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REVIEW OF STUCCO TESTS BY BUREAU OF STANDARDS*

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HE first stucco tests were started in 1911, and consisted of small panels of metal lath, the majority of which were covered with cement and lime stucco in the approximate proportions of 2/3 part cement, 3 parts sand, and 1/3 part hydrated lime, by volume. panels were erected primarily for the purpose of determining the effectiveness of various treatments or protective coatings of the metal itself in preventing corrosion. These tests (which are still in progress) have demonstrated conclusively that galvanizing is the most effective treatment of metal lath for its preservation, and that a coating of asphalt or "dip" offers a sufficient degree of protection to the metal to ensure its satisfactory durability under average exposure conditions. Many of the painted or dipped lath panels are still in excellent condition after nearly seven years' exposure, notwithstanding the fact that the metal is exposed on the inside and the construction not entirely weatherproof. Perhaps the most important lesson from these original tests, especially in view of later experience, was that corrosion of metal lath is one of the minor obstacles to the development of a successful stucco.

The tests made in 1915 were carried out on a large scale, under conditions that similate actual construction. The test panels were large enough to contain window or door openings, and to allow the plasterer the same freedom of action that he would have in a regular wall. Regardless of the distribution of stuccos, the concrete panels as a group have the highest rating, the plaster board panels the lowest. In these tests, the back-plastered metal lath panels probably take second place, and the gypsum block panels are near the bottom of the list.

Method of Finishing Cause of Cracking

There were certain outstanding facts which furnished suggestions for future work. In the first place there was evidence that the prevalence of craze and map cracking on most of the 1915 panels was due to the method of finishing. It has been specified that a sand float finish should be used, and that this finish should be given in the shortest possible time after laying on the finish coat. The purpose of this was to avoid disturbing the so-called initial set of the cement. In consequence the very great majority of the panels were floated when too soft, which resulted in bringing to the surface a rich mixture of cement or cement and lime, subject to high shrinkage upon drying out. We believe now that this accounted largely for the general and early appearance of fine cracks on most of the panels, with some contribution also from the use of too rich mixtures.

Cracks Resulting from Shrinkage of Sheathing

Another peculiarity that impressed itself upon us was the appearance of large and prominent cracks on all the panels over diagonal sheathing. These cracks invariably first appeared off the corners of the windows and running across the direction of the sheathing, and there is no question that they were brought into prominence, if not actually produced, by the shrinkage of the sheathing. The fact that these characteristic cracks did not appear on the back-plastered panels, and that the latter were largely free from prominent cracks, resulted in a higher rating for this group than for the metal lath panels over sheathing.

Weak Base Common Cause of Stucco Failure

One other consistent development in these 1915 panels is of special importance, viz.: It was noted that the stuccos on the plaster board and gypsum block panels and on the monolithic concrete panel coated with bituminous waterproofing were in poor condition, especially after they had passed through the second winter. All of these were stuccoed with the standard mixture of I part cement, 1/10 part hydrated line and 3 parts sand, with only slight modifications in the method of applying. The results obtained on these panels indicate, not that this stucco is bad, but that the combination of this stucco and a weak base is bad. Field observations which I had an opportunity to make last year demonstrated this fact conclusively, that a strong cement stucco on a weak base is a common cause of stucco failure, and in practice this seems to occur most frequently in the application of brown and finish coats much higher in cement than the scratch coat, which logically should be the strongest portion of the stucco. The explanation of this failure must be sought in the wellknown shrinkage of cement mortar upon drying out, and in the subsequent movements caused chiefly by varying moisture conditions.

The 1916 Tests

In laying out the programme for the second year's work it was found most feasible to erect a sort of monitor or penthouse, providing 22 additional panels, on the roof of the original building. This, of course, precluded all but frame construction. The back-plastered panels had shown up so well in 1915 that it was decided to include a larger proportion of these in the new layout, and only onehalf the monitor or annex, as it is more commonly called, was sheathed. To minimize the shrinkage effects 6-in. diagonal sheathing was used, alternating in direction on adjacent panels. It was decided also to change the method of finishing, partly in the use of less water on the under coats, and partly in waiting for the stiffening of the finish coat to develop before finally floating. This procedure, together with the use of a number of leaner mixtures, was adopted in the hope that craze and map cracks would be largely overcome. A number of special features were also included in certain panels with a view to minimizing the effects of movement of the wood frame.

Deductions from 1916 Tests

The deductions from the 1916 tests may be summarized as follows :----

r. Diagonal sheathing of unseasoned wood is apparently an unsatisfactory backing for stucco. With only unseasoned wood available horizontal sheathing would appear to better construction, provided sufficient bracing of the wood frame is assured.

2. Back-plastered construction appears to be best for frame structures, so far as the integrity of the stucco is concerned. This carried with it, however, a need for fuller information regarding the insulating qualities of walls so constructed.

3. Lean mixtures promise better cement stuccos, provided the necessary plasticity and density can be maintained by proper grading of the aggregate.

4. There is still need of further information as to the value of wood lath and high lime stuccos. To date the tests indicate that wood lath is not as satisfactory as metal lath, and there is no conclusive evidence that a modern hydrated lime stucco will endure satisfactorily in severe climates.

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