

Detailed testing: moisture

CIBSE – Studio PDP Retrofit revisit

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The UK Centre for Moisture in Buildings

The aim of the UKCMB is the development of a moisture-safe built environment.



The UKCMB works in a rigorous and transparent manner together with partners from academia, government, industry and the public to substantially improve the way moisture risk is understood and managed in the UK.

www.ukcmb.org

Why moisture balance?

Durability



Health

“Overall 27% of households reported the presence of some damp and/or mould patches on the walls or ceilings in their home”

Energy Follow Up Survey (2021)

“It is costing the NHS some £1.4bn per year to treat those people who are affected by poor housing. These are first year treatment costs alone.”

BRE The cost of poor housing in England (2021)

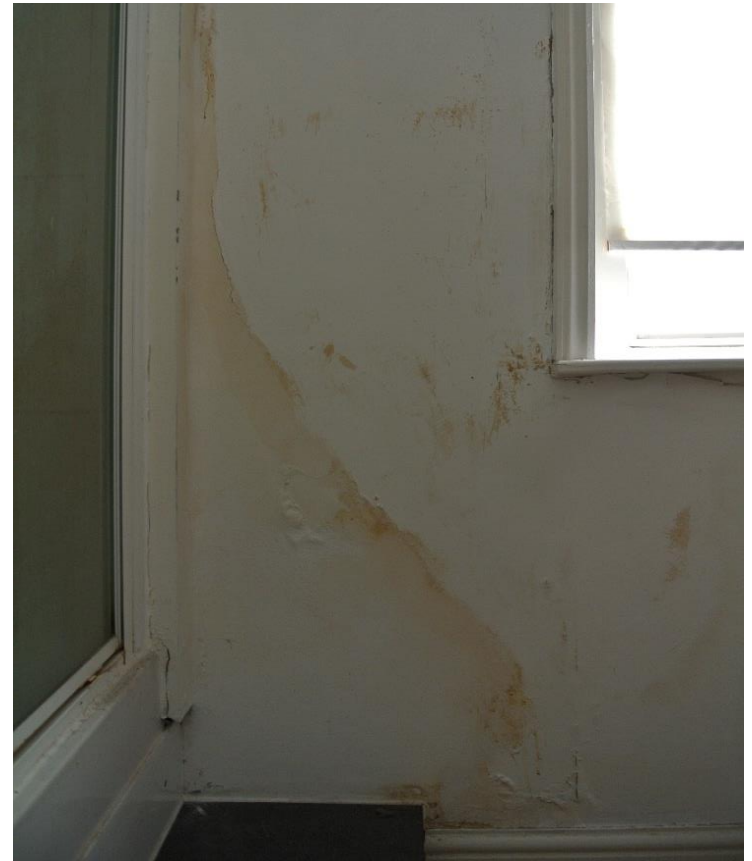
Moisture imbalance: excess



Indoors



At the surface



In the fabric

The eed an integrated approach

Building inspection and report from occupants

- Visual inspection
- IR thermography
- Moisture content measurements
- Questionnaire
- Ventilation inspection

Fungal testing

- Quantification of fungal biomass
- Species identification for indoor air
- Species identification for surfaces

In-situ monitoring

- Temperature
- Relative humidity
- Interstitial monitoring of critical areas

Hygrothermal simulations

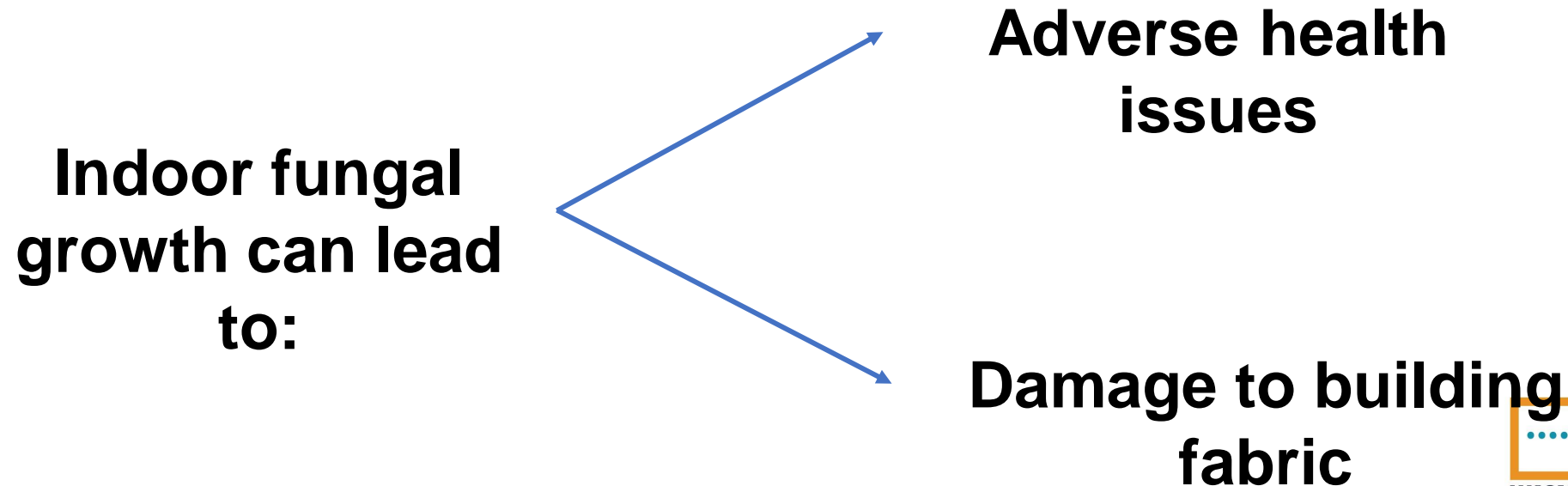
- One / two dimensional simulations
- Comparative analysis of factors leading to moisture damage

Fungal testing



Indoor Fungi: The Problem

The World Health Organisation (WHO, 2009) has reported an increasing trend in the occurrence of dampness and indoor fungi-related issues in the built environment.



Indoor Fungi: The Problem

Awaab Ishak: Toddler's death from mould triggers review of landlord guidance

Housing secretary Michael Gove says the tragedy "should never have occurred" and underlined the need for fresh action to ensure every landlord provides decent accommodation for tenants.

© Saturday 14 January 2023 14:06: UK



Awaab Ishak died in December 2020 from a respiratory condition caused by mould

Extent of mould problem in Herefordshire's rented homes revealed

23rd May

HEALTH PROPERTY



mould is more common in older properties with poor insulation and ventilation (Image: Aimee Rivers / Flickr, CC BY-SA 2.0 licence)

By Gavin McEwan

Hounslow dad forced to 'constantly wipe' mould off walls of council flat that's tearing kids' lives apart

He says the major issues in the council flat are tearing his kids' lives apart

NEWS By Alahna Kindred & Rafi Masuro-Benady
08:48, 20 MAY 2023 UPDATED 08:49, 20 MAY 2023

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'Notable' damp and mould affects up to 160,000 social homes in England, says regulator

NEWS 02:02:23 12:00 AM BY GRANNE CLIFFE

A damp and mould crisis in English social housing has left up to 160,000 homes with 'notable' problems, with a further 8,000 so severe that they "pose a serious and immediate risk to health".

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Nearly one in four Brits have found mould in their homes (Image: SWNS)

NEWS POLITICS FOOTBALL CELEBS TV ROYALS MONEY

More than a fifth of UK homes suffer from mould, damp, or condensation, study finds

Windows, walls, and ceilings are most commonly affected – but Brits are unsure how the problem is caused, or how to tackle it

By Andrew Young

10:06, 27 Jan 2023

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Assessment of indoor fungal growth

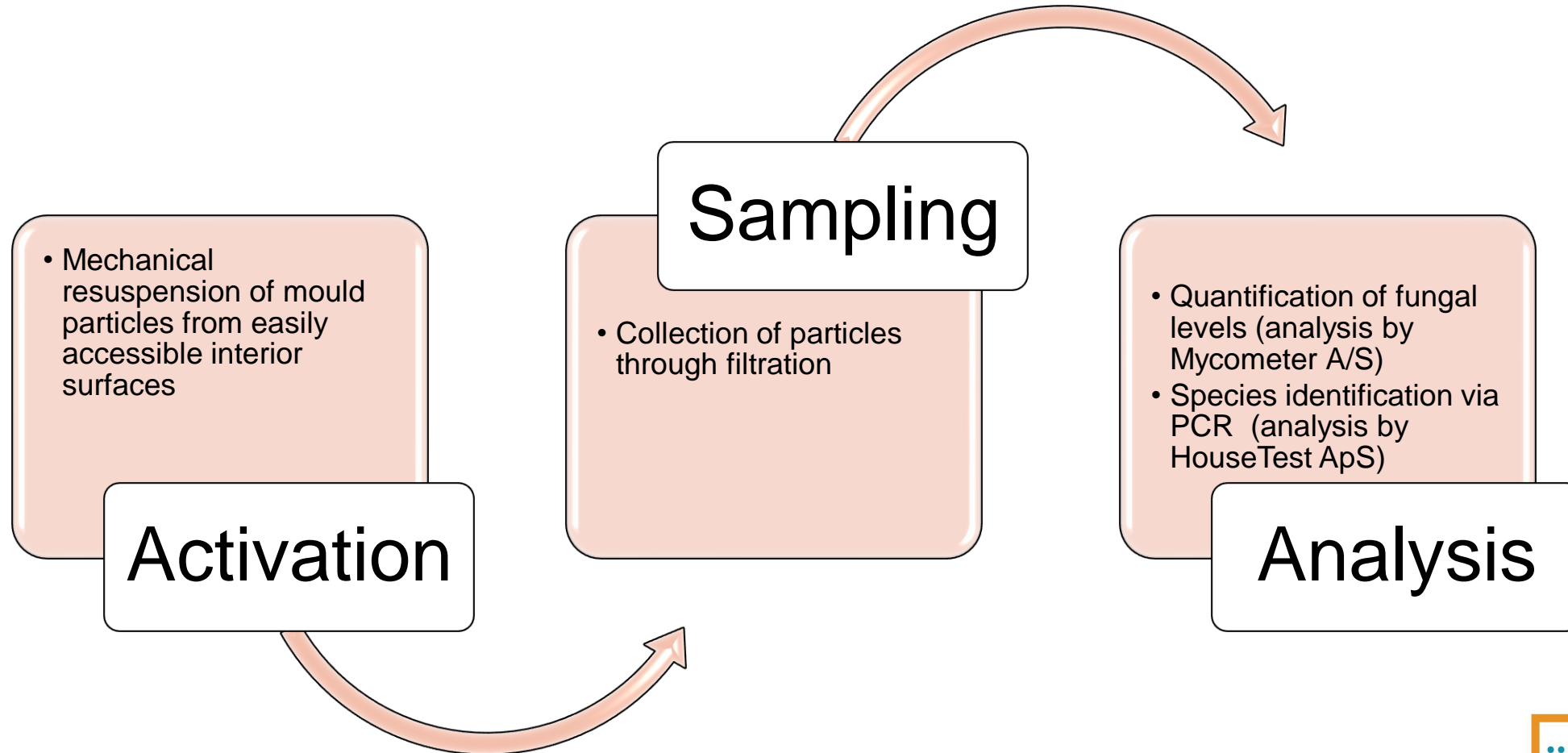
Air sampling

- **Quantification of fungal levels:** *To determine the quantity of mould in the property*
- **Identification of species:** *To understand the reasons mould growth might have initiated*

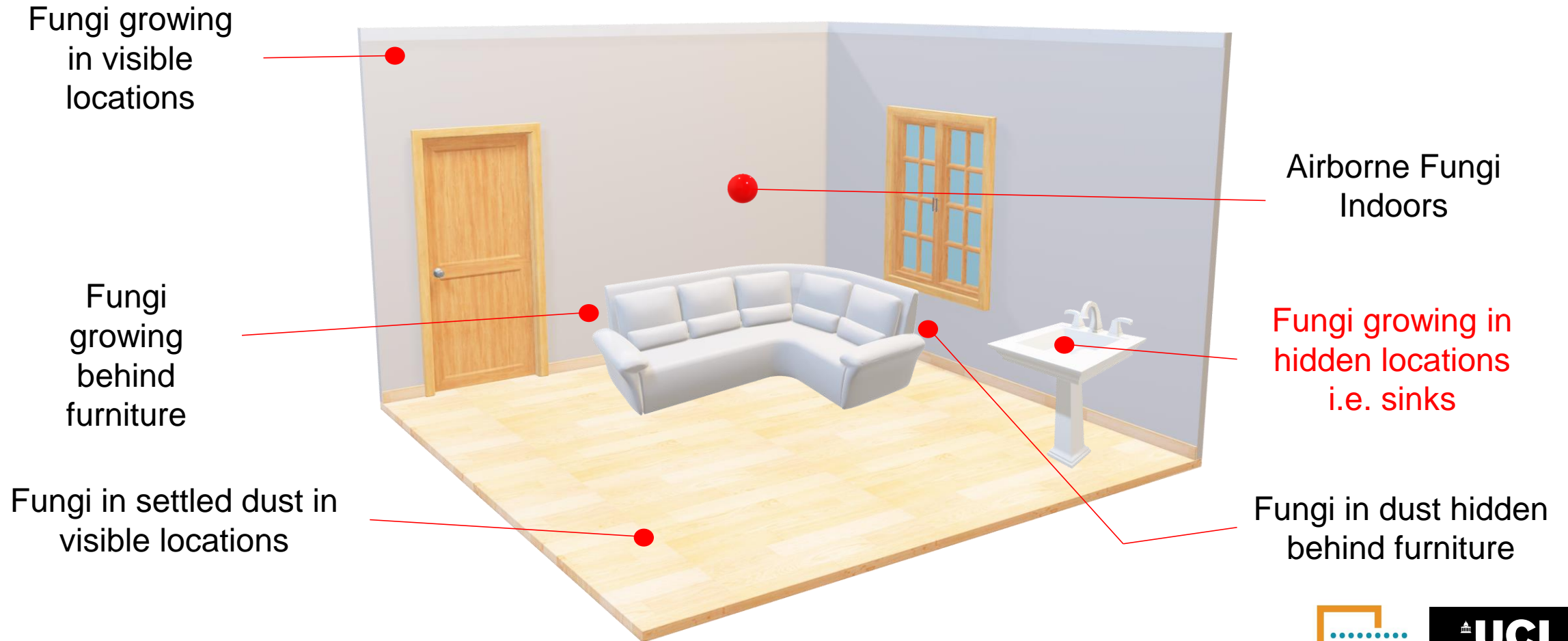
Surface sampling

Species identification: *to understand whether visible mould is active and affects the background contamination levels*

Air sampling protocol



Air sampling protocol



Fungal levels

- Property 1 – Risk deemed medium
Further detailed testing is recommended to eliminate risk of mould growing in hidden location
- Property 2 & 5 – Risk is deemed minor
Properties were well ventilated.
- Property 3 – Risk is deemed high for bedroom
Probable causes for the high values could be the contamination in the loft or existence of plants, higher dust levels
- Property 4 – Risk is deemed high
Probable cause for the high values could be the past escape of water or higher dust levels

Property	FAI	Fungal Levels	Allergens
Property 1 BED BD	D	C	A
Property 1 LR BD	D	B	A
Property 2 LR BD	B	A	A
Property 2 BED BD	A	A	A
Property 2 BED AD	B	A	A
Property 3 BED BD	A	C	C
Property 3 LR BD	A	A	B
Property 4 LR BD	B	D	C
Property 4 LR AD	C	D	C
Property 4 BED BD	A	C	C
Property 5 BED BD	A	A	A
Property 5 BED AD	A	A	A

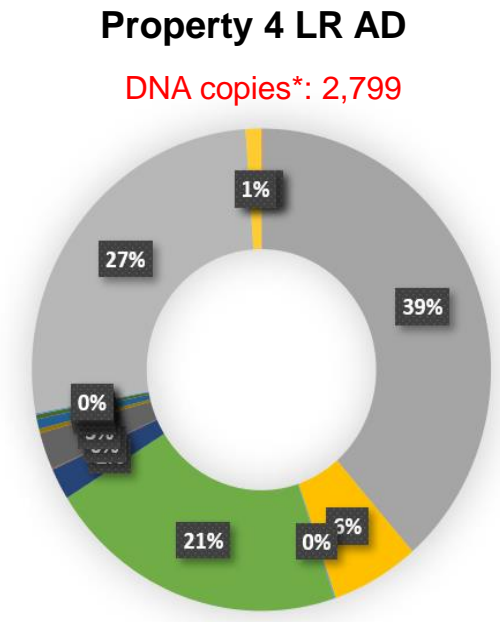
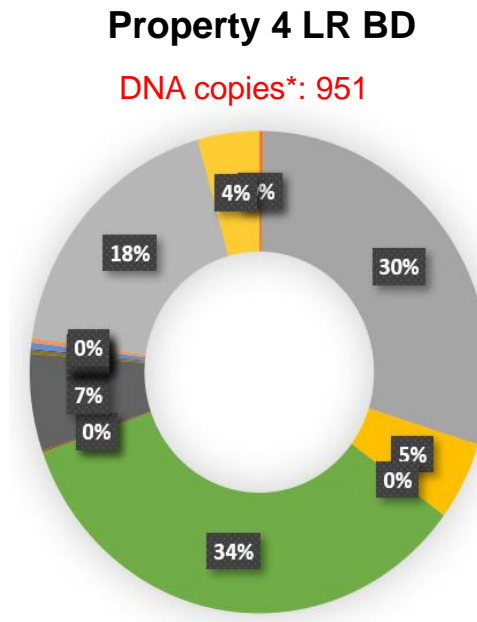
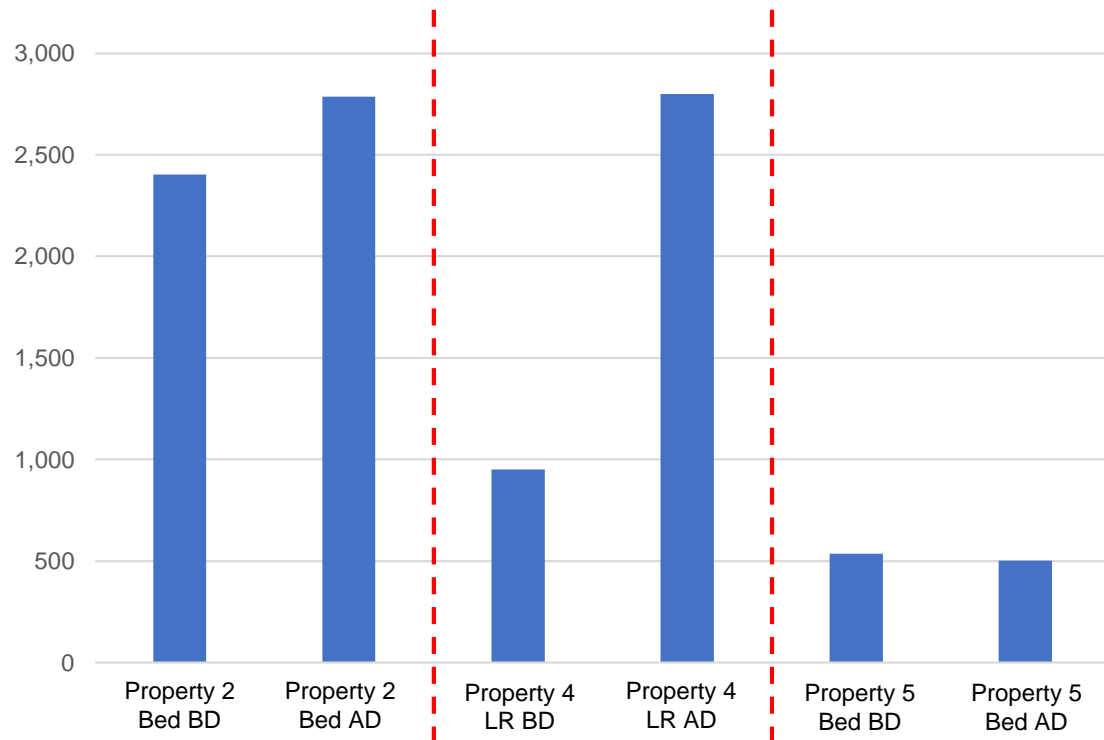
Identified species

Property Location	Room	Depressurization test	Dominant Fungal species (>10%)	DNA Copies of 16 targeted species
Property 1	Bed	BD	<i>Cladosporium sphaerospermum</i> (98.48%)	8,488
Property 1	LR	BD	<i>Cladosporium sphaerospermum</i> (97.26%)	4,604
Property 2	LR	BD	<i>Aspergillus versicolor</i> (79.32%)	798
Property 2	Bed	BD	<i>Aspergillus versicolor</i> (54.45%) <i>Cladosporium sphaerospermum</i> (24.97%)	2,402
Property 2	Bed	AD	<i>Aspergillus versicolor</i> (32.48%) <i>Cladosporium sphaerospermum</i> (47.23%)	2,786
Property 3	LR	BD	<i>Cladosporium cladosporides</i> (15.01%) <i>Cladosporium herbarum</i> (13.46%) <i>Aspergillus versicolor</i> (54.63%)	330
Property 3	Bed	BD	<i>Cladosporium cladosporides</i> (10.82%), <i>Aspergillus versicolor</i> (68.73%)	758
Property 4	LR	BD	<i>Cladosporium cladosporides</i> (29.55%) <i>Aspergillus versicolor</i> (34.49%) <i>Wallemia sebi</i> (18.40%)	951
Property 4	LR	AD	<i>Cladosporium cladosporides</i> (38.51%) <i>Aspergillus versicolor</i> (21.24%) <i>Wallemia sebi</i> (26.78%)	2,799
Property 4	Bed	BD	<i>Cladosporium cladosporides</i> (24.88%) <i>Cladosporium herbarum</i> (40.25%) <i>Aspergillus versicolor</i> (17.25%) <i>Wallemia sebi</i> (11.09%)	1,704
Property 5	Bed	BD	<i>Cladosporium cladosporides</i> (28.34%) <i>Cladosporium herbarum</i> (29.31%) <i>Aspergillus versicolor</i> (27.34%)	535
Property 5	LR	AD	<i>Cladosporium cladosporides</i> (23.29%) <i>Cladosporium herbarum</i> (11.20%) <i>Acremonium strictum</i> (54.88%)	501

- Property 1, 2 & 4 were found to have high number of fungal DNA copies.
- High indoor concentration of the *Cladosporium Sphaerospermum* species may indicate contamination of surfaces such as wallpaper or woodwork.
- The *Aspergillus versicolor* species is one of the most common species in the world and high levels of DNA copies might indicate initiation of growth due to damp-related problems.
- Wallemia Sebi* DNA copies are commonly found in damp environments indicating that Property 4 might still be affected by the escape of water.

Air sampling before vs after depressurisation

DNA Copies of 16 targetted species



- Aspergillus niger
- Chaetomium globosum
- Cladosporium cladosporoides
- Cladosporium herbarum
- Stachybotrys chartarum
- Aspergillus versicolor
- Acremonium strictum
- Alternaria alternata
- Cladosporium sphaerospermum
- Penicillium chrysogenum
- Rhizopus stolonifer
- Aspergillus fumigatus
- Tricoderma viride
- Ulocladium chartarum
- Wallemia sebi
- Penicillium expansum

* Total DNA copies of 16 targetted species

Surface sampling: Swab testing

Property	Sample	Total DNA copies of the 16 targeted species	Total DNA copies of the 3 targeted fungal groups
Property 3	Sample 1: (Loft)	8,124	87,470
	Sample 2: (Loft)	94,237	936,426
Property 5	Sample 1: (Bathroom, Water damage)	7,411,283	58,925,750
Property 4	Sample 1: (Bathroom)	123	42
	Sample 2: (Hallway, past water damage)	26	19
	Sample 3: (Hallway, past water damage)	210	684
Property 1	Sample 1 (Loft Front rafter)	2	2
	Sample 2 (Loft Back rafter)	6	5
	Sample 3 (Bedroom Furniture)	59	158
	Sample 4 (Bedroom Furniture)	293	813
	Sample 5 (Loft Front rafter)	55	29
	Sample 6 (Loft Back rafter)	228	20
	Sample 7 (Bedroom Door Frame)	563	125
	Sample 8 (Bedroom <u>Book shelf</u>)	602	211

Outcomes from fungal testing

- In the majority of cases the mould risk in the tested rooms was deemed to be minor.
- Interstitial fungal growth was identified in one of the tested rooms likely because of past water damage in the property.
- Medium or high levels of fungi were identified in 2 properties despite the absence of visible mould in the rooms. This could be attributed either to a hidden mould source or the level of dust, the existence of plants etc.

Internal wall insulation: condensation risk



Condensation risk analysis

Existing wall at lower temperatures:

- Risk of interstitial condensation and mould growth
- Risk of wood rot for embedded timber
- Risk of frost damage on external surface
- Lower drying (also depending on type of insulation)

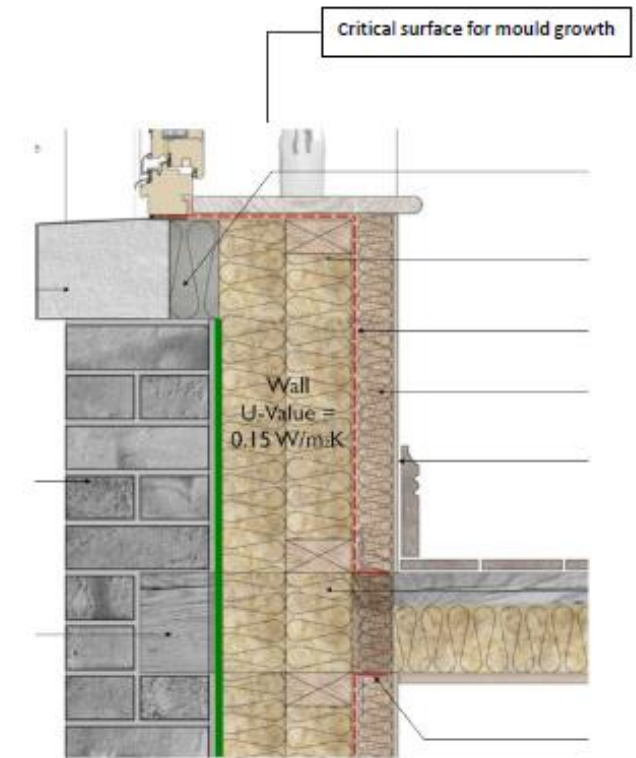
More than just condensation!

Hygrothermal risk assessment



Hygrothermal risk assessment

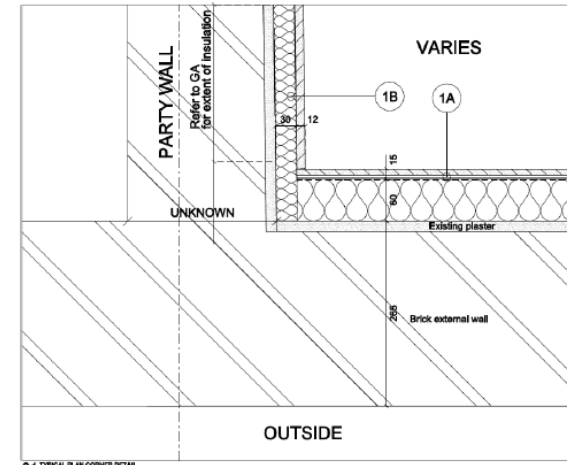
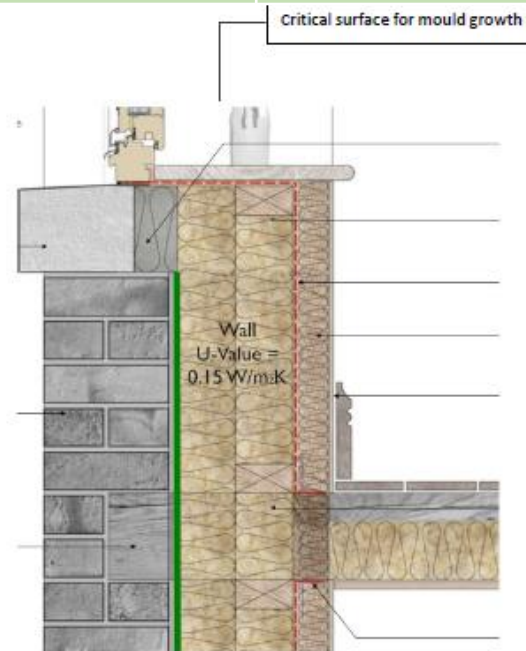
- One-dimensional hygrothermal simulations (e.g. WUFI), based on BS EN 15026
- Criteria for assessment:
 - Interstitial condensation and mould growth
 - Wood rot at joist ends
 - Frost damage on external surface



QODA

Hygrothermal risk assessment

	1 – front (N)	1 – detailed brick information	2 – front (NW)	2 – rear (SE)
Condensation risk	Not likely	Not likely	Not likely	Not likely
Mould growth risk	Likely (subject to brick type)	Low	Likely	Likely
Wood rot (joist ends)	Likely (subject to brick type)	Low	Likely (subject to brick type and timber type)	Likely (subject to brick type)
Frost damage	Not likely	Not likely	Not likely	Not likely



QODA

Moisture analysis

Property 1

Visual inspection:

- No visible mould but medium-high fungal levels
- Moisture damage on wall



Further tests needed

Property 2

Visual inspection:

- No visible mould and low fungal levels
- No moisture damage

Moisture content of joist ends at the end of the wetting period:

- Intermediate floor (6 joists): 11% to 18%
- Ground floor (3 joists): 15% to 18%

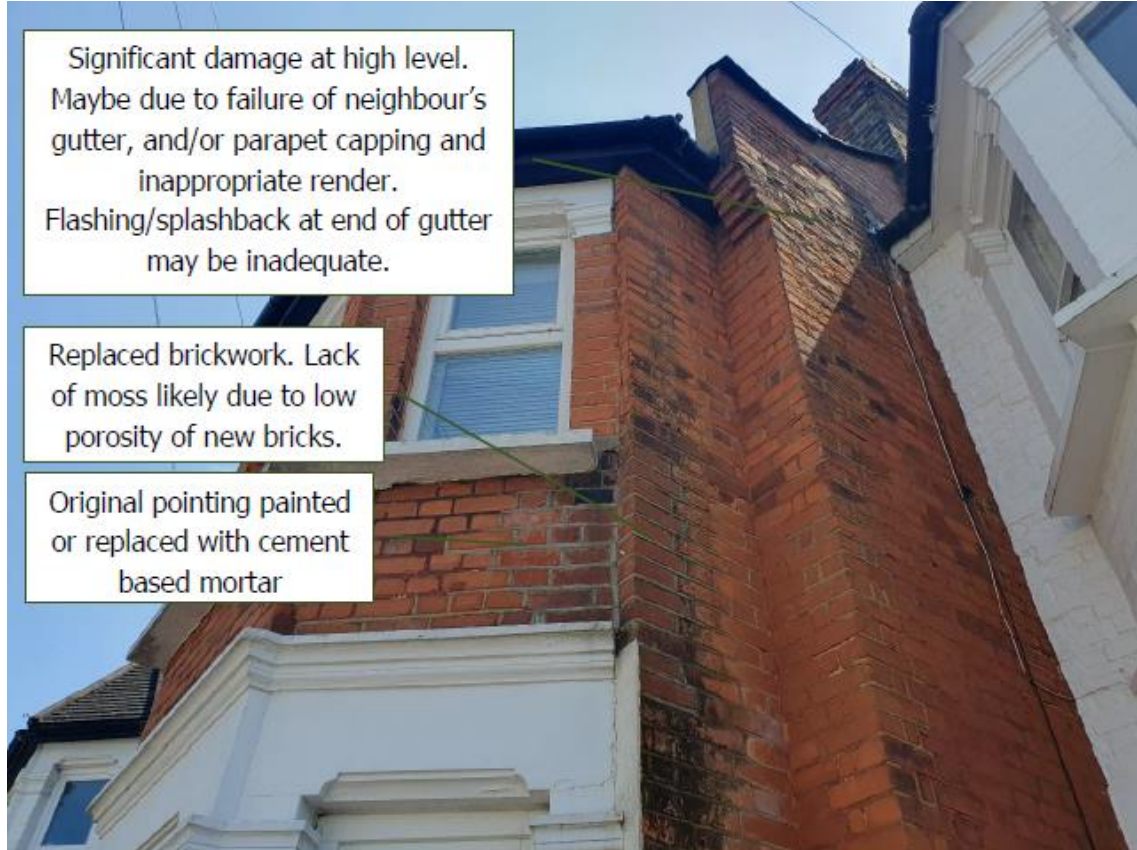
Moisture analysis: further tests



- Salt efflorescence at ground floor level, also in sleeper wall.
- Likely to be due to replacement of suspended floor to solid floor (concrete slab and EPS).



Moisture analysis: further tests



- Maintenance of gutters is an issue: leaking rain water goods
- Potentially leading to frost damage



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Moisture analysis: further tests

- Karsten tube test
- Two-dimensional hygrothermal simulations, focused on frost damage at surface

Damage was:

- Primarily exacerbated by inappropriate cement pointing
- The IWI may be increasing the risk, but to a lesser degree than the cement



Thank you for listening

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