

30. The duties of the Provisional Council shall be to provide the register called for by this Act, to enter therein the names of those who are entitled to registration, and who apply therefor under the provisions of section 7, sub-section (b), and to call within six months from the coming into force of this Act the first general meeting of the Association for the said purposes; and for the purposes of organization of the Association they shall have the powers conferred by this Act on the Council of the Association. The powers of the said Provisional Council shall cease on the election of the first regular Council of the Association.

31. No provision of this Act restricting the practice of the profession or imposing penalties therefor shall take effect until one year after the passing of this Act.

32. Every person registered under this Act may have a seal, the impression of which shall contain the name of the engineer and the words "Registered Engineer, Province of New Brunswick," with which he may stamp all official documents and plans.

33. The activities of the Association are hereby restricted to the functions necessary to the administration of this Act.

## NEW DEVELOPMENT IN SURFACE-TREATED CONCRETE AND STUCCO\*

BY J. C. PEARSON and J. J. EARLEY

THE joint authorship of this paper requires a word of explanation. The writers have been closely associated by their membership on the Advisory Committee of the Bureau of Standards' stucco investigation, and on the Committee on Treatment of Concrete Surfaces of the American Concrete Institute. Both residing in Washington, they have had an unusual opportunity to study and discuss the results obtained from the experimental work of the Bureau in concrete and stucco, as well as those from Mr. Earley's work in connection with his contracting business. These discussions often led to the consideration of possibilities somewhat beyond the range of established practice, and, in fact, beyond the limitations of established theories relating to the gradation and proportioning of the ingredients of mortar and concrete.

It was therefore natural that ideas were conceived which were too visionary to be of use to any committee, but nevertheless deemed worthy of further investigation on the writers' own account. If these ideas proved to have no value, no one would be the loser; if they did amount to anything, the results would be a contribution to our knowledge of stucco and concrete.

### Scientific Combination of Particles

Hence it is a matter of some gratification to the authors to be able to describe these new developments in the treatment of concrete surfaces, the success of which is due largely to scientific studies of the behavior of combinations of various sized particles, and the development of a technique adequate for the molding of these combinations of particles in any desired form and place.

Studies of the experimental stucco panels at the Bureau of Standards led to the general conclusion that by adherence to well established practice, structurally sound and durable stucco could be secured, but that a great deal could be, or ought to be, done to improve its appearance. Cracking and map cracking are common to most stuccos, and are especially objectionable on surfaces of fine texture; the monotony of the cold grey cement color is objectionable, and is only partially relieved by the use of white cement and mortar colors; and finally the muddy appearance (due to cement, or cement and pigment, being too much in evidence) is objectionable from an artistic standpoint.

Consideration of these matters suggested at once the use of less cement, and it became evident that by efforts in this direction improvement in appearance might be ob-

tained. The apparently insurmountable obstacle to this departure from usual practice was, of course, the lack of plasticity in the leaner mixtures. Various methods of overcoming this difficulty were considered, and some experiments were made which indicated that a real improvement might be obtained by substituting fine inert material for a portion of the cement.

The easiest way to accomplish this result seemed to be by using blended cements, that is, normal cements ground with a certain percentage of sand, stone-screenings or other suitable materials. These experiments were never carried very far, however, for it did not seem possible that any method which might be devised for retaining plasticity could bring about the desired result, viz., the elimination of all objectionable features mentioned above.

### Lean Mixtures Successfully Applied

Serious as was this lack of plasticity in the lean stucco mixtures, it was after all, something that could be overcome by work. This was demonstrated by the fact that mixtures as lean as one part cement to six parts of stone screenings were applied on some of the Bureau of Standards panels, with excellent results. But the improvement in these panels as compared with some of the easier working combinations did not seem great enough to justify the increased cost of application. The question finally arose whether by careful attention to gradation of the aggregates this improvement in appearance might not be so enhanced that the cost would be a secondary consideration.

This idea came from the fact that Mr. Earley had succeeded in making complicated casts of concrete from specially graded aggregates in such manner that a very large percentage of the area of the treated surface (first wire brushed and then washed) was aggregate, and a very small percentage cement. Possibly due in part to the higher reflecting power of the surfaces of the exposed aggregates, the color of the concrete surfaces thus produced was determined almost wholly by the color of the aggregates, and only very slightly affected by the cement itself. A most convincing demonstration of this fact was obtained by constructing two concrete slabs containing exactly the same proportions of specially graded aggregate, the one being mixed with gray cement, the other with white cement. After the surface treatment of brushing and washing had been applied, only an expert could have determined which slab contained the grey cement and which the white.

To digress still further for a moment, this method of obtaining permanent and very pleasing colors in concrete surfaces is such an important item in the development of the processes here described, that it is worthy of fuller explanation. Before color in concrete surfaces can be under artistic control, a technique must be developed which has for its medium the elements of the concrete itself.

Although in problems involving appearance aggregate is by reason of its greater bulk the major element, and cement the minor, it is, nevertheless, the color of the cement which is the natural color of normal concrete. The reason for this is that the cement is finely ground and deposits itself, paint-like, over the surfaces of the aggregates and colors the whole mass.

### Aggregate Deposited in Surface

If, therefore, concrete is to receive its color from the cement paste, variation must be obtained by the addition of pigments to the cement following the well-established practice of mixing paints; but if the aggregate is to be the source of color, the concrete must be so designed and manipulated as to deposit in the surface the greatest possible amount of aggregate.

Any great degree of success can hardly be expected in coloring concrete through the cement. The choice of colors is restricted by chemical reaction with the cement, which causes them to fade or change; depth of color is restricted by strength requirements of the concrete, which limits very closely the amount of pigment which may be added to the cement. Therefore, with the choice of color limited by one requirement and the depth of color by another, the cement itself must remain dominant.

\*Excerpts from paper presented to the American Concrete Institute.