

## SURFACE FINISH IN CONCRETE BUILDING

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A pleasing and consistent surface finish generally has not little to do with the strength of a concrete structure, but it is not inconsistent with maximum strength in any structure.

Next to form or design, the character of the surface has most effect on the appearance of concrete, whether in a building arch, wall or abutment; in fact, when the view is had at a very close range, or in such structures as retaining walls or pavements, the surface finish may take precedence over proportion.

It is not intended to attempt a full discussion of the subject, but only to describe some methods used in trying to obtain satisfactory surfaces in the various classes of concrete work done in the South Park system of Chicago.

The imperfections in the exposed surfaces of concrete are due mainly to well known causes which may be summed up as follows:

1. Imperfectly made forms.
2. Badly mixed concrete.
3. Carelessly laid concrete.
4. Efflorescence and discoloration of the surface after the forms are removed.

Forms with a perfectly smooth and even surface are difficult and expensive to secure. Made of wood, as they usually are, it is not practical to secure boards of exact thickness, joints cannot be made perfectly close, the omission of a nail here and there allows warping and the result is an unsightly blemish when least wanted.

Badly mixed concrete gives us irregularly colored, pitted, and honeycombed surfaces, with here a patch of smooth mortar and there a patch of broken stone exposed without sufficient mortar. Careless handling and placing will produce the same defects.

But granting we have the best of labor, that all reasonable expense and care is had in making up forms, in mixing, handling, and placing the concrete, that it is well spaded, grouted, or the forms plastered on the surface, the results are not satisfactory. All these efforts tend to produce a smoothly mortared surface, and the smoother the surface the more glaring become minor defects. The finer lines of closely-made joints in the forms become prominent, the grain of wood itself is reproduced in the mortar surface, hair-cracks are liable to form, and, worst of all, efflorescence and discoloration are pretty sure to appear. We surely have been working on a wrong theory.

It is of doubtful efficiency to line the forms with sheet metal or oilcloth. Imperfections still appear.

Two methods suggest themselves as likely to overcome the defects alluded to above. (1) Treating the surface in some manner after the forms are removed to correct the defects, and (2) using for surface finish a mixture which will not take the imprint of and which will minimize rather than exaggerate every imperfection in the forms and which will not effloresce.

Methods of treating the surface by bush-hammering, tooling and scrubbing with wire bushes and water have been described in various published articles, all of which have for their object the removal of the outer

skin of mortar in which the various imperfections exist. But the method most used in the South Park work is the acid treatment. It consists of washing the surface with an acid preparation to remove the cement and expose the particles of stone and sand, then with an alkaline solution to remove all free acid, and finally giving it a thorough cleansing with water. The operation is similar and always effective. It can be done at any time after the forms are removed, immediately or within a month or more. It requires no skilled labor—only judgment as to how far the acid or etching process should be carried. It has been applied with equal success to troweled surfaces, like pavements, to moulded forms, such as steps, balusters, coping, flower-vases, etc., and to concrete placed in forms in the usual way. It, of course, means that in the concrete facing only such material shall be used as will not be affected by acid, such as sand or crushed granite. It excludes limestone.

The treated surface can be made any desirable color by selection of colored aggregates or by the addition of mineral pigments. The colors obtained by selection of colored stone are perhaps the most agreeable and doubtless more durable.

There have been moulded in the South Parks shops blocks for buildings, columns, architectural mouldings and ornaments with both red and black crushed granite, all treated with the acid to bring out the natural colors of the stone. There has been a large quantity of concrete pavement laid with torpedo sand surface colored a buff sandstone color with a small quantity of yellow ochre and mineral red and treated with acid. The buff color imparted to the surface is a welcome relief from the glare of the ordinary whitish grey concrete pavement in the sunshine, and the etching of the surface adds to the softness of the color, at the same time preventing any slippiness. The same buff color has been used to a large extent in steps, bases of lamp-posts, and other moulded articles to be placed on or near the ground. With sand as the aggregate thousands of pieces have been moulded for coping, balustrades, concrete seats, drinking fountains, pedestals, etc., which, when treated with the acid, appear like fine-grained, almost white sandstone.

Where there are projections or marks left by the moulds or forms they are tooled or rubbed down before treatment, and where it is necessary to plaster up rough places or cavities in the surface it may be done after treatment, and cannot be detected.

These various classes of work have been done on a large scale during the last three years in connection with the improvement of new parks, and have in all cases proved satisfactory.

The second method of preventing or minimizing surface defect has also been tried in the South Park work with quite a measure of success.

During the years 1904, 1905, and 1906 groups of concrete buildings have been erected in nine different parks, costing with their accessories, from \$65,000 to \$150,000 for each group. These buildings are all monolithic structures, with occasional expansion-joints, the exposed surfaces of walls being of concrete com-