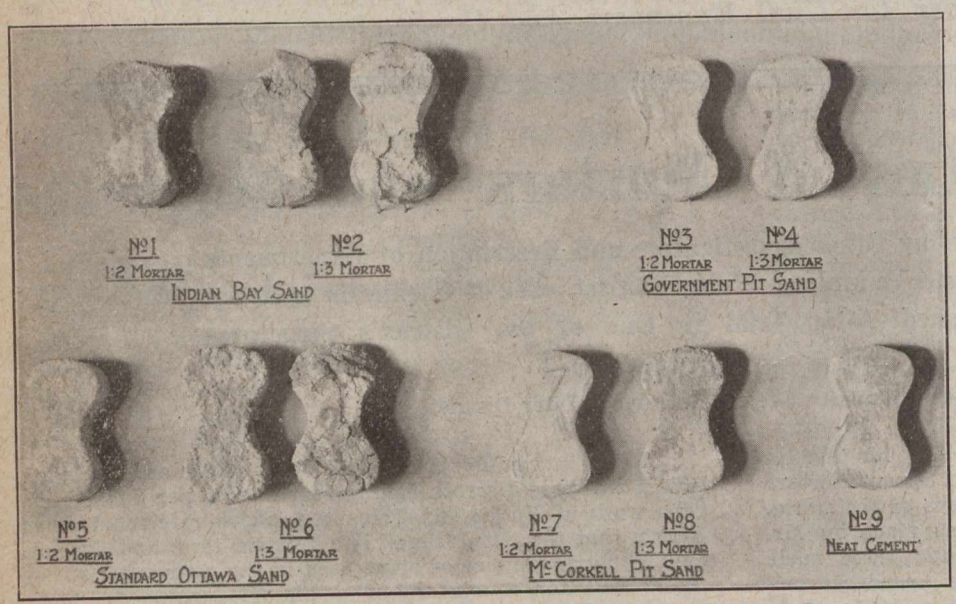
Taylor & Thompson's treatise on concrete, page 140) it will be seen that coarse sands require less water than fine sand to guage them to any given consistency. This is readily understood when one bears in mind the relatively large amount of surface area per unit weight of the fine as compared with the coarse material, and that the surface of the sands must be wetted before they can be brought to the desired consistency. There have been many methods suggested whereby the best mixture of cement, sand and stone for any given purposes can be determined. One of these methods is the arbitrary selection of volumes. For example 1:2:4 mixture meaning, 1 cubic foot of cement to 2 cubic feet of sand to 4 cubic feet of stone.

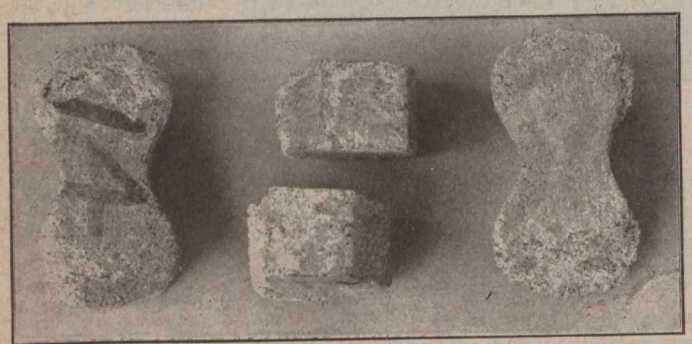



Action of a 10% Solution of Magnesium Sulphate on Various Mortars

Air briquettes cured 24 hrs. in moist closet and 48 hrs. in steam at 150 degs. F., and kept in alkali solution 3½ months.
No. 1 shows slight bulging at one corner; No. 2, distorted and disintegrated; Nos. 3 and 4, slight surface action; No. 5, no apparent action; No. 6, distorted and disintegrated; No. 7, slight surface action; No. 8, slight bulging at one corner; No. 9, no apparent action.

A second method of proportioning is by determining the voids in the sand and providing enough cement paste to fill these voids, then calculating the voids in the stone and allowing enough mortar to fill the voids in the stone, using a little excess cement and also mortar over what is exactly required to fill these requirements.

A third method is to make up compression specimens with various mixes and deciding on that mix which will meet the specifications as to strength and at the same time be a workable concrete.



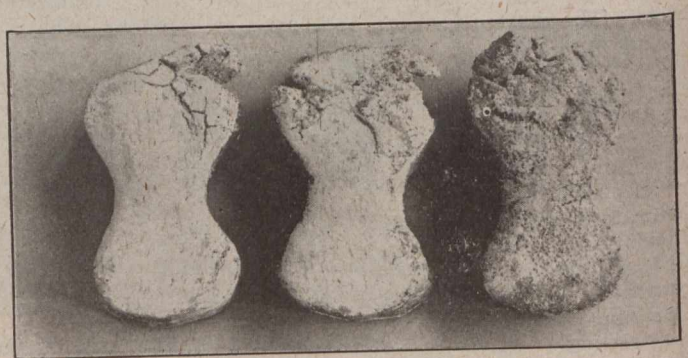
Action of a 10% Solution of Magnesium Sulphate on No. 10 Mortar

1:3 mortar, no chemicals. Cured 24 hours in moist closet and 48 hours in steam at 150 degs. F.

Yet another method has recently been suggested by Capt. Edwards, of Toronto, namely, proportioning a definite weight of cement to a given surface area of aggregate. Charts have been published by him in *The Canadian Engineer* from which the area of surface of the aggregate used can be calculated from its mechanical analysis.

As has been pointed out by many writers on the subject, the method of proportioning concrete by arbitrary selection of volumes may produce good results in practice if care is taken that the exact proportion of the materials specified are actually obtained in the final mix. But the method leaves open many opportunities for error. For example, it is very necessary to specify exactly what is meant by sand and stone. The so-called sand as delivered may contain quantities of material which should be classed as stone, and the material delivered as stone may in the same way contain fine material which should be classed as sand. However, if the percentage sand and stone in these materials is determined they can be so mixed as to give the specified volumes. Instead of considering the one part of cement as a cubic foot it is better to adhere to same unit which is not liable to change, such as a sack of cement which in Canada weighs 87½ lbs. and in United States 94 lbs., including the sack. In this way a definite weight of cement to the sand and stone is always ensured. In many cases contractors have assumed that in the case of a 1:2:4 concrete they were working close enough to the specifications if they used a mixture of one sack cement to six parts of aggregate, and have used as aggregate materials excavated from the pit without separating the sand and stone or making any mechanical analysis of the materials, and the resulting concrete may more resemble a 1:4:2 concrete than a 1:2:4 mixture. It is obvious that there is no comparison whatever between these concretes as to quality.

Capt. Edward's system of proportioning concrete on the cement to surface area idea has met with some criticism from other investigators who take the view that it is not sufficient to merely coat the surface of an aggregate with cementing materials but in addition the voids in the mixture must be filled and a high density secured. Capt. Edwards does not think that the securing of a high density or the filling of voids is greatly to be desired and points out that nature seems to have totally disregarded this refinement in the construction of the hardest, toughest, strongest and most reliable sandstones (mortars) and conglomerates (concretes). He points out that nature has secured the maximum strength for a given amount of cementing material by concentrating that material at the place it will have most effect, namely, at the points of contact of the particles.



Action of a 10% Solution of Magnesium Sulphate on No. 11 Mortar

1:2 mortar treated with 1 per cent. $Al_2SO_4$ and 1 per cent. soap. Cured 24 hours in moist closet.