

CONCRETE TRACK FOUNDATIONS.

AT the last annual Good Roads Congress, held in Pittsburgh, Pa., in February, R. Keith Compton, chairman of the Baltimore Paving Commission, read a paper on "Street Railway Track Construction in Paved Streets." In this paper, after stating the objections raised by electric railway engineers to concrete track foundation, Mr. Compton proceeded to give the experience of Baltimore, which had insisted on 6-inch concrete construction on streets where traffic was heavy. He said in part:—

"In improving streets containing railway tracks the forces of the railway company and that of the paving contractor have to work in conjunction. The railway area is first graded out to the subgrade of the paving by the paving contractor. The railway company then takes charge and grades out to a point six inches below the bottom of the ties. New rails and ties are then installed where necessary, together with any new special work. The ballast, of the size and depth previously noted ($1\frac{1}{2}$ to $2\frac{1}{2}$ inches spread to a depth of six inches), is then placed and thoroughly tamped under the ties and up to a point two inches above the bottom of the ties, the rails brought to the proper grade and line, and when the entire construction is 'tight' the penetration begins.

"The grouting mixture is composed of one part cement to two parts sand, and is of about the consistency of thin cream. The operation is readily done without interruption to car traffic by the use of a small continuous mixer (known as the Coltrin mixer) placed just outside of and parallel with the railway tracks, with a flexible chute, in two sections, to convey the grout from the mixer to the ballast. Starting on the down-grade end and working up-grade, the thin grout is penetrated into the stone ballast, which, as previously noted, has already been securely tamped and made to carry the strain of the passing cars. As already noted, the chute is flexible and in two sections. When a car comes along, the first section is thrown out of service and the second section is lowered to the ballast at about the ends of the ties and the mixer kept in service. After the car passes, the first section is thrown back in service.

"It is true that during this operation some movement occasionally occurs in the tracks, but there is a city inspector on the work at all times who hunts for and locates loose ties and they are immediately tamped up with green concrete.

"The natural supposition is that sufficient movement of the ties and track would occur to injure the concrete while setting, but this is not true if the work is carefully handled and executed. On one street in Baltimore this work was successfully handled with five different lines of cars passing up and down the street with but 20 seconds headway at times during the day, while on another piece of work it was successfully installed with eleven different lines of cars passing over the special work with less than 20 seconds headway at short intervals during the day. The resultant mixture is about one of cement, two of sand and five and one-half of stone, with the concrete very dense, as the ballast has been thoroughly tamped and voids reduced to a minimum.

"This ends the work of the railway company, as after this section of concrete is installed the paving contractor again takes charge, installing the concrete base for the pavement immediately on top of the railway base, and then the paving."

Mr. Larned's Discussion.—In the Aera Magazine for August, Mr. J. M. Larned replies to Mr. Compton's paper as follows:—

"Undoubtedly the character of the construction of a street railway track has much to do with the permanency of the pavement within the space occupied. It should be noted, however, that even under the most ideal forms of track construction the pavement in and around the tracks will always be more difficult to construct and maintain than elsewhere, and that some pavements are eminently unfitted for such use. The most permanent and best fitted pavement for the purpose, should be used within the railway area, regardless of the kind of pavement used upon the rest of the street and, as stated by Mr. Compton, block stone pavement, either new or re-clipped, having the joints filled with cement grout, will give excellent results.

"In considering the more or less permanent character of the track and of the foundation for the same with respect to the pavement, it will always be necessary to consider the density and weight of the traffic which the track and its pavement is to carry. This, however, should not be the only measure for determining the character of the track structure. A track having light and shallow rails, poor joints and ties spaced over two feet apart, even with a concrete foundation, assuming for the moment only that such foundation is the best, may very well be eminently less permanent and satisfactory than a track constructed with heavy deep rails, the best of joints, having ties spaced not over two feet apart, upon a good natural soil bed or upon a reinforced or crushed rock.

Character of Subsoil Important.—"The first factor which should be considered is the character of the subsoil, its bearing power with respect to the distribution of the load and the necessity for subsoil drainage. It is to be presumed that Mr. Compton in his study of Baltimore conditions took these matters under consideration, but there is no mention made of his having done so, and it would be interesting to know the result of such investigation and study if made.

"It is probably true that the majority of soils under present-day conditions need assistance in the distribution of the load. The distributing factors are the ballast, whether it be of concrete or stone; the ties and their spacing, more so in case of rock ballast though not to be disregarded in case of concrete; the rails themselves, as undoubtedly a nine-inch deep rail weighing 130 to 140 pounds per yard will distribute the load over a much wider space than one seven inches deep, weighing but 108 pounds per yard; and lastly, the joint, which is a very important adjunct, as it is a matter of common knowledge that pavement troubles usually begin at the joint.

"I personally visited Baltimore in 1911 in quest of information about concrete track. I found that at the time the street railway there had recently adopted a heavy nine-inch rail weighing about 132 pounds per yard and were preparing to lay it with an improved joint upon rock ballast and it would appear from Mr. Compton's paper that his investigation has produced instead, a concrete ballasted track with a light rail seven inches deep, weighing 108 pounds per yard, no mention made of the joint, and I fear that this will prove to have been a step backward.

"It is also true that a large majority of street railway officials prefer to use track ballasted with broken stone, rather than with concrete, except in especial cases, and we are certainly interested in the correctness of the