

Hutton + Rostron Environmental Investigations Limited

Southleigh Park, Mansion House: Masonry damp and damp-proof course investigation

Site note A6 for 18 January 2021, job No. 152.09

CONTENTS

- 1 Introduction
- 2 Staff on site and contacts
- 3 Observations
- 4 Recommendations
- 5 H+R work on site
- 6 Proposed action by H+R
- 7 Information required by H+R
- 8 Administrative requirements

Attachments

- A Photographs
- B Plans
- C Schedule of observations
- D Masonry analysis results table

Distribution:

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1 INTRODUCTION

1.1 AUTHORITY AND REFERENCES

Hutton + Rostron Environmental Investigations Limited carried out a site visit to Southleigh Park on 18 January 2021 in accordance with instructions from Steve Coull of FSL Group by email, on 10 November 2020 at 13:09. Drawings provided by the client were used for the identification of structures. For the purpose of orientation in this report, the principal elevation was taken as facing south

1.2 AIM

The aim of this survey was to investigate the extent and distribution of residual moisture in load bearing masonry structures and to assess the condition and effectiveness of any existing provision for horizontal damp-proofing, to resist water penetration from below ground

1.3 LIMITATIONS

This survey was confined to the accessible structures. Concealed cavities and 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 any 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 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

2 STAFF ON SITE AND CONTACTS

2.1 H+R STAFF ON SITE

Michael Almond
Clive Stonehill

2.2 PERSONNEL CONTACTED

Site security

3 OBSERVATIONS

3.1 ROOF DRAINAGE

PVC eaves gutters and downpipes were generally in fair condition on the north, east and west sides. The majority of the roof drainage on the south side appeared to be internal, serving parapet gutters. Isolated sections of guttering and downpipes show evidence of intermittent blockage and overflow allowing roof drainage water to pass over structures beneath. These are described in detail at Attachment C

3.2 EXTERNAL GROUND LEVELS AND DRAINAGE

Limited provision had been made for ground and surface drainage, generally associated with tarmacadam hardstanding on the north side. Fall of ground was generally from north/south directing ground and surface water towards the base of the structure across the full width of the north elevation. Hardstanding had been level with internal floor structures in a number of locations to create level access thresholds at ground floor door openings. These were likely to increase the risk of water draining into structures locally, especially where water was able to pond or there was exposure to rain driven by prevailing winds from the south or west. In some locations, hardstanding and compacted soil in contact with the façade had allowed water draining from the roof eaves, where the provision for roof drainage had been compromised, to splash back onto the façade, increasing the risk of damp penetration to the interior. These defects are described in detail at Attachment C

3.3 DAMP-PROOF COURSES

No physical damp-proof courses from original construction were identified on visual non-destructive inspection of external elevations. Injected remedial dpcs had been installed in isolated locations and some vertical damp-proof courses, typically from slate embedded in mortar were noted at the bases of rainwater downpipes. These are described in detail at Attachment C

3.4 RESIDUAL MOISTURE IN MASONRY STRUCTURES

3.4.1 Sampling

A total of 110 No. samples were extracted from representative load bearing structures around the ground floor external walls and at the bases of internal masonry walls, piers and columns. Samples were double bagged on site and returned to H+R's laboratory for gravimetric analysis of available and hygroscopic moisture content. Results are shown on plans at Appendix B and in a table at Appendix D

3.4.2 Results

9 No. samples were classified as moist, with available moisture contents of between 2% and 5%. These samples were from structures that were either heavily exposed to wind driven rain or were likely to have been vulnerable to condensation since the building had become vacant. An isolate wet sample (5-8% available moisture) was obtained from the base on an internal WC wall and was likely to have resulted from a plumbing leak or persistent splashing of water onto floor surfaces. This sample was also hygroscopic indicating chemical contamination. Only 5 other samples had hygroscopic moisture contents above 2%, indicating minimal presence of soluble salts in masonry mortar or plaster. 100No. samples, approximately 91% of the total extracted, were classified as dry, with available moisture contents below 2%

3.4.3 Commentary

The results confirmed that the masonry structures of both the original house and west wing have a very low vulnerability to penetrating damp from below ground. Effective maintenance of roof, ground and surface drainage, repairs to plumbing and heating and ventilation of the buildings appropriate for normal occupancy are likely to further reduce the residual moisture contents of masonry structures over time. See recommendations at 4.3 below. H+R can provide further advice on remedial damp-proof detailing and protection of vulnerable materials from problems of damp and intermittent condensation when required

4 RECOMMENDATIONS

4.1 ROOF DRAINAGE

No urgent remedial works are required but the provision for roof drainage should be subject to an effective programme of routine inspection, cleaning and repair, to ensure that water draining from roof surfaces is discharged clear of the structure at all times pending, during and after refurbishment. The capacity of the roof drainage system should be checked by undertaking calculations based on up-to-date meteorological data, making allowance for predicted increase in the frequency and intensity of future rainfall patterns. Consideration should be given to installing an automated blockage and leak detection system in locations that are difficult to access for routine maintenance

4.2 EXTERNAL GROUND LEVELS AND DRAINAGE

Allowance should be made for a reduction in external ground levels around the base of the structure where these rise to within 200mm of internal floor levels. Surface drainage provision on the north side should be reviewed and enhanced, generally to intercept ground and surface water draining towards the building from the north and direct it clear of the foundations and bases of external walls. Below ground drainage pipework should be inspected in detail using CCTV equipment as required and maintained free of obstruction pending, during and after refurbishment. Additional drainage capacity may be required to meet modern standards and to accommodate any increases in roof drainage capacity after refurbishment

4.3 DAMP-PROOF COURSES

No chemical injected or other remedial damp-proof courses are required or recommended. The application of cementitious internal wall renders or 'waterproof tanking' is strongly discouraged and may be detrimental to the fabric of the building. Where reduction of external ground levels, as described above, is impractical or undesirable allowance should be made for detailing the bases of all earth retaining walls with drained cavity waterproofing, or ventilated dry linings based on studded plastic vertical separating membranes, to fully isolate timber, hygroscopic materials and vulnerable finishes from damp or potentially damp masonry structures. Reference should be made to the recommendations included in BS 8102:2009. H+R can provide additional advice on remedial detailing when required

5 H+R WORK ON SITE

- 5.1** H+R inspected the structure for defects liable to allow water penetration before and after refurbishment
- 5.2** H+R took samples from representative masonry masses, so as to determine their gravimetric and hygroscopic moisture content

6 PROPOSED ACTION BY H+R

- 6.1** H+R will advise on remedial detailing, so as to minimise the risk of damp and decay problems after refurbishment if instructed
- 6.2** H+R will advise on conservation of original fabric with regard to damp, decay and salt damage, as necessary and if instructed
- 6.3** H+R will review proposed remedial details as these become available if instructed
- 6.4** H+R will return to site to inspect sample remedial details if instructed
- 6.5** H+R will liaise with conservation and historic building authorities, if instructed, so as to ensure the cost-effective conservation of original fabric
- 6.6** H+R will liaise with building guarantors, as necessary, so as to ensure the issuing of collateral warranties and building guarantees at practical completion, if required

7 INFORMATION REQUIRED BY H+R

- 7.1** H+R require up-to-date copies of project programmes, as these become available
- 7.2** H+R require copies of up-to-date lists of project personnel and contact lists as these become available
- 7.3** H+R require copies of proposed remedial details for comment as these become available
- 7.4** H+R should be informed as a matter of urgency if further significant water penetration occurs onto site; so that advice can be given on cost-effective remedial measures, to minimise the risk of cost or programme overruns and so as to minimise the risk of damp or decay problems during the latent defect period

8 ADMINISTRATION REQUIREMENTS

- 8.1** H+R require formal instructions for further investigations and consultancy on this project
- 8.2** H+R require confirmation of distribution of digital and printed copies of reports and site notes

Attachment A



Fig 1:

3.1.1, east side; showing biological growth and staining to render below a cover flashing installed on recent refurbishment



Fig 2:

3.1.1, central section; showing 'dog leg' in gutter which increased the risk of blockage and overflow locally



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 3:

1.1.1, west side; showing residual flashing chased into masonry indicating the presence of lean-to structure, subsequently demolished



Fig 4:

1.1.1, east side; showing water splashing back onto elevation render from hardstanding, increasing the risk of water penetration into the structure and interior



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Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 5:

1.1.1, east end; showing external ground levels approximately 300mm above finished floor level on the interior, relative to the door threshold



Fig 6:

1.1.2, west side; showing residual hardstanding forming a level threshold to the entrance doors in the east-facing return wall. Note biological growth at the base of the north façade, consistent with water splashing back onto the structure following failure of the eaves gutter



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C

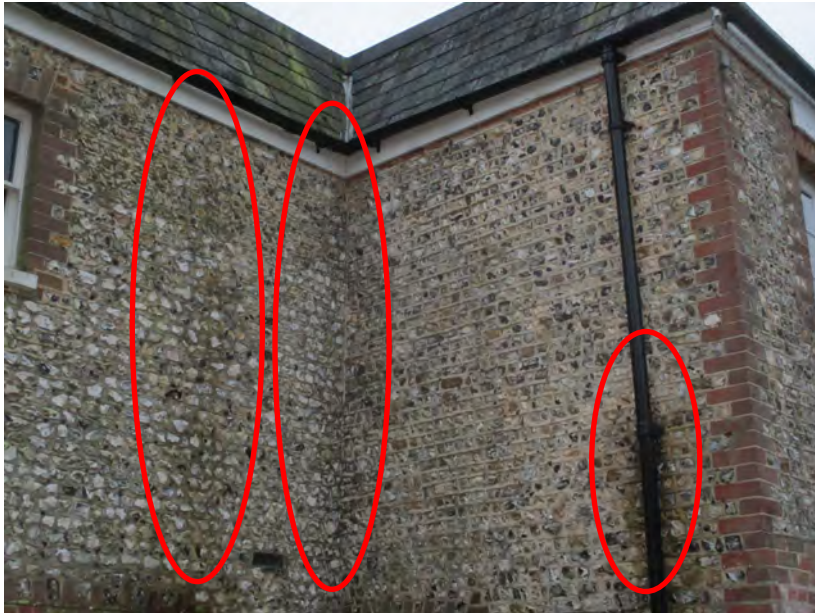


Fig 7:

1.1.2, west side; showing 3 no. areas of staining to façade masonry, consistent with localised failure of the provision for roof drainage



Fig 8:

1.1.2, central section; showing general fall of ground from north to south, draining surface and ground water into the footings of the north elevation



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 9:

3.1.2, east side; showing redundant surface drainage gulley significantly above grade, where hardstanding locally was assumed to have been broken up

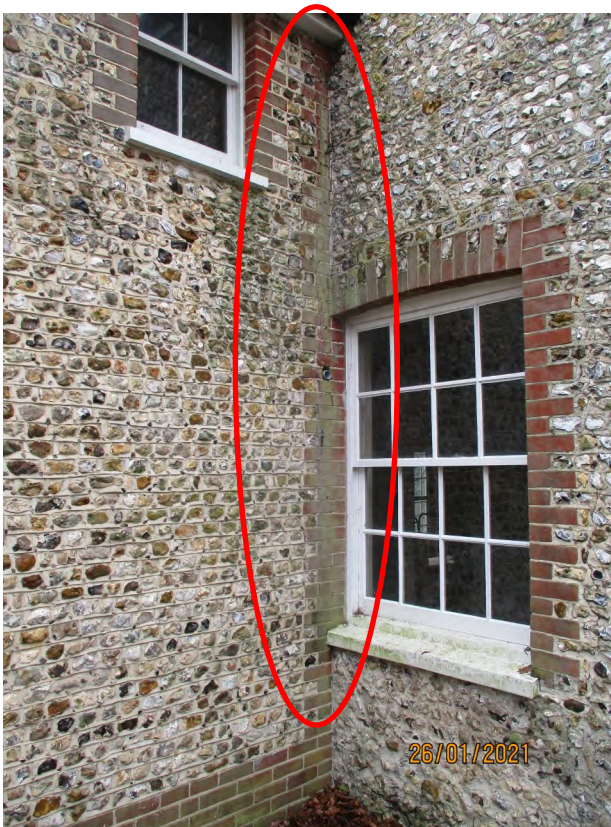


Fig 10:

1.1.3, west end; showing biological growth on masonry to full height, indicating intermittent failure of the provision for roof drainage. Note biological growth on east facing ground floor sills consistent with restricted drying



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 11:

1.1.3, north facing elevation, central section; showing partial damp-proof course in brickwork, installed on a previous refurbishment. Ground levels had risen to the level of the DPC, increasing the risk of water penetration to the structure



Fig 12:

1.1.3, central section of north facing elevation; showing partial dpc installed in new brickwork, constructed on a previous refurbishment. Note biological growth on tarmac surfaces and 'step out' brickwork, consistent with intermittent failure of the roof drainage system and water ponding intermittently against the structure



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 13:

1.1.4, ground level sill; showing vertical crack through masonry and patch repairs to façade below, indicating previous problems of intermittent water penetration



Fig 14:

1.1.4, west side; showing biological growth on brickwork indicating persistently damp conditions at the base of the façade, where drying was restricted by a ventilation housing



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 15:

1.1.4 and 1.1.5; showing general fall of ground from north-west to south-east, directing ground and surface water towards the masonry and foundations of the structure



Fig 16:

1.1.5, masonry above east ground floor window; showing vertical crack in structure which may indicate progressive settlement



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 17:

1.1.5, lower east side of east ground floor window; showing vertical crack in masonry which may allow water penetration to the structure. Note weathering and efflorescence affecting pointing mortars at low level and previous patch repairs



Fig 18:

1.1.6, west end; showing damp affected masonry and concrete bunding around a rainwater gully at ground level, indicating intermittent failure of the provision for roof drainage



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 19:

1.1.6, central section; showing 'weather struck' pointing at low level, which may have been intended to throw surface water clear of the base of the structure. No provision for horizontal damp-proofing was identified



Fig 20:

1.2.1; showing general arrangement of galetted flint façade finishes and generally good condition of 2 no. rainwater outlets and associated downpipes at high level



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 21:

1.2.2, central area; showing biological growth affecting masonry at high level, indicating raised exposure to weathering and possible intermittent failure of the provision for roof drainage on the reverse of the parapet wall

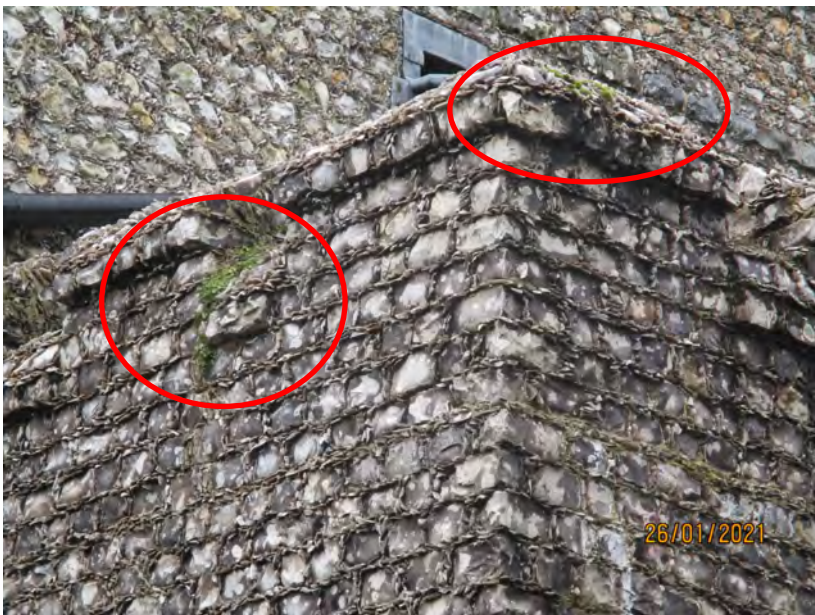


Fig 22:

1.2.2, south-east corner of single storey extension; showing plant growth on 'sky' surfaces of decorative crenelated masonry



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Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 23:

1.3.1; showing general view of principal south elevation



Fig 24:

1.3.1, south-west corner of structure; showing plant growth affecting parapet masonry at high level



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Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 25:

1.3.1, west side of central bay;
showing soiling of the façade where
water splashed back from ground
having drained over projecting
architectural details at high level



Fig 26:

1.4.1, base of mature tree on west side
of south-west bay; showing ground
levels raised close to finished floor
level on the interior and biological
growth affecting sheltered masonry
features



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B
and in the Schedule of Observations at Attachment C



Fig 27:

1.4.2, rainwater downpipe on south side; showing lead fittings retained on previous refurbishments. Note colonisation of adjacent masonry by plant growth which may indicate intermittent failure of the provision for roof drainage during and since previous occupancy



Fig 28:

1.4.2, north side; showing saturated ground in contact with the façade, with ground levels around 250mm below finished floor level on the interior



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 29:

1.3.2, east side; showing drip rebate formed in external masonry sill to first floor window on previous refurbishment and repointing of galeted flints below



Fig 30:

1.3.2, base of façade at return corner; showing residual encaustic tiles and concrete paving and low retaining wall, possibly where an orangery or greenhouse had been constructed and subsequently demolished. Note ground levels equivalent to finished floor level on the interior, increasing the risk of water penetration to the base of the structure



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 31:

1.3.3, west end; showing made ground and residual concrete paving approximately level with floor finishes on the interior. Note rainwater downpipe discharging onto ground with no provision for surface drainage



Fig 32:

1.3.3, central section; showing weather struck pointing to dressed flint details above ground floor window and door openings. Note vertical cracks through pointing indicating that mortar was of cementitious type and vulnerable to shrinkage and failure caused by thermal movement



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 33:

1.3.3, west end; showing made ground and tarmac hardstanding in contact with the façade. Note redundant drain at south-west corner of structure, which may have been part of a previous ground and surface drainage system



Fig 34:

1.4.3, north end; showing staining to masonry below a defective joint in eaves guttering, allowing intermittent escape of water



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 35:

1.4.3, central section; showing biological growth on masonry at the base of the façade, where water splashed back from made ground at the base of the wall



Fig 36:

1.4.3, view from south-west; showing soil in contact with the façade vulnerable to saturation, where surrounded by hard landscaped areas and kerbs



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 37:

1.4.3, south end; showing vertical crack in masonry between brick embellishments to the first-floor window and surrounding coursed flints



Fig 38:

West wing, north-west corner; showing holes drilled in external wall brickwork, consistent with fungicidal wall irrigation on a previous refurbishment



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 39:

West wing, north-west corner; showing structural repairs to suspended timber first floor structures, consistent with a previous outbreak of timber decay



Fig 40:

West wing, north side; showing holes drilled in masonry consistent with installation of a chemical injected vertical dpc on a previous refurbishment



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 41:

West wing, electrical inlet room on north side; showing rows of horizontal holes drilled in external wall masonry, consistent with the installation of a chemical injected dpc on a previous refurbishment



Fig 42:

West wing, electrical inlet room on north side; showing rows of horizontal holes drilled in external wall masonry, consistent with the installation of a chemical injected dpc on a previous refurbishment



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C

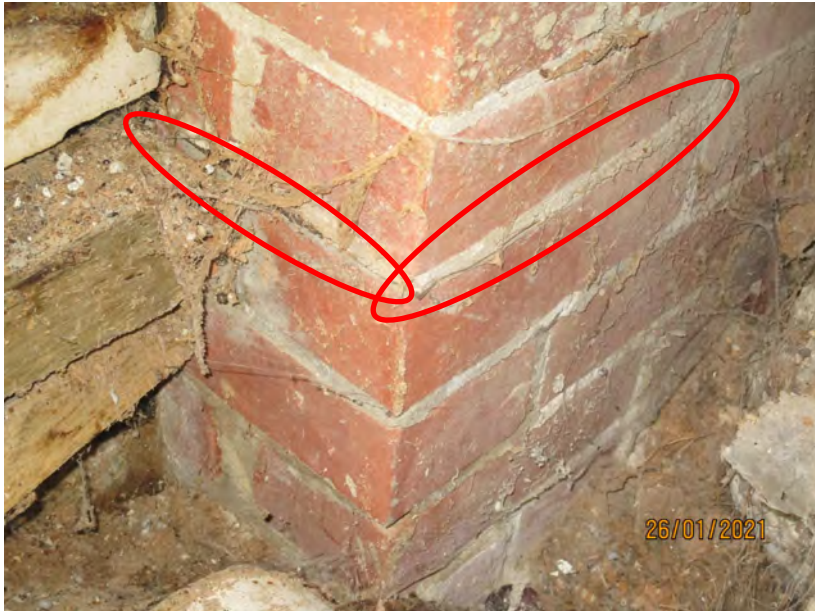


Fig 43:

West wing, south side; showing internal brick structures assumed to be of more recent construction than the main house, with a flexible plastic horizontal dpc below the level of floor finishes



Fig 44:

West wing, south side; showing floor structures broken out clear of the south elevation, where raised external ground levels had increased the risk of damp penetration to the interior



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 45:

West wing, north-east corner; showing horizontal rows of holes drilled into masonry indicating installation of a chemical injected damp-proof course on a previous refurbishment. Note underpinning concrete below the east end of the north wall



Fig 46:

West wing, internal wall on east side; showing horizontal row of holes at base of wall consistent with the installation of a chemical injected damp-proof course on a previous refurbishment



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 47:

West wing, east end of south wall; showing internal floor structures isolated from evidently damp masonry at the base of the south elevation by a trench, assumed to have been an underfloor heating detail



Fig 48:

Main house, north side, typical room to west of main entrance; showing north external wall dry lined to full height



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 49:

Main house, north side, room to west of main entrance; showing north external wall dry lined to full height



Fig 50:

Kitchens on north-east side of main house; showing typical isolated defect to decorative finishes and skim plaster, which may indicate problems of surface and interstitial condensation behind units on previous occupancy



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 51:

Main house, north-east room at ground floor level; showing north external wall dry lined to full height



Fig 52:

North-east conservatory, north end; showing general arrangement of knapped flint and galetted internal wall finishes, marble floors and full height glazing



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 53:

Main house, library on south side; showing walls detailed with high quality solid oak and veneer panelling to full height, restricting detailed inspection of loadbearing masonry walls



Fig 54:

Main house, south-west room, west side; showing structures around full height glazed doors to the exterior dry lined to full height



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 55:

Cellar, south side; showing generally good condition of exposed brick wall and soffit surfaces



Fig 56:

Cellar, south side; showing generally good condition of exposed brick wall and soffit surfaces



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C

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Fig 57:

Cellar, north side; showing generally good condition of vaulted brick structures and arrangement of water heating plant



Fig 58:

Cellar, west end of corridor; showing floor drain receiving condensate water from heating plant



Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C



Fig 59:

Cellar, north-east corner; showing water ponding on floor surfaces, assumed to have escaped from plumbing systems. Water may also have been draining into the wall/floor junction from retained soil on the north side



Fig 60:

Cellar, south side; showing twin sumps, with pumps controlled by flotation switches, receiving water from below the floor screeds, including a sub-floor channel at the north wall/floor junction. Sumps may also have been receiving water from surface drains, as shown in fig.58 above



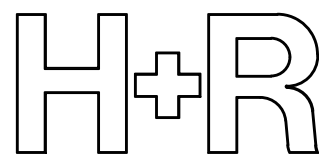
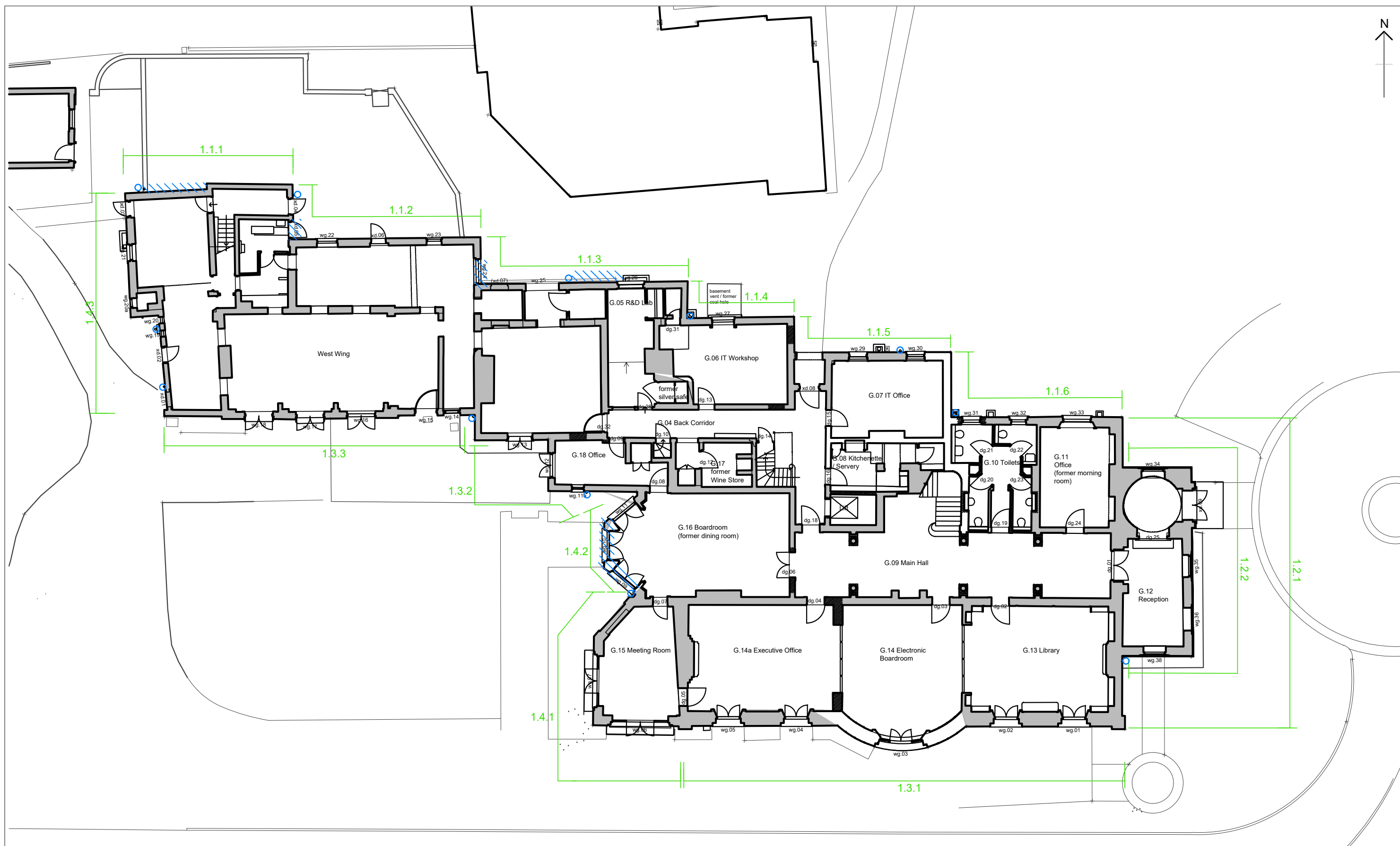
Southleigh Park - Mansion House

Masonry damp investigation

18 January 2021

Reference numbers (1.1.1 etc.) refer to locations shown on plans at Attachment B and in the Schedule of Observations at Attachment C

Attachment B



Southleigh Park, Mansion House - Ground Floor
Masonry damp and DPC investigation
26 January 2021

Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221
152.09 Site Note A6 -Not to scale- © Copyright Hutton+Rostron 2021

Key:

-  Area showing signs of visible damp on the exterior
-  Approximate location of rainwater downpipe

Attachment C

SCHEDULE OF OBSERVATIONS AND RECOMMENDATIONS

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
1 EXTERIORS			
1.1.1 Location numbers refer to plans at Appendix B	Roof drainage	A 'dog leg' in the eaves gutter on the west side of the projecting bay had been vulnerable blockage and overflow in the past, allowing surface water to drain over structures beneath. However, no salt efflorescence, biological growth or other defects indicating intermittent overflow were noted	
	Render and flashings	The upper surface of masonry at low level on the east side was covered with a rolled lead sheet flashing approximately 2m above external ground level, which appeared to have been installed on recent refurbishment. The base of the façade section was detailed with a render coat across its full width which showed extensive staining and biological growth below the flashing, consistent with focused wetting from the 'sky' facing surface of the projecting masonry. Further staining and mould growth was noted at low level on the east side, where water splashed back onto the façade from concrete hardstanding at the base of the wall. The render also appeared to have been recently installed, possibly where alterations had been made to the façade at low level on a recent refurbishment. Efflorescence on brickwork and residual sheet lead flashings chased into masonry above the render panel on the east side were consistent with a lean-to structure roof having been installed until recent demolition, protecting the façade render and brickwork from general weathering in the past	

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
	External ground levels and drainage	Horizontal concrete slabs were in contact with the façade across its full width, extending approximately 2.5m from the elevation. These were assumed to have been supports for plant or to have formed the base of a lean-to structure prior to its demolition. Water draining from eaves gutters tended to splash back onto the façade from the hardstanding, which was likely to have increased the risk of water penetration to the structure. On the west side, the junction between the slabs and the elevation render was detailed with a mortar fillet, which was covered in moss and other biological growth. This appeared to have been exposed prior to demolition of the lean-to structure on the east side. Ground levels were approximately 300mm above finished floor level on the interior, indicating that any provision for horizontal damp-proofing was likely to have been bridged, allowing external surface water to drain to the interior	
1.1.2	Roof drainage	Biological growth affected masonry at high level in three locations: approximately 1m east of the return corner, below a joint in the eaves gutter and behind the rainwater downpipe at the north end of the return. All these defects were consistent with intermittent blockage and overflow of the roof drainage system due to reduced maintenance, allowing water to drain over the elevation masonry, supporting biological growth and increasing the risk of damp penetration to the interior	
	External ground levels and drainage	Compacted unmade ground and rubble were in contact with the façade across its full width, generally around 200mm below internal floor level but rising towards the east facing return, where material had been overlaid with tarmacadam to form a level threshold pavement. Water had splashed back extensively onto the façade at the base of the wall, consistent with historic intermittent failure of the provision for roof drainage.	

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
		The general fall of ground was from north to south, towards the masonry and foundations of the structure. It was highly likely that ground in contact with the footings was persistently saturated, which may have increased the residual moisture content of loadbearing masonry locally. A surface drainage gulley was noted below the east ground floor window but this was 150mm above grade, preventing it from receiving any surface water run-off. It was likely that paving or hardstanding served by this gulley had been broken up since installation	
	Damp-proof courses	A series of small holes had been formed at the base of the pier separating the 2 ground floor door openings in the east facing return wall, consistent with the installation of an injected chemical damp-proof course on previous refurbishment. This may have been carried out in response to perceived problems of damp penetration due to the general fall of ground locally and raised external ground levels to the north. The base of the downpipe at the north end of the east return wall showed a vertical slate dpc behind but the downpipe discharged directly onto paving, increasing the risk of ponding locally and further adding to the moisture content of soil in contact with the footings of the north elevation	
1.1.3	Roof drainage	The eaves gutter received surface water from mansard roof pitches and flat roofed areas to the south and west, and discharged via a central rainwater downpipe, with a nominal diameter of 80mm. The downpipe discharged to a linear surface drain at the base of the elevation which was partially obstructed by leaves and debris. This may result in intermittent ponding of water in contact with the façade, increasing the risk of water penetration to the structure and interior	
	Façade masonry	Coursed flints and brickwork embellishments below the west end of the eaves gutter showed extensive	

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
		biological growth and staining, indicating intermittent blockage and overflow of the eaves gutter, allowing surface water to drain over structures beneath. Lichen growth was noted on the upper surfaces of window sills, notably on the east facing return at ground level, indicating restricted drying due to the easterly orientation and exposure to rain draining over the glazing above and the surrounding masonry from defective roof drainage systems in the past	
	External ground levels and drainage	Tarmacadam hardstanding was in contact with the façade across the full width of this section, with the general fall of ground from north/south directing surface water against the base of the structure. A linear drain had been installed across the base of the north facing elevation which was extensively obstructed by leaves at time of survey and may be vulnerable to blockage and overflow. Moss growth on tarmac and biological growth over 'step out' brickwork to the east of the central downpipe both indicated intermittent ponding and persistently damp conditions close to the masonry and foundations of the structure	
	Damp-proof course	An opening at the centre of the section at ground level had been modified on previous refurbishment, with new brickwork and coursed flints constructed to reduce the width of a previous opening. A sheet plastic dpc had been installed to the east and west of the new opening but these did not appear to link to existing damp-proof courses at the base of the original wall. External ground levels rose to within 20mm of the new dpcs, increasing the risk of water penetration to the structures where ground surfaces were vulnerable to intermittent ponding	
1.1.4	Roof drainage	No defects allowing escape of water were noted. The depth of the eaves increased over previous sections of the north facing elevations, extending to around 400mm from the facade	

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
	Façade masonry	The first-floor window sill appeared to have been replaced on a previous refurbishment and was not detailed with a drip profile or rebate, which may allow water from glazing to drain over masonry beneath, increasing the risk of damp penetration to the interior. The ground floor window sill was cracked at its centre, which may allow surface water to drain into the structures beneath. Patch repairs had been undertaken to masonry immediately below the ground floor window opening, indicating previous problems of water penetration	<i>The first floor sill should be modified or replaced, to provide an effective drip edge or rebate</i> <i>The crack in the ground floor sill should be repaired during the next redecoration cycle</i>
	External ground levels and drainage	Tarmacadam hardstanding was in contact with façade across its full width, interrupted by a former basement access which had been modified to provide ventilation for plant on a previous refurbishment. The sheet lead flat coverings to the vent abutted the façade without a flashing but the extent to which this increased the risk of surface water draining against the structure was mitigated by the sheltered northerly orientation. It was possible that the open gap between the vent cover and the facade may be blocked by debris on future occupancy. General fall of ground was from north-west to south-east, draining from hardstanding to made ground to the east	
1.1.5	Façade masonry	Brickwork on the west side of the porch arch to the entrance doorway showed minor biological growth at low level, which extended across the east facing return wall. These defects were associated with restricted drying due to the easterly orientation but may indicate intermittent failure of the roof drainage system on previous occupancy. A vertical crack was noted extending from the upper west corner of the east ground floor window to the end of the parapet wall above the flat roof over, where it abutted the first floor east facing elevation. Some patch repairs to pointing had also been undertaken locally, including 3 no.	<i>Consideration should be given to a review of vertical and diagonal cracks in masonry by the Structural Engineer</i>

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
		courses of flints below the north facing parapet wall. A vertical crack was also noted extending to ground level from the lower east side of the same window. Vertical cracks and open joints in masonry may have allowed water penetration but exposure to wind driven rain was limited by the sheltered northerly orientation. Repairs at high level were likely to have been occasioned by previous failure of the provision for flat roof drainage allowing water to saturate the parapet masonry and causing damage to bedding mortars and pointing	
	External ground levels and drainage	Fall of ground was generally from north to south, directing ground and surface water towards the base of the structure. Façade pointing showed weathering and surface efflorescence to approximately 400mm above external ground level, indicating the absence of horizontal damp-proof course and intermittent saturation of soil in contact with the structure. Turf, made ground and tarmacadam hardstanding to the north and west all tended to drain towards the base of the structure in locations 1.1.5 and 1.1.6	
1.1.6	Roof drainage	The first-floor north eaves gutter and the flat roof to the single storey structure on the west side discharged to a hopper approximately 4m above external ground level. This in turn drained to a bunded gulley at ground level. Masonry around the gulley showed extensive biological growth, indicating intermittent escape of water from the roof drainage system which, in combination with intermittently saturated ground due to restricted drainage, maintained persistently damp conditions at the base of the wall and may increase the risk of damp penetration to the interior	
	Façade masonry	The coursed flint façade showed biological growth to approximately 4m above ground level on the east side, where mature trees encroached on the structure. This was unlikely to have caused significant problems of raised residual moisture in loadbearing masonry. The	

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
		central ground and first floor windows were linked by a vertical crack on the east side, which continued at the junction between the central first floor brick reveal embellishments and the surrounding flint façade. The extent to which this defect increased the risk of water penetration to the structure was mitigated by the sheltered northly orientation	
	External ground levels and drainage	Made ground, partially overlaid with chippings, showed extensive biological growth and was patently saturated across the full width of the elevation. Ground levels rose generally towards the north-east corner of the structure but no provision for horizontal damp-proofing was identified that may have been bridged by the raised external ground levels. horizontal pointing lines close to ground level had been weather struck, which may have increased the ability of the surface to shed water clear of the footings but no dpc was identified behind	
1.2.1 (East elevation at high level)	Roof drainage	2 no. lead hoppers were installed to discharge water from parapet gutters, approximately 4 and 8m from the south end of the façade. Hoppers were linked to the south of the ground floor extension and drained via a hopper serving the extension roof to a bunded gulley at ground level. The gulley trap appeared to be partially blocked by silt and debris at time of inspection, but no defects indicating intermittent escape of water from the roof drainage system were noted on the façade	<i>Allowance should be made for a general inspection, cleaning and repair of the provision for drainage below ground level, serving all foul, waste and surface water drains</i>
	Façade masonry	The east, south and west principal elevations of the building were finished with knapped flints with wide galetted mortar joints, producing a highly textured and generally impermeable surface finish. No significant defects of the façade masonry allowing water penetration were identified on preliminary inspection from ground level	
1.2.2	Façade masonry	Galetted flint masonry was in generally good condition, with discolouration on the north side, where drying was	<i>Allowance should be made on future occupancy for routine detailed</i>

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
(Facades at ground level)		restricted and climbing plants had previously been positioned. Some biological growth was noted around the decorative crenelations above the extension flat roof, notably towards the centre of the east side. The 'sky' surfaces of the crenelations also appeared to hold water and not to drain freely to the flat roof or exterior, which may increase the residual moisture content of the masonry structures at high level and allow water penetration to the interior	<i>inspection of the parapet masonry around flat roof structures and for effective maintenance of pointing and flints, galletting etc. to prevent significant water penetration to the structure at high level</i>
1.3.1	Elevation masonry	Coursed knapped flints with flint shard galletting were in generally good condition, indicating a very high quality of workmanship on original construction and effective maintenance on previous occupancy. Isolated areas of vegetation growth were noted, including the 'turret' detail to the crenelated parapet wall at the south-east corner of the structure. Unfinished masonry sills at first floor level showed mould and lichen growth, consistent with significant exposure to rain driven by prevailing winds from the south and west. No drip edges or rebates appeared to have been provided to the undersides of sills on preliminary inspection from ground level but this did not appear to have increased the amount of surface water that drained back onto the façade locally. Weather struck pointing had been placed over ground floor reveals to throw surface water clear or openings beneath. Window and door reveals at ground and first floors were deeply recessed which would have further reduced the risk of water penetration to the structure	
	External ground levels and drainage	Paving provided access to ground floor glazed doors was laid to fall generally from north to south, away from the masonry and foundations of the structure. Between door openings exposed soil formed planting beds, overlaid with gravel, typically finished around 250mm below floor level on the interior. No formal surface drainage system was identified but the existing	

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
		provision appeared to have been effective in preventing significant water penetration at the base of the structure. Soiling of masonry on the west side of the central curved bay indicated water splashing back onto the structure from soil at ground level, where it had drained from projecting turret details above the first floor	
1.3.2	Façade masonry	No significant defects were identified and elevation masonry was in generally good condition, possibly being of a more recent date than the principal south elevation and south-west bays. A drip rebate had been cut into the underside of the sill below the west facing first floor window, which may have been formed on a previous refurbishment to reduce the amount of surface water draining over structures beneath where there was exposure to rain driven by prevailing winds from the west. Galletting around flints immediately below the sill appear to have been re-pointed	
	External ground levels and drainage	Residual oversite concrete and caustic tile fragments were consistent with a covered walkway or possibly an orangery or glasshouse having been built against the structure in this location and subsequently demolished. External ground levels were equivalent to internal floor finishes, which was likely to have increased the risk of water penetration to the structure after demolition of any external roofs or shading	<i>Consideration should be given to a general reduction in external ground levels on proposed refurbishment, to say, 200mm below floor level on the interior</i>
1.3.3	Roof and surface drainage	A retained lead rainwater downpipe and hopper, serving parapet gutters on the reverse of the crenelated masonry at high level, discharged onto the ground surface where landscaped levels rose to the height of internal floor finishes at the west end. No formal provision for surface drainage had been made, allowing made ground and residual concrete paving to become saturated where in contact with the structure	
1.4.1	Elevation masonry	Vegetation was colonising open joints in the structure towards the south-west corner of the south-west bay,	

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
		notably around the crenelated parapet wall details. A course of wider dressed flints had been included in the elevation to form a drip course detail, in combination with a line of weather struck pointing immediately beneath, around 300mm below the head of the parapet. Pointing appeared to have been replaced on a previous refurbishment. Similar details were noted above window openings and below parapets across the full width of the south elevation. Coursed and galetted flints showed some discoloration where a mature tree was planted immediately against the façade on the west side but no defects that significantly increase the risk of wind driven rain penetration were identified	
	External ground levels and drainage	The stone flagged pathway running parallel to the facades was separated from the elevations by a band of made ground covered in chippings, approximately 2m wide. A geotextile membrane had been placed below the chippings, presumably to suppress weeds. Ground levels at the base of a mature tree, close to the façade at the north-west corner of the south-west bay, rose to above floor level on the interior, which may have increased the risk of water penetration to the structure locally. External sills, steps and masonry embellishments at the base of the west façade showed widespread biological growth, where drying was restricted by shade from the evergreen mature tree	
1.4.2	Roof drainage	Lead rainwater downpipes and hoppers had been retained at the junction with section 1.4.1 on the south side. Biological growth to parapet wall masonry adjacent to the intermediate hopper serving the first-floor flat roof indicated intermittent failure of the provision for roof drainage, allowing surface water to drain into surrounding structures. However, no significant surface staining or biological growth was noted at time of inspection. The downpipe discharged	

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
		below ground level without a surface drain or bunded gulley at the base	
	Façade masonry	Isolated vegetation growth was noted on masonry at high level, generally at or above a triple drip course of dressed flints approximately 500mm below the parapet wall to the single storey structure. This was consistent with intermittent failure of the provision for roof drainage behind and increased residual moisture content of masonry immediately above the drip course, which would have interrupted drainage through the masonry bedding mortars and pointing. Steps to ground floor windows and glazed doors showed extensive biological growth where they were sheltered by a nearby deciduous tree, restricting drying	
	External ground levels and drainage	Made ground was in contact with the base of the façade and was extensively colonised by moss and vegetation on the north side of the ground floor bay. However, external ground levels were approximately 300mm below floor level on the interior and the general condition, thickness and form of construction of the external walls was unlikely to have permitted significant water penetration to the interior on previous occupancy	
1.4.3	Roof drainage	Vertical staining on the façade with approximately 1m from the north end was consistent with intermittent escape of water from a defective joint in the mansard eaves gutter. Discoloration and biological growth on masonry at the south end may also be associated with periodic blockage and overflow of the eaves gutter, combined with restricted drying due to the proximity of an evergreen mature tree	
	Elevation masonry	Coursed flints and brickwork had been repointed above the south first floor window. A vertical crack had formed between this window and the surrounding masonry, which may allow water to drain into the structure where there was exposure to rain driven by prevailing winds from the west. General biological	

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
		growth at the base of the façade was consistent with water overflowing from eaves gutters splashing back onto the façade from unmade ground	
	Eternal ground levels and drainage	Made ground, covered in chippings, was in contact with the façade across its full width, replaced with tarmac for approximately 1.5m at the south end. Fall of ground was generally from north to south, parallel to the elevation, with surface water discharging to a larger area of tarmac to the south and south-west. Made ground in contact with the façade was surrounded by hardstanding and kerbs, which may have increased the risk of saturated soil resting in contact with the façade over time. This in turn may have increased the risk of water penetration to the structure and interior	
2 INTERIORS			
2.1 West wing	Existing provision for damp-proofing	No physical or horizontal damp-proof courses were identified in external wall masonry. Extensive remedial damp-proofing and wall irrigation works had been undertaken on the north and west sides, where raised external ground levels tended to increase the risk of water penetration to the base of the structure and timbre structural repairs consistent with a previous outbreak of dry rot had been undertaken at first floor level. Raised external ground levels were also noted on the south side but no defects associated with damp affecting masonry structures were identified. Brickwork on the south side was generally exposed and was found to include isolated sections of flexible plastic dpc, integrated with vertical and horizontal damp-proof membranes installed around timber framed glazed external doors, which appeared to have been replaced on a previous refurbishment. If these dpcs were continuous throughout the south elevation brickwork they would have been partially bridged by solid internal floor structures. These in turn had been broken-out at	

LOCATION	OBSERVATION TYPE	OBSERVATIONS	COMMENTS
		door openings, cutting the floor structures back from the external wall masonry. Excavation at the north-east corner exposed underpinning concrete but no horizontal dpc was identified	
2.2 Main house, rooms on north side	Existing provision for damp-proofing	No significant defects associated with damp penetration at the bases of walls were identified. Some rooms, including those on the east and west sides of the entrance doorway had been dry lined to full height, possibly in response to damage to decorative finishes due to moisture migration through the bases of walls, where external ground levels were raised and the general fall of ground tended to direct ground and surface water towards the structure. Dry lining may also have been intended to raise surface temperatures to reduce the risk of intermittent condensation and enhance thermal comfort with occupancy. Dry lining continued beyond the rooms at the north-east corner to the east conservatory	
2.3 Main house, internal rooms and rooms on south side	Defects associated with damp	A library to the south-east was panelled to full height. Solid plaster finishes to the curved central bay were free of significant defects associated with damp or salt migration through the structure from the exterior or from below ground. Similar finishes, also free of visible defects, continued along the south side to the south-west conservatory	
	Internal loadbearing structures	No defects associated with rising or penetration damp were found to be affecting internal walls on preliminary visual inspection. Isolated damage to finishes and skimmed plaster, consistent with interstitial efflorescence of hygroscopic salts was noted in the kitchen areas to the north-east. However, these wall surfaces were highly likely to have been vulnerable to intermittent condensation on previous occupancy	

Attachment D

Table of material moisture contents

Attachment D

Samples of masonry were drilled from walls in areas vulnerable to damp penetration. The samples were placed in sealed containers and tested at the H+R laboratory in accordance with the procedure for gravimetric measurement of moisture content as described in the appendix to BRE Digest 245

Sample Number/Location	Moisture content % w/w			Hygroscopic moisture content % w/w	Available moisture content % w/w
1	2.67	D		1.00	1.67
2	0.11	D		0.06	0.06
3	0.29	D		0.12	0.17
4	0.23	D		0.53	-0.30
5	0.11	D		0.16	-0.05
6	0.40	D		0.40	0.00
7	1.18	D		0.58	0.60
8	0.83	D		0.83	0.00
9	0.21	D		0.27	-0.06
10	0.59	D		1.08	-0.49
11	1.29	D		0.59	0.70
12	0.44	D		0.42	0.02
13	0.33	D		0.23	0.10
14	1.15	D		0.47	0.68
15	0.17	D		0.19	-0.02
16	0.35	D		0.47	-0.12
17	10.73	W	H	4.33	6.40
18	0.62	D		0.49	0.12
19	0.67	D		0.60	0.07
20	2.89	D		1.12	1.77
21	0.92	D		0.52	0.40
22	0.54	D		0.45	0.09
23	0.93	D		0.40	0.53

24	0.75	D		0.55	0.20
25	0.40	D		0.30	0.10
26	3.65	M		1.25	2.40
27	6.46	M		1.72	4.73
28	0.21	D		0.21	0.00
29	0.51	D		0.32	0.18
30	0.56	D		0.56	0.00
31	0.53	D		0.25	0.28
32	0.80	D		0.86	-0.05
33	0.65	D		0.59	0.06
34	0.12	D		0.20	-0.09
35	1.74	D		0.49	1.25
36	0.41	D		0.48	-0.07
37	0.35	D		0.14	0.21
38	1.25	D		0.65	0.60
39	0.62	D		0.45	0.18
40	0.93	D		0.99	-0.07
41	0.80	D		0.77	0.03
42	0.86	D		0.84	0.02
43	2.53	D	H	2.36	0.17
44	0.00	D		0.00	0.00
45	0.00	D		0.00	0.00
46	0.29	D		0.18	0.12
47	0.44	D		0.39	0.04
48	6.93	M	H	2.48	4.44
49	1.47	D		0.15	1.32
50	0.84	D	H	16.62	-15.78
51	0.36	D		0.31	0.05
52	3.17	M		0.89	2.29
53	1.88	D		0.91	0.97
54	0.42	D		0.21	0.21
55	6.99	M	H	3.47	3.52
56	0.61	D		0.13	0.48
57	3.34	M		1.32	2.02
58	1.50	D		0.35	1.14
59	2.95	M		0.85	2.09
60	0.45	D		0.24	0.21
61	0.89	D		0.58	0.31
62	0.21	D		0.26	-0.05
63	0.26	D		0.26	0.00
64	0.72	D		0.72	0.00

65	0.51	D		0.46	0.05
66	1.00	D		0.48	0.52
67	0.90	D		0.72	0.18
68	0.49	D		0.15	0.34
69	0.85	D		0.44	0.40
70	1.56	D		0.62	0.94
71	1.37	D		0.32	1.05
72	1.48	D		0.29	1.19
73	2.12	D		0.56	1.56
74	3.19	M		0.88	2.31
75	1.20	D		0.60	0.59
76	0.91	D		0.35	0.56
77	0.93	D		0.21	0.72
78	0.35	D		0.15	0.20
79	0.99	D		0.56	0.43
80	0.92	D		0.40	0.52
81	0.19	D		0.13	0.06
82	4.29	D	H	2.34	1.95
83	1.98	D		1.26	0.72
84	0.78	D		0.45	0.33
85	0.92	D		0.58	0.34
86	0.73	D		0.44	0.29
87	1.03	D		0.65	0.38
88	0.85	D		0.46	0.39
89	1.01	D		0.37	0.64
90	0.82	D		0.36	0.46
91	0.23	D		0.21	0.02
92	0.83	D		0.36	0.46
93	0.84	D		0.40	0.44
94	0.00	D		0.00	0.00
95	2.34	M		0.16	2.18
96	0.95	D		0.49	0.46
97	1.67	D		1.01	0.65
98	0.87	D		0.41	0.46
99	0.99	D		0.45	0.55
100	0.94	D		0.53	0.41
101	0.76	D		0.31	0.46
102	0.96	D		0.31	0.65
103	1.83	D		0.86	0.97
104	1.55	D		0.64	0.91
105	1.16	D		0.58	0.58

106	0.27	D		0.10	0.17
107	1.65	D		0.82	0.84
108	1.79	D		0.95	0.84
109	2.10	D		0.96	1.14
110	0.66	D		0.31	0.36

Hygroscopic moisture is the 'air dry' moisture content of the sample at 75 per cent relative humidity. High levels above, say, 2 per cent are attributable to salt contamination. Hygroscopic salt commonly accumulates in old plaster and masonry that has been subject to dampness penetrating from the ground over many years. High levels above, say, 2 per cent of available moisture (liquid water) in the sample indicate continuing dampness due to liquid water in the sample usually resulting from faulty rainwater and plumbing goods