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Does Plaster Retard the Drying of Walls After Flooding?

Dr Brian Ridout, Ridout Associates

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Front cover: Flooding in Stroud, Gloucestershire. © Nick Turner, Alamy Stock Photo

FOREWORD

Remedial works after flooding can range from highly invasive approaches involving extensive removal of affected building fabric, to more 'minimalist' approaches. These approaches differ widely in their respective heritage, social and economic impacts. The project described in this report forms part of a Historic England research programme that sets out to answer the question: How well do 'minimal' approaches to recovery perform compared to conventional methods which are more invasive, disruptive and costly? Dr Brian Ridout, the author of this report, is a biologist and building scientist. He is an international expert on timber decay and damp problems, and worked for many years in Historic England's Building Conservation and Research Team.

SUMMARY

After fire or flood, wall plaster is usually removed from walls in an effort to speed drying. This report presents the results of some preliminary, small-scale experiments to find out whether the removal of lime plaster does in fact speed the drying of walls. The experimental procedure uses a simple and rapid methodology to compare the drying rates of samples of lime plaster and brick as a starting point for further research. The results suggest that a wet wall will not dry more quickly if lime plaster is removed.

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IMAGES

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CONTACT DETAILS

conservation@historicengland.org.uk

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1 INTRODUCTION

Wall plaster is usually removed after fire or flood in the belief the plaster will impede wall drying. If this is true then we would expect the plaster to be drying at a slower rate than the brick behind. If drying was at the same rate or faster than the brick, then the relatively thin layer of plaster should not have any significant retarding effect. If the drying curve of the plaster was steeper, then it might even help to pull water from the wall and leaving the plaster on would be an advantage. This can be investigated by plotting drying curves of brick and plaster specimens with the same dimensions. The following experimental procedure has been used as a starting point, because the methodology is simple and rapid.

2 MATERIALS

The following samples have been collected:

- **Wall and ceiling plaster**
  Bryn Hafod House, Kettering
  Late 19th century

- **Wall plaster**
  13 Oak Cottages, Quarry Bank Mill, Wilmslow, Cheshire
  Late 18th century

- **Brick**
  Ditherington Flax Mill
  Late 18th century

3 METHOD

1. Samples were cut with an angle grinder into blocks that were approximately 50mm x 50mm x 20mm thick (the 20mm being the original thickness of the wall plaster sample). These are shown in Figure 1.

2. Six no Brick (D1–D6) and six no Oak Cottage (A1–A6) samples were allowed to equilibrate at warm room temperature for 3 days and then weighed.

3. Samples were submerged for 12 hours in tap water to simulate flooding.

4. Blocks were then blotted to remove excess water and allowed to dry at a warm room temperature. They were stood in a metal baking tray, with three of the plaster samples top-coat up (A1–A3) and three base-coat up (top coat about 1mm thick). This is shown in Figure 2.

5. Samples were weighed at 60-minute intervals. The drying period was long and so there are gaps in the data during the nights. The environment was monitored.

6. Dry weights were obtained by cooking for five hours at 45°C.

Figure 1: The labelled samples.
Figure 2: After soaking, with A4–A6 inverted.

4 RESULTS

4.1 Moisture Absorption and First-stage Drying

Equilibrium moisture contents (%mc) after 3 days at room environment, together with wet %mc and volume are all shown in Table 1. The room environment was monitored at 30-minute intervals throughout the drying and proved to be reasonably consistent:

Mean relative humidity (%RH) = 46.4 ± 3.44
Temperature (°C) = 22.1 ± 0.51

Table 1				
Sample No	Material	Equilibrium %mc	Wet %mc	Volume cm^3
D1	Brick	0.1	16.0	47
D2	Brick	0.0	16.5	49
D3	Brick	0.1	15.6	44
D4	Brick	0.0	15.1	60
D5	Brick	0.0	14.6	57
D6	Brick	0.0	16.3	51
A1	Lime plaster	0.6	16.5	50
A2	Lime plaster	0.4	19.0	62
A3	Lime plaster	0.7	17.0	46
A4	Lime plaster	1.1	18.2	45
A5	Lime plaster	1.3	20.0	50
A6	Lime plaster	0.9	20.3	42

Samples were nearly dry before immersion, with a slightly higher moisture content in the plaster. The volumes of the samples were reasonably consistent.

Saturated moisture content means and standard deviations are as follows:

Brick: 15.7 ± 0.73 (n = 6)
Plaster: 18.5 ± 1.55 (n = 6)

These results suggest that the lime plaster absorbs more moisture than the brick (18.5% compared with 15.7%). However, Table 2 shows that this difference diminishes over a few hours (compare means in red) and then moisture contents decline at a similar rate.

Figure 3 illustrates the early response, where the line for the plaster is steeper than the line for the brick until these drying curves converge after about 10 hours. The lines continue together for these particular samples as shown in Figure 4. Gaps in the curves are hours when measurements were not taken.

Table 2					
Sample No	% mc after drying times (hours)				
	5	15	25	30	40
D1	14.0	9.9	6.3	4.3	1.6
D2	14.7	11.0	7.7	5.9	2.4
D3	13.7	9.7	6.2	4.3	1.6
D4	13.4	9.5	6.2	4.3	1.5
D5	13.0	9.5	6.4	4.6	1.7
D6	14.7	11.4	8.5	6.8	2.5
Mean/sd	13.9±0.69	10.2±0.80	6.9±0.99	5.0±1.06	1.9±0.45
A1	14.3	9.8	6.0	4.2	1.6
A2	17.1	13.1	9.6	7.6	3.1
A3	15.1	11.0	7.9	5.9	2.4
A4	15.4	10.0	5.0	2.8	0.8
A5	16.2	11.3	7.0	4.8	1.5
A6	17.9	12.9	8.7	6.2	1.6
Mean/sd	16.0±1.35	11.3±1.44	7.4±1.70	5.3±1.68	1.8±0.79

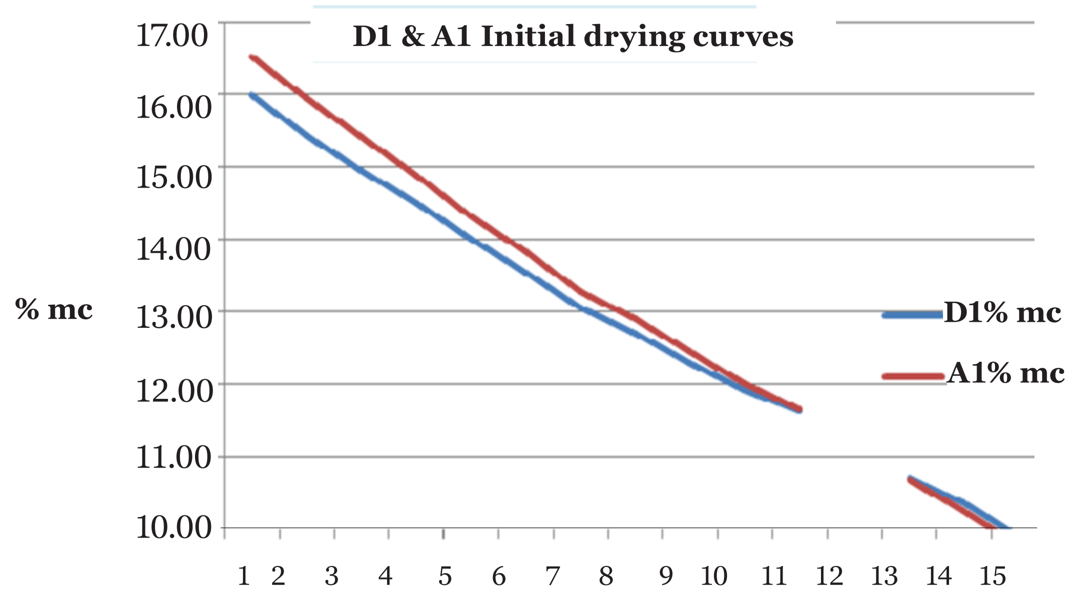

Figure 3

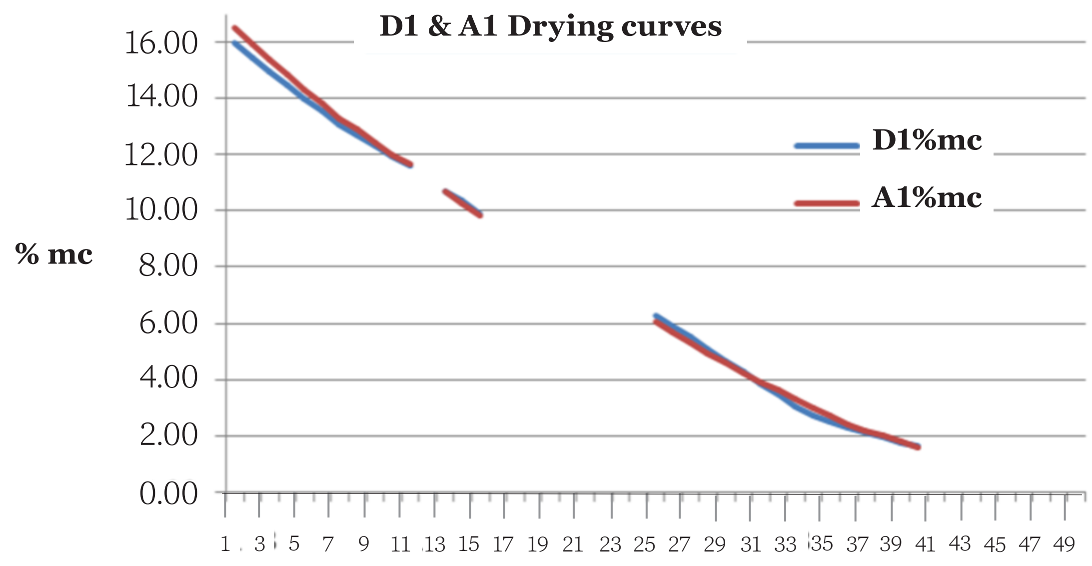

Figure 4

4.2 Within-sample Variation

The brick and lime plaster samples used are subsets of a similar size from the original pieces. Variation in moisture sorption between the brick samples, and between the plaster samples should therefore be caused by natural material variation and not because the materials came from different sources.

The six brick samples provided a mean moisture content after soaking for 12 hours of 15.7 % with a standard deviation of only ± 0.7. The six first stage drying curves are shown in Figure 5, where it will be seen that the angle of the drying line is similar so that they are all drying at the same rate even if the starting moisture content and slope varies slightly. The lines are not entirely straight because these curves were obtained in a fluctuating room environment.

The six lime plaster samples provide a mean moisture content after 12 hours soaking of 18.5% ± 1.55. The variability is greater than found in the brick and is shown in Figure 6. Nevertheless the drying rate (slope of the line) is similar to that of the brick.

Plaster samples A1–A3 were dried with the top coat face upwards and A4–A6 with the rougher base coat upwards. The effects of this are shown in Figures 7–9.

In each graph, blue is brick, red is plaster with the top coat uppermost (A1–A3), whilst green is the exposed base coat (A4–A6). In each case the A1–A3 drying curves are similar to the D1–D3 brick, whilst the A4–A6 curves cut across the other two at a steeper drying angle.

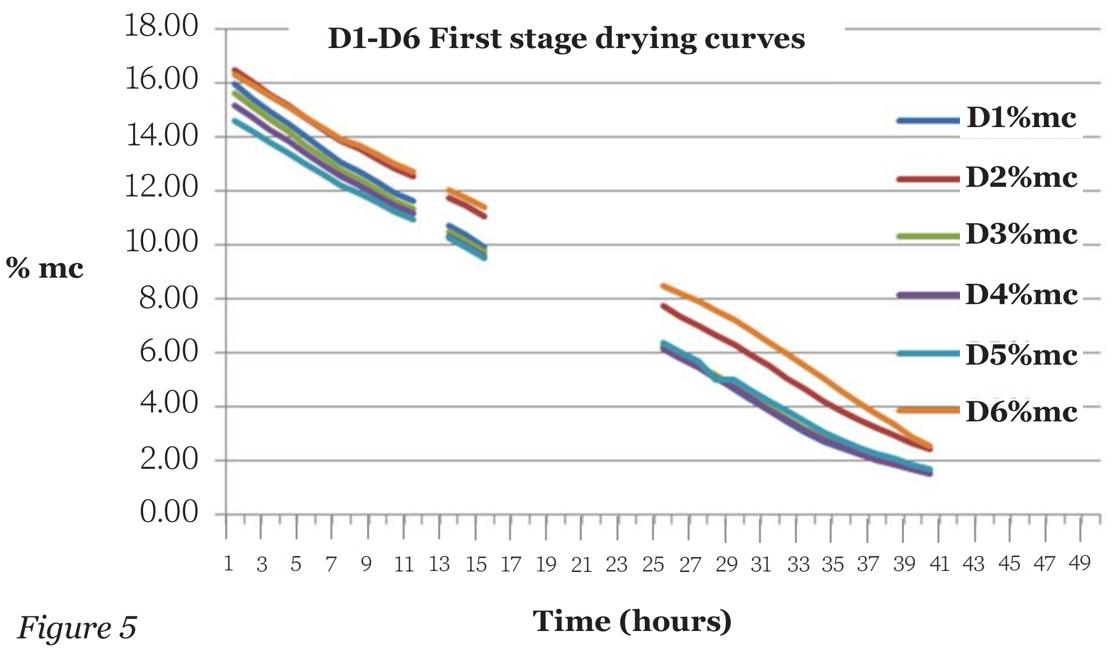

Figure 5

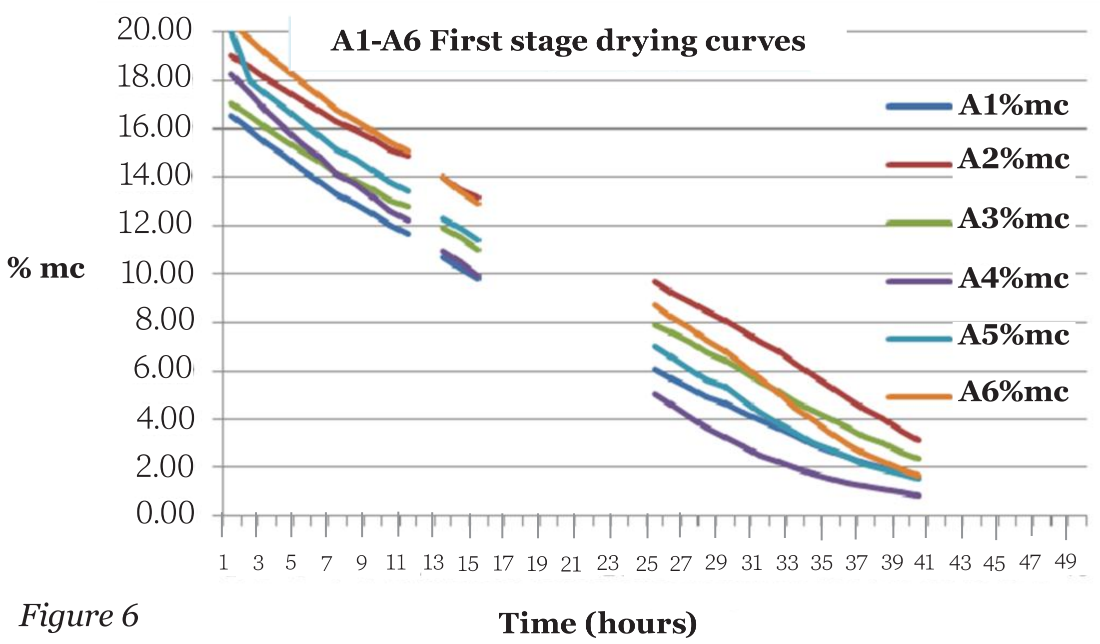

Figure 6

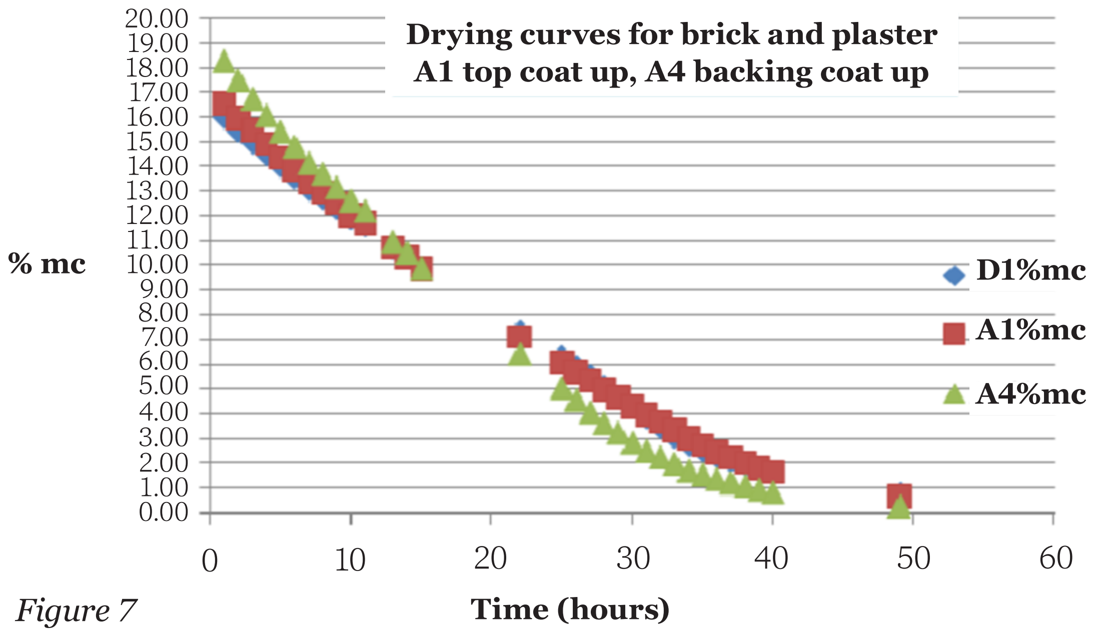

Figure 7

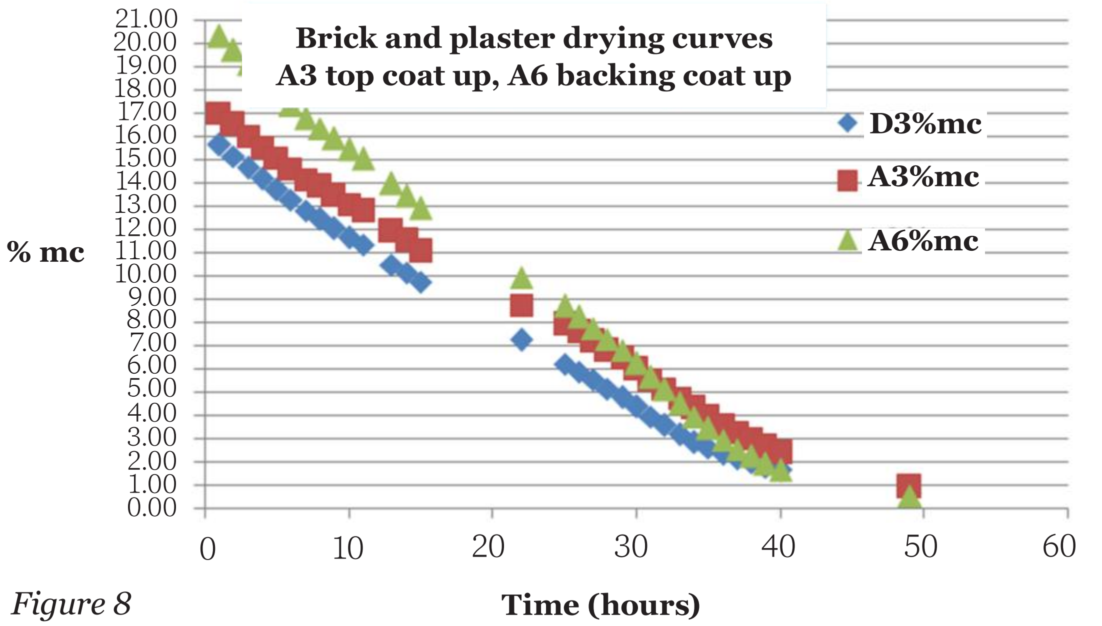

Figure 8

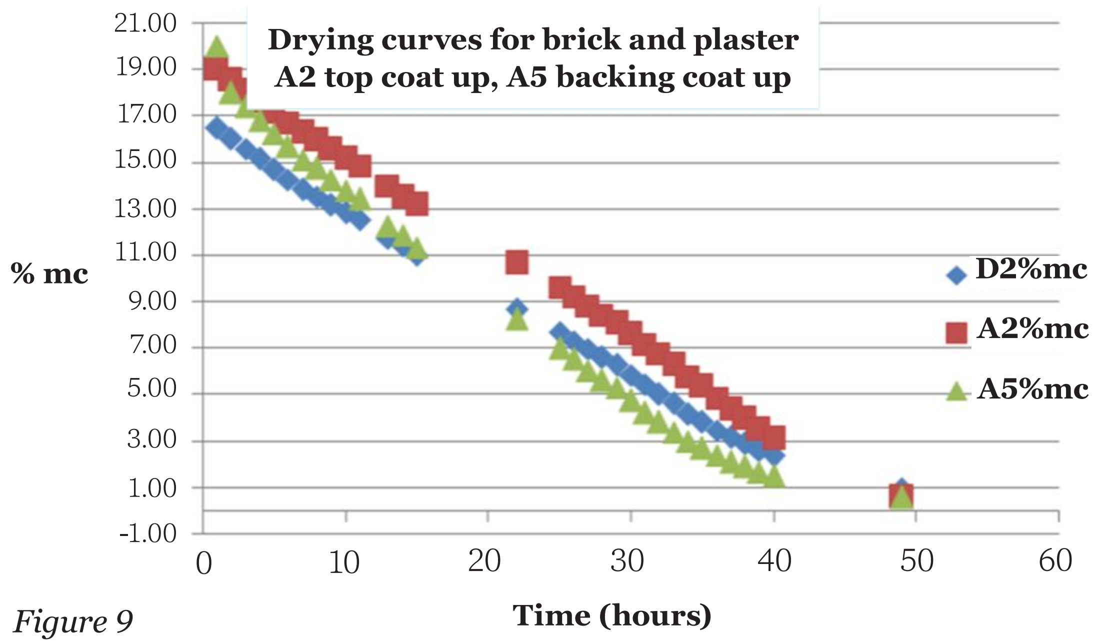

Figure 9

4.3 Second-stage Drying

The first set of results indicated when second-stage drying might be expected, but this commenced in the middle of the night when no readings were taken. The entire experiment was therefore run again to second stage drying in a more practical time frame. The results are shown in Figures 10 and 11. Second stage drying seems to commence at about 2% for both the brick and the lime plaster.

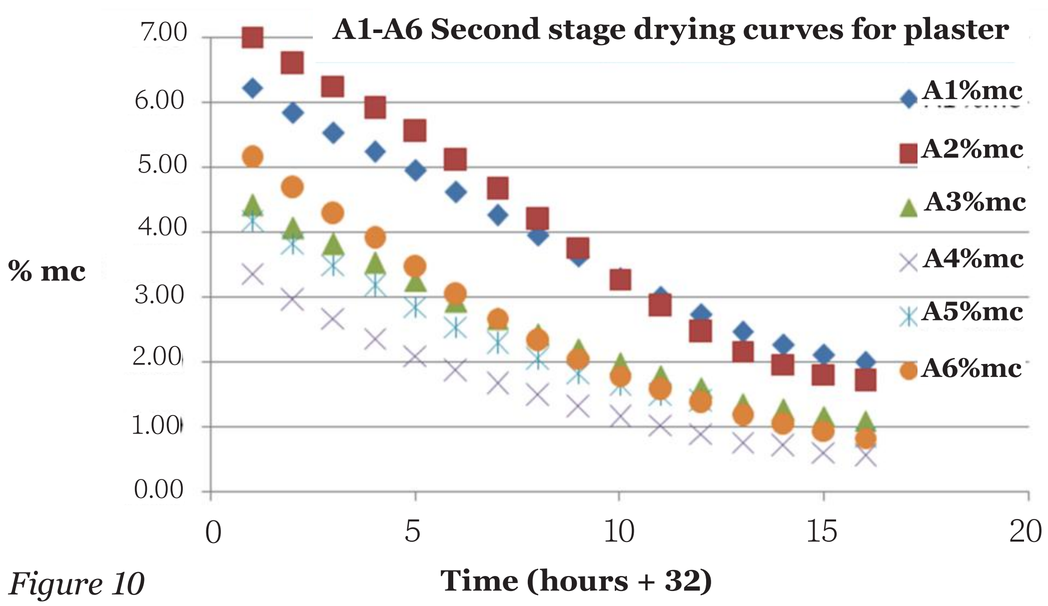

Figure 10

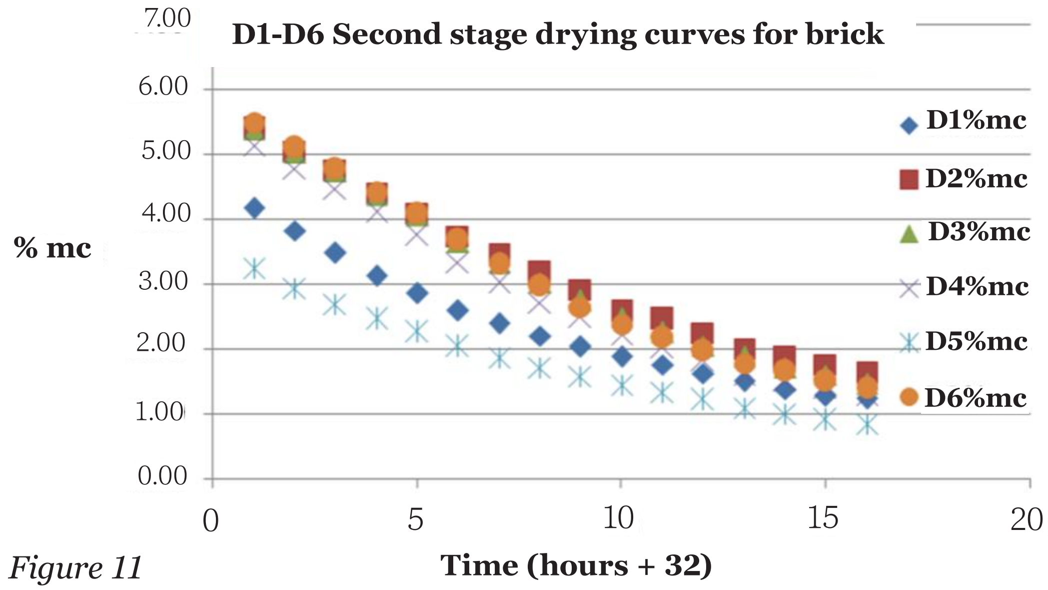

Figure 11

5 CONCLUSIONS

The brick and lime plaster samples used in this experiment dried at similar rates, with the rough plaster base coat providing the steepest drying curve. The moisture content of the plaster was sometimes a percentage or two higher than the brick, but both showed a rather wide and overlapping moisture distribution, so this difference is unlikely to be consistent or significant.

The plaster layer, even where a little wetter, is still very thin compared with the thickness of the wall and there are no indications that it would retain moisture and impede drying. These results do not support the idea that removing lime plaster will increase the drying rate of the wall behind.






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