

Fig. 1 shows gravity dam section with rock surface roughened so that stability against sliding depends on shearing strength of concrete or rock.

Fig. 2 shows hollow reinforced dam section on earth foundation provided with toothings and anchoring wall. This method is comparatively new and has been described fully in the transactions of the American Society of Civil Engineers, December, 1917, in the article on the "Reconstruction of the Stony River Dam."

In both cases, Figs. 1 and 2, no concrete has been added to the amount required for stability against overturning, except in that in the second case a small amount of concrete was added to form toothings and anchoring wall. Inasmuch as this anchoring wall is merely an extension of a cut-off wall, but heavily reinforced and thicker, it serves two purposes—namely, (a) safety against sliding; and (b) increase in percolation distance in conjunction with sheet piling.

E. MAERKER.

Jackson, Mich., November 21st, 1919.

### ECONOMIC STATUS OF GUARANTEES FOR PAVEMENTS ON ROADS AND STREETS\*

THIS committee has very carefully considered the points brought up in the discussion of its progress report† during the annual convention held in New York, February, 1919, and in the technical press thereafter. It feels that certain of the criticisms of its report were based upon an incomplete understanding of its aim and scope, but realizes the difficulty of discussing a subject of this kind after listening to the reading of a somewhat lengthy and comprehensive report without having had opportunity to study it thoroughly.

It has been suggested that it would be helpful if the committee were to indicate what it considers a proper period of reasonable life without repairs for various kinds of pavement under different conditions. An earnest effort to compile such a table, which would cover all possible conditions, clearly showed however that the wide variation necessary in a general schedule would render the figures worthless and would probably lead to a very heated discussion as to whether the figures cited were to be regarded as a measure of the life of various types of pavement when laid upon different kinds of foundations and subjected to traffic of various densities, and the attempt was therefore abandoned. Each set of conditions must be given individual consideration, and the committee believes that the determination of such reasonable periods in any particular case would not be extremely difficult and that any competent engineer can do this satisfactorily.

The committee's recommendation that the guarantee bond be supplemented by a cash retainer was based largely upon the difficulty sometimes experienced in having necessary repairs made within a reasonable time and was designed to provide a means of enforcing this necessary provision of any paving contract without first having to resort to a lawsuit. As a rule, a municipality has no fund available for this class of work and the cash retainer therefore serves two purposes:—

1. It tends to bring the contractor back to make the repairs, as he knows he will collect some money toward the expense involved.

2. It gives the municipality cash with which to make the repairs and thus avoids the necessity of going through the formalities and oftentimes difficulties of securing an appropriation, with all the attendant delays.

In this connection the committee recommended that a greater percentage be retained on resurfacing work as compared with new construction, in order to provide for approximately the same amount of retained money per square yard of finished pavement in both cases. This did not mean, as was assumed by some members, that the committee felt that resurfacing work, properly conducted, involved any greater

guarantee liability than new construction work. On further consideration of the matter, your committee believes that reasonably adequate protection would be assured to the municipality by a reduction of the amount of the retained moneys from 10% to 20%, as at first recommended, to 5% and 8%, respectively. It further feels that such a provision cannot be justly held to be a curtailment of a contractor's working capital.

### Fifteen Cents Per Square Yard

In arriving at this conclusion, your committee takes the position that fifteen cents per square yard to cover guarantee liabilities may be assumed as a fair average. On this basis the following figures may be considered as typical and illustrative of the principle involved:—

	Resurfacing.	New work.
Construction cost per sq. yd. ...	\$1.50	\$2.50
10% profit .....	.15	.25
Guarantee .....	.15	.15
Total .....	\$1.80	\$2.90
Retained (8%) .....	.15	(5%) .15
Payment on completion .....	\$1.65	\$2.75

In both cases the contractor receives a payment equal to his construction cost plus profit, the municipality retaining an amount practically equal to the sum included by the contractor in his bid as necessary to cover the guarantee provisions. This amount per square yard is the same for both types of construction and has not been expended by the contractor in his work and will not be expended by him except where defects in construction have occurred. While held by the municipality, the contractor will be paid interest on it. This amount, while sufficient to cover ordinary defects in workmanship and insure the making within a reasonable time of necessary repairs, is totally insufficient to cover extensive repairs rendered necessary by serious defects or failure of the work, protection against this being assured by the guarantee bond.

Your committee further believes that the criticism that its provision as to forfeiture of all retained moneys in case of failure to make ordered and necessary repairs is too drastic, is well founded and has modified its progress report in that respect by providing that the city may make these repairs at the expense of the contractor and such expense shall be deducted from the retained money. When any part of the retained money is due to the contractor, only such balance as has not been expended by the municipality shall be considered to be due and payable. When the cost to the city of such repairs exceeds the amount of retained money, the balance shall be recoverable from the sureties.

### Amendments to Progress Report

It therefore submits as its final report, all of its progress report down to the paragraph commencing: "For new construction involving grading," etc., and adds thereto the following:—

"For new construction involving grading, foundation and wearing surface, we would recommend that an amount equal to 5% of the aggregate cost of these items be retained.

"For surfacing on an old foundation, we would recommend retaining an amount equal to 8% of the cost of surfacing.

"In the case of a two-year guarantee, the whole of the retained money should be payable at its expiration and not before. In the case of a five-year guarantee, one-fourth of the retained moneys should be payable two years after the completion of the pavement and the balance in three equal instalments. The date when payments of retained moneys become due shall be governed by the clause previously recommended for pavements completed and accepted between November 1st and May 15th.

"If the contractor, having received notice from the engineer, fails to make and complete the ordered repairs within a reasonable time (not to exceed thirty days in any case), the city shall have the right to undertake and complete the ordered repairs at the expense of the contractor or his sureties."

\*Final report of committee (Francis P. Smith, consulting engineer, New York, chairman) to the American Road Builders' Association.

†Published in *The Canadian Engineer*, June 12th, 1919.