THE ABUSE OF CEMENT.*

By D. B. Butler.

The treatment which cement sometimes has to undergo at the hands of inexperienced users, makes it a matter for wonder that failures are not more frequent. One of the most prolific causes of failure is insufficient attention to the setting properties of the cement under treatment. In very hot weather it is no uncommon thing for a cement to have a very quick initial set, and in using such a cement, therefore, in order to obtain its full strength, it must be mixed and in its allotted position within a very few minutes of adding the water. This often entails the mixing of very small quantities at a time, and if due precautions are not taken, a larger quantity is mixed than can be manipulated before setting commences. This generally results in the use of additional water, and the serious detriment, if not total destruction, of the setting properties of the cement. Many cases of failure have occurred in which the cement being a good quality, though somewhat quick setting, point strongly to over-manipulation or "killing."

Another frequent cause of unsatisfactory work is a dirty and unsuitable aggregate. The admixture of a very small proportion of dirt or loam is quite sufficient to materially deteriorate the strength of a concrete, and too much stress cannot be laid upon the necessity for seeing that all aggregates are free from any foreign dirty matter. A case of structural failure came under the notice of the author a short time back, in which the cement used was perfectly good, but the finer portions of the aggregate consisted of very fine sand, so fine that 60 per cent. passed through a sieve having 70 holes per lineal inch, and 80 per cent. through a sieve having 50 holes per lineal inch. The structure of which it formed part had to bear a considerable thrust, and to aggravate matters, instead of this sand being properly mixed, large patches occurred in which there was no cement at all. In addition to this, the sand contained a considerable portion of loam or foreign matter, and it is not to be wondered at that failure resulted.

The neglect of the proper cooling or aeration of a cement is a frequent cause of trouble, and to ensure satisfactory work, proper cooling cannot be too strongly insisted upon. Of course cement may give good results when used hot from the mill, and the author has manufactured cement which has turned out satisfactorily under these conditions, but to use cement in this state is to court failure. It is sometimes specified that the manufacturer shall store the cement in his warehouse at a stated thickness of say 3 ft., for a certain period, and have it turned over three or four times at regular intervals before being supplied for use, but if this had to be done with the entire output of every factory, it would necessitate an enormous increase in warehouse room, to cover the first cost of which would entail a largely increased price to the consumer. It it therefore advisable, where cement is being used in considerable quantities, to construct temporary cooling sheds, with a good, dry, boarded floor, where the cement can be turned out in sacks or barrels and thoroughly aerated before use. It is sometimes contended that the cement, even if shipped hot, cools sufficiently during transit. Although it undoubtedly cools to a certain extent, it is doubtful if, when tightly packed in barrels, or closely stowed in sacks, it cools sufficiently to allow of its being immediately used with safety.

The exposure to extremes of temperature has perhaps more to answer for in the shape of unsatisfactory work than is generally recognized. If exposed to a summer sun immediately after being gauged, naturally a great deal of the necessary moisture is evaporated, leaving the cement without sufficient to complete the crystallization already set up. The result frequently is that the work crumbles, and shows signs of failure. On the other hand, exposure to frost acts on the water, and by expansion destroys the surrounding concrete. The author once had occasion to investigate a case of failure in which frost was the undoubted cause of the mischief, as there was no fault to be found either with the cement, aggregate, or manner of manipulation. The concrete flooring of an outhouse in some new farm buildings was commenced late in December, and left partly completed owing to the Christmas holiday. As frost set in with unusual severity during the interval, the work was not revisited until the return of milder weather, three or four weeks afterwards, when it was found that that portion which was laid immediately before the frost, was utterly destroyed, while the proportion previously laid, which had sufficiently hardened to prevent total destruction, showed signs of flaking on the top where it had been floated or trowelled. In this case the cement had to bear the blame, although the destroyed portions, afterwards relaid with the same materials, gave perfectly satisfactory results. During severe weather, therefore, proper precautions should be taken to protect freshly laid concrete from the effects of frost.

To summarize the preceding remarks, the chief points requiring attention in the use of cement, in order to obtain the best results, are the following :—(1) Sound, well ground cement, of steadily increasing strength. (2) Due attention to the setting properties of the cement. (3) Clean, well-proportioned aggregate. (4) Proper maturing of the cement before use. (5) Protection from extremes of temperature. If these points always received the amount of attention due to their importance, failures in cement work, apart from defective design, would very rarely be heard of.

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APPROXIMATE ESTIMATES.

We have devoted much space in our columns, says The Building News, to estimating buildings, and to the methods in use for taking out quantities; but for the architect's purposes a more expeditious mode of calculation for obtaining approximate estimates is necessary. The ordinary cubing process is open to some objections. The pricing of the voids or spaces with the solid portions is not altogether satisfactory; indeed, without some attention to the proportion between the two, and the character of the building, it is eminently unscientific. Every architect is aware that the open spaces of rooms very materially affect the estimate. A building like a large hall or a place of worship, inclosing one large room, and a building of the same dimensions divided into small rooms, give very different results, and if cubed at a price that would be fair for the first, would be disproportionately inadequate for the latter. It is true that the practical man may so regulate the price per foot in each case as not to go far wrong; but this knowledge requires a large and varied experience. In buildings like hospitals and barracks the proportion of the voids to the solid structure ought to be ascertained before the ordinary price per foot can be arrived at. The author of a paper on this subject, Mr. S. Alcock, surveyor of the Royal Engineer Civil Service, has written some sensible remarks on the question worthy of attention, his remarks bearing more particularly on barracks. He shows that if the cubical contents of the rooms were deducted from the contents of the whole structure, the remainder would represent the cube contents of the actual building materials in the walls, floors, ceilings, and roofs, and a price per cubic foot on this remainder would be a much closer and more reliable approximation to the cost; but as these several parts vary considerably in price, as, for instance, the walls being less per cube foot than the floors, this plan still leaves much to be desired. He suggests a method that has been used by some, that "a much more reliable approximate estimate of the cost might be made by pricing the enclosures or envelopes to the rooms or apartments at so much per hundred square feet, taking the walls according to their thickness and manner of finishing each face, including all digging, concrete footings, plastering, papering, coloring, lime-whiting, etc., in fact, all work and material expended on the walls; and for the dimensions (1) the length, and (2) the height from the bottom of foundations to the eaves if the wall maintains the same thickness throughout, or to the change in thickness if the thickness is changed, and making no deductions for doors, windows, or other similar openings." The floors are similarly to be taken by the square of 100 ft., including all joists, boarding, bridging, hearths, the upper floors to include lathing and plastering, and the ground floor dwarf walls and any concrete to the ground under the boarded floor. The roof covering should include not only the slate or tile, but leadwork, rafters, boarding, trusses, skylights, etc.

This mode of estimating the constructional envelope, instead of taking solids and voids together, is much more reasonable, as it takes into account the materials and labor in a more precise and definite form. By using a schedule of prices calculated for each of these main superficies—namely, for the walls, the floors, and the roof—we can obtain a very approximate idea of the total cost.