

WINDOW AND CEILING PLASTER CONDITION SURVEY

51-53 RICHMOND STREET, MANCHESTER

JOB NO. 213-41



EMINENCE DEVELOPMENTS LTD

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CONTENTS

1 Introduction

2 Observations

3 Recommendations

Appendices

A Common decay organisms

B Specialist search techniques and their limitations

C Remedial building works and environmental control

D Maintenance and monitoring

E Photographs

F Drawings

1 INTRODUCTION

1.1 AUTHORITY AND REFERENCE

Hutton+Rostron Environmental Investigations Limited carried out a timber window and ceiling plaster condition survey at 51-53 Richmond Street, Manchester on 29 November 2022 in accordance with instructions received from Kieran Hedges of Eminence Developments Ltd by email dated 30 November acceptance of H+R Order Form dated 28 November 2022. Reference was made to drawings supplied by Stephenson Hamilton Risley Studio, reference 7593 for the identification of structures. For the purpose of orientation in this report, the principal elevation to Richmond Street was taken as facing north-west

1.2 AIM

The aim of this investigation was to assess the condition of the timber windows and plaster ceilings and to give recommendations on any remedial works required

1.3 LIMITATIONS

This survey was confined to the accessible structures. The condition of concealed timbers may be deduced from the general condition and moisture content of the adjacent structure. Only demolition or exposure work can enable the condition of timber to be determined with certainty, and this destroys what it is intended to preserve. Specialist investigative techniques are therefore employed as aids to the surveyor. No such technique can be 100 per cent reliable, but their use allows deductions to be made about the most probable condition of materials at the time of examination. Structures were not examined in detail except as described in this report, and no liability can be accepted for defects that may exist in other parts of the building. We have not inspected woodwork or other parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect or, in the event that such part of the property is not free from defect, that it will not contaminate and/or affect any other part of the property. The recommendations in this report are included to advise and inform the design team appointed by the client. The contents of this report do not imply the adoption of the role of Principal Designer by H+R for the purposes of the Construction (Design and Management) (CDM) Regulations 2015. No formal investigation of moisture distribution was made

1.4 H+R STAFF ON SITE

Chris Whitfield
Catherine Knowles

1.5 PERSONNEL CONTACTED

Charlie Egan – Stephenson Hamilton Risley Studio Ltd
Sami Challah - Albert Jones (Textiles) Ltd

2 OBSERVATIONS

See Figures 1-71 in the Schedule of Photographs at Appendix E. Photograph locations are identified on the Drawings at Appendix F

2.1 WINDOWS

- 1 Construction: All timbers were of softwood species, probably Scots pine (*Pinus sylvestris*). Windows were mortise-and-tenon jointed and generally of 6-pane segmental-headed form, except at 2nd floor level where square windows were of 4-pane. Windows generally included inward opening hoppers except for the 2 no. transom windows which were fixed. Ironmongery included hinges, quadrant stays and latches. Glass was fixed from the interior of the frame and held with putty internally and externally. Glass was generally rippled which is typical of old 19th century glass. The glazing to the lower ground floor windows included wired glass as a safety measure, also available in the late 19th century. The perimeter of the window openings were sealed with cement mortar externally. The windows were decorated with numerous layers of green paint
- 2 Condition: Windows to the front elevation were inspected externally from ladder. All other windows were inspected internally where accessible. A proportion of windows were inaccessible for tactile assessment internally due to stored goods. Where accessible, no significant timber decay was detected in the windows from 2nd-upper ground floor level. However, all windows at lower ground floor level were decayed at the base of their frames. Decay was primarily caused by wet rot fungi and was progressive due to the damp conditions below ground level. A proportion of the inaccessible windows particularly to the rear elevation were at a heightened risk of damp and decay due to ongoing water penetration caused by defective eaves gutter drainage. Decorative finishes, glazing putty and perimeter mortar sealant were in poor condition. Most windows included the original ironmongery, but most windows were inoperable due to their infrequent use and over-painting. A small number of broken panes of glass were noted

2.2 DOORS

- 1 Construction: All timbers were of softwood species, probably Scots pine. The double doors to the front elevation were of mortise-and-tenon ledged construction with vertical tongue and groove boards. The original double doors into the lower ground floor had been replaced with metal doors but the originals were stored on site. Ironmongery included a range of tower bolts, drop bolts, hinges internally and externally, some of which were probably original. The perimeter of the door openings were sealed with cement mortar externally and the doors were decorated with numerous layers of green paint. The 2nd floor emergency door was metal and of relatively modern construction. The 1st floor door appeared to be of similar construction to those of the front elevation but both faces had been over boarded with hardboard

- 2 Condition: Doors were generally free from major decay where accessible. However, a proportion of the door frames to the front elevation were partially decayed at their base. Decay was caused by wet rot fungi and previous repairs had been attempted in some locations. Decay also extended into the timber threshold step of the loading door D.05 where it was embedded in the masonry. The 2nd floor door and frame were damp beneath the leaking eaves gutter but no significant decay had yet occurred

2.3 CEILINGS

- 1 Construction: Lath and plaster ceilings were supported from softwood floor joists at 1st and upper ground floor level. Riven laths nailed to the underside of the joists supported lime plaster comprising a base/backing coat and finishing plaster. Remnants of lath and plaster also remained at 2nd floor level fixed to the underside of the common rafters. Plaster was decorated with limewash and film-forming paint finishes. Modern suspended ceilings had been installed over the office, toilet and kitchen. There was no ceiling at lower ground floor level and no evidence of there ever having been a ceiling here
- 2 Condition: There was widespread cracking in the remaining lime plaster at 2nd floor level and several laths were partially decayed. Decay was historical and pre-dated the last phase of re-roofing in the 20th century. There was localised cracking in the ceilings at 1st and upper ground floor level, but area of cracking was deemed insignificant following tactile assessment. However, a section of ceiling plaster at upper ground floor level had separated from the laths and was potentially vulnerable to detachment. This was directly beneath the 1st floor Office and may have occurred during the last internal fitout of the building or from increased loadings in the Office. In the few locations where floorboards could be raised at 2nd floor level the plaster 'keys' were in good condition

3 RECOMMENDATIONS

3.1 WINDOWS AND DOORS

- 1 Detailed inspection: If the intention is to retain and refurbish the existing windows and doors then allow for a detailed inspection of each following the provision of safe high-level access. H+R can provide this service if required
- 2 Repairs: Repairs should be undertaken by a conservation joiner. Decayed joinery should be cut back to 'sound' material and new timber appropriately jointed so that the frames are renewed to their original form. No preservation or chemical remedial treatments are required. Renewed elements or splices to partially decayed softwood frames should be replaced with a suitably specified durable softwood timber species (H+R should be requested to advise further on specification) or Accoya (Acetylated Pine species). Splices should be arranged so that water drains outwards from the component and away from the interior of the building. A suitably specified elastic epoxy resin should be used between the splice repair and sound timber, following the manufacturer's recommendations. Epoxy fillers should only be used for very small areas of the surface imperfections so long as the moisture content of the associated timber is less than 20 per cent w/w. Broken glazing should be replaced as necessary with a suitably specified heritage glass. Natural linseed oil putty should be used for the glazing compound and a traditional burnt sand mastic for the perimeter sealant, applied in accordance with best practice. Existing historical ironmongery should be retained and like for like replacements sought where missing/damaged
- 3 Redecoration: Prior to any repairs or refurbishments, existing paint layers should be tested for potentially hazardous metals such as lead. Where practical and beneficial, existing paint layers could be retained as lead-rich paint is helpful in preventing fungal colonisation. Where it is necessary to remove paint layers because they are detached, provided that paint dust can be safely contained, suitable mechanical abrasion may be the most appropriate method of removal. Redecoration should be carried out in a suitably dry and dust free environment using an appropriately matched moisture vapour permeable paint. Ensure timbers are suitably 'dry' before painting i.e. wood moisture content is below 16 per cent w/w. H+R can provide further recommendations on specification if required

3.2 CEILINGS

- 1 Repairs: Allow for localised repairs to the lath and plaster ceiling in the areas identified on the drawings. Carefully release the defective plaster from the laths. Replace any partially decayed laths. A conservation plasterer should replaster with a lime, sand hair mix to match the existing. Ensure the floor voids are carefully cleared of any remaining loose debris and dust without damaging the plaster 'keys'. Ensure any new ceiling finishes applied over the lath and plaster are fixed to the underside of the floor joists

Appendix A

COMMON DECAY ORGANISMS

1 DRY ROT

Dry rot (*Serpula lacrymans*) belongs to the same group of fungi as most of the common mushrooms and toadstools. Reproduction is by means of spores which are produced in enormous numbers by the fleshy pancake-shaped fruiting body. These fruiting bodies generally only appear when the fungus is stressed or dying off. A well established infestation may produce fruiting bodies more than one metre across and be accompanied by thick layers of rust-coloured spore dust. Each minute spore has an outer coat which affords it some protection against heat and desiccation, and germination has been achieved after a twenty-year latent period. Dry rot spores are ubiquitous and there is no domestic or natural environment entirely free of them. They can be found throughout the environment from high up in the jet stream to the middle of the countryside

Spores will germinate and grow in timber with a moisture content of between 20 and 30 per cent. The fine fungal thread (hypha) digests the cellulose and hemi cellulose fractions of the wood, but is unable to attack the structural linings. These remain as a brittle matrix which cracks into cubes under differential stresses. Cuboidal cracking is also a characteristic of many wet rots and does not automatically indicate the presence of dry rot

Fungal hyphae may clump together into a variety of structures known as mycelia which take various forms depending on the surrounding conditions. They may fill a humid cavity as a cotton wool-like mass, or grow across the surface of the timber, as a grey-white skin. Active dry rot has a fresh white or greyish appearance and smells strongly of mushrooms. Distinctive patches of lilac or canary yellow pigmentation are usually present

Some hyphae group together to form conducting strands. These have a fairly impervious outer layer rich in chitin, the major constituent of insect cuticle. The strands, which may reach a centimetre in thickness, are flexible when moist, becoming progressively more brittle as they dry out. Their main function is the conduction of nutrients, through or across inert non-nutrient materials (brickwork etc) to other timbers. Their relatively impervious outer layer, together with an unusual alkaline tolerance, allows them to survive in the mortar layers within masonry and walls. An infested area may be full of dry rot strands. The dry rot fungus may tolerate relatively lower moisture contents and, through this, and other quirks in its biology, is potentially capable of considerable destruction. Realisation of this potential, however, requires a narrow range of environmental conditions and, in practice, several factors restrict growth

Dry rot hyphae may attack timber with a moisture content of about 18 per cent; however, spores would not germinate under these conditions. This moisture content is still 5 to 10 per cent wetter than timber should be in a healthy domestic building, and indicates water penetration or, perhaps, faulty plumbing. There is no evidence that dry rot can 'wet up' timber to any appreciable extent under conditions expected in a healthy building, although this is often claimed. The fine attacking hyphae, unlike the coarse conducting strands, are susceptible to desiccation and dry wood may disperse moisture faster than it can be transported. This means they cannot move through dry masonry and wood or across ventilated cavities

The total breakdown of wood by fungus produces considerable quantities of water. It has been suggested that dry rot can sustain itself on this 'metabolic' water alone. However, in practice, external drying factors disperse the moisture so that favourable conditions can be maintained only in exceptional circumstances such as behind impermeable finishes or in sealed cavities

In order to thrive, dry rot requires a moisture content in timber in excess of 20 per cent, and a relative humidity above 95 per cent. Below these levels the fungus will cease to cause current decay problems. Temperature is also a strong regulating factor, and growth ceases at about 25°C, a temperature frequently exceeded in roof spaces, for example. Large radiators can be particularly lethal to dry rot and measurements of 30°C with 20 per cent relative humidity are not unusual in their immediate vicinity

Dry rot is attacked by many other decay organisms which cause particular damage when the fungus is under stress will eventually destroy it. However, under dry conditions, dead dry rot does not disappear. Strands may eventually darken and the fungal mats may lose their fresh appearance, becoming tinged with brown, and leathery or papery in texture. The decayed wood becomes powdery as it dries, shrinks and distorts, which can be the first sign of decay having occurred behind paint finishes

2 WET ROT

Wet rot is caused by a number of basidiomycete fungi of which the most important are *Coniphora puteana* (cellar fungus), *Poria fungi*; *Fibroporia vaillantii*, *Poria placenta*, *Amyloporia xantha*, *Geophyllum trabeum*, *Phellinus contiguus*, *Donkiporia expansa*, *Pleurotus ostreatus*, *Asterostroma* and *Paxillus panuoides*. They attack both softwoods and hardwoods causing a darkening of the timber (brown rot) or bleaching (white rot). Wet rot fungi usually occur in persistently damp conditions, needing an optimum moisture content of 50 to 60 per cent. Unlike dry rot, the conducting strands of wet rot fungi do not extend far from their nutrient wood, hence they cannot travel through masonry and brickwork. The fruiting bodies occur rarely in buildings. Wet rot has been known to hollow out giant beams. Wet rot *Coniphora puteana* is responsible for up to 90 per cent of wood decay within buildings but raises less concern than dry rot, possibly because it is more easily controlled by standard building techniques. Some wet rots are also called soft rots as they destroy both cellulose and lignin, leaving the colour of the wood largely unaltered, but producing a soft felty or spongy texture. Soft rot is caused by *Chaetomium globosum* and a number of other fungi also found growing on wet wood in buildings

3 WOOD-BORING INSECTS

The common furniture beetle (*Anobium punctatum*) has a life cycle consisting of four stages - egg, larva (which causes all the damage), pupa and adult. The eggs are laid in end grain or in existing flight holes and hatch in 4 to 5 weeks and the new larvae bore directly into the wood. The larvae feed and grow within the wood creating a network of tunnels closely packed with frass (small ellipsoidal pellets). The larvae are whitish, curved, approximately 6mm in length and have well defined dark-brown jaws. When fully grown the larva excavates a small chamber and pupates producing a beetle after 6-8 weeks which bores through a thin layer of wood producing the characteristic emergence holes 1-2mm in diameter. Emergence usually occurs between May and August. The life cycle depends on the condition of the wood, the temperature and humidity. The life cycle usually takes a minimum of 3 years within buildings. Attack is usually confined to the sapwood of softwoods and hardwoods but may occur in the heartwood in timbers such as beech, birch, spruce or in timbers modified by fungal decay. As sapwood only makes up a small cross section of the majority of structural timbers in older buildings, attack is often of little or no structural importance. In most instances of suspected attack, the infestation has died out long ago due to unfavourable environmental conditions. Careful checking is therefore required to establish that living woodworm are present

In cases of active infestation the environmental conditions are often marginal allowing the life cycle to continue but at a very slow rate. Small changes in the environmental conditions can tip the balance against insects. Woodworm attack is often very localised to small areas of high humidity or especially 'palatable' timber and further spread is highly unlikely

In the British Isles, death watch beetle (*Xestobium rufovillosum*) infestations occur most commonly in oak, probably because this wood used to be extensively employed in construction, but infestation can also occur in elm, walnut, chestnut, elder and beech. The life cycle is similar to that of the common furniture beetle but can take many years to complete from one year under experimental conditions, to ten years or more in a building (Ref 11). The hatched larvae wander over the surface of the timber before burrowing into it. When it is fully grown it pupates and changes into the adult beetle which does not emerge until the spring of the following year producing a 3mm diameter hole

In old buildings severe damage can be caused under favourable environmental conditions. Softwoods are occasionally infested where they are in close proximity to damp infected hardwood. Infestation is confined to fungal decayed or damp affected timbers. Many existing cases probably arose from the reuse of infected timbers from demolished buildings and from the use of unseasoned timbers used in their construction. Attack is not confined to the sapwood and often the heartwood is entirely consumed causing severe structural damage. Damage is most severe where ventilation is poor and where timbers are in contact with damp masonry

Death watch beetles are not active fliers. A localised attack of death watch will not automatically spread to the whole house and infest every timber in the building. Lowering of moisture contents of the timber in conjunction with careful observation to determine the level and extent of activity should provide control of the insects. Some severe cases may merit the use of local insecticide treatments as a first aid measure. However, the chemical must be targeted properly or large quantities of toxic pesticides will be used to little effect

Woodworm and death watch beetle infestation will not flourish if the moisture content of timber is below about 14 to 15 per cent. The risk of infestation of insect attack is slight, in timbers with a moisture content at or below 14 per cent and the insect larvae will desiccate below about 12 per cent moisture content. The infestation will eventually die out if the timber moisture content is maintained below this. Healthy roof timbers should have a core moisture content of between 14 to 15 percent, while suspended floor timbers should be between about 11 and 14 per cent. Installation of a central heating system may reduce these moisture contents to about 9 per cent particularly in exposed timbers

It is absolutely necessary to recognise whether an insect infestation is 'active' or 'dead'. The presence of fresh frass (bore dust) in conjunction with damp timbers may be acceptable evidence of active infestation

Appendix B

SPECIALIST SEARCH TECHNIQUES AND THEIR LIMITATIONS

1 PRELIMINARY INSPECTION AND INVESTIGATION

The basis of any investigation is an understanding of building structures and defects and how these may interact to produce the ecological niches in which various decay organisms can thrive. With experience, an initial visual inspection can give a good idea of the areas that will need further study. A check-list for this preliminary investigation includes building defects, significant timber structures and concealed cavities

The condition of concealed timbers may be deduced from the general condition and moisture content of the adjacent structure. Only demolition or exposure work can enable the condition of timber to be determined with certainty and this destroys what it is intended to preserve. A non-destructive approach is therefore required and to help reduce uncertainty, specialist instrumentation and test equipment can be useful. However, it is important to remember that all tests and instruments are only aids to the surveyor, and must be interpreted with experience and care. A slavish reliance on any technique and failure to take into account its limitations is a recipe for disaster. No technique can be 100 per cent accurate or reliable

The techniques that may be used for preliminary investigation include resistance-based timber moisture meters, capacitance masonry moisture detectors, borescopes and Rothounds

2 DETAILED INVESTIGATION

The findings from the initial investigations are followed up by more detailed study. The aim is to determine as far as possible the distribution and extent of all significant decay and organisms in the building, the distribution of micro environments predisposed to timber decay and the building defects that cause them. The extent of significant timber decay should also be determined as far as possible. Active decay organisms may not yet have caused significant timber decay. Conversely, there may be significant decay even when the decay organisms that caused it have been dead for many years. This may seem obvious but many expensive 'treatments' are carried out on insect or fungus damaged timber that has not been infected for tens or even hundreds of years. Key factors that may be noted are species and viability of decay organisms, moisture content of materials, ambient relative humidity, and ventilation. Timber species and previous chemical treatments may also be significant

It is important that the results of the investigation are co-ordinated with the building structure bearing in mind the characteristics of particular periods and methods of building. They should also be carefully recorded and quantified where possible. This allows analysis of the results by other experts, reduces the 'grey' area in which disputes of opinion can arise and forms a basis on which future investigations can build. Photography can be especially valuable and may be used when necessary

3 ROTHOUNDS

Rothounds are specialist search dogs trained to help find dry rot (*Serpula lacrymans*) in buildings. Rothounds may indicate areas of active dry rot even before they are visible to the naked eye. This will occur if the dry rot is just developing, is inside the substance of the timber, between the timber and another surface or within porous masonry. Such indications may be confirmed by comparing them with measurements of the moisture content of the structure or by the use of a drilled sample. Rothounds will not indicate the remains of dead dry rot infestations

In areas indicated by Rothounds the significant timber structures should be checked for structural decay or high moisture levels. Even if these are not found steps should be taken to reduce moisture levels and increase ventilation. This may be all that is required to stop a developing problem and all that is then required is to check the area in 6 months. For this purpose Hutton + Rostron again favour the Rothounds

3.1 Capabilities

- a May detect living dry rot (*Serpula lacrymans*) by the scent of the metabolites produced by the fungus
- b May detect the scent of dry rot even when hidden behind panelling, under floors, behind plaster or in other concealed cavities
- c May detect the scent of dry rot at a distance of several metres depending on scenting conditions
- d May detect early dry rot growth before it is detectable by the unaided human eye
- e May discriminate between living or dead dry rot and between dry rot and other fungi instantly
- f Actively search for dry rot in buildings at high speed, covering 20 to 50 rooms in an hour g May indicate extent and spread of dry rot infestation
- g Will search small inaccessible areas and roof spaces i Will work in furnished and inhabited buildings
- h Totally non-destructive
- i Will work 2-4 hours per day

3.2 Limitations

- a Trained only to indicate living dry rot, not wet rot or dead dry rot. Will not indicate fruiting bodies on old dead outbreaks of dry rot
- b Indicate the scent of dry rot and the point of maximum scent. This may need interpretation as scent can occasionally be moved by air currents from the point of origin
- c Scent will not travel through impermeable surfaces such as neoprene. However, it may be detected at the edge of an impermeable barrier, e.g. around the edge of a room with a rubber-backed carpet covering an infected floor
- d Indicate dry rot infection, not decay. Therefore heavily decayed but inactive outbreaks may give a weaker indication than a recent highly active outbreak that has not yet caused significant decay

- e Maynot work if there is a corrosive or choking dust or vapour. However, Rothounds should not be put off by smells and may detect even small amounts of dry rot in the presence of other strong scents

3.3 Uses

- a Survey of properties prior to purchase, renovation, change of occupancy etc, to quickly check for hidden problems
- b Preliminary survey of properties with suspected decay problems to determine existence and extent of dry rot infestation
- c Survey of properties with known dry rot problems to determine activity and extent of infestation
- d Survey of properties undergoing remedial works to check for additional hidden areas of infestation
- e Survey of properties after remedial works to check for efficiency of treatment
- f Routine survey of properties with past problems thought to be at risk in order to detect recurrence of infestation at an early stage before significant decay can occur
- g Periodic survey of properties with known problems awaiting renovation, to detect 'hot spots' of dry rot activity

These can then be dealt with by 'reactive maintenance' allowing outbreaks to be controlled by minor exposure works and environmental controls. This avoids expensive building or remedial works. Further decay is prevented and infection controlled with significant savings on eventual renovation

4 FIBRE-OPTIC BORESCOPE EXAMINATION

A technique we have found routinely useful over the last 15 years is the use of fibre optics. We use long reach, fixed side view, rigid borescopes and high-power light sources. Although this is comparatively expensive it is essential for getting a clear view across a cavity such as a floor space. It also minimises the time spent and the number of holes drilled. Fibre optic inspection can reveal extensive decay and the consequences of water penetration. However, most wood-destroying fungi will not live on the face of timber which is exposed to air movement because this produces a drying effect. It is always a possibility that a fungus, especially dry rot, is travelling behind a wall plate, for example, and is not detectable from the cavity. Fibre optic inspection may not, therefore, find a minor attack which is developing, but it should indicate where these might be initiated so that faults can be identified and remedied. The siting of inspection holes depends on the points at risk within the room and will usually be located adjacent to balcony floors, flat roofs, cracks in rendering and other points where faults may have resulted in water penetration. Inspection may also be limited in areas of tiled and glued flooring materials and ornate or special wall coverings. Inspection holes are numbered and capped off for future use

5 THE MEASUREMENT AND SIGNIFICANCE OF MOISTURE CONTENT

The moisture contents in timber, mortar and plaster are measured by a variety of methods. Timber moisture content might be ascertained by the use of a standard resistance-type moisture probe which measures the moisture content at the surface of the wood.

However, this moisture content will be subject to considerable fluctuation, depending on current relative humidity and temperature. A rafter in a roof in summer may, for example, have a moisture content at the surface of 16 per cent which might rise to over 20 per cent in winter. This difference would not necessarily reflect increased water content resulting from a fault in the roof, but might simply be a redeposition of water resulting from a considerable drop in temperature

The condition in the core or subsurface of a timber will remain relatively stable which is why the centre of thick timbers may be preferentially decayed. It is this 'deep' moisture content which must be measured if results are to be meaningful. For this reason, a hammer probe with insulated electrodes or deep moisture probe is used to measure the moisture content within the timber. Healthy roof timbers should maintain a stable core moisture content of between about 12 per cent and 16 per cent, whilst suspended floor timbers (excluding ground floors) should be between about 11 per cent and 14 per cent. Central heating will usually reduce this figure to around 9 per cent

Similarly, surface moisture content readings in plaster and mortar are of limited value except for purposes of comparison. A surface capacitance meter may be used on plastered walls. For further investigation absolute measurements of moisture content may be made on site by means of a carbide-type gas pressure meter

Alternatively, samples are taken back to the laboratory in sealed vials, and the moisture contents are measured by the oven and balance method. For this, mortar samples are obtained by drilling holes in the wall and dust from the first inch of each hole is discarded. Dry mortar and plaster should have moisture contents below about 2 per cent. At levels much above this the moisture content of incorporated timbers will exceed 20 per cent and may easily reach levels at which fungal decay is likely

6 OTHER TECHNIQUES

Other techniques that may be used include microscopy, laboratory culture, hot wire anemometry and electronic RH measurement. We have also developed special instruments for measuring 'available' water in materials and for ultrasonic detection of timber-boring insects. More exotic techniques may sometimes be useful such as pheromone insect traps, infra-red thermography, shortwave radar, automatic weather stations and total building monitoring using specialist data loggers

Appendix C

REMEDIAL BUILDING WORKS AND ENVIRONMENTAL CONTROL

The most critical factors for the environmental control of decay organisms are available moisture and temperature. The former is dependent on such factors as moisture content, relative humidity, micro-ventilation, and salt content. In simplistic terms it is necessary to correct building defects leading to high moisture contents in timber and to increase ventilation around timber at risk

In practice there are two problems; first it is necessary to identify the significant building defects and then the best techniques must be chosen to control the environment at each point. This may be achieved by analysing the building in terms of moisture sources, moisture reservoirs and moisture sinks

It is not possible to prevent moisture entering a building entirely and often attempts to block the movement of moisture through a building structure using impermeable materials are ineffective. They may also be counter-productive as they can prevent moisture being dissipated, resulting in high moisture levels and decay in adjacent materials. The more effective and robust approach is that used in traditional buildings. Here, porous materials are preferred, and every moisture source is balanced by a moisture sink. Thus ground water may penetrate masonry but is evaporated off before it reaches timber structures. Similarly, water vapour is introduced by occupation, but is ventilated out via windows, chimneys and other passive and active forms of ventilation. Failure to balance a moisture source with an appropriate sink may result in moisture moving into vulnerable materials and eventually causing decay and other problems

Moisture reservoirs occur when a moisture 'source' has not been balanced by a 'sink' and water has accumulated in a porous material. Typical examples of this are to be found when thick masonry walls have been soaked by persistent leaks or when chimney breasts have been filled with rain water from uncapped chimneys. Such reservoirs may take years to dry out, even when the source has been dealt with. As a result, they can act as a source of moisture for recurrent timber decay over a long period. A special case of this phenomenon occurs when large quantities of water have been used in fighting a fire

In practice then, each area of decay is associated with a building defect, resulting in an increased moisture source, a blocked or inappropriate moisture sink or a moisture reservoir. The appropriate building measures should then be specified to correct that defect

A common example might be the bridging of a damp proof course by raised ground levels. This will act as a moisture source and may result in decay of timbers in an adjacent floor space. Reducing the ground level will cut off this source and will also provide a sink of moisture by allowing evaporation from the exposed wall. The sub-floor moisture level might also be controlled by increasing the other available moisture sinks. Cleaning pre-existing airbricks or inserting additional sub-floor ventilation would be a common measure. In general, it is important to increase evaporative surfaces and avoid obstructing them during refurbishment

Another common example would be a blocked and overflowing parapet gutter acting as a moisture source. This could wet up gutter soles, joist ends and wall plates as well as any other structure in an expanding cone extending from the leak down through the building. Preventing this moisture source may require a number of measures such as increasing the capacity of down pipes, re-lining the gutters and fitting thermostatically controlled trace heating tape to increase free flow of snow melt water

Any failure in a roof finish, gutter or coping will generally result in significant water penetration into the masonry wall beneath, which will then act as a moisture reservoir. Any timber in contact with this reservoir will be at risk of decay as it will tend to 'wick' moisture from the masonry. Steps must therefore be taken to isolate in-contact timber from the masonry using such measures as DPC membranes or joist hangers producing an air gap. It will also be necessary to ensure the timbers are adequately ventilated so that any moisture that is absorbed can be breathed off. Closed cavities or water-impermeable layers over timbers at risk must therefore be carefully searched out and rectified using knowledge of historic methods of construction. Bricked-in lintels and sealed up emulsion-painted sash windows are typical examples of structures at risk in this way

Having cut off the moisture source to a moisture reservoir and protected the 'at-risk' timbers it is next necessary to provide safe 'sinks' for the moisture. This will ensure that the reservoir is dried out in the long term. In some cases, the reservoir can be removed entirely, for example damp pugging can be dug out and replaced. In most cases it is a matter of promoting ventilation around a wicking surface on the reservoir and ensuring that the moisture-laden air can be vented to the outside. Dry lining systems can be useful for this purpose as can the good old-fashioned chimney. Raising the temperature will promote the process of wicking and evaporation. General house heating can help but care must be taken to ensure that water vapour is not being 'pulsed' into other parts of the building by a sequence of evaporation and condensation down a temperature gradient. Heating can be especially useful if it is possible to heat the reservoir material itself. We have devised special systems for heating large section timbers and masonry for this purpose but again the old-fashioned fire-place and chimney is very useful

In some cases, dehumidifiers can be used in the short to medium term, but care must be taken. They often require special 'tenting' and monitoring so that moisture is removed from the appropriate material and not from the world at large. They also require high air temperatures and high RH's to extract moisture efficiently

In all cases most of the remedial building works that may be required are quite within the capacity of the general contractor. Most are traditional repairs though some may take advantage of new materials or techniques such as dry lining, joist hangers and tanking. New and potentially useful products are coming into the building market all the time, for example, time controlled automatic fans, hollow ventilating plastic skirting boards, plastic masonry drains, roof space ventilating systems and moisture permeable paints. All such products and techniques can be used to help in making the environmental control of timber decay even more efficient and economical. All that is required is careful analysis of each situation and a little scientific understanding

Appendix D

MAINTENANCE AND MONITORING

The investigation and building works described in the previous appendices should put a building back into a state of structural and environmental health. The environmental control approach will also mean that a building is less likely to develop problems in the future. This is because the effect of minor building failures should be 'buffered' by the robustness of the systems established. Fortunately, most traditional systems are robust in this way. This is why older buildings may tolerate a considerable amount of neglect and abuse before developing severe problems. However, the long-term health of the building will always depend on adequate maintenance. This is no less true of buildings treated with timber preservatives

A detailed investigation carried out as part of an environmental control policy provides an excellent basis on which to plan the most cost-effective maintenance program. Indeed, the building works required for environmental control are often best integrated into such a program. Short-term 'emergency' measures can be taken to simply halt further decay and measures to replace damaged structures or prevent future problems can be delayed to fit into a longer term plan of works. This flexibility in scheduling work as a result of the environmental approach allows further saving of costs and inconvenience

A maintenance program must also include provision for the routine inspection of all significant parts of the building at appropriate intervals. This should aim to detect and correct problems developing before they cause significant damage. Again the information gained in the investigation can be used to decide on the most cost effective inspection interval

In many cases remote monitoring systems can be very useful in increasing the efficiency and reducing the cost of maintenance programs. They can be especially useful for checking the moisture content of inaccessible timbers in roof spaces, behind decorative finishes and in walls. H+R have developed the Curator building monitoring systems for this proposal

Sensors can be placed at all critical points after the investigation or after the remedial building works. Areas can then be closed up and finishes re-applied, for example sensors may be placed in lintels, joist ends, valley gutter soles or in damp walls to monitor drying. It is important to use enough sensors and to place them with an understanding of the moisture distribution processes because conditions can vary even in a small area. It is these local variations in conditions that produce the environmental niches which decay organisms exploit

If more than 30 sensors are deployed, taking the readings can become onerous and this may result in human error or negligence. In these situations automatic monitoring systems become desirable. H+R have developed a number of specialised 'Curator' data logging systems to do this. With larger systems, the wiring of sensors can also become a problem. For systems requiring 100 or more sensors we can use a 'Curator A' unit working via a single 4-core main cable connecting up any number of nodes, each supporting 4 sensors. This system can be programmed with logging intervals and alarm limits for each sensor and can be read via the telephone system via its own modem. Data from the system can then be analysed using CAD and programs for statistical interpretation on a remote computer

Appendix E



Fig 1:

North-west elevation; showing the windows and doors to the front elevation. Window references can be found on the Drawings

Close-up external tactile assessment of the windows was not possible at 2nd and 1st floor level

Note the original rainwater downpipe location (arrowed). Adjacent 2nd and 1st floor windows would have been at a heightened risk of decay



Fig 2:

North-west elevation; showing evidence of historical water penetration in the location of the uPVC downpipe. W2.06 and W1.06 are at a heightened risk of decay



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Fig 3:

North-west elevation; showing W0.01 and W0.02. The stone sills generally had a good fall but there were some areas of pooling water evident by moss growth. However, no significant timber decay was detected in the frames



Fig 4:

North-west elevation, W0.02; showing exposure of the bottom beneath the numerous layers of paint. No significant timber decay was detected



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Fig 5:

North-west elevation, W0.02; showing build-up of green decorative finishes. Note the orange undercoat/primer



Fig 6:

North-west elevation, W0.02; showing build-up of green decorative finishes. Note that there was also a 'baby blue' finish



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Fig 7:

North-west elevation, W0.02; showing missing mortar/mastic sealant at the reveal. No timber decay was detected in the frame where accessible behind the brickwork



Fig 8:

North-west elevation, D.04; showing the tongue and groove softwood loading doors



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Fig 9:

North-west elevation, D.04; showing hinge for the cast-iron winch bracket. The small pocket was filled with debris. The door frame was damp and superficially decayed in this location. Decay was not significant

All debris was removed by H+R



Fig 10:

North-west elevation, D.04; showing the accumulation of debris that was removed from the cast-iron hinge pocket



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Fig 11:

North-west elevation, D.04; showing superficial decay in the base of the door frame. No major decay was detected



Fig 12:

North-west elevation, D.04; showing mechanical damage to the softwood threshold caused by foot traffic and wear. Moss growth was present where water was able to pool in the depression in the threshold



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Fig 13:

North-west elevation, D.04; showing partial decay in the lower 300mm of the door frame. Decay was caused by wet rot and common furniture beetle



Fig 14:

North-west elevation, D.04; showing partial decay in the threshold where embedded in the brickwork.



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Fig 15:

North-west elevation, D.04; showing wear in the threshold. The depth of the timber had reduced by approximately 1/3rd



Fig 16:

North-west elevation, D.04; showing a view of the underside of the threshold. There was degradation to the timber caused by chemical attack. However, damage was only superficial



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Fig 17:

North-west elevation, D.05; showing the tongue and groove softwood entrance door



Fig 18:

North-west elevation, D.05; showing partial decay in the lower 150mm of the door frame. Note the decayed void had been infilled with mortar



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Fig 19:

North-west elevation, D.03; showing metal security doors to the lower ground floor

The original softwood tongue and groove double doors had been removed following mechanical damage. The doors can be found in the lower ground floor



Fig 20:

North-west elevation, D.03; showing a split through the lower 1m of door frame. The base of the frame was also decayed by wet rot and wood-boring weevil



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Fig 21:

North-west elevation, D.03; showing partial decay in the lower 600mm of door frame

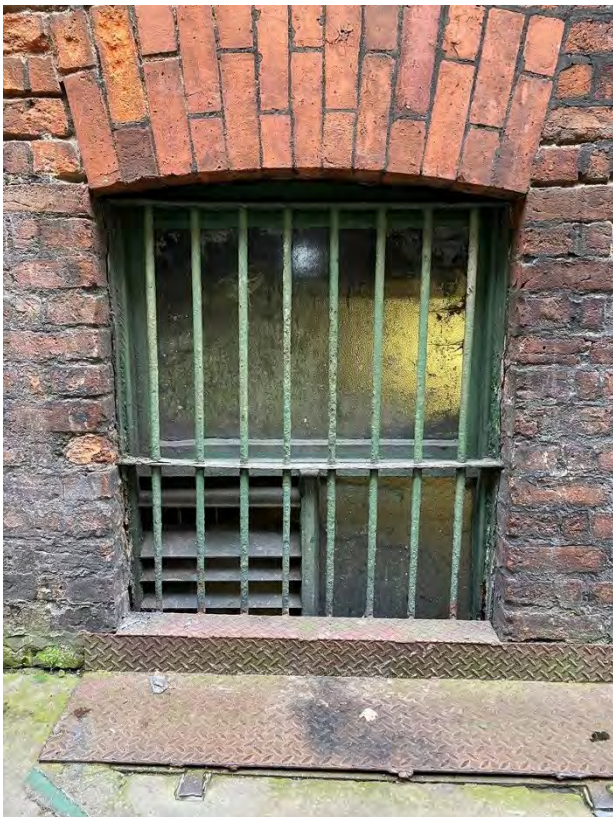


Fig 22:

North-west elevation, WB.01; showing window which extended below footpath level. The lower portions of the windows were decayed by wet rot and wood-boring weevil



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Fig 23:

North-west elevation, WB.01; showing decay in the frame extending 300mm above footpath level



Fig 24:

North-west elevation, WB.02 and WB.03; showing only the upper hopper lights remaining. The lower 2/3rd of the window openings have been infilled with brickwork. No major timber decay was detected in the hopper frame



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Fig 25:

South-east elevation; showing windows at 1st floor level which were inaccessible for external tactile assessment. There was no evidence of major decay. However, the bottom rails were particularly vulnerable to decay in areas of pooling water/moss growth



Fig 26:

South-east elevation, W1.07; showing biological growth to the masonry where the neighbouring eaves gutter was leaking onto the brickwork. This window and the windows directly beneath were vulnerable to damp and decay



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Fig 27:

South-east elevation, W1.09; showing saturation of the masonry beneath the leaking eaves gutter. The transom window was damp and vulnerable to decay. However, no major decay was detected where accessible



Fig 28:

South-east elevation, D.02; showing saturation of the masonry beneath the leaking eaves gutter. The door frame was damp and vulnerable to decay. However, no major decay was detected where accessible



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Fig 29:

South-east elevation, D.02; showing a close-up of the damp and superficially decayed doorframe

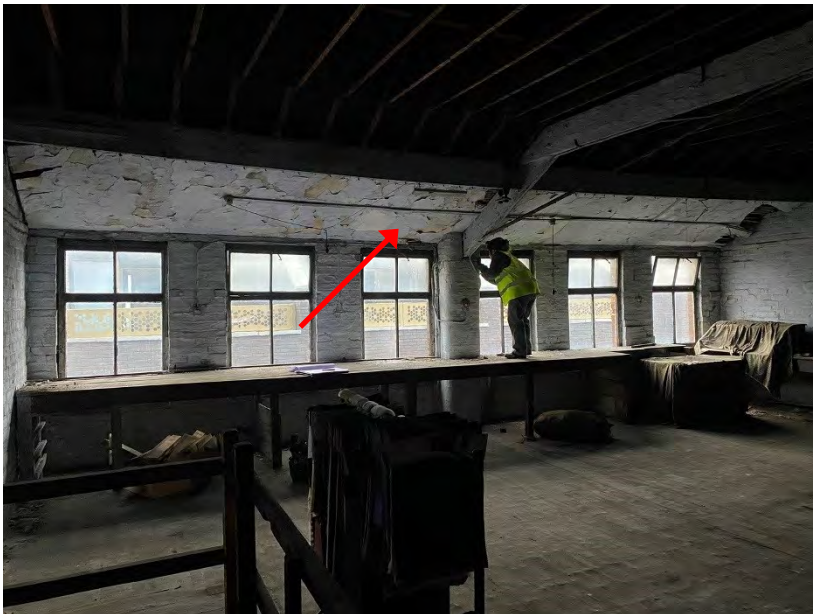


Fig 30:

Second floor; showing inspection of the softwood hopper windows to the front elevation

Note the lath and plaster applied to the underside of the common rafters (arrowed)



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Fig 31:

Second floor; showing an example of cracked and loose plaster



Fig 32:

Second floor; showing a removed piece of lime plaster with hair



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Fig 33:

Second floor, W2.05; showing softwood hopper window with metal quadrant stay. The majority of hoppers were inoperable



Fig 34:

Second floor, W2.05; showing 'ripples/waves' in the glass typical in old 19th century windows



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Fig 35:

Second floor; showing typical example of the widespread cracking in the plaster



Fig 36:

Second floor, W2.01; showing biological growth to the bottom rail of the window. The exteriors of the window are vulnerable to decay. However, no major was detected in the frame internally



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Fig 37:

Second floor; showing loose plaster and damaged laths



Fig 38:

Second floor; showing lath and plaster applied to the underside of the common rafters. Note the new rafters applied over former skylight openings



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Fig 39:

Second floor; showing widespread cracking through the plaster



Fig 40:

Second floor; showing missing plaster and historical decay in the laths



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Fig 41:

Second floor; showing riven laths. A proportion of the laths were partially decayed by historical damp and timber decay



Fig 42:

Second floor; showing cracking through the plaster over the toilet



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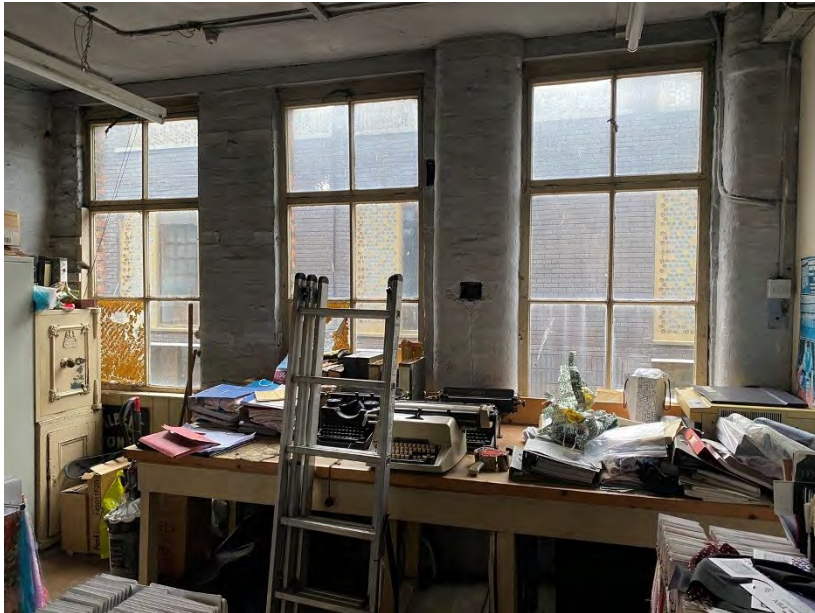


Fig 43:

First floor; showing softwood hopper windows to the front elevation. No major damp or decay was detected where accessible



Fig 44:

First floor; showing minor cracking in the ceiling. Tactile assessment suggested there was no risk of imminent failure



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Fig 45:

First floor; showing softwood hopper windows to the front elevation. No major damp or decay was detected where accessible



Fig 46:

First floor, W1.01; showing an operable hopper window with intact metal quadrant stay



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Fig 47:

First floor, W1.01; showing superficial decay in the bottom rail of the window caused by condensation. No major decay was detected where accessible internally



Fig 48:

First floor, Office; showing inspection of the void above the modern suspended ceiling



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Fig 49:

First floor, Office; showing modern gridwork suspended ceiling hung from wires. Wires appeared to be fixed to the floor joists. There was no obvious major cracking in the lath and plaster



Fig 50:

First floor, Office; showing ceiling/floor hatch



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Fig 51:

First floor; showing minor cracking in the ceiling. There was no risk of imminent failure on this location



Fig 52:

First floor; showing isolated area of missing plaster. The remaining plaster had a good bond to the laths



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Fig 53:

First floor; showing area subject to water penetration to the rear elevation



Fig 54:

First floor; showing damp and partially decayed lath and plaster ceiling over W1.09. The window was damp but no significant decay was detected



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Fig 55:

First floor; showing minor cracking in the ceiling. There was no risk of imminent failure on this location. There appeared to have been a historical leak in this location



Fig 56:

First floor, Toilet; showing inspection of the void above the modern suspended ceiling



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Fig 57:

First floor, Toilet; showing a view of the lath and plaster ceiling above. There was no obvious cracking in the plaster



Fig 58:

Upper ground floor; showing D.045 and D.05. There was no significant damp or timber decay in the doors. However, doors had suffered localised surface damage from historical use



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Fig 59:

Upper ground floor, W0.01-W0.03; showing a general view of the softwood hopper windows. No major decay was detected internally or externally



Fig 60:

Upper ground floor; showing impact damage to the plaster surrounding the floor/ceiling hatch



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Fig 61:

Upper ground floor; showing large crack and area of loose plaster directly beneath the Office



Fig 62:

Upper ground floor; showing large crack and area of loose plaster directly beneath the Office. Plaster was vulnerable to detachment in this area



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Fig 63:

Upper ground floor; showing cracking through lath and plaster ceiling above fireplace



Fig 64:

Upper ground floor; showing area subject to water penetration. Windows were inaccessible for tactile assessment but they were vulnerable to damp and decay in this location



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Fig 65:

Upper ground floor; showing damp and partially decayed ceiling laths. Decay in the laths was caused by wet rot fungi



Fig 66:

Upper ground floor; showing a view inside the floor/ceiling void. This area of ceiling was vulnerable to detachment due to the additional weight of the water



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Fig 67:

Lower ground floor, WB.01; showing altered window which included a louvered window and chicken-wire glass. This glass may date from the late 19th century



Fig 68:

Lower ground floor, WB.02; showing an operable hopper window. No significant decay was detected in this window. However, the lower portions of the window have been removed and the opening bricked-up



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Fig 69:

Lower ground floor; showing windows to the rear elevation. The base of all window frames were damp and partially decayed by wet rot



Fig 70:

Lower ground floor, WB.07; showing an example of decay in the base of the frame



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Fig 71:

Lower ground floor, WB.08; showing decay in the bottom rail

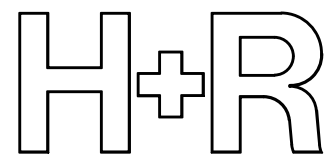


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Appendix F

Earlier location of downpipe. Adjacent windows at a heightened risk of historical timber decay

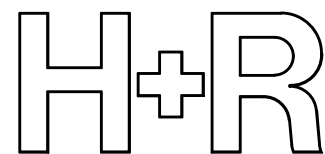
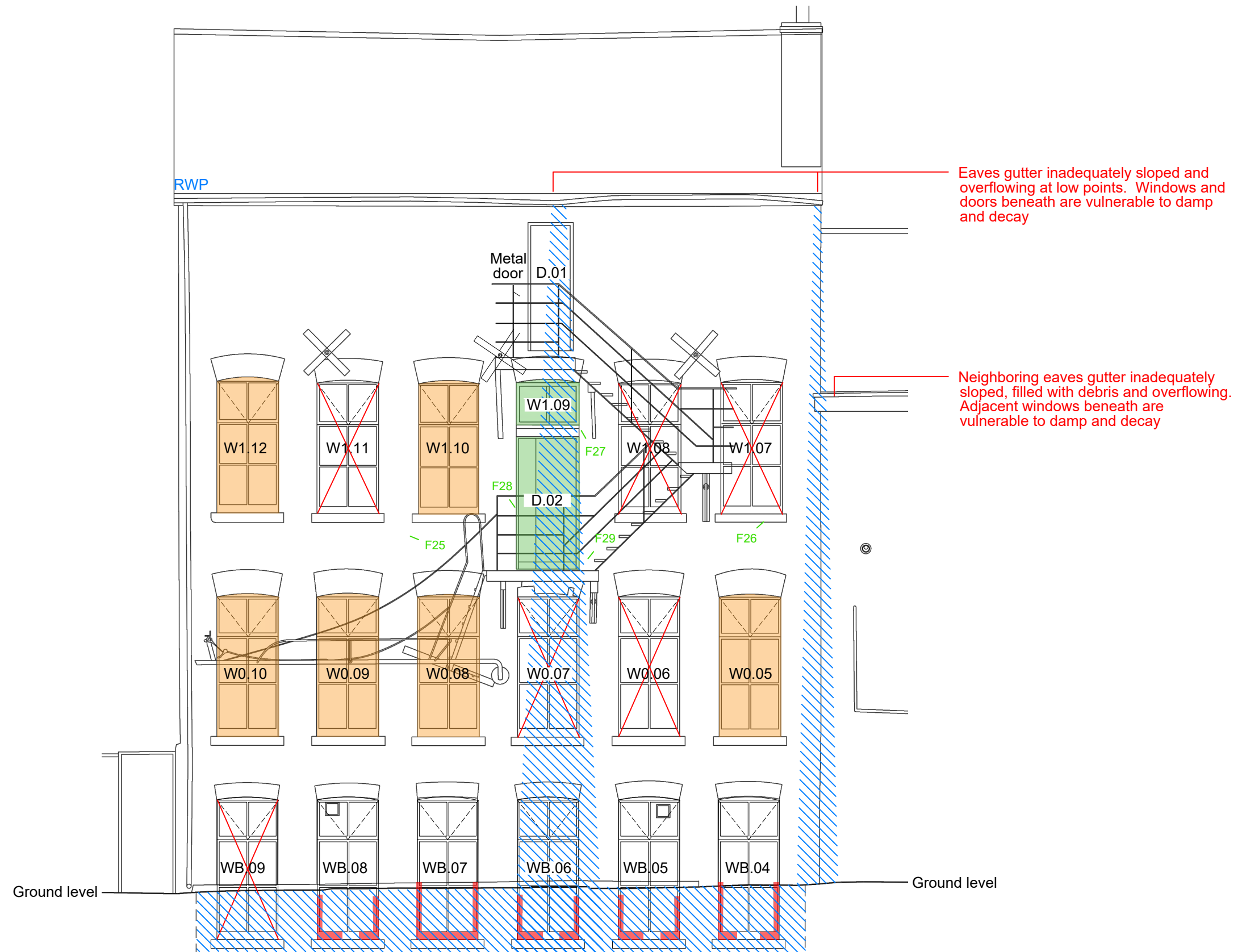
Location of current downpipe. Adjacent windows at a heightened risk of historical timber decay



51-53 Richmond Street, Manchester - Front (North-west) elevation
WINDOW AND CEILING PLASTER CONDITION SURVEY
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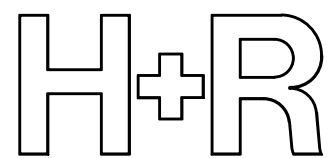
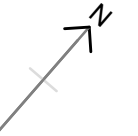
Key:	W0.01	Window/Door reference		Internal and external inspection - No significant decay detected
		Hopper window		Internal inspection only - No significant decay detected
		F1-24		
		Area subject to water penetration		
		Area subject to timber decay		
		Inaccessible for internal inspection		
		Rainwater downpipe		



51-53 Richmond Street, Manchester - Rear (South-east) elevation
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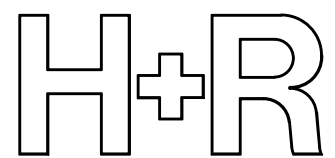
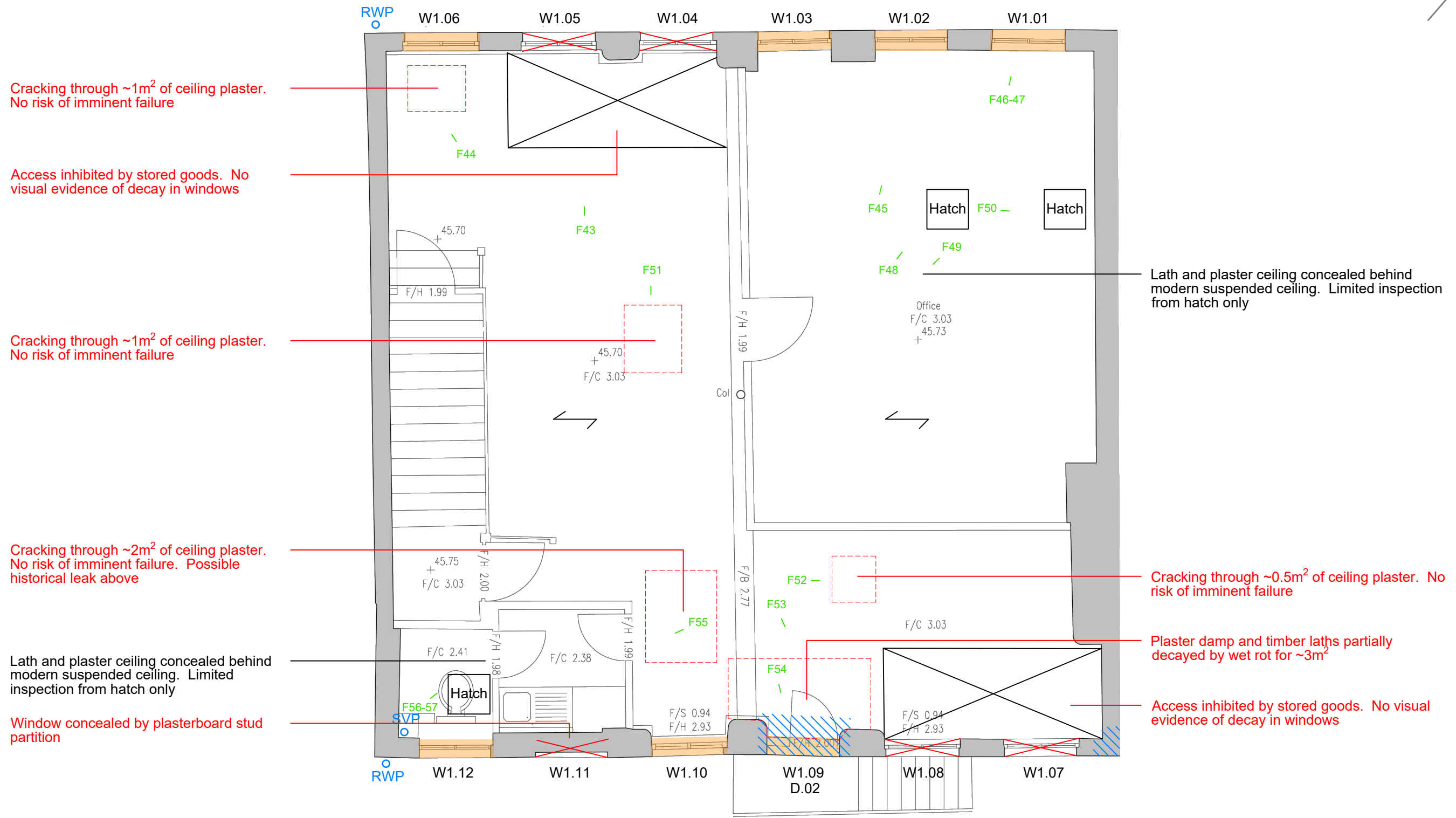
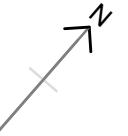
Key:	W0.01	Window/Door reference		Internal and external inspection - No significant decay detected
		Hopper window		Internal inspection only - No significant decay detected
		Photograph location		
		Area subject to water penetration		
		Area subject to timber decay		
		Inaccessible for internal inspection		
		Rainwater downpipe		



51-53 Richmond Street, Manchester - Second Floor/ Attic
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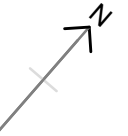
Key:	W0.01	Window/Door reference		Internal and external inspection - No significant decay detected
	— F30-42	Photograph location		Internal inspection only - No significant decay detected
		Area subject to water penetration		
	RWP	Rainwater downpipe		
	SVP	Soil vent pipe		
		Area of defective lath and plaster		



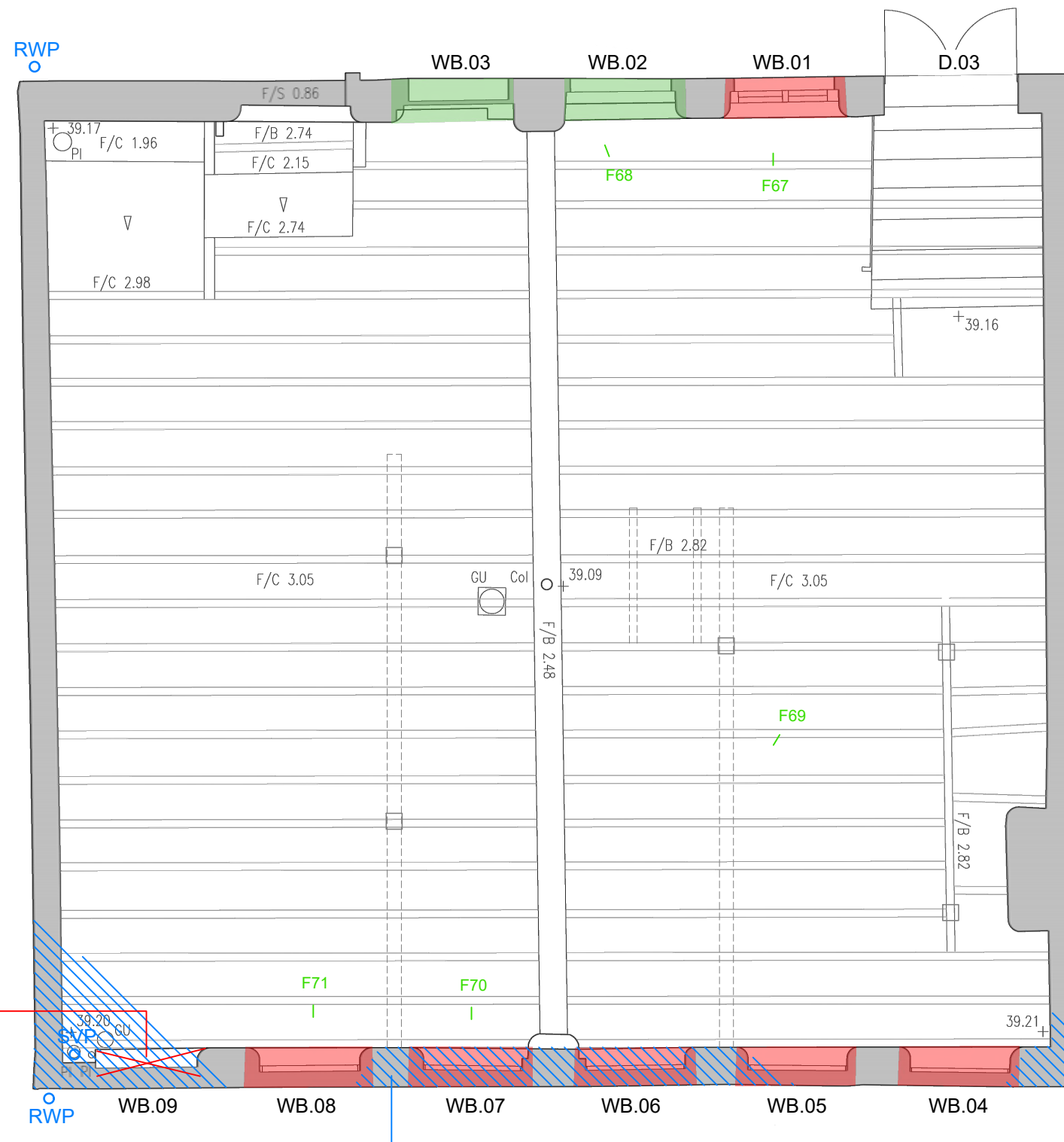
51-53 Richmond Street, Manchester - First Floor
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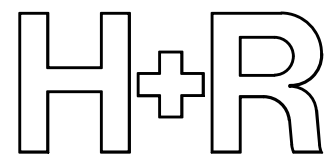
Key:	W0.01	Window/Door reference		Internal and external inspection - No significant decay detected
	— F43-57	Photograph location		Internal inspection only - No significant decay detected
		Area subject to water penetration		
	RWP	Rainwater downpipe		
	SVP	Soil vent pipe		
		Inaccessible for internal inspection		
		Area of defective lath and plaster		



Window opening boarded-up internally



Note: No ceiling at this level



51-53 Richmond Street, Manchester - Lower Ground Floor
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Key:

W0.01	Window/Door reference
— F67-71	Photograph location
///	Area subject to water penetration
RWP	Rainwater downpipe
SVP	Soil vent pipe
—	Area subject to timber decay
X	Inaccessible for internal inspection

	Internal and external inspection - No significant decay detected
	Internal inspection only - No significant decay detected