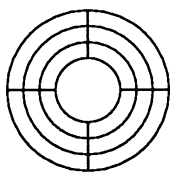


Manchester Building and Testing Laboratories Limited



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29 November 2022

RE: NatWest Building University of Manchester - Facade Samples

Recom Solutions, Manchester University Nat West Building Oxford Road and Dover Street Elevations

Observations and Conclusions.

Comparison between the Oxford Road Elevation and the Dover Street elevation.

- 1 The front elevation render (Oxford Road) differed in analytical test results to that of the side elevation (Dover Street).
- 2 Both were made up of two undercoats with evidence of the first coat having been correctly scratched in both instances in order to receive the final undercoat.
- 3 The total thickness of render in each elevation varied between 16 mm to 20 mm which is normally considered adequate.
- 4 The thickness of each succeeding render undercoat was generally not thicker than the preceding coat which is generally a specific requirement.

5. The corrected cement content was 18% to 20% Ordinary Portland Cement (OPC) in the two coat Oxford Road samples with the preceding coat slightly the richer in cement which again is generally a specific requirement.
6. The sand to cement ratio was between 18% to 19% OPC in the Dover Street sample with the preceding coat slightly the richer in cement which again is generally a specific requirement.
7. The sand recovered from each render layer was tested to check its loose fill bulk density. The two samples from the Oxford Road elevation measured 1460 kg/m^3 whilst the two samples from Dover Street measured 1495 kg/m^3 . OPC generally has a loose fill bulk density of around 1450 kg/m^3 thus there is little difference between mix proportions calculated by weight and those interpreted by volume.
8. The mix proportions were generally around 1:4 to 1:4.5 both by weight and interpreted by volume.
9. The big difference found was the quality of the sand used. The sand used on the render samples taken from the Dover Street elevation was found to be reasonably well graded and compliant with BS1200 Type A as referred to in clauses 6, 7 and Table 1 of BS 5262 which was Typical UK Practice in the last century.
10. The sand used on the render samples taken from the Oxford Road elevation was found to be very poorly graded, almost single sized and at significant variance to Table 1. In general, it is prone to high shrinkage, cracking and possible loss of adhesion.
11. There appears to be a higher incidence of failure in the render on the Oxford Road elevation than the Dover Street elevation.

- 12 Perhaps the most important factor in any render is the choice of a correct, well graded sand that satisfies the relevant British Standard Specification and is derived from a reliable and repeatable source.
- 13 If you work on the principle that by halving the diameter of a particle its total specific surface is increased exponentially. For example, using sand just one grade finer than it should be, the total specific surface of the sand is increased exponentially and almost quadrupled.
- 14 This means that the water/cement paste (which is the ‘glue’ sticking it all together,) has to cover almost four times as great an area than it was designed to be, and also at a significantly thinner application rate. With the free water content having to be similarly increased just to achieve a correctly workable mix the strength is decreased and the shrinkage, loss of adhesion and cracking is correspondingly increased.
- 15 Thus it can be seen that a good reliable choice of sand ($\leq 5\text{mm}$) is of vital importance. Mean mix proportions of the render average out at 1:4 to 4.5 by mass or mortar designation ‘ii’ to BS 5262 Table 2 and they are fairly consistent taking Table 2 recommendations for severe exposure.
- 16 Table 2 also recommends a “first undercoat thickness of 8 to 12 mm with a second undercoat thickness of 6 to 10 mm with a total thickness of not normally less than 20 mm excluding texture.”
- 17 All the samples showed clear evidence of adequate scratching on the first undercoat. It is impossible to know if the correct curing time elapse has occurred between coats so that the application of a new shrinkable render coat being placed onto a first coat that is still shrinking is avoided. This, of course, applies to all newly applied coats.
- 18 Due to the age of the render the source of the well graded sand used in the Dover Street render has probably been long since exhausted.

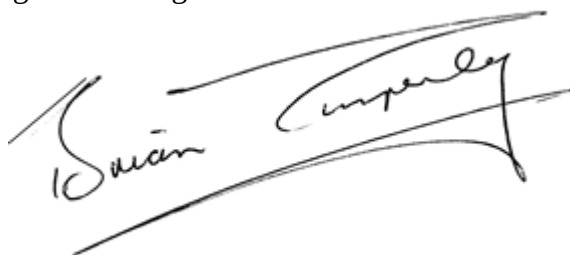
- 19 I believe the best possible way of going forward would be to consider using a modern proprietary patching render that contains such things as shrinkage compensators, bonding intensifiers, etc. by following the manufacturers preparation and application requirements together with correct jointing details.
- 20 Generally avoiding long narrow render applications etc.
- 21 Cutting out affected areas using non-percussive techniques that could loosen any adjoining render, always and following manufacturer's instructions at all times.
- 22 There are plenty of specialist high quality patching-render applicator manufacturers such as Sika and Webber together with many other premium grade manufacturers etc. that supply proprietary specialist premium patching mortars.
- 23 The paint already on the structure generally is applied at a total thickness of 0.7 mm to 0.9 mm.
- 24 The render at the Dover Street elevation is very wet behind the paint film and this suggests that a leakage from above is probably causing this phenomenon, with the paint film locking it in the render. This source should be checked because where the render becomes saturated behind the paint film it could easily be subject to frost and freeze-thaw attack. This already appears to have started or occurred.
- 25 Should you wish to discuss this further please do not hesitate to contact us and discuss the situation in greater depth.

Gradings

Sample number	Oxford Road	Dover Street	BS 1200	
Recovery and grading of sand			Type S	Type G
5.00 mm	100.0	100.0	98-100	98-100
2.36 mm	100.0	100.0	90-100	90-100
1.18 mm	99.5	95.8	70-100	70-100
600 µm	97.5	77.1	40-100	40-100
300 µm	80	32.2	5-70	20-90
150 µm	1.5	2.3	0-15	0-25
75 µm	0.5	0.9	0-5	0-8

Highlighted in **yellow**: - Indicates failure to the required BS 1200 Type 'S' and is classed as single size and much too- fine.

Manchester Building and Testing Laboratories Limited.



Brian Timperley

6 Grading

The sand shall be of type A or type B and graded within the limits given in Table 1, when determined according to clause 4.

Table 1 — Sands for external renderings, internal cement and lime plastering

BS sieve	Percentage by mass passing BS sieves	
	Type A	Type B
mm	%	%
6.30	100	100
5.00	95 – 100	95 – 100
2.36	60 – 100	80 – 100
1.18	30 – 100	70 – 100
µm		
600	15 – 80	55 – 100
300	5 – 50	5 – 75
150	0 – 15	0 – 20
75	not greater than 5	not greater than 5

NOTE Sands complying with the grading requirements in Table 1 for sieve apertures in the range 6.3 mm to 600 µm but exceeding the requirements for the percentage passing the 300 µm, 150 µm and 75 µm sieves may also be considered as being satisfactory where there is evidence of acceptable performance in use. Although insufficient information exists to provide generalized and authoritative guidance on the use of such materials, local experience of their performance in use may help in the evaluation of their suitability for particular applications.

Table 2 Table deleted

6.2 A sand whose grading falls outside the above limits on sieves other than the 5.00 mm sieve in Table 1 and the 2.36 mm sieve in Table 2, by a total amount not exceeding 5 % shall be regarded as being within those limits. This 5 % can be split up, for example, as 1 % on each of three sieves and 2 % on another, or 4 % on one sieve and 1 % on another.

NOTE 1 Sands which just fall outside the above limits due to a small excess of coarse particles can often be made to comply with this British Standard by screening through a suitably sized sieve. Finishing coat sands as specified in Table 2 can often be obtained by screening undercoat sands in a similar manner.

The required grading for either undercoats or finishing coats can often be attained by blending together sands which are by themselves unsuitable.

NOTE 2 The most suitable grading of sand for an external rendering will depend, to some extent, upon the finishing treatment. The sand grading specified will, in general, be suitable for the undercoats and for some finishing coats such as the smooth (floated) finishing coats, the scraped finishes and for pebble-dash or dry-dash. For some textured finishes, such as those produced by treatment of the freshly applied final coat with a tool, it may be desirable to remove the coarser particles (e.g. by screening through a 2 mm sieve), while for others such as “torn texture”, some proportion of material coarser than 5 mm may be needed. For roughcast (wet dashing or harling) the grading and maximum size, will vary according to the texture required and the type of aggregate: the proportion of coarse material (over 5 mm) to fine should be about 1 : 2.

7 Supplier’s certificate and cost of tests

The supplier shall satisfy himself that the output at the source of production complies consistently with the requirements of this British Standard and, if requested, shall give a certificate to this effect to the purchaser or his representative.

If the purchaser or his representative requires independent tests or the certification of individual consignments, the samples shall be taken before or immediately after delivery at the option of the purchaser or his representative, and these tests shall be carried out in accordance with the appropriate requirements of this British Standard on the written instructions of the purchaser or his representative.

Unless otherwise specified with the enquiry and order, the supplier shall supply free of charge the material required for testing and the cost of the tests (unless otherwise stipulated) shall be borne:

- a) by the supplier, in the event of results showing that the material does not comply with the standard;
- b) by the purchaser, in the event of results showing that the material does so comply.

8 Additional information to be furnished by the supplier

When requested by the purchaser or his representative, the supplier shall provide any of the following additional particulars.

8.1 Source of supply

8.1.1 County.

8.1.2 Parish.

8.1.3 Name of quarry or pit.

8.1.4 For material dredged from seas, estuaries or rivers, the precise locality from which the material was obtained shall be stated.

8.2 Group classification (determined according to the group classification of aggregates given in BS 812).