CEMENT AND CONCRETE

[NOTE.—Contributions suitable for publication in this Department are invited from subscribers and readers]

SELECTING PROPORTIONS FOR CONCRETE.

The growing use of concrete for structures in which great care must be taken to have only the best material and workmanship, has stimulated investigations into the effect of varying the relative proportions of sand and stone in the mix, the proportion of cement to the total remaining the same, and the result has demonstrated very conclusively that the proper grading and relative proportion of the ingredients has a great influence on the quality of the concrete produced. To demonstrate this great effect, the writer at one time made up a set of beams 6 inches square and 6 feet long, varying these relations very widely from almost all stone to almost all sand, and broke the beams after thirty days with the following results:—

Proportions.	Modulus of Rupture. Lbs. sq. in.
1 : 2 : 6	319
1 : 3 : 5	285
1 : 4 : 4	209
1 : 5 : 3	151
1 : 6 : 2	102
1 : 8 : 0	41

By inspecting the above table it is seen that although the amount of cement in each of the above beams was the same (namely, 1-9 of the total material, some of the beams were over 700 per cent. stronger than others.

In investigating this subject over a term of years, it has been found that there is one combination of any given sand and stone which with a given percentage of cement makes the strongest concrete, that is, the concrete which contains the least percentage of voids, or otherwise, that which weighs most per cubic foot.

It is found also that this dense concrete is least permeable to water and consequently is the most durable, and it is also found that as a practical advantage such concrete is most easy to place, working "slick" and filling up all voids and bad corners.

The above stated law that the densest concrete is also the strongest gives a very easy way of proportioning the materials at hand so as to obtain the best and strongest concrete possible with these given materials. That is, to obtain these proportions by trial, as follows:—

Procure a piece of steel pipe 8 to 12 inches in diameter and about a foot long and close off one end, also obtain an accurate weighing scale. Weigh out any proportions selected at random, of cement, sand and stone, and of such quantity as will fill the pipe about three-quarters full, and mix thoroughly water on an impervious platform, such as a sheet of iron; then, standing the pipe on end, put all the concrete in the pipe, tamping it thoroughly, and when all is in, measure and record the depth of the concrete in the pipe. Now throw this concrete away, clean the pipe and tools and make up another batch with the total weight of cement, sand and stone the same as before, but with the proportions of the sand to the stone slightly different. Mix and place as before and measure and record the depth in the pipe, and if the depth in the pipe is less and the concrete still looks nice and works well, this is a better mixture than the first. Continue trying in this way until the proportion has been found which will give the least depth in the pipe. This simply shows that the same amount of material is being compacted into a smaller space and that consequently the concrete is more dense. Of course, exactly similar materials must be used as are used on the work, and after having in this way decided on the proportions to be used on the work it is desirable to make such trials several times while the work is in progress, to be sure there is no great change in materials, or, if there is any change, to determine the corresponding change in the proportions.

The above described method of obtaining proportions does not take very much time, is not difficult, and a little trouble taken in this way will often be productive of very important results over the guess method of deciding proportions so universally prevalent. I have repeatedly known concrete to be increased in strength fully 100 per cent. by simply changing the proportions of sand to stone as indicated by the above method and not changing the amount of cement used in the least.

A person interested in this method of proportioning will find on trial that other sands and stones available in the vicinity will give other depths in the pipe, and it is probable that by looking around and obtaining the best available materials the strength of the concrete obtainable will be very materially increased.

As a guide to obtaining the best concrete, the proportion of cement remaining the same, the following are the results of extensive tests:—

The stone should all be of one size or should be evenly graded from fine to coarse, as an excessive amount of the fine or middle sizes is very harmful to strength.

All of the fine material smaller in diameter than one-tenth of the diameter of the largest stone should be screened out from the stone.

The diameter of the larger grains of sand should not exceed one-tenth of the diameter of the largest stone.

The coarser the stone used the coarser the sand must be, and the stronger, more dense and watertight the properly proportioned work becomes.

When small stones only are used the sand must be fine and a larger proportion of cement must be used to obtain equal strength.—By William B. Fuller, Consulting Civil Engineer, New York, in The Western Builder.

EXPANSION JOINT IN CONCRETE ROOFING.

In an article on the construction of walls and roofs for a building in a recent issue of "System," O. M. Becker, industrial engineer, and William J. Lees, construction engineer, of the International Harvester Company, made some interesting observations on the use of concrete in factory roof construction. Recognizing that the qualities desirable in a roof are strength combined with lightness, resistance to heat conductivity, fire and acid resistance and weather tightness, they hold that except possibly for the last named quality these desirable qualities are all to be