FLOYDCONSULT
Building science, timber & Conservation
Tel: 07762614364 / 01562885806
http://www.floydconsult.co.uk/
tim@floydconsult.co.uk

An investigation of dampness levels at

Marble Hill House, Twickenham

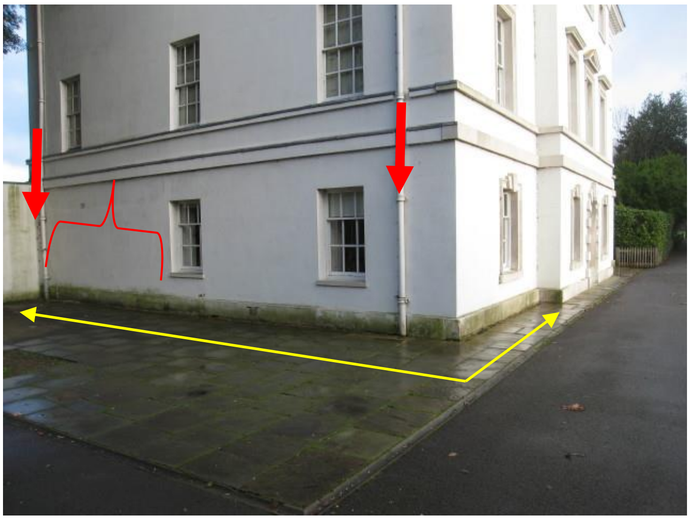
Tim Floyd MSc MRICS– 0044(0)1562885806
184 Yoxall Road, B90 3RN
http://www.floydconsult.co.uk/

1 INTRODUCTION

Following instructions from Robert Illingworth of English Heritage, I visited the above building on Wednesday 5th December 2012 to investigate 2 areas of the ground floor – namely damage to the wall coverings in the Paper Room and damage to the floor in the Hall (see ground floor plan, page 10).

2 THE PAPER ROOM

Internal wall finishes are deteriorating in the NW corner of the building (Paper Room).

1 N elevation of Paper Room showing incorrect surface falls around the NW corner. Water is able to percolate between the paviours – presumably migrating to the wall base. Wall siphons (of some kind) have been installed to the extent of the red bracket. The plinth is composed of stone units. The facade finished in stucco.	
2 Wall siphons continue along W elevation to extent of bracket. Gulleys and possibly downpipes were blocked. (Drain runs recently inspected and found to be clear). External paviours do not seem to have sufficient falls away from building perimeter. Small trench installed at wall perimeter (yellow arrow) – filled with pea gravel – which was very wet. Plinth along W elevation has been covered (in render?).	

3 The N and W internal walls have been rendered with hard (almost certainly cementitious) render – much of which has blown (for one or a combination of reasons which will only become obvious after the damaged render is removed). In places salts are efflorescing through the surface. The floor has been covered with a resin based substance – almost certainly as a damp proofing measure. See masonry analysis.	

2.1 Masonry analysis (column positions shown on ground floor plan)

Samples of the masonry were removed from the wall in accordance with BRE digest DG245. 3 columns were removed from the wall (A1 – 250mm, 2 – 500mm, 3 – 750mm, 4 - 1000mm, 5 – 1500mm and 6 – 2000mm). Columns 1 and 3 are incomplete due to sampling difficulties at the columns bases (and top in the case of column 3).

The absolute moisture content (%mc) of a sample is derived from the difference between the wet and dry weights. The dried samples are then subjected to an environment suppressed at 75% relative humidity (RH). This particular RH is used as those minerals (or salts) which attract moisture at RHs<75% (*very loosely* referred to as hygroscopic salts) are generally considered to be more prevalent in ground as opposed to surface water. This is the hygroscopic moisture content of the sample (%hmc). Its presence and distribution profile within the wall *can* indicate a ground rather than surface water problem.

The positions of the columns are shown on the floor plan – (page 10). Very generally - %mcs are considered significant if >3% and %hmcs considered significant if >5%, although this would depend on whether a sample of stone, brick or mortar was being assessed.

Note:

As the removal of physical samples was possible in this instance, no environmental data was recorded. The building as a whole was previously fitted with a Meaco monitoring system together with an air conditioning system. All available data from the Meaco system has been obtained. However unfortunately the Paper Room was not monitored and no environmental data exists.

Sample	%mc	%hmc
Col 1 – Floor +250mm	No access	
+500mm	2.6	0.5
+750mm	3.3	0.0
+1000mm	2.4	0.0
+1500mm	4.4	1.0
+2000mm	4.4	0.4
Col 2 – Floor +250mm	1.1	0.4
+500mm	1.2	0.4
+750mm	10.2	0.0
+1000mm	7.4	0.6
+1500mm	0.0	0.8
+2000mm	1.5	0.5
Col 3 – Floor +250mm	No access	
+500mm	1.8	0.7
+750mm	8.0	2.1
+1000mm	1.6	0.5
+1500mm	1.9	0.6
+2000mm	No access	

2.2 Discussion

The masonry samples show the N wall is evenly damp – almost to ceiling height (2000mm).

The W wall shows a (very) wet band at 750 – 1000mm above floor level. This would seem to be a result of the wall construction – where the masonry below about 500mm (see photo 2) is an enlarged (stone) plinth – with that above probably being soft brick encased in hard render. The plinth along the W elevation has been covered in a render. It is probable that wind driven rain is running down the wall to the step created by the plinth – then capillarizing into and behind the base of the external render. The covering of the plinth might also be allowing water to track up between the covering and the plinth itself from the wet trench.

A *similar* process is probably on going along the N elevation, with the difference being the plinth is exposed stone and there is no high volume water collection system such as the stone filled trench along the W and S elevations. The perpetual shade experienced by the N elevation will also effect how water moves in the wall. However on balance of probabilities the moisture distribution in the N wall (being evenly damp to 2000mm) would seem to be related to preferential moisture transference from the abutting W wing wall to the sheltered N facade. The construction of the W wing wall is different to the house generally. As such it is possible water is able to move more freely in it and transfer into the N wall of the main building.

What is clear is that there have been ongoing battles with the high moisture levels in these two walls for many years. While the installation of wall siphons might be exacerbating the problem, introduction of the gravel filled trench along the W elevation with blocked gulleys and downpipes overflowing into them - almost certainly has.

It is probable that the renovations and alterations carried out by the GLC in the mid 60s would have included alterations to the external ground, possibly including the addition of tarmacked surfaces up to the paviours on the N, W and S elevations. The addition of the tarmacked surfaces (carried out by whoever and whenever), would probably have set in motion a chain of events culminating in the problems experienced today.

2.3 Recommendations

Ideally the incorrect falls of the surrounding hard standings to the N, W and S elevations must be addressed. This would involve relaying all the paviours around the N, W and S elevations to fall away from the building perimeter and installing either sub surface or open channel drains to collect and discharge all collected surface water. However achieving a solution to this (and the problematic junction of the W wing wall with the NW corner of the building) would be so invasive as to make it impractical.

The stone filled trench along the W and S elevations could be replaced with an open channel which discharges into the downpipe gullies. The ends of the downpipes should be changed to spouts which discharge into the same grated gulleys as opposed to travelling sub surface where they become blocked out of view. This should decrease the water loading on the W wall.

A small amount of groundwork to the N elevation should bring long term benefits, where the paviours shown in photo 1 could be relayed (and well grouted) to fall away from the building. However water collection/discharge could be a problem due to the existing falls. The only possibility would seem to be the installation of a soakaway in the front lawn.

Even if a large scale groundwork project addressing all the points above was initiated, the N and W walls would remain wet for many months and years and certain measures would have to be carried out internally regardless of any external works.

Internally all loose plaster should be removed from the N and W walls. This will have to be carried out with care (to preclude the damage which often results when chiselling well bonded cementitious material off soft brickwork). Ordinarily the recommendation would be to line the wall in moisture resistant plasterboard and simply allow the wall to be damp. This might have been rejected in the past due to the difficult curves and contours in the W wall and it will probably now be necessary to board straight over the alcove. Any well bonded cementitious render can just remain on the wall. The wall lining will have to be well designed around the N window and ideally the cavity should be air tight.

However the overall design of the wall lining and cavity can only be finalised when the loose render has been removed and the extent of the wall siphons and condition of the masonry have been confirmed. It would be advisable to block the siphon cavities completely.

Tim Floyd MSc MRICS– 0044(0)1562885806
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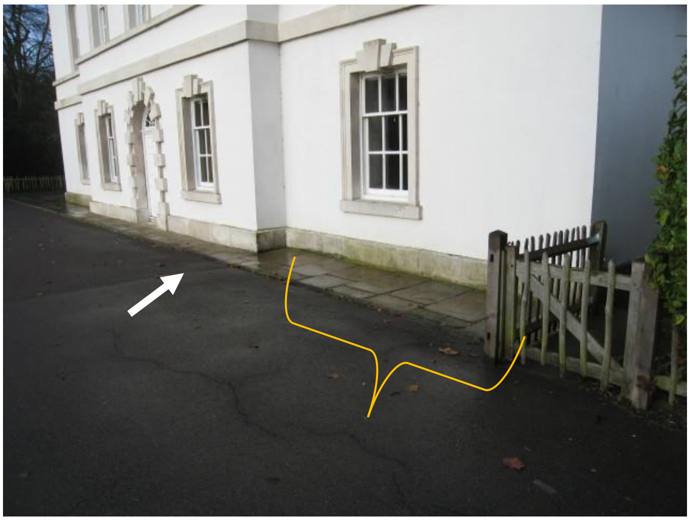
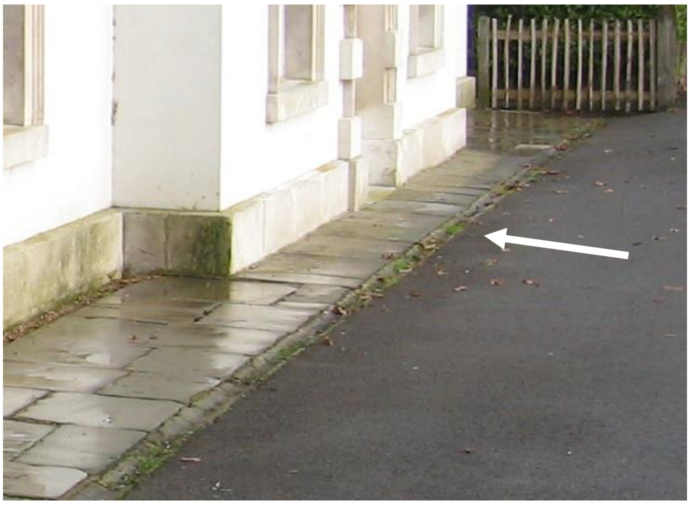
http://www.floydconsult.co.uk/

3 THE HALL

Deterioration of the stone floor tiles in the SE corner of the Hall has recently accelerated (photo 6).

The upper 1 – 4mm of the floor tiles (probably limestone) has delaminated locally, leaving spots of lighter coloured substrate.

4 Problems with collection and discharge of surface water – similar to that shown in photo 1. Water has been percolating into the cellar (extent shown by bracket), causing plaster loss from the S wall	
5 The open channel – into which the tarmac and paviours shed water – has open joints and falls to the point arrowed - where leaves have been collected then deposited where the water has disappeared. below ground	

6 The floor surface is darkening – possibly due to excess moisture, with small areas of the floor surface disassociating from the floor tiles. It is understood this process has accelerated recently.	

3.1 Data collection and analysis

In situations where physical sampling is not possible, collection of environmental data is often the next best thing.

The environment of the Hall was monitored for a month. A logger was sealed against the floor surface over the damage. A second logger was adjacent to the first but unsealed and able to equilibrate with the air in the Hall – circled in photo 6. The window shutters were closed for the monitoring period. These data sets are shown in graph 1 at the end of the report.

The environment of the cellar was also monitored for the same period as this is possibly the main point of moisture ingress and almost certainly affects the environment of the Breakfast Parlour (and therefore the Hall) – graph 2.

The building is equipped with a Meaco monitoring system. All available data was acquired. Although the Hall and the adjacent Dining Room are monitored – no data from these areas was made available. Data sets from the Breakfast Parlour were obtained – and are shown in graphs 3 – 5.

At the time of writing this report, details of the air conditioning system used in the building have yet to be made available.

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3.2 Discussion

Graph 1

The data from graph 1 shows the environment at the floor surface to be approaching 90%RH indicating there is excess moisture at the floor surface. The environment of the Hall generally has a much more variable RH. Looking at 01/01/2012 for example, in a 24 hour period the RH ranges from over 70% (equating with an air moisture loading of 9g H_2O/M^3) down to under 55% (7g H_2O/M^3). This variation occurs at a relatively stable 15⁰C temperature showing that moisture is probably being extracted from the environment – but being reintroduced - 24 hours later. The reason for this is unclear.

Graph 2

As would be expected the environment of the cellar is stable. There was no great difference in the environments of the air at ceiling and floor – with the levels gradually rising to a constant 70%RH @ 20⁰C. This equates to reasonably high level of air moisture which either finds its way up into the Breakfast Parlour, condenses out on walls elsewhere in cooler parts of the basement or exits the basement completely through vents in the cellar door.

Graphs 3 – 5

The environment of the Breakfast Parlour is as variable as that of the Hall. Graph 4 shows the data from June only. Although the sun is at its highest, this data set should represent that period when the S facade is affected most by solar gain.

It can be seen that although the temperature is maintained between 17 - 20⁰C, the RH ranges from 52% - 75%. Again this is likely to be the result of air conditioning, with moisture emanating from the cellar below.

General

Graph 1 confirms there is excess moisture at the floor surface which is likely to have emanated from the external defective surface drainage - *if the pre-existing moisture in the room is regularly removed by the air conditioning system*. Graphs 2 – 5 seem to show that water is also drawn from the defective external perimeter surfaces into the (elevated and constant air temperatures of the) cellar. Graphs 3 – 5 indicate the temperature of the Breakfast Parlour is probably affected more by the cellar below - as its temperature is closer to that of the cellar rather than the Hall. Graph 5 should be treated with a degree of caution due to breaks in the data and high readings recorded in June 2012.

The existence of the air conditioning system probably makes the movement of water from outside to in (and therefore the deterioration of the floor surface which is probably caused by salt migration and crystallisation) - more efficient. However this can only be confirmed when more information on the system is obtained – see recommendations.

3.3 Recommendations

The open channel arrowed in photo 5 could be repaired to collect and discharge surface water more effectively. While the overall problems with surface water collection and defective falls are similar to those experienced on the W and N walls, repair of the open channel arrowed in photo 5 should produce particularly good results along this elevation in the long term.

If, in an ideal world, all water ingress could be stopped, the drying rate of the wall base and consequently the sub floor of the Hall would be dependent on the internal air conditioning.

It is widely accepted that the %RH of air within a museum or building containing organic delicates should be maintained between 45 – 60% - with the gold standard 55%. Assuming the environment is effectively sealed (windows and doors do not remain open), maintaining a stable temperature is often all that is required to maintain a stable RH. However, in this case a stable temperature has not maintained the RH which is a matter for concern not so much for the condition of the Hall floor, but for the rest of the collection housed in the building.

As such it is important that following repair of the open channel along the S elevation, the existing systems of the building are fully assessed, namely:

1. Air conditioning

It is important that a full map of the air conditioning system is obtained. This should include:

When it was installed.

What type of system has been employed (simple air circulation or more advanced HVAC system).

How and where it has been fitted within the building (it is known to use existing flues and fireplaces to an extent).

How it is activated – humidistat, thermostat, timer etc. – and what the program settings are.

How and when it was last calibrated/serviced.

2. Environmental monitoring

The Meaco system requires upgrading. This could be possible with a change of software and possibly an upgrade of the controller (the unit responsible for interrogating the sensors and storing the data). The sensors require recalibration but can probably be retained.

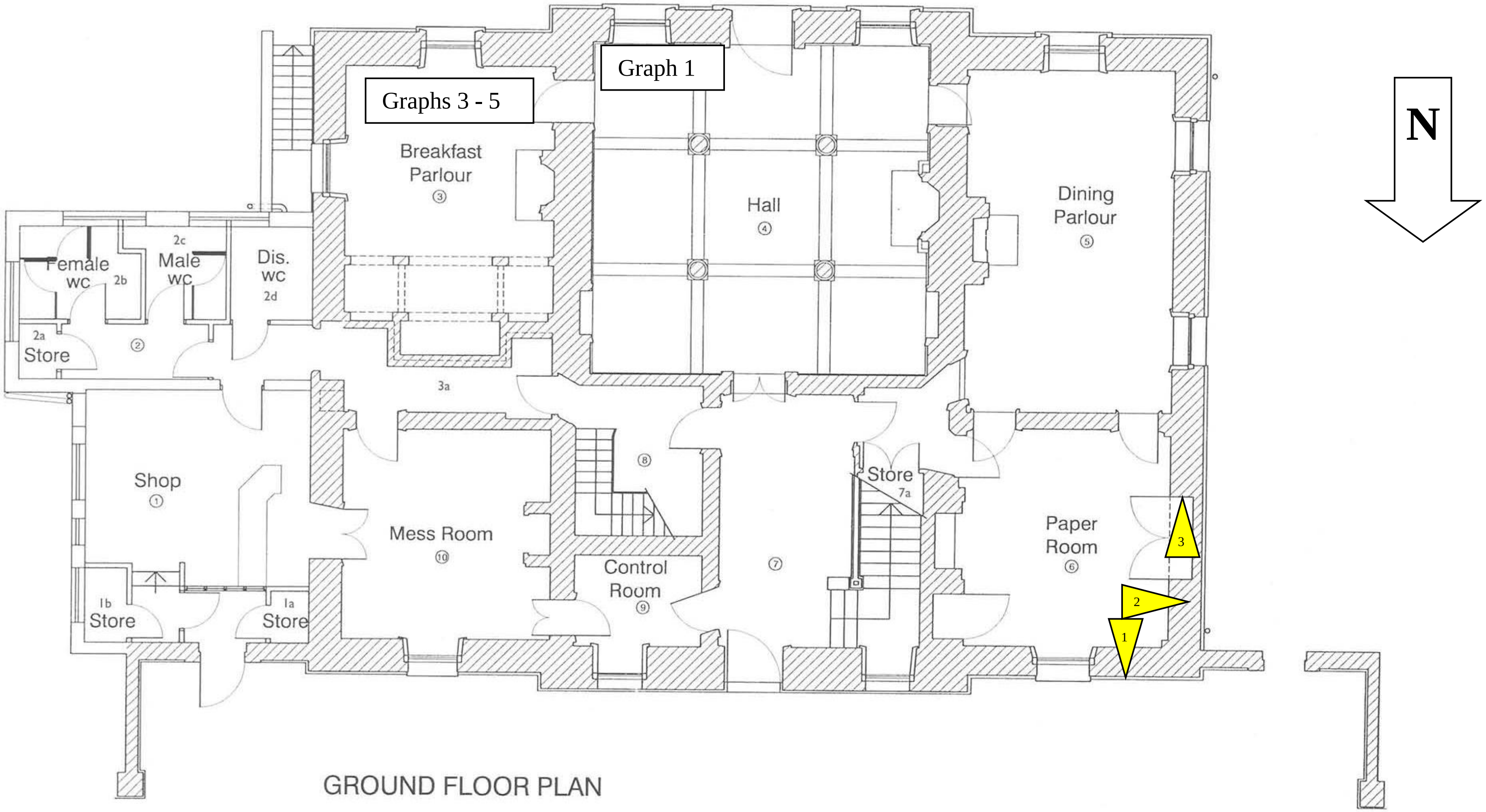
A system should then be put in place where the data is downloaded (by the property manager?) to a separate file and analysed/checked every year at the very least.

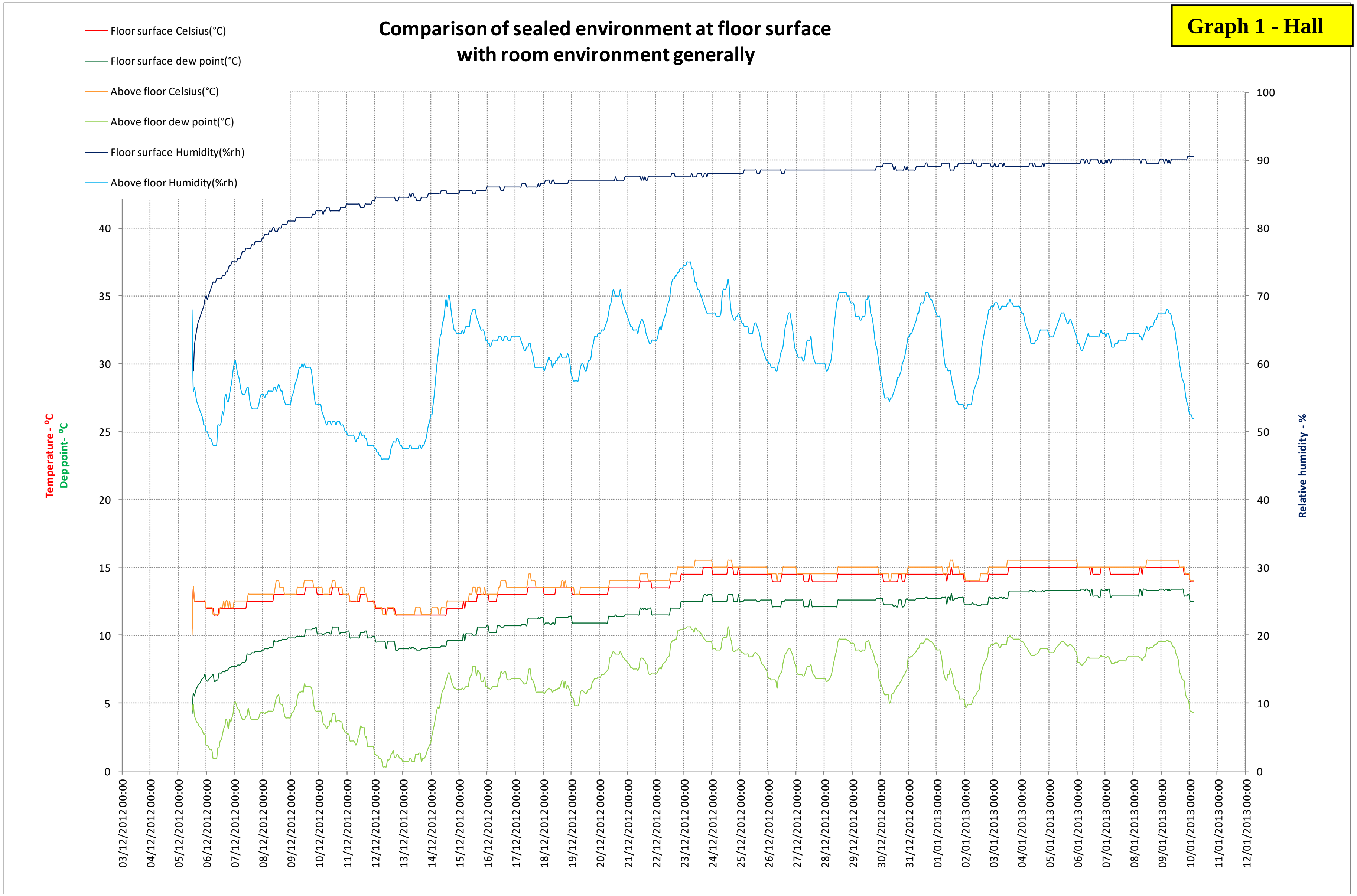
Maintaining a %RH at 50 – 60% is good for collections, although excess/residual moisture from the sub floor will still be able to migrate through the floor tiles – causing continued deterioration for a time.

However if the environmental monitoring system is over hauled – with sensors placed at floor level in the hall – the efficacy of addressing external surface water should be measurable over months and years.

When more information on the air conditioning has been received – further recommendations will follow.

Tim Floyd – January 2013


Graphs 3 - 5
Graph 1
N
Breakfast Parlour
Hall
Dining Parlour
Female WC
2b
2c
Male WC
Dis. WC
2d
2a
Store
3a
Shop
Mess Room
Store
7a
Paper Room
Control Room
1b
Store
1a
Store
1
2
3
GROUND FLOOR PLAN


Graph 1 - Hall
Comparison of sealed environment at floor surface with room environment generally
Floor surface Celsius(°C)
Floor surface dew point(°C)
Above floor Celsius(°C)
Above floor dew point(°C)
Floor surface Humidity(%rh)
Above floor Humidity(%rh)
Temperature - °C
Dep point- °C
Relative humidity - %
0
5
10
15
20
25
30
35
40
50
60
70
80
90
100
03/12/2012 00:00
04/12/2012 00:00
05/12/2012 00:00
06/12/2012 00:00
07/12/2012 00:00
08/12/2012 00:00
09/12/2012 00:00
10/12/2012 00:00
11/12/2012 00:00
12/12/2012 00:00
13/12/2012 00:00
14/12/2012 00:00
15/12/2012 00:00
16/12/2012 00:00
17/12/2012 00:00
18/12/2012 00:00
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22/12/2012 00:00
23/12/2012 00:00
24/12/2012 00:00
25/12/2012 00:00
26/12/2012 00:00
27/12/2012 00:00
28/12/2012 00:00
29/12/2012 00:00
30/12/2012 00:00
31/12/2012 00:00
01/01/2013 00:00
02/01/2013 00:00
03/01/2013 00:00
04/01/2013 00:00
05/01/2013 00:00
06/01/2013 00:00
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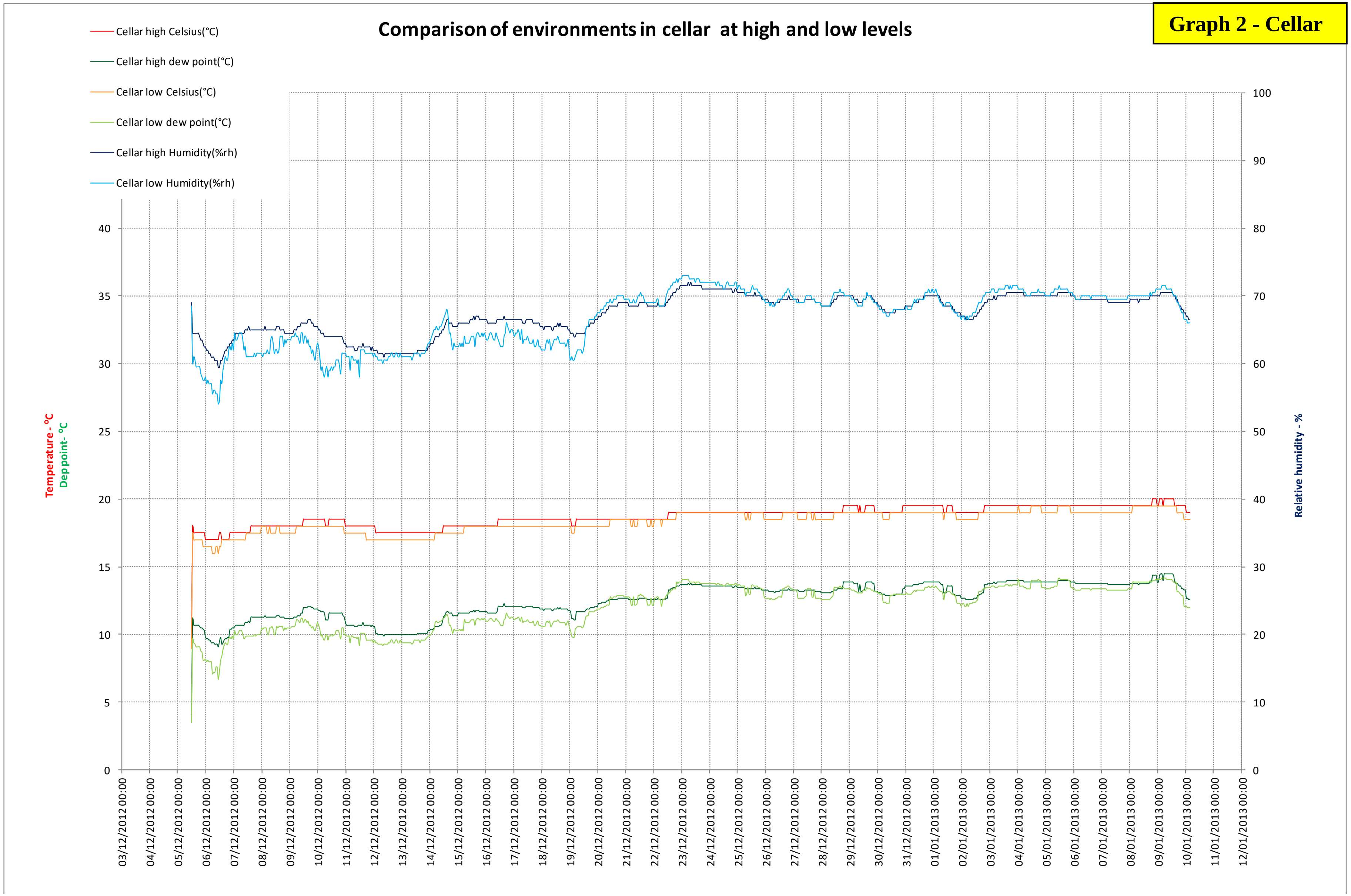
12/01/2013 00:00


Graph 2 - Cellar
Comparison of environments in cellar at high and low levels
Cellar high Celsius(°C)
Cellar high dew point(°C)
Cellar low Celsius(°C)
Cellar low dew point(°C)
Cellar high Humidity(%rh)
Cellar low Humidity(%rh)
Temperature - °C
Dep point - °C
Relative humidity - %
0
5
10
15
20
25
30
35
40
10
20
30
40
50
60
70
80
90
100
03/12/2012 00:00
04/12/2012 00:00
05/12/2012 00:00
06/12/2012 00:00
07/12/2012 00:00
08/12/2012 00:00
09/12/2012 00:00
10/12/2012 00:00
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31/12/2012 00:00
01/01/2013 00:00
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05/01/2013 00:00
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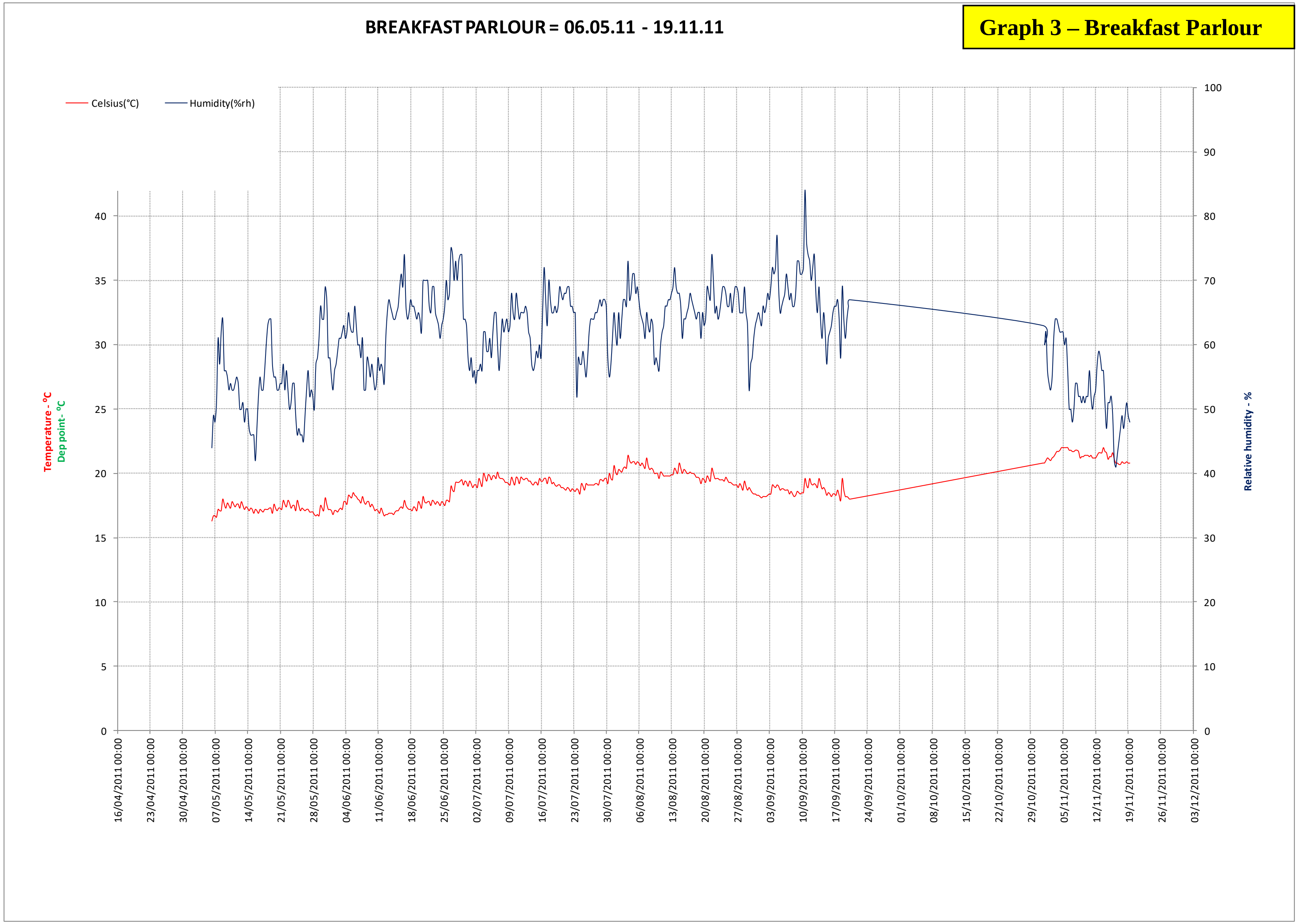
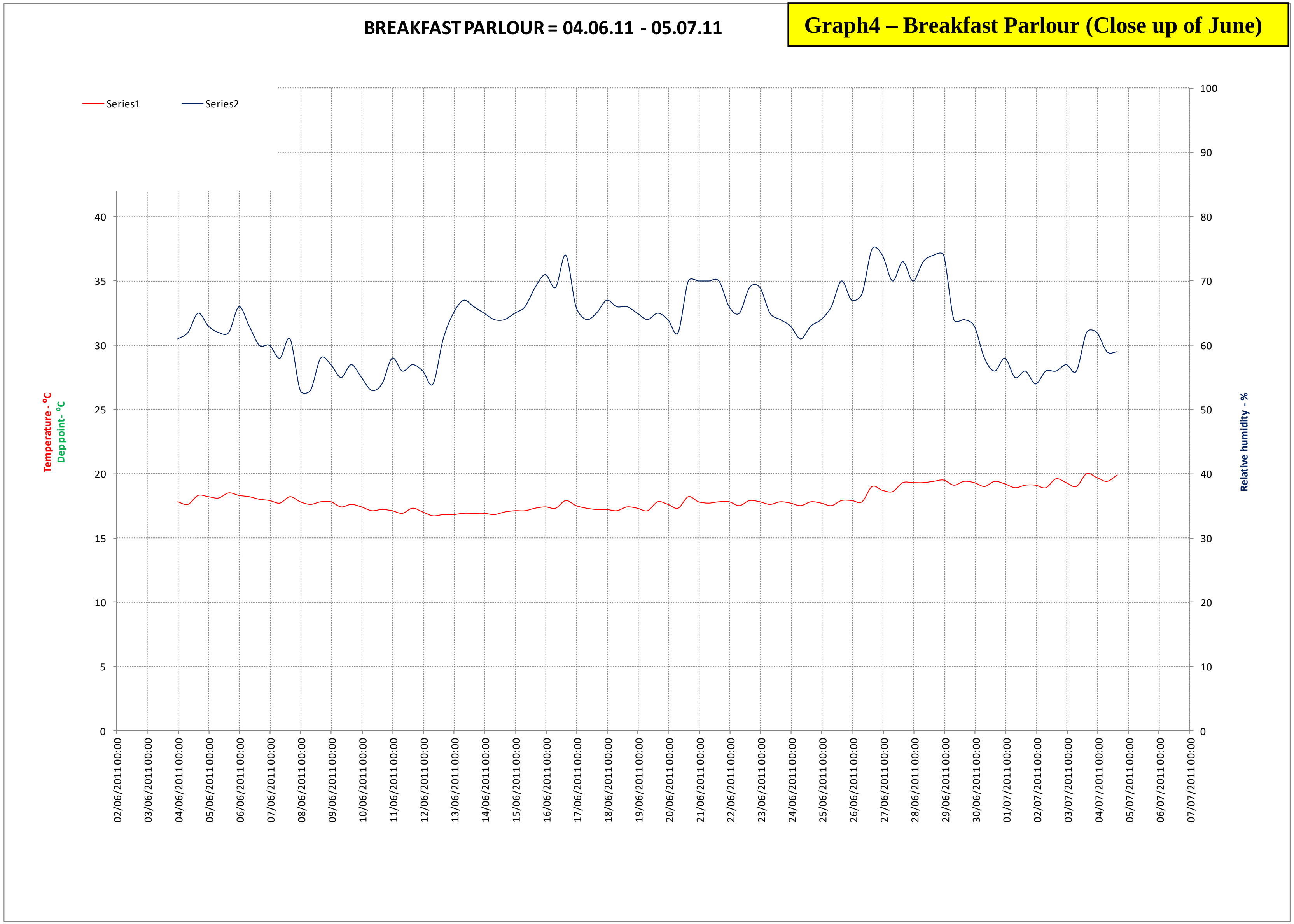
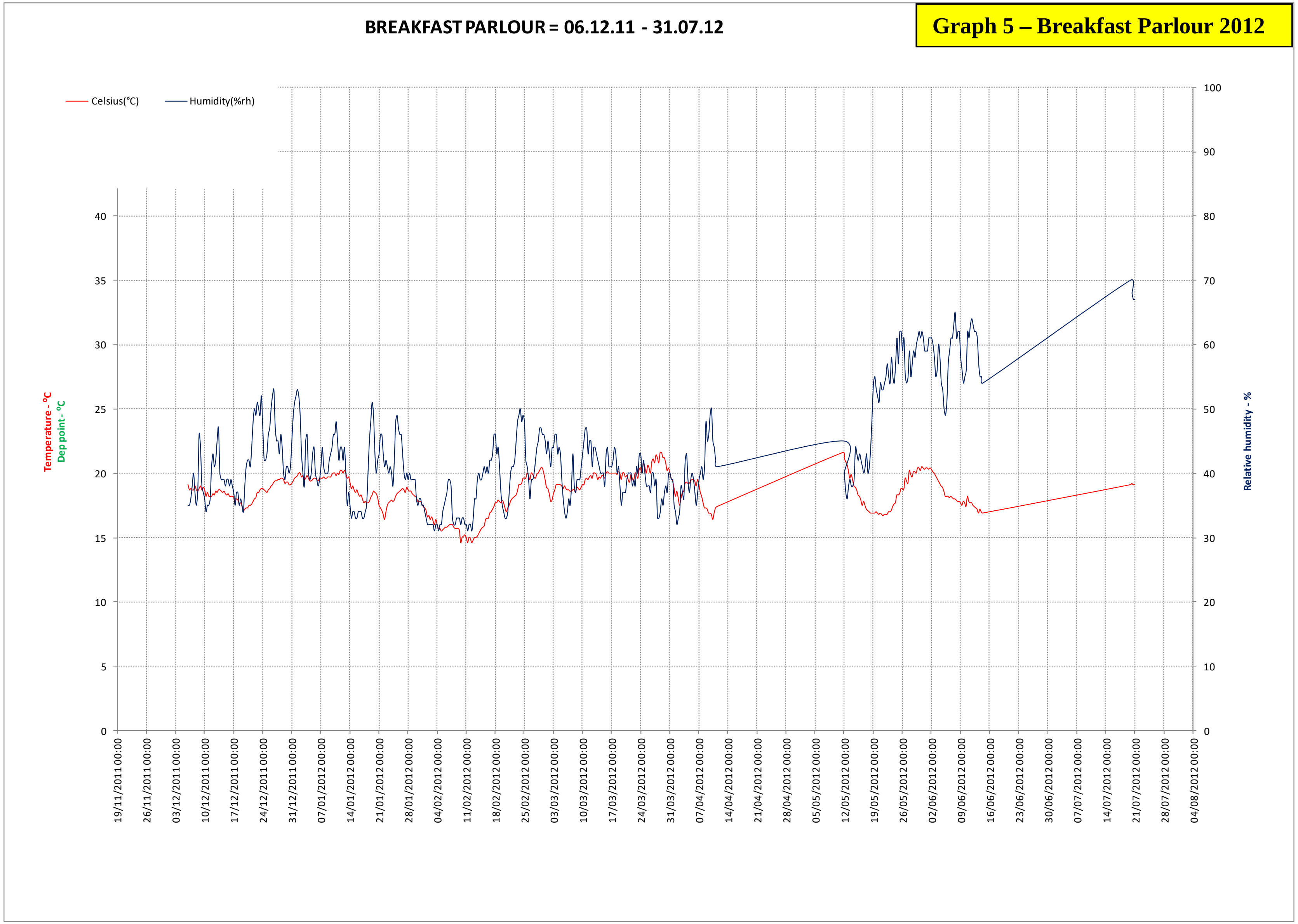
12/01/2013 00:00


BREAKFAST PARLOUR = 06.05.11 - 19.11.11
Graph 3 – Breakfast Parlour
Celsius(°C)
Humidity(%rh)
Temperature - °C
Dep point - °C
Relative humidity - %
0
5
10
15
20
25
30
35
40
0
10
20
30
40
50
60
70
80
90
100
16/04/2011 00:00
23/04/2011 00:00
30/04/2011 00:00
07/05/2011 00:00
14/05/2011 00:00
21/05/2011 00:00
28/05/2011 00:00
04/06/2011 00:00
11/06/2011 00:00
18/06/2011 00:00
25/06/2011 00:00
02/07/2011 00:00
09/07/2011 00:00
16/07/2011 00:00
23/07/2011 00:00
30/07/2011 00:00
06/08/2011 00:00
13/08/2011 00:00
20/08/2011 00:00
27/08/2011 00:00
03/09/2011 00:00
10/09/2011 00:00
17/09/2011 00:00
24/09/2011 00:00
01/10/2011 00:00
08/10/2011 00:00
15/10/2011 00:00
22/10/2011 00:00
29/10/2011 00:00
05/11/2011 00:00
12/11/2011 00:00
19/11/2011 00:00
26/11/2011 00:00
03/12/2011 00:00

Graph4 – Breakfast Parlour (Close up of June)



Tim Floyd MSc MRICS– 0044(0)1562885806
184 Yoxall Road, B90 3RN
http://www.floydconsult.co.uk/



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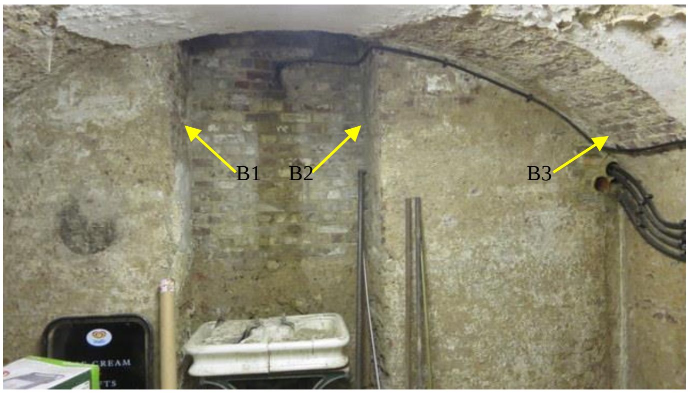
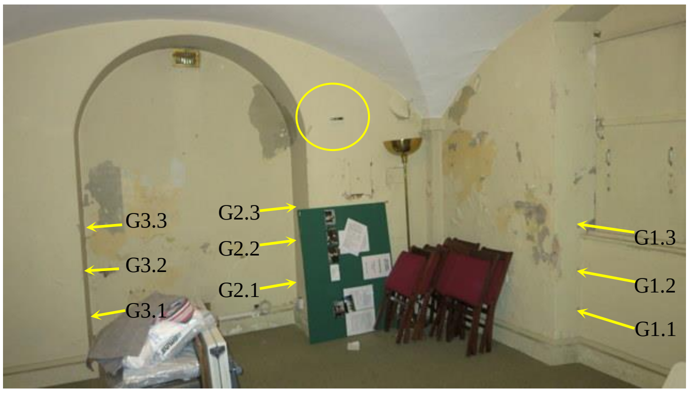
ADDENDUM – SITE VISIT 08.03.17 .

INTRODUCTION

Following instructions from Ndai Halisch of Historic England, I revisited the building on the 8th and 17th March to effectively repeat the survey carried out 05.12.12.

Since the last survey, some work has been carried out to the external perimeter

EXTERNAL	
7. N elevation adjacent to Paper Room It is understood the external paving has been re-laid in the area shown, which does appear to be drier – less covered in moss – than when visited 4 years ago – see page 1 above. The paviours shed water away from the building, although it does not seem to be channelled away once it has reached the tarmac.	
8. W and S elevations The pea gravel trench has been removed from the W elevation, but a small section still remains where it returns along the S elevation. This small section of trench should be removed as per the W elevation. That part of the open channel circled opposite has been replaced. However the falls are still incorrect (see page 5 above) and water is not efficiently channelled to a collection point. **See discussion.**	
INTERNAL	
9. SE corner of the Breakfast Parlour The electric socket box to the LHS of the photo has rusted and it is understood there have been problems with the electrics. Cut marks in the floorboards indicate localised replacement, possibly due to previous decay (?). All accessible timber shows low mcs, although rusting of the electrical socket confirms the masonry is damp. **See discussion.**	

10. S elevation below Breakfast Parlour. This area is immediately adjacent to the defective surface drain shown above. 3 dowels were installed to monitor moisture in the masonry – **see dowel monitoring section.** The masonry that came from the wall was exceptionally wet.	
11. NW corner of the Paper Room The condition of the internal plaster is quite similar to that seen in December 2012 – see page 2 above. A dowel monitoring system was installed to assess the moisture content of the walls over the next few months. A logger was also placed to acquire relative humidity and temperature levels. **See monitoring section below.**	
12. S side of central Hall The area of deterioration, previously reported to be an actively growing damp problem, was confirmed as being the result of spillage of cleaning fluid. However the data previously acquired (comparative RHT recorded sealed and unsealed at floor surface) did indicate elevated moisture levels (graph on page 11 above). As such the monitoring process is being repeated.	

DISCUSSION

N and W elevations

Certain works have been carried out since 2013 which do improve the ability of the external perimeter to shed water clear of the building and the appearance of the surface of the paving slabs and base of the walls is much improved (in terms of biological growth) than it was in 2013. Certain improvements could still be made in terms of effective collection of shed surface water on the N elevation and possibly changing the arrangement of the downpipes on the W elevation to ones with spouts and gulleys.

Previous acquisition of mortar samples showed a wet band of masonry at 750 – 1000mm at the position of column G2 (observation 11 above) and at 750mm above floor level at column G3. It was not previously possible to draw any correlation between the wet masonry, the damage to the internal plaster and the overall source of moisture. As previously mentioned it may be that the band of moisture and also at least some of the damage to the internal plaster may be due to the construction of the wall.

There are a number of unknowns regarding the wall construction of the Paper Room. It seems unlikely that the stone plinth extends right through the thickness of the wall as the upper edge of the plinth visible on the N wall is lower than the upper edge of the internal masonry skirting at the same point.
In some positions on the W elevation, drilling of the holes for the dowel monitoring system produced light coloured dust with very little resistance to the drill. In others, red coloured brick dust was produced. The dust coming from the holes drilled in the N elevation was red/brown with little resistance to the drill.

Historical documentation could suggest that there have been alterations to the structure in this corner and this may be one of those occasions where, barring further invasive and destructive exposure, production of a full and detailed picture of cause and effect may not be possible.

In order to determine the current moisture status of the wall in a way which can be replicated in following months, a dowel monitoring system was inserted-see observation 11 above. The moisture content of a timber dowel inserted into a hole equilibrates with the moisture content of the masonry over 4-6 weeks. The dowels are then cut into 2 or 3 sections which represent varying depths from the wall surface . 3 columns of dowels have been positioned-each dowel marked as shown in the photo. The idea of inserting 600 mm long dowels through the reveals in the wall as opposed to a shorter length inserted perpendicular to it, is that data will be acquired from more of the wall fabric. As previous masonry sampling indicated high moisture contents at approximately 750 mm above floor level, 3 dowel placements have been used in each column being 350 m above floor level (Gx.1), 750 mm above floor level (Gx.2) and 1000 mm above floor level(Gx.3).

As a control to this process, an environmental logger was placed above the area of masonry monitoring to record the relative humidity and temperature of the room. This will be significant, as the Paper room is an unusual structure being a small self-contained masonry vaulted space above ground - which may well generate environments that have contributed (possibly to a large extent) to the condition of the internal wall covering.

When the dowels are returned in a couple of weeks' time, the results will be tabulated and further discussion made.

S elevation

There are perimeter surface water drainage problems (similar to those on the N elevation and possibly on the W) along the S elevation, which have not been adequately corrected. It seems that the original defective open surface water channel has been replaced with new channel units which have incorrect falls and do not channel the water efficiently to a place of discharge. The tarmac associated with the road surface means water readily collects in the in the open channel but is then unable to escape.

This defective management of surface water may be a contributory factor to the damage seen in observation 12 above (although as previously mentioned it seems this is more the result of chemical spillage), but is definitely a contributory factor to the high water levels found in the cellar below the Breakfast Parlour and to the decorative damage, rusting of electrical services and possible previous timber decay in the SE corner at ground floor level of the same room.

Environmental monitoring of the area of floor in the central hall will be repeated for another month cycle and the data compared with that of 2013.

3 dowels have been inserted at approximately 2 m above cellar floor level in the S wall below the Breakfast Parlour. The material that came from the holes was exceptionally wet and even if the external perimeter drainage was corrected immediately, it is probable that the moisture contents of the subterranean masonry (and therefore the ground floor wall bases) would remain at or close to these levels for some considerable time (probably years).

RECOMMENDATIONS

The dowel moisture contents and environmental monitoring will provide further information in a couple of weeks.

In the meantime, as previously stated in the 2013 report, it would be advantageous to obtain details of the heating and ventilation system that is fitted in the building. This would include which rooms are affected or fitted with it, how the air is recycled, heated or dehumidified. One of the main reasons this is so important is that the system could be used to help future remediation work.

As the finer aesthetic details of this building are particularly significant, it seems as if a degree of plaster replacement will be unavoidable internally. With regard to the Paper Room, it would be important to bear in mind that removal of hard internal plaster, if not carried out with care, could result in collateral damage to the underlying substrate. The same comment applies to other more localised areas of potential plaster replacement along the rest of the W elevation and areas of the S elevation.

All replacement plaster should be fully vapour permeable. Any paint covering in the Paper Room is likely to be subject to the effects of transitioning moisture and as such must not form a separate layer and also be fully vapour permeable- which means Limewash. It is important to remember that the lower levels of plaster may well experience damp shadow, and paint colour selection should be trialed with this in mind.

With regard to the external drainage, the perimeter water should be intercepted by a system which can effectively collect and discharge all surface water clear of the building to a collection point. The replacement of the open channel on the S elevation hasn't been successful and it could be argued that addition of something along the lines of an ACO slot interceptor drain would have a better chance of effectively draining the external perimeter (of both the S and N elevations). It may be that some paving slabs along the S and N elevations need to be re-laid to achieve suitable levels for the interceptor drain as work proceeds.

With regard to the W elevation, collection of surface perimeter water will always be a problem due to prevailing weather, the building design and its 'Wing wall' and the large mature evergreen tree in the NW corner - all creating a water catchment area. Even though the paving seems to have a fall away from the perimeter of the building, biological algal staining indicates water still dwells in this area due to the reasons given above.

Final report to follow in a couple of weeks. I will contact a representative of the building to retrieve the dowels and environmental loggers on or around 21st April.

Tim Floyd – March 2017

5 Dowel monitoring and environmental monitoring results

Dowels

Dowels were left in the wall to equilibrate with the masonry and removed after approximately 5-6 weeks. Their timber moisture contents, after this time, are reasonably accurate representations of the masonry moisture content.

The 600mm long dowels were cut in to 2 sections, with X.1 representing the masonry mc from the surface to approximately 300mm depth and X.2 representing the mc at depth

Dowel mcs <17% indicate dry masonry. 17- 25% indicate damp masonry, those >25% indicate wet masonry and those >35% generally indicate saturated masonry (the term saturated meaning the existence of free water – where the pore structure and fissures of the masonry are full and not able to hold any more water.

			April '17	
Floor + 350mm	G1.1-1		13.0	
	-2		17.7	
Floor + 750mm	G1.2-1		15.3	
	-2		21.1	
Floor + 1000mm	G1.3-1		14.2	
	-2		18.5	
Floor + 350mm	G2.1-1		31.3	
	-2		38.8	
Floor + 750mm	G2.2-1		24.7	
	-2		28.7	
Floor + 1000mm	G2.3-1		21.3	
	-2		29.8	
Floor + 350mm	G3.1-1		31.9	
	-2		35.3	
Floor + 750mm	G3.2-1		20.6	
	-2		22.5	
Floor + 1000mm	G3.3-1		15.8	
	-2		19.3	
	B.1-1		46.2	
	-2		51.1	
	B.2-1		44.1	
	-2		39.3	
	B.3-1		50.4	
	-2		54.5	

Discussion

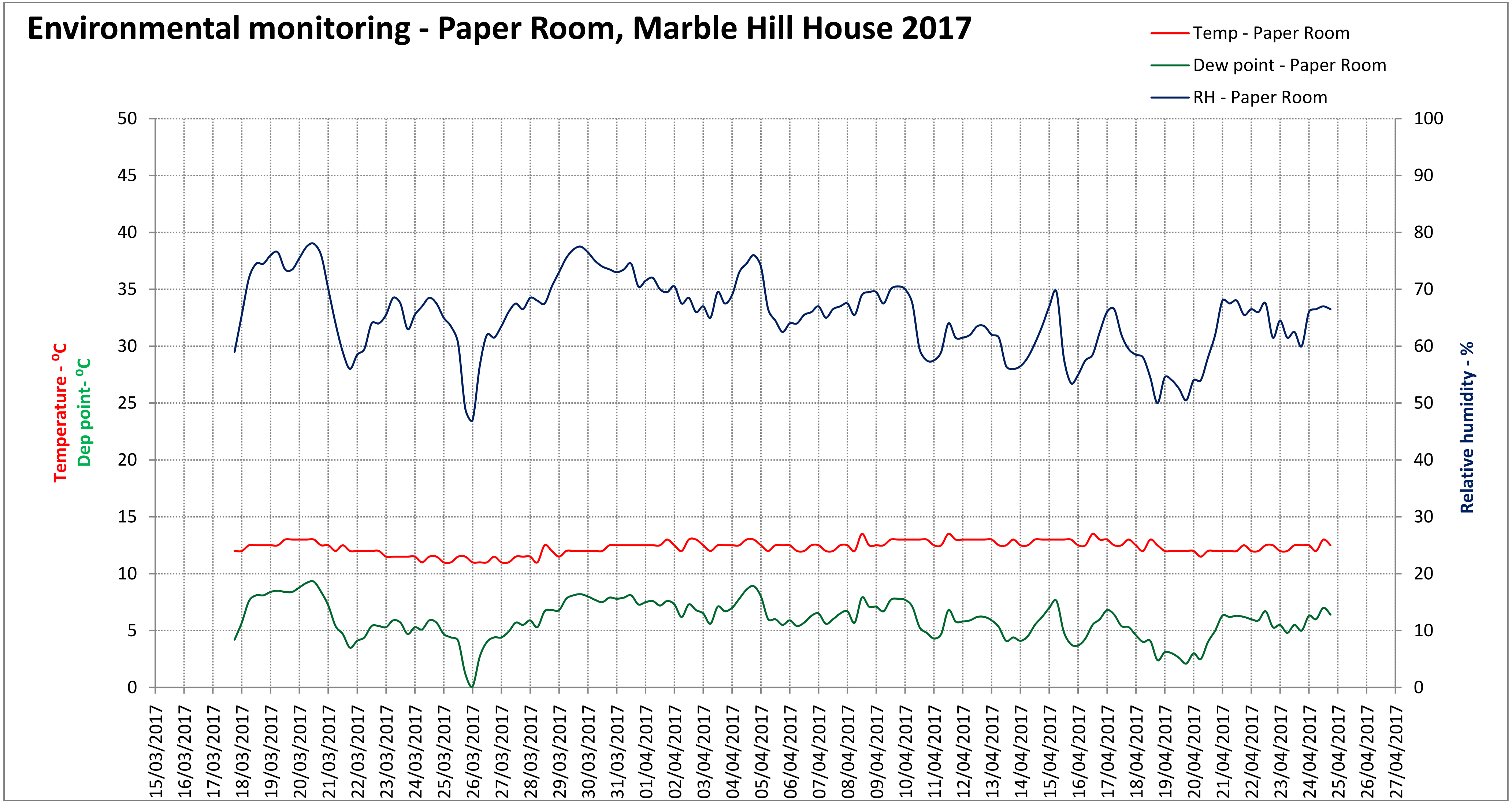
The results indicate the masonry represented by column G1 is effectively dry, increasing slightly at depth (towards the NW corner). Interestingly there is little variation in the mcs of the 3 dowels (with regard to height).

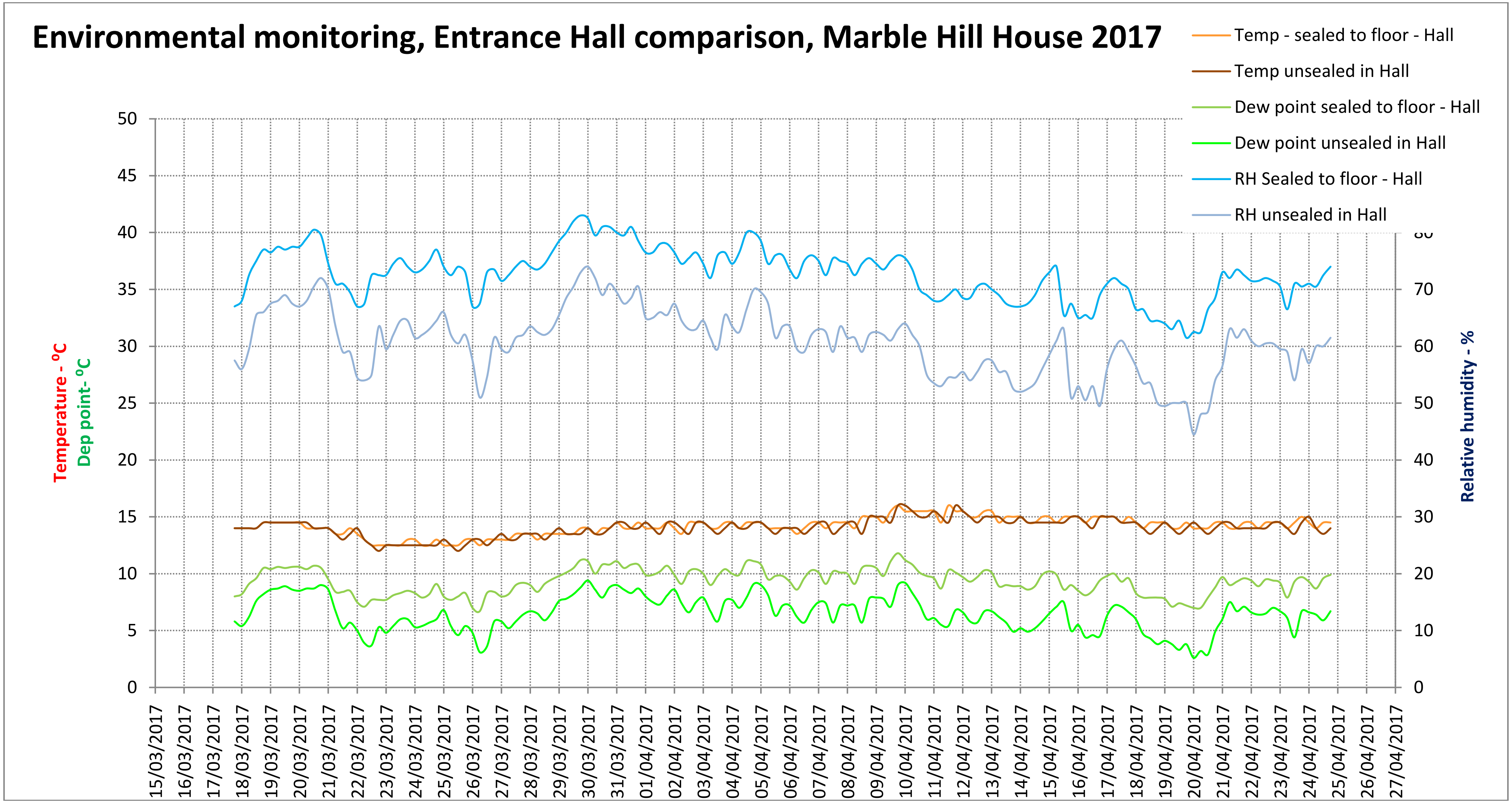
The dowels of column G2 indicate very high water loading at the base of the wall, with high mcs at depth at both 750 and 1000mm above floor level.

Column G3 again has saturated masonry at floor + 350mm, reducing to just damp above this point.

All dowel monitoring in the cellar showed the masonry to be saturated.

Environmental monitoring – (Grid lines mark mid-night – 00:00 hrs).





Environmental monitoring, Entrance Hall comparison, Marble Hill House 2017
Temp - sealed to floor - Hall
Temp unsealed in Hall
Dew point sealed to floor - Hall
Dew point unsealed in Hall
RH Sealed to floor - Hall
RH unsealed in Hall
Temperature - °C
Dep point- °C
Relative humidity - %
0
5
10
15
20
25
30
35
40
45
50
60
70
15/03/2017
16/03/2017
17/03/2017
18/03/2017
19/03/2017
20/03/2017
21/03/2017
22/03/2017
23/03/2017
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27/04/2017

Discussion

The environment in the Paper Room is quite variable. Although the temperature is reasonably stable, there is significant variability in humidity. The external environment was not monitored, although this variation in RH is almost certainly in response to external conditions – becoming 'damper' during wetter periods.

The comparison of data acquired from loggers sealed and un sealed adjacent to the Hall floor was similar to that recorded in 2013 – (see page 11), with the exception that the data of the sealed logger in 2013 showed high and stable RH against the floor surface, whereas this data set shows the RH (and dew point) curve profiles replicating each other – albeit the RH of the sealed logger being approximately 10% higher than the unsealed logger. The reason for this is unclear – possibly indicating a less effective seal this time around. With regard to overall variability, the fluctuations and graph profiles bear some resemblance to those recorded in the Paper Room, indicating the main driver of RH fluctuation in this case is also the external environment.

Conclusions

it is understood that there is a simple system of air ducts heat and circulate air to all rooms (except the paper room).

The data from the environmental monitoring of the hall do not give us any insight into the condition of the building with regard to dampness, other than the internal relative humidity is driven by external weather conditions. This is not unusual where the internal environments of most buildings (modern and historic) are affected often to a great extent by external weather conditions. It is possible that as the external ground becomes wet due to rainfall there is a lag effect and the relative humidity of the internal environment elevates some hours after rainfall. However this could only be confirmed with further environmental monitoring with a logger placed externally to enable comparison with external weather conditions.

However, the masonry of the cellar is saturated and therefore it is unlikely that the change in internal RH in the hall is readily affected by saturation of the external ground and wall bases (which are probably always wet). As such it would seem more likely that air leaking into the building from outside is the main reason for RH variability.

The variability in the environment of the paper room does seem to match that of the hall quite closely. As the doors to the Paper Room are kept closed for much of the time, and the Paper Room is not heated by the same system as the rest of the house, it must be that the air of the Paper Room readily equilibrates with the air of the rest of the building somehow.

With regard to the dowel moisture contents, this indicates that the moisture problem is one of surface water which has affected the wall bases (especially in the case of G2 and G3) and then been able to rise up the wall to at least 1000 mm, helped by impermeable internal and external wall coverings making capillary action more efficient. As the walls are effectively sealed in, the water has probably risen as far as it is able and the wall bases and lower 1-1.5 m of masonry will be wet. This situation would seem to continue for all of the W wall of the Paper Room. (There were no opportunities to take physical samples from the W wall of the Dining Parlour.

Recommendations would include ensuring all surface water is effectively collected and discharged clear of the building. Even after this is done it is unlikely the moisture content of the wall bases will respond very quickly-possibly never responding to a significant degree and always remaining damp-wet. In situations such as this, cases can be made to replace the external hard cementitious render with a more vapour permeable one and possibly even to break out the internal concrete slab and fit something like a Lime Crete floor build-up which should preclude the deflection of water from the soil up into the wall bases. However clearly this would be quite intrusive.

As such, in this case it is recommended that external surface water is stopped from affecting the wall bases (using the specifications already put forward-with some work already carried out). It is also important that the present structure of the wall is established. The Paper Room should be plastered internally with a lime plaster-preferably lime putty. The base of the wall will be damp and it is very possible that a damp shadow will occasionally be noticeable at the base of the W wall. As such it is important that the colour of the Lime Wash is chosen with care so as not to magnify the appearance of damp shadow.

Tim Floyd-May 2017