

Construction.—An exact subgrade is necessary to save the concrete that would be wasted in evening up inequalities in the foundation. The extra time and attention spent on getting an exact subgrade will be well repaid.

The materials should be placed well in advance of the laying, so that when the mixer has once commenced operations the work may be continuous. If the road is being constructed of imported materials, the use of a stock pile to prevent shortage will materially reduce the loss from delays in operation. In order that the minimum amount of work may be done in taking materials from the subgrade and placing them in the mixer, it is advisable that the superintendent and foreman should each have a list of the amounts to be distributed for every hundred feet. A little attention to this detail will save largely in the item of labor.

Rejection of Materials.—Materials should be rejected before they are unloaded to come on the work. As good quality is essential in both sand and stone, both these materials should be checked up from day to day in order to secure the best results.

Equipment.—Attention should be given to the screed or strike board or template as it is often called. This should be heavy enough to screed the concrete properly, and it should be cut to conform to the crown of the road. It should be provided with handles and be shod with a steel angle-iron bent to the shape of the roadway. Wooden floats should be provided for doing the necessary floating, and the float to be used at a joint should be split in such a manner that it will ride over the joint smoothly and will cover an area of at least one foot on either side of the joint. Steel forms, while more costly than those of wood, are far more economical in the long run and pay for themselves in a short time.

Measuring Barrows.—Barrows should be of such a type that their measurement can be regulated by the bolting of boards across the rear part of the barrows to make the quantities adjustable. Forks should be provided for taking the stone from the subgrade in order to eliminate the dirt.

To insure a sufficient supply of water a pipe line should be installed, for although tank supply may amply provide for the mixer, it can scarcely take care of that and attend to sprinkling too.

The concrete road presents a good problem for the application of labor-saving devices in the handling of materials and many different installations have shown reasonable cost reductions. The industrial railroad has played a large part in this.

The forms should be placed in such a way as to give them stability and they should above all be tight. The sub-grade should be kept drenched with water immediately ahead of the laying of the concrete.

An ordinary concrete force in operation on a 16-foot road is comprised of from 32 to 35 men doing all branches of the work and it is quite often necessary to rearrange the gang so that the best results may be secured in keeping the mixer in continuous operation.

Suitable measuring tanks should be provided so that the amount of water may be such as to make the separate batches of the same consistency, the ideal consistency of concrete being where it will just settle and will not run. This is very important as the density of the resultant concrete is dependent upon it; if too wet the materials will run on the grades.

The concrete should be well spaded and kept high above the screed or strike board on the mixer side. Tamp-

ing should not be allowed. In screeding, the screed should be slowly pulled back and forth, advancing it slowly with each operation. When approaching a joint the screed should be brought up to the joint and carried back in order that the surface may be uniform. No more floating than is absolutely necessary should be resorted to as the primary object is to have the wear on the surface taken by the stone, and not by the thin mortar layer produced by floating.

Placing of joints should always be perpendicular to the surface of the pavement. If they are not, in subsequent expansion there is often riding of the slabs. In many instances it may be necessary to stiffen up the consistency of the concrete in order that the screeding on grades will not give a ridgy effect. If possible, all work on grades of over 4 per cent. should be worked up-hill. The cement factor should be taken daily and reported to the division engineer.

Curing.—Curing properly is as necessary as good construction, for upon this depends to a large extent the strength of the resultant concrete. Sprinkling should be commenced as soon as the surface will not pit and a cover of 2 inches, at least, of sand or loam should be spread over the surface. This cover should be kept saturated with water for ten days. Care should be taken, however, not to place cover until the concrete is sufficiently firm to withstand the impact caused by placing. Sprinkling should be done in such a manner as not to wash the cover from the surface. When the temperature gets below 50° F. in the middle of the day, sprinkling and cover may be omitted. When concrete is laid in cold weather its curing period should be lengthened, as low temperature retards its gain in strength. Work done in November should be allowed to cure from four to six weeks.

It has been our aim to designate essentials in design and specifications; to hold only such standards as have been proven practical, from our field and laboratory tests; and to employ only such methods of construction as will insure serviceable pavements at the lowest possible costs.

As you are aware, I have not attempted in this paper to cover the subject fully; limitation of time, to say nothing of other limitations, would not allow that. I have tried to suggest features which may some time lack sufficient attention, and to emphasize other features of whose importance we feel certain.

In conclusion, let me say that the ideas presented in this paper are based upon such knowledge as may be gained by inspection of concrete pavements in various parts of the country, and, more validly, on the actual construction in New York State of 201 miles of second-class concrete pavement, 1:2½:5 mix, a type which we have ceased using; and upon the actual construction of 364 miles of cement concrete pavement, 1:1½:3 mix, built in the last four seasons. There still remain 127 miles of this type of construction under contract in New York.

"The extension of the Chicago drainage canal for two miles at Joliet to a new 24,000 h.p. hydro-electric plant on the Des Plaines River is proposed, in order to provide power for operating pumping stations of the Chicago waterworks. The sustained opposition of the city of Joliet and of private concerns proposing water-water projects has been overcome, the city being assured of ample protection against floods and overflow. It is estimated that the extension and power plant will cost about \$6,600,000 and that the work can be completed in three years. It is necessary to wait, however, for the passage of a bill by the Illinois Legislature authorizing the Sanitary District of Chicago to build the extension, dam and power plant. This bill has been prepared."—U.S. Exchange.