AGGREGATES FOR CONCRETE AND METHODS OF REINFORCING.

An important point in connection with reinforced concrete frequently presents itself, namely, as to the nearest place where the materials, such as sand and gravel or chippings, can be obtained, and it is a question well worth close consideration because in nearly all instances the cost of the proposed structure will be of course affected by the cost of its constituents, and these are in turn much influenced by the cost of freight and carriage.

In many places the Eastern Counties flint is practically the only stone locally obtainable, but though this makes good, tough concrete, it is unreliable for fire-resisting purposes owing to its tendency to crack and "fly" under heat.

The same remarks apply to limestone, but it has not the redeeming feature of being more fire-resisting after being broken; in fact, it is not advisable to be used at all where fire-resistance is an important consideration, as it is very apt to disintegrate to powder under the action of heat, but it is not to be condemned entirely as it is quite a serviceable material apart from increased fire risk.

Sandstone can be obtained in many parts of the country in almost unlimited quantities, but, as a rule, it is too soft, too porous and too absorbent for use in reinforced concrete work. Samples should always be taken and tested by crushing, and if it is found that it will stand about 1½ tons per square inch, and that the difference in weight, when clean and dry and after being two days under water, does not exceed 8 per cent., it may be safely used.

Quartzite stone is fairly good if not too soft and open in texture, in which case the same precautions apply as for sandstone.

With reference to what may be called artificially-produced aggregates, broken earthenware and stoneware from the potteries district make quite a good aggregate, but those who have not had experience with this material for reinforced concrete will be disappointed to learn that the same must be unglazed, thus preventing the use of the many hundreds of tons of broken crockery now existing in some of the older Pottery towns, as the glaze prevents the proper adhesion of the cement; but doubtless this difficulty will be surmounted in time.

Burnt clay and gault are quite permissible materials, provided that they are tough and hard and do not soften or "crumble" after being left in water for two or three days.

Speaking generally, broken bricks are not a good aggregate for reinforced concrete, although they have given excellent results in mass concrete. They are usually too soft and yield too much blunt dust, and have frequently old mortar adhering to them; if, however, they are hard and close in texture and free from mortar they may be safely used.

It is well known that coke breeze makes an excellent class of concrete, but it must be remembered that such cannot be regarded as being really fireproof.

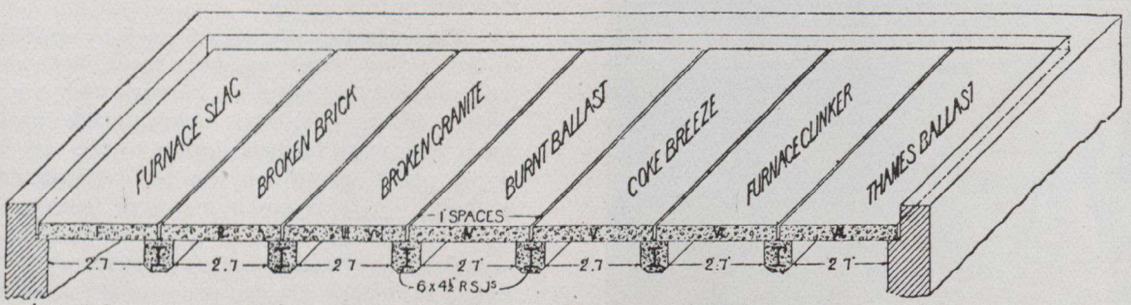
In the case of ashes, only those that will float in water and which are of a uniform color and texture, and quite free from adhering pieces of coal and dirt, should be used, while with clinker only that which is really hard and clean is serviceable. In both cases if the washing and riddling or screening are carried out as one process, a more reliable result will be obtained. The question of sulphur must, however, be carefully watched.

Slag from furnaces, whether blast or cupola, makes also quite a good aggregate, provided it is hard and tough and free from dust, and its sulphur contents carefully noted.

As is well known, all clinkers, breeze, slags, etc., contain a certain amount of sulphur which is apt to attack the reinforcing steel with disastrous results. The maximum allowable percentage of sulphur in reinforced concrete aggregates is now being made the subject of tests and experiments. There is an important point in connection with the presence of sulphur, namely, that if it is in the form of "sulphate" it is practically harmless, but if in the form of "sulphide" it is very deleterious, and anything more than a very small amount indeed should not be allowed.

Care should also be taken with all artificial aggregates that no free lime is present; but, as in the case of sulphur, there are two forms of this material present, one the free lime referred to, which is dangerous and the other carbonate of lime which is practically harmless.

Before leaving the subject of aggregates, the author would draw attention to the recent important fire tests, made by the British Fire Prevention Committee, of concrete composed of various descriptions of material, the proportion of cement, sand and aggregate being identical in each case, i.e., 1 : 2 : 3, except with the burnt clay and coke breeze where there was no sand, the proportion being 1 : 0 : 5. The illustration, Fig. 1, kindly supplied by the British Fire Prevention Committee, shows diagrammatically the arrangement of the test, which was simultaneous, and exactly the



No. I.	No. II.	No III	No. IV.	No V	No. VI	No. VII.
Top: Slab cracked across in two places.	Top: Slab cracked across in three places; slight curve downwards.	Top. Slab cracked across in three places, curved downward about ½ in	Top No cracks; not curved downwards.	Top No cracks; not curved downwards.	Top Slab cracked across in two places, curved downwards about ⅝ in	Top Slab cracked across in very many places; curved downward about 2 in
Underside; Curved downwards ¼ in.; slight cracks visible.	Underside: Curved downwards ¼ in.; slight cracks visible.	Underside. Curved downwards ½ in.; no cracks visible; about 1 in. washed off by water	Underside: Not curved downwards; no cracks visible; about 3 in. washed off underside (in parts) by water	Underside: Not curved; no cracks visible; about 1 in. washed off underside (in parts) by water.	Underside Not curved, one slight crack visible, pitted in places about 1 in. deep by water	Underside: Curved downward 1¼ in., and bad cracks all over in all directions, mainly longitudinally; much washed off by water

Fig 1.—Arrangement and results of Experiments by the British Fire Protection Committee with Concretes composed of various aggregates.

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