

METHODS OF VIBRATION OF CONCRETE ACCORDING TO FRENCH PRACTICE *

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SYNOPSIS

French practice goes in for heavy vibrating or tamping of pavement concrete. Brief descriptions of several machines are given, some of which run on side rails and others rest directly upon the fresh concrete. A feature of the practice described by M Fedi is a brushing machine for roughening the surface to make it skid proof by removing the fine material during the setting and hardening period. M Fedi believes in use of lean mixtures with enough vibration or ramming to force the individual pieces of large size aggregate into such intimate positions that they are securely bonded to each other by a minimum amount of cement. Almost no cracking and little wear was observable on ten year old pavements, in the heart of Paris, laid by these methods.

Machines for the construction of concrete pavements in France may be classified into two categories

1 Those for use without side-forms, or lateral rails, where apparatus and machinery are handled and moved by hand, or are made to roll directly on the freshly laid concrete

2 Those provided with tracks or side-forms, on each side of the pavement, on which machinery is mounted

EQUIPMENT FOR TYPE 1

There are several machines that will either ram, tamp, or vibrate concrete. The hand rammer is the most primitive. Then we have the vibro-rammer, the effect of which is intermediate between that of ramming and of vibration. The long roller is employed for hand-surfacing. Some of these rollers act by means of the vibrators placed in them as well as by their weight. Since they rest directly on the fresh concrete their weight aids in compaction.

Another machine is called a vibro-hammer. Of these we have the "vibro-

pil," the "velo-rammer," and the "vibro-plat." These tamp the concrete with high frequency vibration but at a very small rate, such as from one to two tenths of a millimeter. Their use assures a fairly uniform surface.

The "vibro-tasseur" rams the concrete at low frequency but at a large rate, such as one to four centimeters. A surface identical with that produced by the preceding apparatus is secured.

There is a most satisfactory machine with multiple pneumatic rammers whose speed of tamping is adjustable. This machine is mounted on large, wide rollers which sink but slightly in the fresh concrete at first, and do not sink at all after it is rammed. A motor is part of the apparatus. This is followed by a surfacing machine which moves transversely across the pavement on suitably ballasted big rollers. A very stiff dry concrete made with large size aggregate can be satisfactorily surfaced with this machine.

And then there is a patented brushing machine for roughening the surface of the concrete to make it skid proof. The machine is started running after the initial set has taken place and it is kept running during the hardening of the concrete. It wears away the cement paste by means of the wire brushes which are driven by the motor of the machine.

* Information taken from "Les Bétons et les Revêtements Bétonnés de Chaussées" by J. Fedi, together with facts observed in the field by Professor Crandell.

EQUIPMENT FOR TYPE 2

There are several machines that may be mounted on the side-forms or on rails on either side of the pavement. Among these is the Dingler ramming machine equipped with transverse lines of mechanical rammers. This machine performs in a very energetic manner. It is extremely heavy and requires excellent support to do good work.

The Fedi ramming machine is equipped with longitudinal lines of mechanical rammers which work and shift transversely, and then may be moved longitudinally. This machine has some advantages over the Dingler since the weight may be limited by leaving off extra rammers. The ramming may be as powerful as desired. Any width of pavement may be rammed.

The Dingler and the van Steenkist machines do surfacing work similar to that produced by the preceding one. The van Steenkist type has a telescopic frame which makes it easily adaptable to different widths of pavement.

The Fedi surfacing machine does its work on tracks identically as well as the machine described in Type 1. Similarly, there is a Fedi brushing machine on tracks that operates in the same manner as before described.

From the illustrations and the description furnished it will be inferred that the French methods of vibrating or tamping concrete are severe. This is true. I have seen many a dry mix that American contractors would say is not workable finished perfectly by the French methods. The rough treatment accorded concrete in the making seems to secure results that are satisfactory. Fedi says that pavements laid without machinery are not of much value, and that if machinery is used it should be of such a nature that a dry, lean mix can be vibrated or tamped so as to produce a "visible mosaic surface" that provides

rugosity (skid-proofness) and still is well finished. To that end he uses the brushing machine to clean off the fines, thus exposing the coarse aggregate.

If we think back on our American practice it will be recalled that in the Vibrolithic pavement, invented by Mr. Stubbs, a course of large, extraordinarily tough, hard, dense stone was incorporated in the surface before or during the time of vibration. M. Fedi makes sure that such stone constitutes the large aggregate for his pavements, but he does not spread a layer over the top as did Mr. Stubbs. Instead he uses a wire brush of rather large diameter which revolves, brushing away the fines and exposing the large aggregate. This makes a skid-proof surface. It is of course essential that the large size aggregate shall be firmly held in the concrete, otherwise there will be considerable deterioration.

Fedi states that there is a great difference in the hardness of the large size aggregate and the cement paste. He believes in a minimum of the latter, for he seems to think that a lean concrete can be made to do better work than a rich one, if both are vibrated or tamped. He would vibrate, tamp, or ram the lean mix until he forces the individual large size aggregate into such intimate positions that each piece is securely bonded to its neighbor by a minimum amount of cement. He believes that steel reinforcement is preferable to increased thickness of slab when and if the subsoil is not stabilized. The vibro-rammer seems to be preferred to any other type of apparatus for producing the results desired by M. Fedi. Such ramming apparently forces a settlement of the concrete onto the subgrade in such a way that no further settlement will be possible without erosion.

I visited several jobs which M. Fedi built, and examined them with great care. The aggregate was all that could be de-

sired. A very lean mix had been used with a minimum water cement ratio, and the resulting concrete had been vibrated, steel brushed, and settled so thoroughly that during the ten year period that this pavement had been in use there was almost no cracking, little wear, and excellent service. These pave-

ments are in the heart of Paris and have been under heavy traffic for years.

M. Fedi believes that troubles with our pavements are too much cement, too poor an aggregate, and too little vibration. To this he adds the necessity of making them skid-proof by removing the excess mortar from the surface.