Building Forensics

defect investigation & analysis

Report undertaken in 2009 the details have been removed for confidentiality purposes

MOULD REPORT ON PROPERTY X

1. The following report is based on a survey undertaken on 1st April 2009. Sampling protocols and investigation follows guidelines as set down by ACGIH[1] and IICRC S520[2] guidelines.

2. **Objective**

The objective of this report was to assess or identify the possible health risk to future occupants in light of previous surveys and reports which identified the presence of various moulds some of which were known to be "Toxic " to humans. The property has been said to be repaired and refurbished by insurers NHBC to remove both mould contamination and remove or repair construction defect likely to cause future mould growth.

3. **Note**

In line with the ACGIH and previous observations made in December 2008 the sampling hypothesis was developed to identify both the presence of mould and growth or potential growth factors. The accuracy of any survey or report can only be attributable to factors at the time of the survey and therefore it is essential to identify where possible, any factors which may influence or alter findings in respect of future health or the development of latent damage.

4. **Relevant and known or proven Factors**

   a. The concrete floors in the lounge were measured in December for moisture content and found to be above 95%Rh. This measurement was achieved using humidity sleeves within 30 minutes. The accuracy was not confirmed by calcium carbide as it was used only as an indicator. The cause of this high moisture content is believed to be due to construction design fault and is therefore long term. This type of insulated floor cannot under normal or realistic time frames dry naturally and requires vacuum or high pressure drying systems to bring to equilibrium and compliance to British Standards prior to the installation of resilient flooring.

   b. During the survey of April 1st it was noted that a new laminate floor had recently been installed and although no visible damage was apparent, the rest of the flat fitted with similar but original flooring displayed typical water damage markers. It must therefore be presumed that the sub floor is wet and that moisture presence will cause both floor failure and result in potential mould growth.

   c. During the initial survey of December 2008 it was also noted that construction defect was a contributor to mould growth in various areas and as total redecoration has occurred investigation was seen as impractical without major intrusive investigation.

[1] American Conference of Government Industrial Hygienist
[2] Institute of Industrial Cleaners and Restoration Contractors

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d. Although accurate moisture content of the floor was not possible due to applied finishes, the following non invasive investigations were undertaken which confirmed the presence of high moisture content.

5. **Ultrasonic scanning**

The floor of the lounge was scanned from the known or suspected wet areas to the furthest assumed drier areas. While scanning does not provide measured or meaningful scale of moisture content it can be utilised for comparison purposes.

Readings were as follows:

a. Windows parallel to Thames 6 readings ranging from (20 to 100)
b. Door area adjacent to hall (0)

6. Conductive moisture pins

Two metal pins 2mm diameter some 40 mm long were inserted through floor panel joints vertically onto the concrete floor (screed).These pins were attached to a conductive meter calibrated for wood. It should be noted that WME[3] is not a calibrated measurement but meant as a guide only.

As a rule of thumb it is recognised that EMC[4] values of concrete measured against a WME meter accept that concrete (screed) is wet over 7% moisture content.

The following two areas and findings were recorded:

a. Adjacent to Thames side lounge window 26% mc
b. Door area adjacent to hall 12% mc
c.

7. Infra Red Thermography

The lounge, now suspected of being wet and coupled to known building defects was subjected to an Infra red scan. This identified a cold patch adjacent to the windows which from moisture content analysis proved to be dry. This area was therefore subject to cold bridging or thermal insulation problems and the area was opened to find that insulation was missing as was fire protection. Externally it could be seen that external water proofing had not been applied to a satisfactory standard and that both air and moisture could readily enter into this room wall void and result in Dew point and mould. See photos 25-26

[3] Wood Moisture Equivalent
[4] Equilibrium Moisture Content

Conditions on the day of survey
The flat was unoccupied and unheated. The following specific readings are approximate.

Area	Temperature	Relative Humidity	Specific Humidity Kg dry air
Flat	14	54	.055
Lounge	14	57	.0057
Ambient	14	42	.004

Fig1. Initial readings prior to turning on heating

Area	Temperature	Relative Humidity	Specific Humidity Kg dry air
Flat	18	51	.00625
Lounge	18	54	.007
Ambient	15	40	.004

Fig2. Readings after turning heating on for 1 hour

It can be seen that even when in temperature equilibrium, the lounge, the initial failure point regarding moisture ingress and floor failure, is wetter than the rest of the property and that by raising the temperature for a short period resulted in elevated specific moisture content confirming that the property is still wet.

8. Investigation
The confirmed presence of moisture in the property coupled to the camouflage of mould and moisture markers, by recent redecoration meant that invasive investigation or sampling protocols needed to reflect likely cost benefits. Therefore a sampling protocol was designed to accommodate these issues.

9. Base sampling (prior to air movement)

- **a.** Sample air in communal hall with flat door closed to obtain background
- **b.** Sample flat areas with doors closed
- **c.** Lounge
- **d.** Hall and hot water cupboard
- **e.** Master bedroom
- **f.** Main bathroom
- **g.** Second bedroom

10. As the flat has been completely redecorated and cleaned, a disturbed air test was required, however due to windows and doors being left open to provide air changes of dilution from previously identified contamination problems this was seen of limited benefit. Therefore a negative pressure of 40 Pascal's was installed using Minnesota blower doors to draw any possible contamination to sampling points.

11. The application of negative pressure resulted in substantial entrainment dust being visible around room perimeter floors and especially external walls. This indicates possible failure of Part L building regulations in respect of building envelope and Fire regulations. This may also indicate that the property is exposed to weather ingress and Dew Point or condensation problems, which may result in mould or movement of contamination through interstitial cavities.

12. Sampling

Sampling of the air for non viable fragments of mould was undertaken in the following areas as a uniform air mix had been established with doors open:

a. Small bedroom
b. Lounge
c. Hall and hot water cupboard
d. Main bedroom /ensuite

13. Following the air sampling intrusive investigation was undertaken to the following suspect areas:

a. Hole in wall Lounge where cold spot was identified.
b. Main bedroom bathroom cavity wall where plasterboard was previously replaced due to visible mould
c. Main bedroom hall cavity wall previously replaced due to mould growth.

Note

Items 13 b & c were sampled to assess contamination possibly present within the void but likely to emerge in the future.

14. Following air sampling and the revelation of dust entrainment from negative pressure it was recognised that this was only possible due to the presence of construction dust which may not have been present uniformly.

Therefore the negative pressure was replaced with positive pressure and smoke pencils were used to identify leakage points around windows at floor level. All windows appear to leak and this may be seen ingress points for moisture and cause future mould, corrosion and rot problems.

15. HEALTH, HAZARD & RISK & MANAGEMENT

Note

The following information is provided for information purposes only and is not connected to the report data. The true extent of possible hazard is unknown and indeed may or may not exist and as such much will depend on risk appetite. It should be fully understood that this section "Health Hazard & Risk Management" is based on the fundamentals of risk management and is not and indeed cannot be substantiated or denied by scientific evidence. For your information I have been challenged by academics to substantiate some points regarding health hazards. I cannot substantiate nor can they deny relevant points because academia has yet to research these issues, what can be said is the scientific evidence from detailed experiment has yet to be undertaken. In the meantime I will rely on international training, anecdotal evidence and world wide experience to form the opinion that mould is or can be hazardous to some if not all people.

For more information and published scientific data please see our mould and reference section in www.buildingforensics.co.uk

Exposure to hazardous materials is subject to various national legislation and legal obligations for employers, landlords and general duty holders but risk & hazard management is universally accepted as essential in reducing the potential of physical harm.

Internationally assessments of risk and hazard management recognize the following statements and protocols.

"In the absence of confirmed evidence to the contrary it must be assumed that where a hazard may exist, it should be accepted as present and controlled by risk management". Risk & Hazard management is utilized in occupational health and generally protects workers who may be exposed to any form of hazard for the working day (8hours). It should be recognized that in a domestic situation people may be in their homes for far longer periods.

The Hazard

Some moulds are known to cause infection of the ear, eye, skin, and lung and the second most common, Aspergillus flavus is known to produce aflatoxin, one of the most potent carcinogens known to man. Penicillium and Aspergillus moulds can produce mycotoxins such as Ochratoxin which can damage kidneys, liver and cause hemorrhaging of the brain and lungs. Fusarium mould can produce toxins similar to the female sex hormone estrogen and targets the reproductive organs, similarly some moulds can produce mycotoxins such as Saratoxin H which can cause spontaneous abortion in animals and can reduce the immune system making affected individuals more susceptible to infection.

Note

The USA Federal Emergency Management Agency FEMA have published a technicians terrorist response guide which specifically mentions mould mycotoxins T2 as a chemical / biological weapon used by terrorists.

In the UK "JANES" (Fighting Ships) have published a similar guide and response advice.

Although live mould is considered hazardous, dead or (non viable) mould releases exotoxins from cell walls which fragment. This fragmentation or natural decay may follow the application of biocides or dessication (where the mould is dried out)

Typically the release may contain microscopic particulates which carry metabolites, and toxins which include allergens such Glucans that are readily inhaled to deep lung and or be absorbed through the skin. These contaminates are linked to the following symptoms in some individuals:

- Production of possible allergic response from IgE in body defence
- Very young who's immune system has yet to develop
- The older person who's immune system is failing
- Excess alcohol and or illegal drug abuse
- Those with reduced immune system due to chemotherapy, transplant rejection drugs
- Those displaying any of the following symptoms from exposure.

    - Flu like symptoms, skin irritation, allergies
    - Nose bleeds and coughing up blood
    - Respiratory problems (asthma)
    - Heart disease
    - Lung infection and liver disease
    - Skin irritation and wound infection (mould and bacteria)
    - Depression

It should be recognized that exposure to mould or bacterial hazards may cause both acute and chronic symptoms. People react differently to exposure and some may react after short or minimal exposure (Type A) but others may be exposed for relatively long periods before symptoms are recognized (Type B) Type A people usually feel better when removed from exposure but Type B people may find that once symptoms do appear they are consistent and may require prolonged medical assistance.

Identifying Risk Markers

The home or built environment has the following indicators of biological amplification or mould growth

- Musty or malodor exists
- Historic leaks or flood events or water staining
- Condensation
- Visible mould
- Visible indicators of moisture damage, (swelling, cracking, surface finishes

Risk Assessments

- In the absence of proof to the contrary "Any person or persons may be affected by the allergens assumed expected, or known to be present"
- In the absence of confirmed evidence to the contrary but in line with known toxic components (T2 Toxins –Tricothesenes), mould should be considered as allergenic or a health hazard.

- Where moisture or water damage evidence exists in the built environment, the presence of mould and or bacteria should be considered as present.

Risk Management

- Reduce exposure by engineering controls
- Remove moisture source
- Remove visible mould
- Assess or investigate hidden mould
- Decontaminate surfaces, air and voids
- Certify effective sanitation

16.Sample results

Static Air Test

Note. Level of detection <33 Red denotes toxic mould

No	Area	Species	Count m³
1	Landing communal	Cladosporium	33
2	Lounge	Ascospores	33
3	Hall & Immersion	Cladosporium	33
4	Master bed & ensuite	Chaetomium	33
		Stachybotrys	33
5	Main bathroom	Ascopores	33
		Pen/Aspegillus	100
6	Second bedroom	Pen /Asp	100

Disturbed Negative Air Test

No	Area	Species	Count m³
7	Second bedroom	Alternnaria	33
		Ascospores	800
		Chaetomium	3600
		Cladosporium	300
		Pen /Asp	1500
		Stachybotrys	67
8	Lounge	Ascospores	230
		Chaetomium	1300
		Pen/Asp	1800
		Stachybotrys	67
9	Hall & immersion	Ascospores	230
		Chaetomium	1100
		Cladosporium	370
		Pen/Asp	470
		Stachybotrys	100
10	Master bed & ensuite	Ascospores	200
		Chaetomium	930
		Cladosporium	100
		Pen/Asp	670
		Stachybotrys	130
11	Cut hole in wall lounge (cavity) Following remedial works.	Cladosporium	100
		Pen/Asp	67
		Stachybotrys	33
12	Master bed bathroom wall	Ascospores	100

	cavity where mould removal was said to have been undertaken.	Chaetomium Cladosporium Pen/Asp Stachybotrys	200 33 400 330
13	Master bed hall wall cavity where mould removal was said to have been undertaken.	Chaetomium Pen/Asp Stachybotrys	730 1500 67

15. PROJECT RISK MANAGEMENT

From the sampling results it can be seen that applying negative pressure has contaminated the property with several "toxic moulds" believed to have been pulled or released from interstitial cavities. The property must now be seen as a potential health hazard and required decontamination prior to entry.

Decontamination

No visible mould was apparent during the initial investigation and development of the sampling hypothesis as all surfaces had been redecorated. Therefore decontamination was required to the air and settled spores.

A Hydrogen Peroxide based thermal fog was introduced and allowed to fill the property. The fog mixture was designed to penetrate and dwell for a period long enough to oxidize likely hazardous mould components. (Decontamination was undertaken after sampling.

Personal Protection to level B (body fully protected)with self contained breathing apparatus was used to protect both skin, eyes and respiratory systems.

16.Discussion

The flat is still wet and has serious insulation, water leak potential, building defect and cold bridging or thermal loss issues. These factors coupled with increased heating likely from occupation may increase the likelihood of mould growth and health hazards. While mould sampling identified only non viable spores or fragments it must be reasonably assumed that viable spores are present and that dormant hyphae are established within voids which are readily activated by increased temperature and conditions of habitation.

The lab analysis of mould samples show high levels of "toxic" types of mould and this must be recognised as a possible or potential health risk.

The sampling protocols can be interpreted in various ways and for discussion purposes the following debate points are made:

a. The property was relatively clean prior to application of negative air pressure

This is correct but considering the property had been said to be decontaminated, repaired and renovated with cleaning and redecoration it should have been clean but unacceptable levels of "Toxic" mould were present. The initial sampling of points 1-6 was in undisturbed air and therefore must be seen as a base line only. Had air been disturbed prior to sampling higher quantities could have been expected.

b. Toxic mould was pulled from voids where it presented no real risk

The presence of "Toxic Mould" in any part of a property is unacceptable. All parts of a building are said to be linked and are termed interstitial cavities. Changes in atmospheric pressure, temperature, stack effect, alterations in the pressure plain will pull or push contamination from voids. The application of negative air pressure simply accelerated this process.

c. Negative air pressure pulled contamination from other flats

This is possible and could add to the overall picture of contamination within the whole Pacific Wharf, however, sampling protocol has shown that all areas of flat 416 already had high levels of toxic mould and this would mean that all rooms below or above were equally contaminated and although possible it is unlikely.

It should be noted that a base level (sample1) of 33 Cladosporium only, was detected from the communal landing and as this sample did not contain any of the other contaminates found in 416 it must reasonably be presumed they came from within the flat.

- Stachybotrys
- Chaetomium
- Pen/Asp
- Ascospores

18. Conclusion

a. The property is poorly designed and built and despite retrofitting of insulation and moisture or vapour barriers the property envelope and indeed internal build are leaking air and moisture which requires further investigation.

b. Decontamination of previous mould contamination was not undertaken in any form acceptable or recognised as effective.

c. It is my suspicion based on evidence gathered that the floors of flat 416 are wet and that resilient flooring which has been laid over them likely to result in failure from swelling, and mould (rot). Further intrusive investigation required to confirm.

d. The property has voids containing mould spores and or mycotoxins likely to be released over a long period and most likely to cause health hazards.

e. The whole of the property block should be surveyed from a point of view which identifies:

- Thermal breaks and missing insulation
- Air and moisture leakage
- Vapour barriers and drying plan issues
- Ventilation rates
- Mould

Report Ends

Jeff Charlton

Annex 1
The qualifications and experience of the surveyor Jeff Charlton

I have undertaken worldwide disaster recovery for 25 years as a consultant and contractor winning two industry "Disaster Recovery of the Year Awards. Specifically dealing with fire, floods, explosion, natural disasters requiring building decontamination and restoration.

Qualifications

British Institute of Occupational Health		Certified in Polarised light Microscopy
British Institute of Occupational Health		Certified in Method of Determining Hazardous Materials
Institute of Occupational Health & Safety		General Certificate and associate member
SK laboratories	UK	Sampling techniques and protocols for air sampling
Health & Safety Executive	UK	Certified asbestos removal supervisor & surveyor

Aeotech Laboratories	USA	Indoor Air Quality Microbiology
American Indoor Air Quality Association		Certified in Meaningfull mould investigations
Hydrolab	USA	IICRC Mould Decontamination Supervisor
Restoration Industry Association	USA	Applied Microbial Remediation Technician
Restoration Industry Association	USA	Certified Restorer
Restoration Industry Association	USA	Water Loss Specialist
Restoration Industry Association	USA	Certified Mechanical Hygienist (HVAC systems)
National Institute Decontamination	USA	Certified technician and instructor
OSHA Occupational Safety Health	USA	Hazmat Technician (Hazwopper)
Dolco Corporation	West Germany	Moisture in buildings and differential pressure drying
Prof Alvin Rola'n Stockholm Sweden		Theoretical & Practical Sanitation

- Member of the UK Heating & Ventilation Contractors Association TR17 task force on developing the standard for ventilation system cleaning and hygiene.
- Member of the American IICRC task force on developing the S520 standard on mold and decontamination best practice.
- Principle instructor with Bio Recovery & Decontamination Institute UK
- Initial sponsor and founder chairman British Damage Management Association

Annex 2 Photo log following

Annex 2

19.Photo Log

15. Sealing vents and holes prior to application of negative air

16. Applying negative air pressure

17. Scale reading 10 moisture content

18. Scale reading 40 moisture content

19. Off scale 100 moisture content

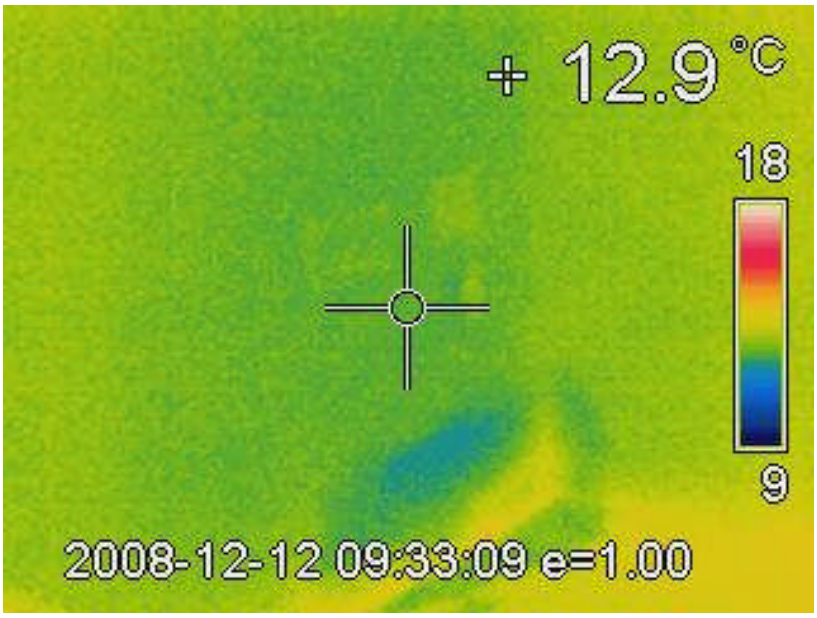
20. Measuring screed at 11.1% WME at far end of lounge

21. Screed shows 25.5% WME at window area of lounge

22. Showing dust entrainment under negative pressure

23. Showing dust entrainment under negative pressure

24. Showing chemical smoke being sucked out under windows under positive pressure



25. Infra Red scan showing cold spot below plug sockets (investigation required)

26. Lounge cold area from infra red survey showing missing insulation, vapour barriers etc.

27. Outside view of photo (25- 26) showing gaps in brickwork and lack of weatherproofing (sealant)