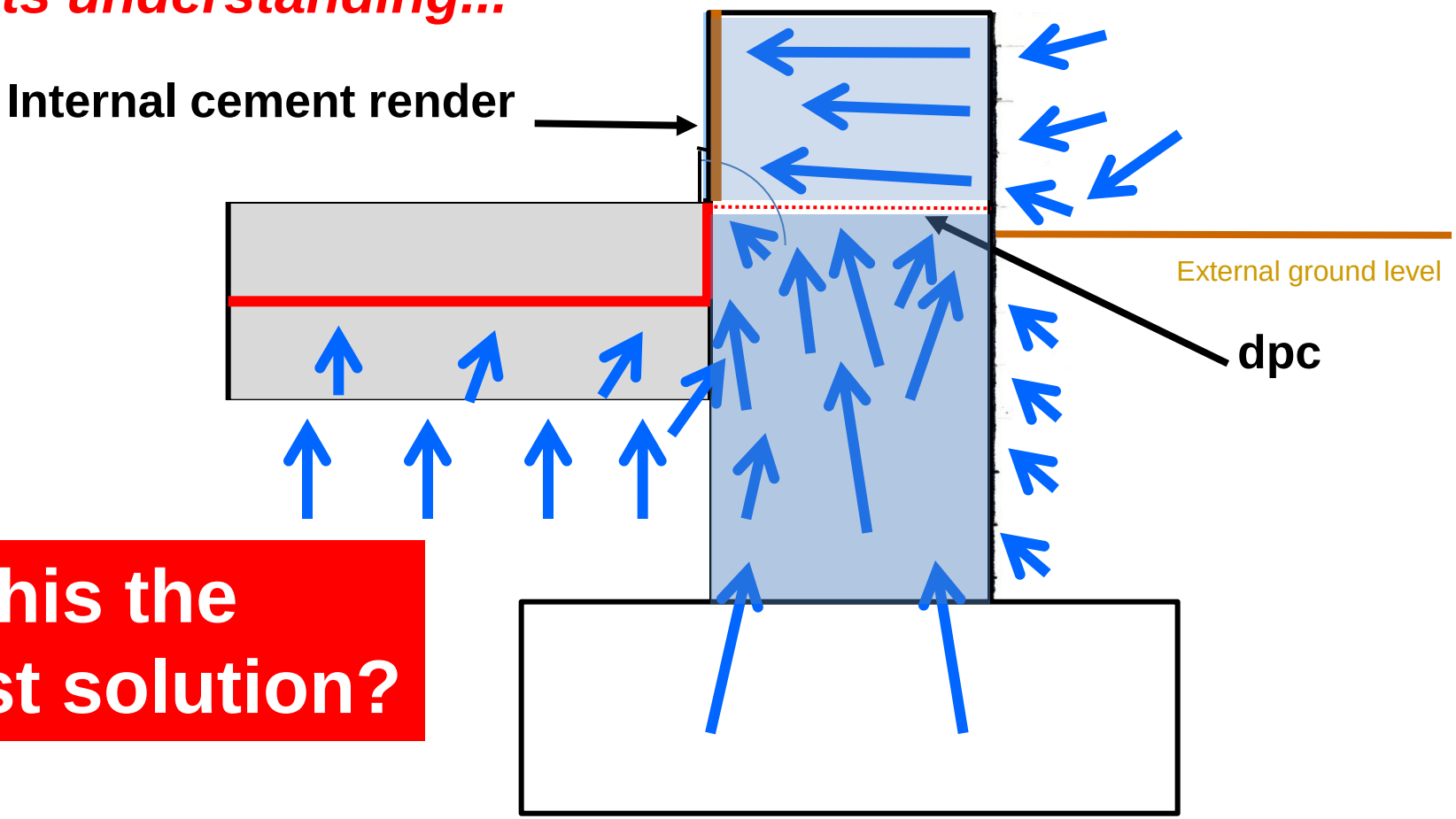
and its understanding...



Retrofitted damp proof course!

The right approach to dampness…

and its understanding...

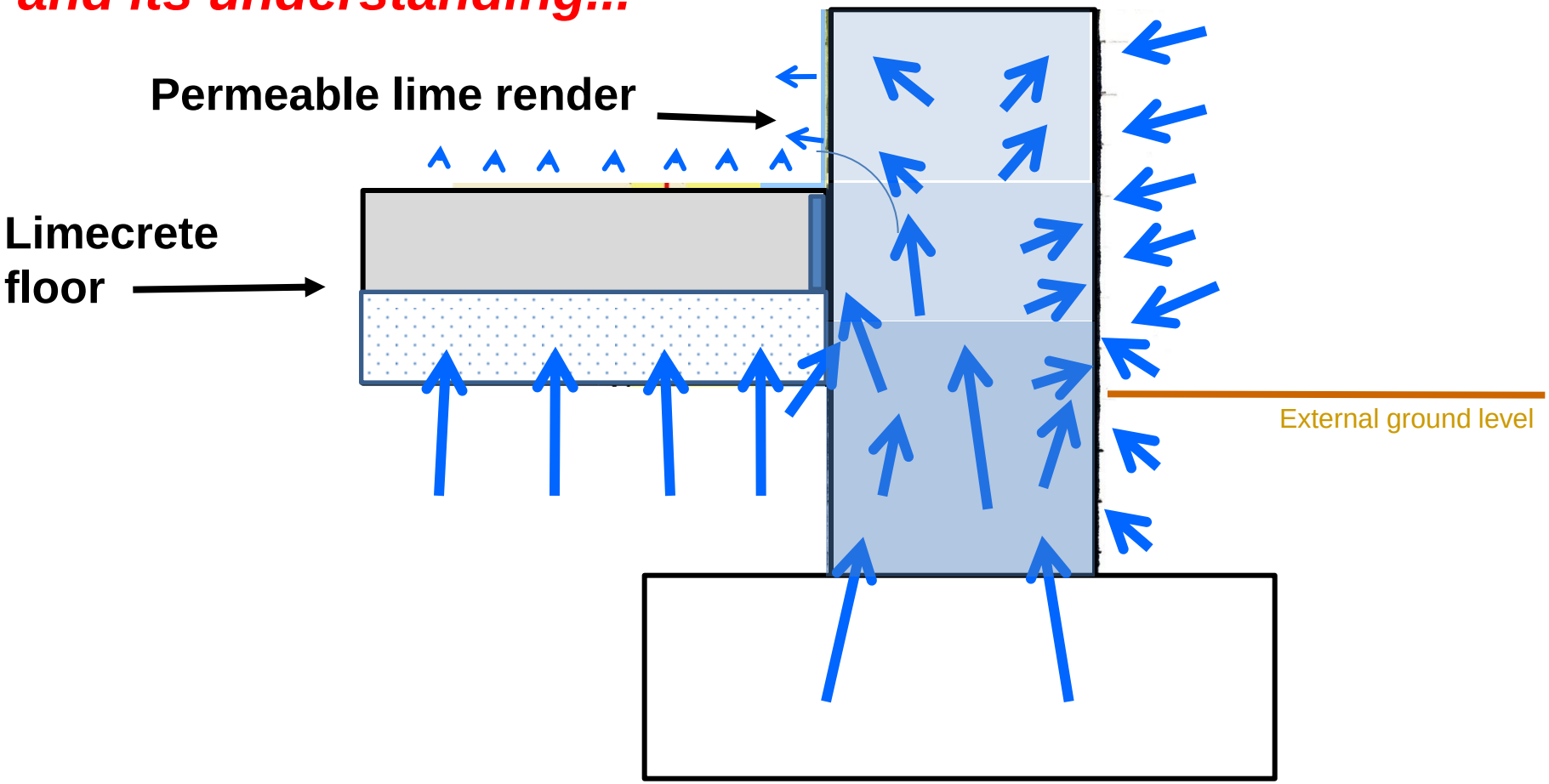


Is this the best solution?

Retrofitted damp proof course(s)!

The right approach to dampness…

and its understanding...

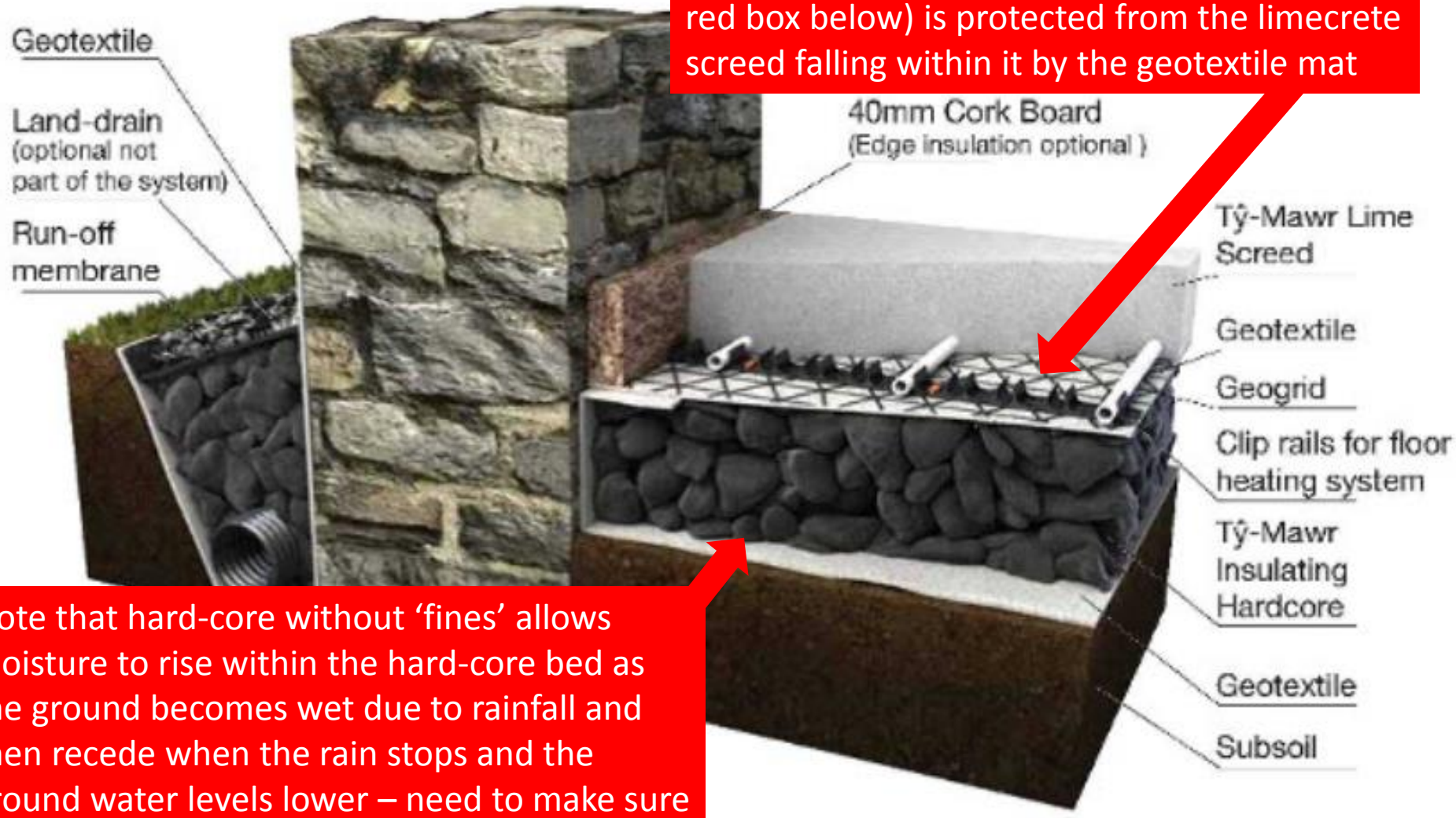


Reintroduce vapour permeability

The right approach to dampness…

Replacement with a permeable floor - Limecrete

The right approach to dampness…

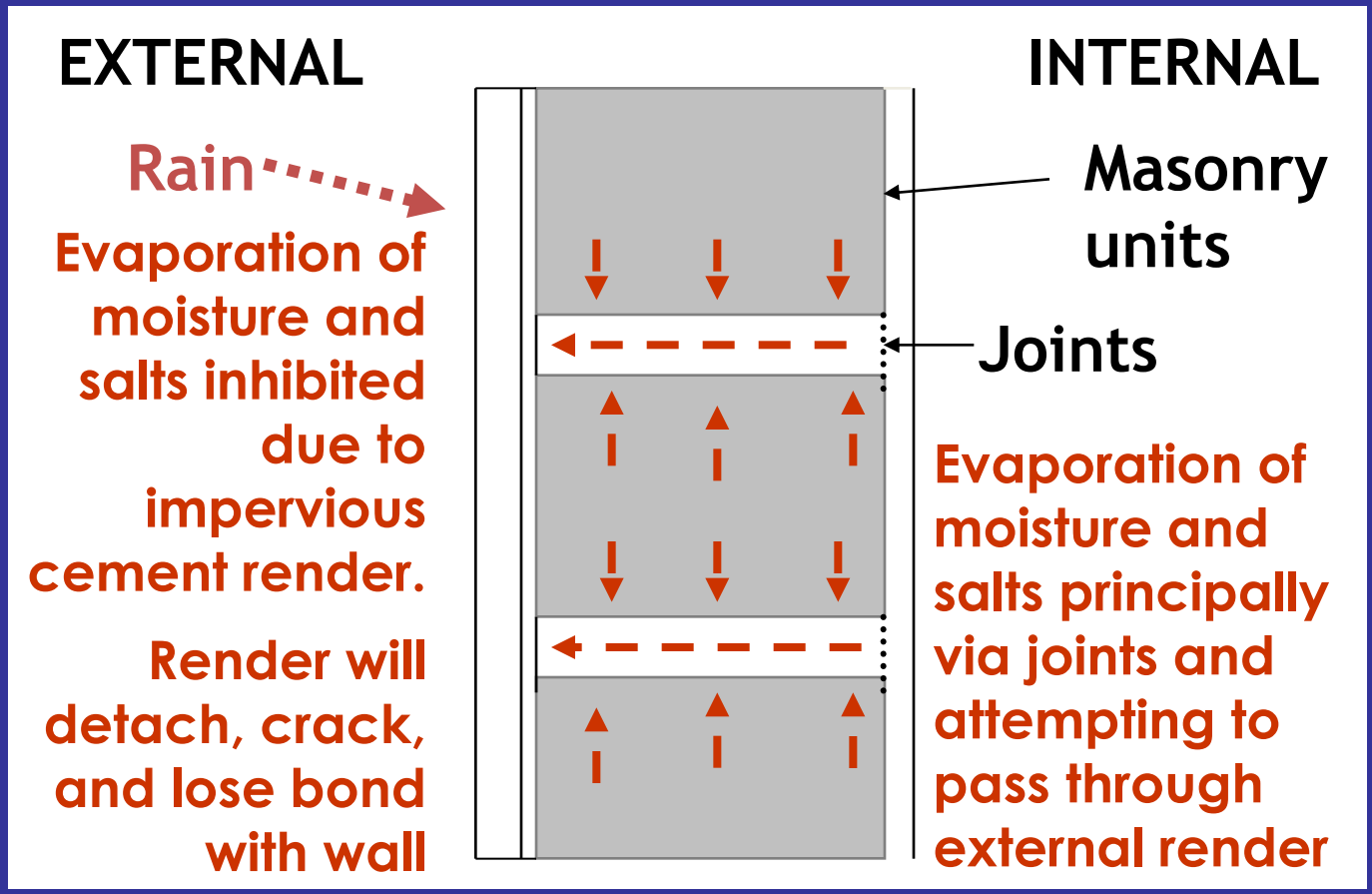


Note that the hard-core without ‘fines’ (see red box below) is protected from the limecrete screed falling within it by the geotextile mat

Note that hard-core without ‘fines’ allows moisture to rise within the hard-core bed as the ground becomes wet due to rainfall and then recede when the rain stops and the ground water levels lower – need to make sure that water drains away from the building

Technology of traditional renders

Cement renders applied to solid walls

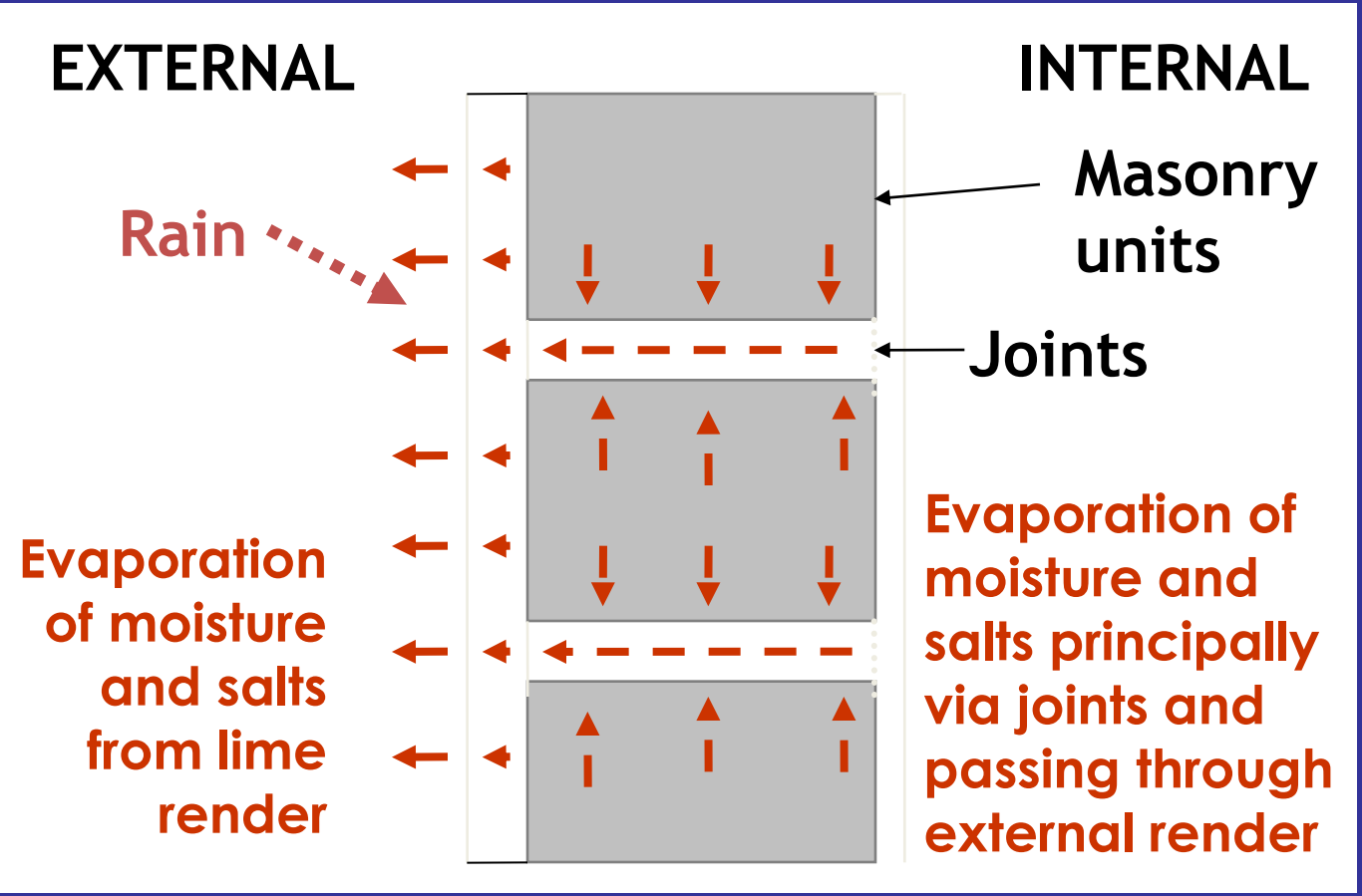


Walls stopped from breathing

Trapping moisture causes deterioration of fabric

Technology of traditional renders

Lime renders applied to solid walls



Trapping moisture causes deterioration of fabric

Understanding Penetrating Damp

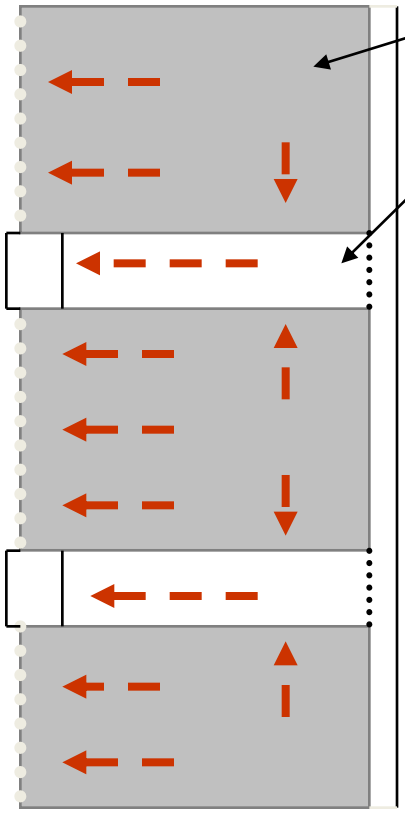
Relationship of Masonry and Joints ~ Misunderstood ~ Causing Deterioration

Rain

Evaporation of moisture and salts via the face of masonry units causing their deterioration

Due to cement mortar pointing which will become defective

EXTERNAL



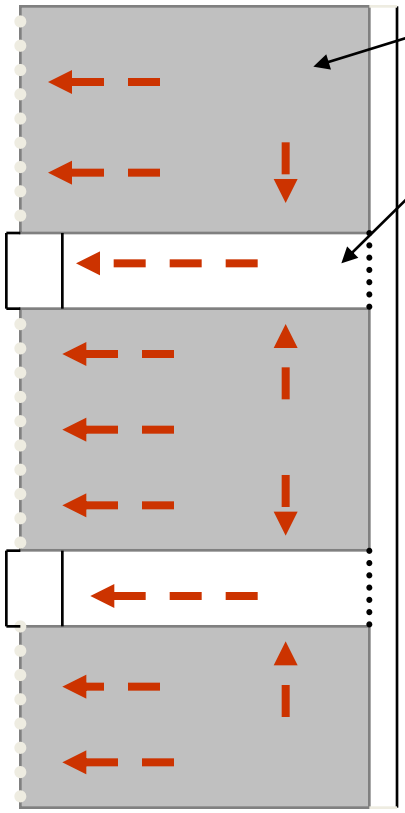
Evaporation of moisture and salts principally via masonry units

INTERNAL

Trapping moisture causes deterioration of fabric

Understanding Penetrating Damp

Relationship of Masonry and Joints ~ Misunderstood ~ Causing Deterioration



Evaporation of moisture and salts principally via masonry units

Trapping moisture causes deterioration of fabric

Understanding Penetrating Damp

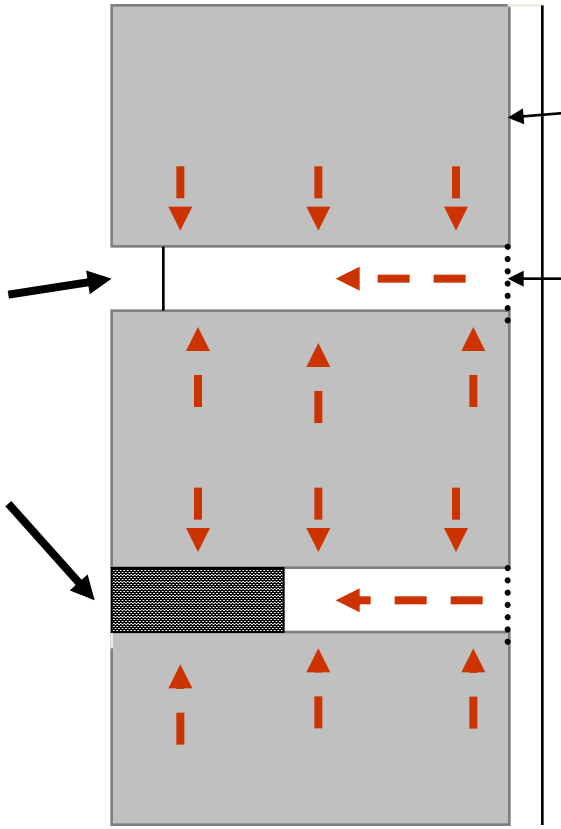
Technology of Solid Masonry Walls

EXTERNAL

INTERNAL

Over a period of time the face of joints will erode

Then repointed ~ the process to start all over again



Masonry units

Joints

Joints to be in a lime mortar and finished flush, but with no feathered edges.

Walls must breathe ~ no matter how thin

Trapping moisture causes deterioration of fabric

Poor and Inappropriate Work

Who is at fault?

Why does it happen?

What are the implications?

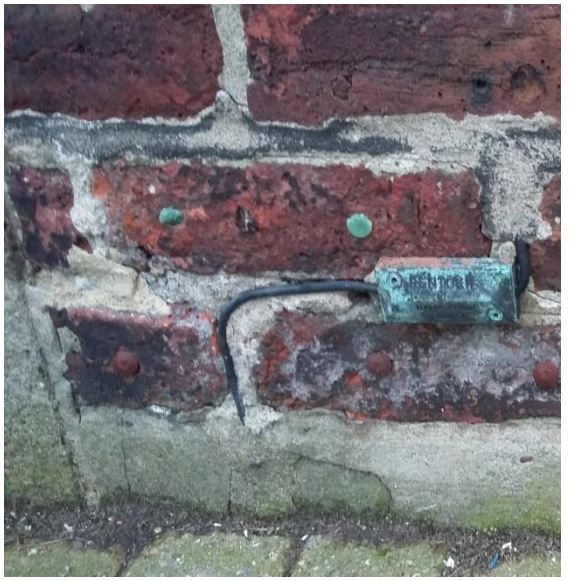
Poor and Inappropriate Work

Who is at fault?

Why does it happen?

What are the implications?

Damp – solid walled building circa 1840



Damp – solution a thick render

Damp – solution a thick render

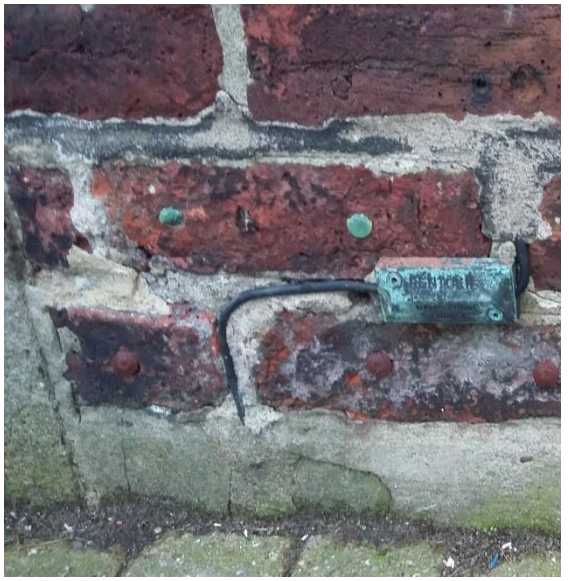
Damp – solution a thick render

Damp – solution a *very* thick render

Damp – solution dpc’s

Damp – solution dpc’s

Damp – are these the right solutions?



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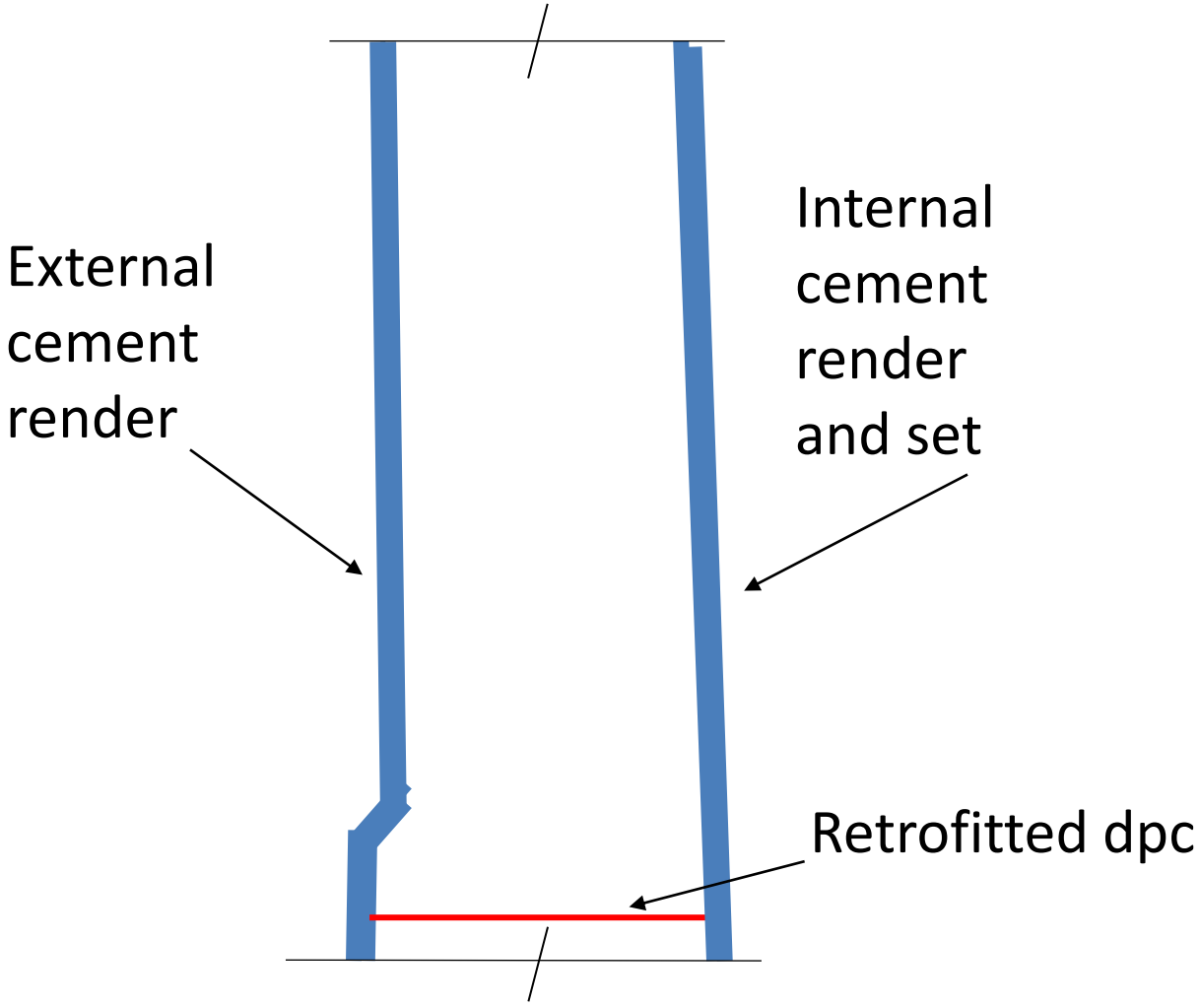
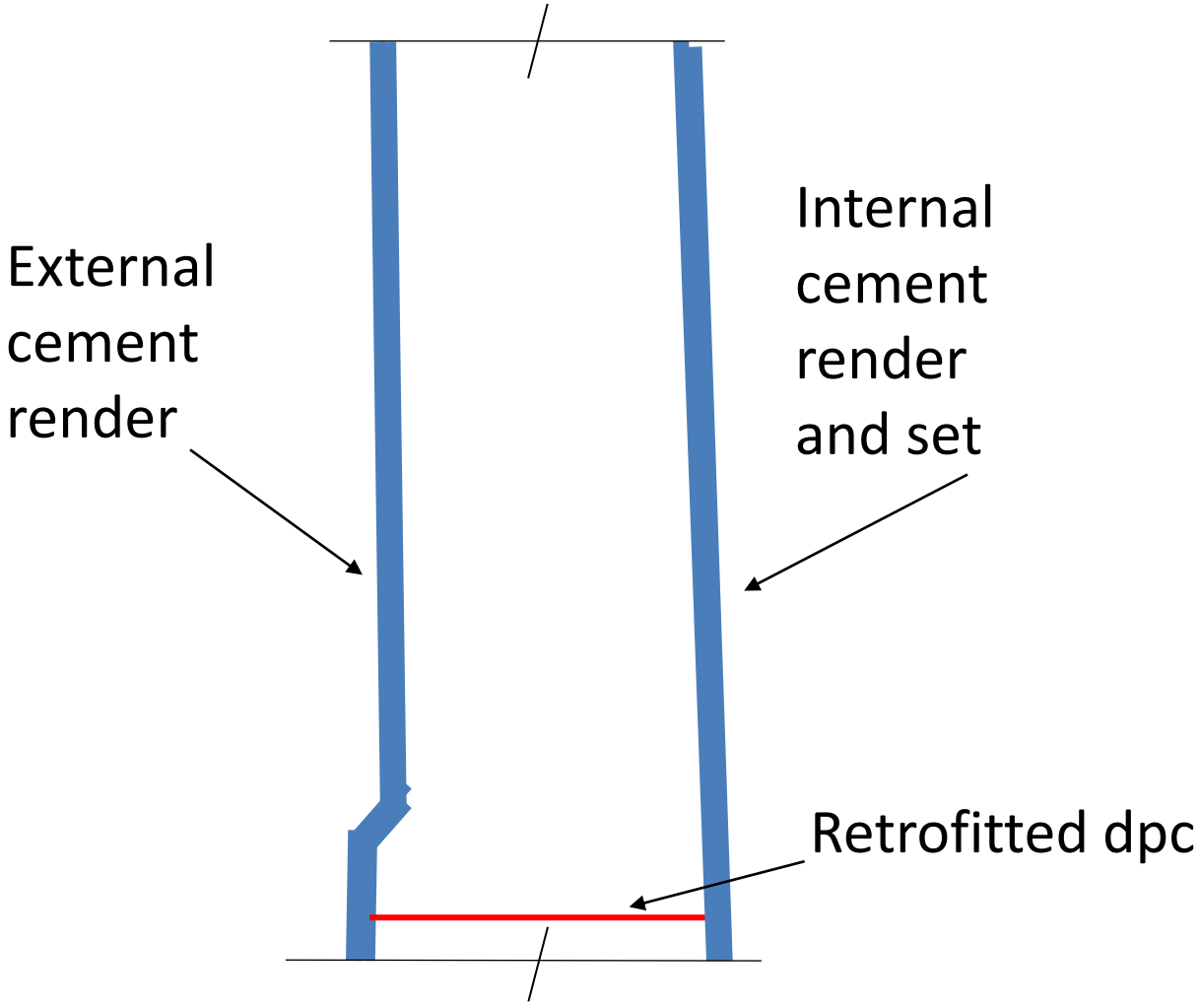


Damp – are these the right solutions?

Are we tackling the cause of the problem?



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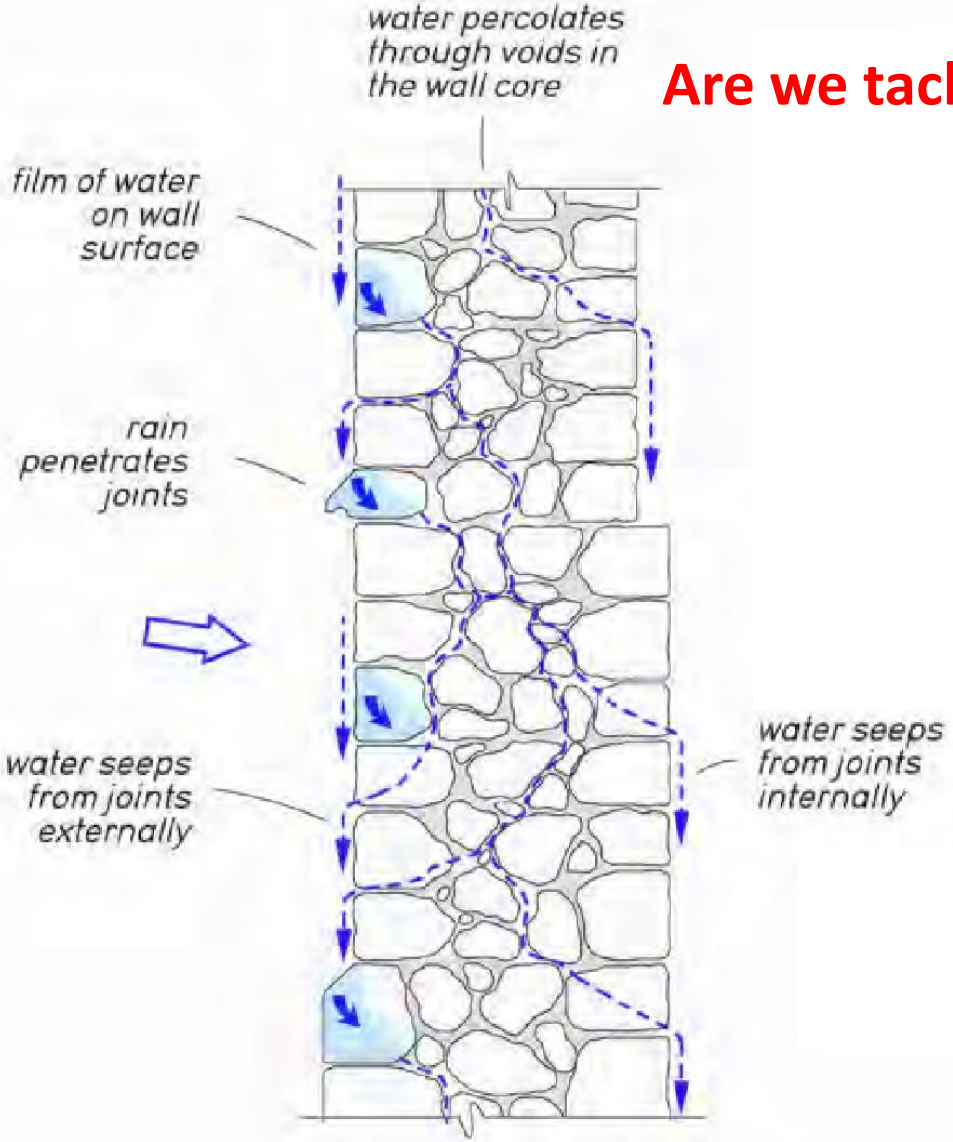
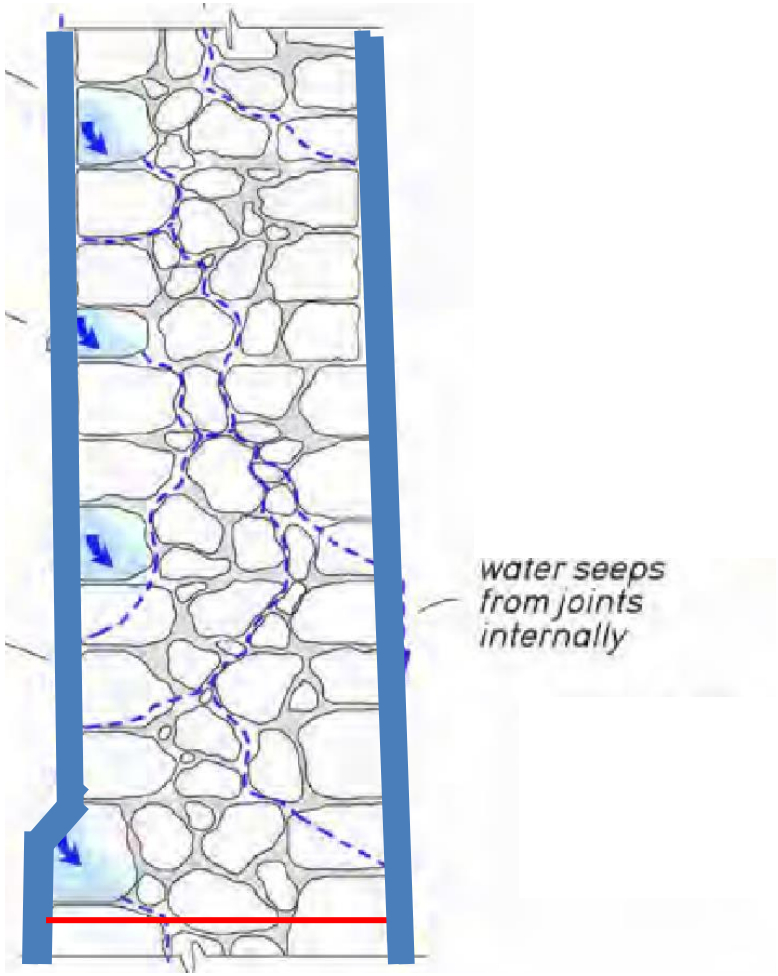


Are we tackling the cause of the problem?

No – there are voids present in Wall

Damp – are these the right solutions?

This is not the solution……



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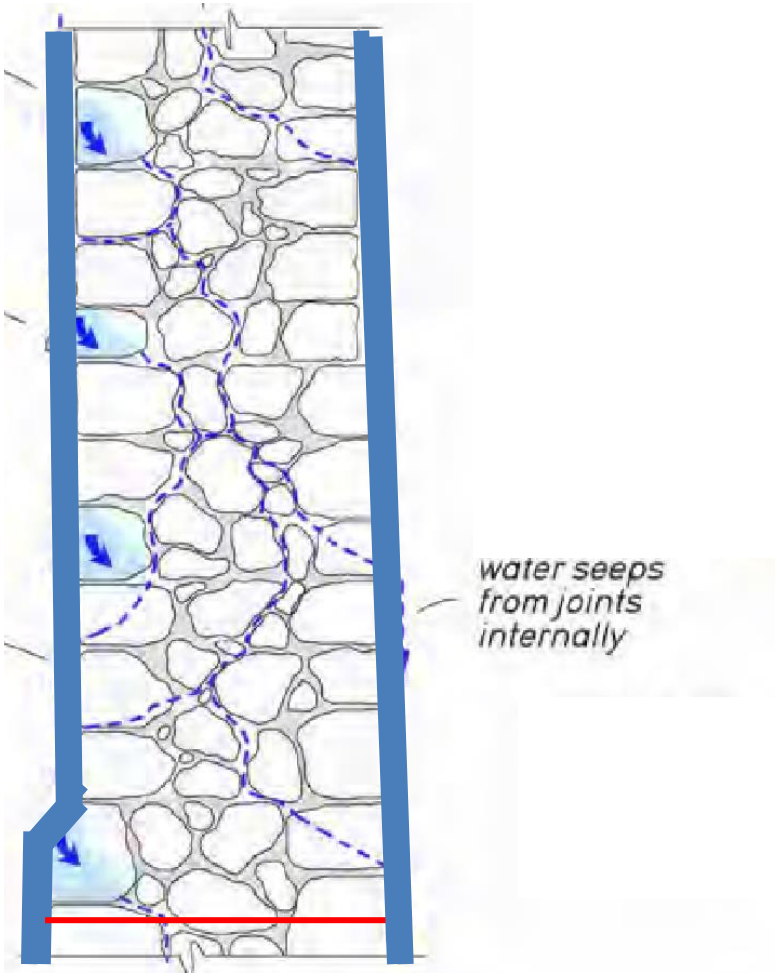
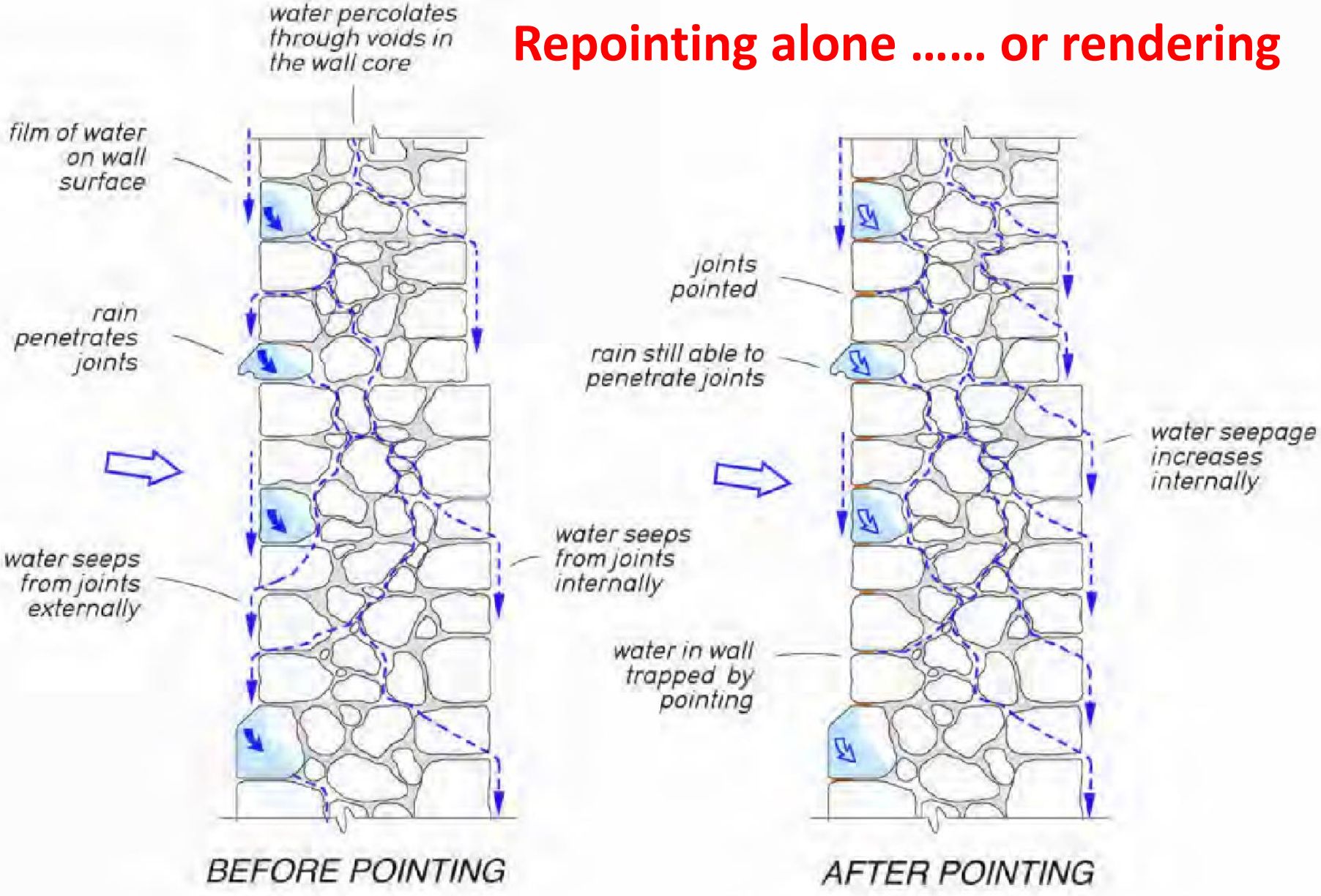


WHAT IS THE SOLUTION?

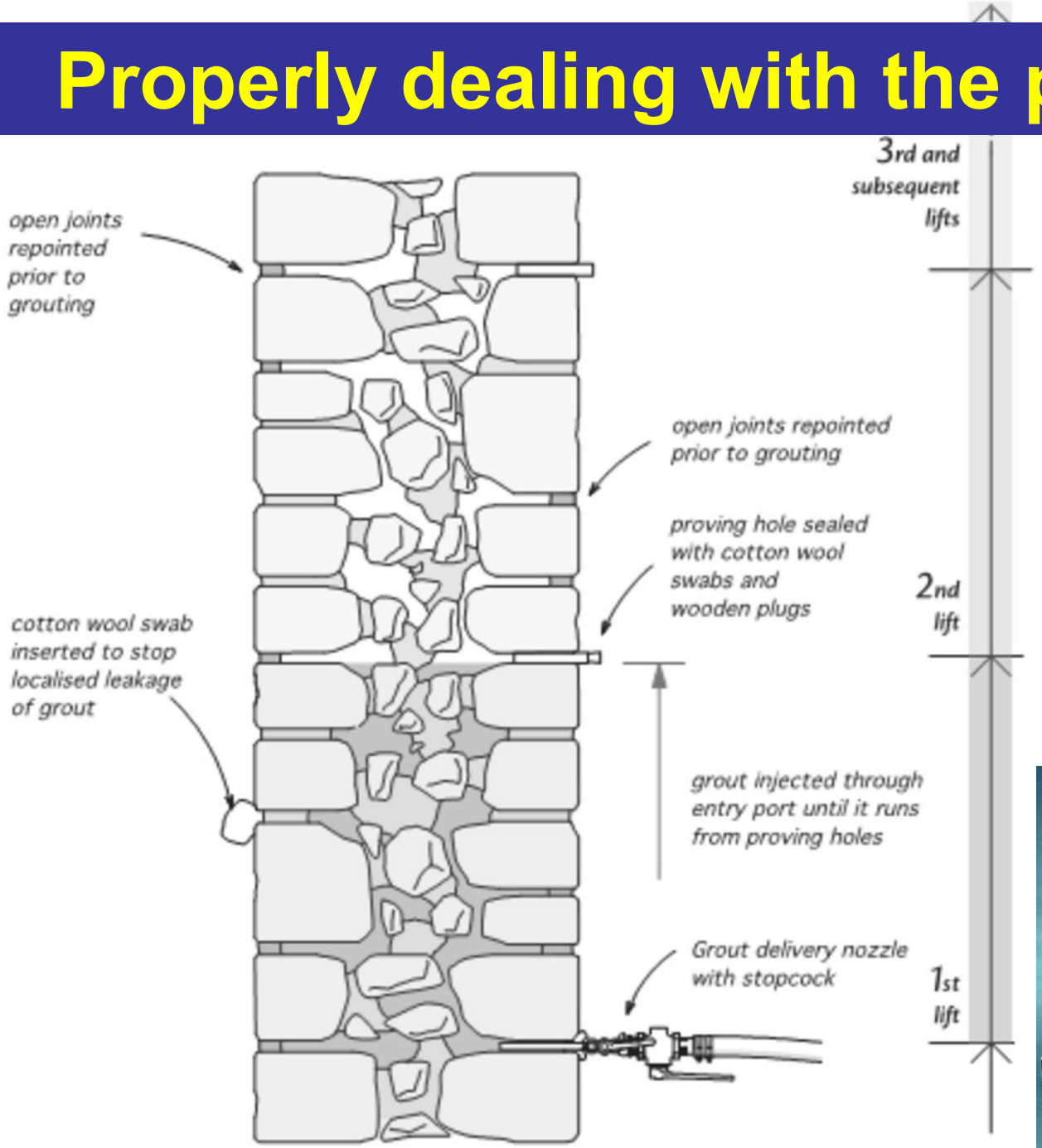
Damp – render/ repointing making it worse

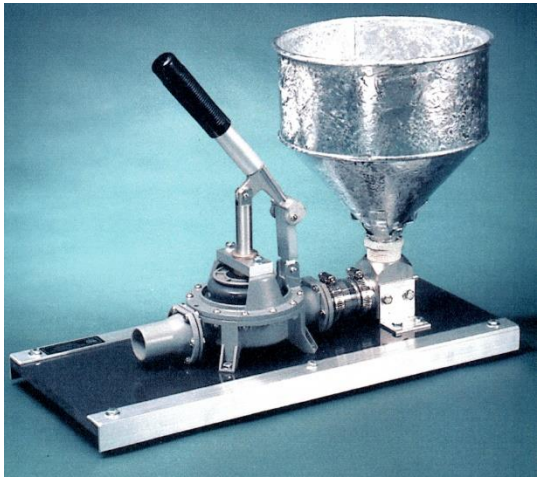
Repointing alone …… or rendering



Properly dealing with the problem…

Grouting





Properly dealing with the problem…

Grouting

Unless we investigate properly we won't deal with the cause of dampness

Properly dealing with the problem…

Grouting

Unless we investigate properly we won't deal with the cause of dampness

Unless we properly deal with dampness before retrofitting we take huge risks