

The specimens referred to in Table I, p. 31, were tested in a 50-ton machine. The following results of tests, which may be considered as typical, show how the strength of concrete, having a 2-in. slump, increases with age:—

TABLE II

Type of Cement.	Nominal Mix.	Compressive Strength (Lb. per Sq. In.).				
		3 Days.	7 Days.	28 Days.	3 Months.	1 Year.
Ordinary Portland . . .	1 : 2 : 4	1,400	2,500	3,900	4,800	6,500
Rapid-hardening P. . .		2,500	3,500	5,000	5,500	7,000
High Alumina . . .		7,000	7,300	8,000	No appreciable increase	

**MIXING CONCRETE.**—It is most important that the materials shall be thoroughly mixed in correct proportion. The mixing should be continued until the concrete is of a uniform colour and consistency. Concrete is either (1) hand-mixed or (2) machine-mixed.

1. *Hand-mixing.*—This method is still adopted on small jobs. The mixing should never be carried out on the bare ground, as this results in the materials being contaminated by the earth which is scraped up. It should be done on a proper close-boarded platform or staging, 9 or 10-ft. square, preferably made of t. and g. floor boards fixed to five lengths of 4-in. by 2-in. battens. The joints of the boards must be close to prevent the escape of liquid grout. Sometimes the boards are protected by a covering of sheet iron or zinc plate, and a raised kerb round three of the sides is provided. The platform should be quite level to prevent the water from draining off, and it should be placed conveniently near to the place at which the concrete is to be deposited. A water point is brought near to the platform.

Careful measurement (or weighing) of the materials is essential for good quality concrete. It should be done in relatively small quantities, and a convenient form of measure for the sand and coarse aggregate is a square or rectangular box or frame, similar to the batch box H, Fig. 23; it is without a base. This measuring frame should not be too large as to become unwieldy to handle conveniently; one of 1-cub. ft. capacity is often preferred. A wheelbarrow, of known capacity when filled level with the edges, is also used instead of a frame.

If a 1 : 2 : 4 composition (requiring 1-cwt. bag of cement, 2½-cub. ft. of sand and 5 cub. ft. of broken stone, p. 30) is specified, a convenient size of mix would be 5-cub. ft. of sand, 10-cub. ft. of broken stone to 2 bags of cement, and the internal dimensions of the frame would be as indicated at H, Fig. 23.<sup>1</sup> This is preferred to a large

<sup>1</sup> The concrete must be mixed and deposited as quickly as possible, and the size of the mix should therefore depend upon the amount of labour available.

frame which would be filled to the level of a mark which becomes obliterated in course of time.

The measuring frame is placed on and near to one end of the platform, filled to the top with the coarse aggregate, and then lifted. If the frame is of 2½-cub. ft. capacity, it is laid on the platform near the heap already formed, again filled with coarse aggregate and removed. This is repeated until four frames of coarse aggregate have been measured; after it has been levelled off, two bags of cement are emptied and evenly distributed over the coarse aggregate. The measuring frame is placed on the heap and filled level to the top with sand and removed; this is repeated to give two frames of sand. Some prefer to add the sand after two frames of coarse aggregate have been measured; the remaining two frames of coarse aggregate are then added, followed with the cement.

The materials are then mixed at least "twice dry and twice wet." Usually two men, one on each side of the heap, shovel the heap to one side, turning and sprinkling the materials in the process. This operation is repeated, the heap being thrown back to its original position. If necessary the materials are again turned over until the colour is uniform, free from streaks of brown and grey. Water is then added. Only the correct amount of water (varying with the nature of the work and materials, and probably determined from a slump test (see p. 31), must be used. It may be measured by a bucket of known capacity, probably 2½-gals. The water should not be thrown on to the heap from the bucket, as this washes the cement from the aggregate, but rather sprinkled on by means of a watering-can, having a rosehead, and which is filled from the measured pails. Usually a third man adds the water whilst the other two attend to the mixing and turn over the heap at least twice, as above described, until a uniform consistency is obtained.

An alternative method of mixing is to spread the measured sand in a layer of even thickness on the platform, the cement is distributed over this, both are mixed together until the colour is uniform, the coarse aggregate is thrown over the mixture which is turned over at least twice. Water is added and the whole again turned over two or three times.

2. *Machine-mixing.*—Concrete is now chiefly produced by mechanical mixing except where only small quantities are required. Machine-mixing is faster and cheaper than hand-mixing, and it generally produces a more thorough mix having additional strength.<sup>1</sup> There are two groups of mixers, *i.e.*, (a) batch mixers and (b) continuous mixers.

(a) *Batch Mixers*, which are portable, include the (i) tilting drum and (ii) closed drum types. Each is usually driven by either a petrol or oil engine or an electric motor.

(i) The *tilting drum mixer* (see line diagram J, Fig. 23) consists of a hopper and mixing drum. Correct quantities of cement and aggregates are loaded into

<sup>1</sup> In the Code of Practice for Reinforced Concrete (see p. 29) it is recommended that concrete should be mechanically mixed; if mixed by hand an additional 10 per cent. of cement should be used.