

laggings were removed. As a rule, the concrete was allowed to set for two days before striking the ribs.

Granolithic.—Granolithic, consisting of one part cement and one part finely ground granite dust, was used to form the finished invert. On the arch a little sand was mixed with the granite (about one of sand and three of granite) to toughen the granolithic and give it a smoother finish. The total thickness of one inch was put on in three layers, without the use of centering, the last layer being polished with plasterers' tools. Nails were driven in the concrete at springer level by the engineers, every ten feet, and a light strut was fixed with wedges to this level by the plasterers. Then, with a centre on this piece an arm was used to sweep out the finished circle of the sewer.

The plasterers made a narrow fillet of cement at each length to the finished diameter and, after these had set, used them as profiles to test their work with a straight-edge. A part of the invert, 1 ft. 6 in. wide, was left unfinished until the entire length from shaft to shaft had been lined, when fresh levels were given on the invert by forming fillets across the 1-ft. 6-in. space at each 10-foot length. This method gave the men a space to stand on while working the sides, and ensured the absence of traffic while the invert was setting.

The concrete and granolithic proved quite effective in stopping any leakage left in the iron joints, and formed a water-tight sewer with a hard and smooth invert.

The writer had occasion to remove a portion of sewer constructed similarly to the above which had been in position for a dozen years or more. In it the concrete lining was exceedingly hard and smooth, while the iron segments completely retained their black coating. The sewage had had no effect upon the granolithic beyond forming a slimy skin upon it.

CANADIAN IMPORTATIONS OF STONE.

The imports of stone are classified as building stone of all kinds, except marble, manufactures of granite and other stone, and marble and its manufactures. The total value of the imports during the calendar year 1911, according to statistics contained in the annual report on mineral production in Canada by J. McLeish, B.A., was \$1,140,846, as compared with a value of \$845,123 in 1910, showing an increase of \$295,723, or about 35 per cent. Of the total imports in 1911, \$392,868 in value was classed as building stone, and included 21,356 tons of rough stone, valued at about \$3.98 per ton, and 52,908 tons of dressed stone, valued at about \$5.82 per ton. The imports of sawn granite, manufactures of granite, and manufactures of stone N.O.P., were valued at \$207,836; paving blocks, \$64,676; marble and manufactures of, \$384,252. There was also an importation of refuse stone of 226,122 tons, valued at \$91,214.

During 1910 the imports of building stone were \$311,595; manufactured granite, \$192,213; paving blocks, \$74,100, and marble, \$267,215. The imports during both years were derived chiefly from the United States and Great Britain, the United States supplying building stone, paving blocks, and marble principally, and Great Britain mainly manufactures of granite. Marble is obtained in some quantity also from Italy and other countries. The total value of the imports from the United States in 1911 was \$946,624; from Great Britain, \$175,169; from Italy, \$6,334, and from other countries, \$12,719.

The value of the imports from the United States in 1910 was \$640,084; from Great Britain, \$160,664; from Italy, \$31,314, and from other countries, \$13,061.

OPPORTUNITIES FOR HIGHWAY ENGINEERING IN CONTRACTORS' ORGANIZATION.

By H. B. Pullar, A. M. Am. Soc. C.E.

THE recent rapid development of paving and road building has opened up a new demand for engineers, and this new demand must be filled by engineers trained along new and specific lines. Until recently a general civil engineering course amply prepared an engineer with sufficient knowledge to take care of any general road or paving work which might come under his supervision, but in this day of specialization it is necessary that engineers entering into this new field be more carefully prepared to successfully meet and solve the numerous and varied paving problems and direct to the best advantage the enormous fund now being appropriated for good roads and pavements. An enumeration of a few of the problems with which a paving contractor has continually to contend, and the place waiting for the highway engineer with respect to their proper solution, are pointed out in Mr. Pullar's paper before the Society for the Promotion of Engineering Education at its convention in Minneapolis in June.

Formerly an engineer desiring to specialize in road and pavement construction was limited in his field of endeavor to accepting positions with the state, county or city, or to act as a consulting engineer to public officials having charge of paving and road work. To-day there is a much broader field, and one in which the opportunities for advancement and the compensation are much greater than they were even a few years ago. This field is the up-to-date contractors' organization. There is a distinct and urgent demand for good highway engineers in contractors' organizations, and the day does not seem to be far distant when public officials will demand that work be given only to contractors having a capable and efficient organization, which necessarily must include a highway engineer.

Practically up until the present time there has never been a demand for highway engineers by contractors, because there were only a few different standard types of pavements and the contractors were familiar with the classes of construction they bid upon and did not attempt to enter into other fields. To-day the problem is entirely different, and in place of the few standard types of pavements and roads there are numerous and varied types which call for different construction.

In nearly every case where contractors to-day wish to bid on paving construction they are confronted with specifications calling for numerous different types of construction. They have not always been educated into the proper method of laying these different classes of pavements, but are usually willing to take a chance, and the result has been that there have been many failures, which have been due to improper handling of materials and improper construction, but which have been unjustly blamed to the new type of pavement or road. As is always the case when any industry is rapidly developing, there are also many new types of paving, both patented and otherwise, which are continually being brought upon the market, some of which will undoubtedly prove a success, but as usual the majority will soon be discarded as being unsuccessful and unsatisfactory.

With the advent of the highway engineer into the contractors' organization, a great per cent. of failures will be eliminated, for if he is properly trained he will be