

# Highway Shoulders as Related to the Pumping Problem

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● PUMPING of rigid pavements cannot occur unless there is water under the pavement. In most cases the major portion of this water originates on the surface and drains between the shoulders and edge of pavement to the surface of the subgrade or subbase. When this condition exists in combination with a repetition of heavy axle loads and certain textured subgrades or subbases pumping is likely to develop.

The Committee on Maintenance of Concrete Pavements as Related to the Pumping Action of Slabs was created by the Highway Research Board in 1942 for the purpose of studying pumping, how to prevent it and to determine the best means of maintaining pavements after pumping has started. Early studies by this committee showed that pumping could be prevented by using granular subbases. As axle loads and frequencies increased an action similar to pumping began to develop on some dense graded granular subbases.

The effect of pumping of rigid pavements constructed on a fine-grained soil subgrade is well known. The effect of the similar action that occurs on the surface of a dense granular subbase, which could be termed "erosion," "jetting," "blowing" or possibly "pumping," is not so well known at present. Although Indiana has only a few localized areas where erosion of the granular subbase has caused severe stressing, it is conceivable that cavities could develop in sufficient magnitude to affect materially the life or performance of the pavement. Experiences indicate that the most severe erosion of the subbase occurs during abnormally wet cycles.

Investigations in Indiana show that most of the water that makes either pumping or erosion possible originates on the surface of the pavement, or, in some cases, on poorly drained shoulder areas. It is admitted along the edge of pavement to the surface of the subgrade or the surface of the subbase course. In general, the major portion of the admitted water can be attributed to the failure of the shoulder material to make sufficient contact with the pavement edge to maintain a water-tight seal. This leakage may be attributed to shrinkage, if the shoulder is constructed of high volume change, fine-grained soils; to possible frost movements of the shoulder material; to cavities in the shoulder, adjacent to the edge of pavement (usually caused by debris from the grading operations); and possibly to placement of porous, uncompacted granular materials against the edges of pavement. The latter item may vary widely when granular subbases are used since it depends on the amount and location of excess material deposited at form side during fine grading operations.

The quality of the material to be used in shoulder construction can be specified to obtain the best material economically available. On one project in Indiana the shoulder soil was selected on the basis of a maximum plasticity index and a maximum volume change, based on the field moisture equivalent. If a higher quality shoulder is required than can be obtained from the better soils on the project then the shoulder should be constructed with granular materials or paved.

Good maintenance that will insure good surface drainage, and the use of good shoulder materials, well placed, is necessary if surface waters are to be properly controlled along the edge of pavement. There are indications that the construction of edge gutters, dowelled to the edge of the slab, materially assist in preventing surface waters from draining to the surface of the subgrades or subbases.

The Pumping Committee has long recognized the value of shoulder treatment and the importance of good shoulder maintenance. At the last annual meeting of the Highway Research Board this committee sponsored a panel discussion on shoulder maintenance. The committee also recognizes that if water is allowed to reach the subgrade or subbase, and the pavement deflections are of sufficient magnitude, it will be necessary to provide properly drained subbase courses to prevent pumping or erosion.

The committee would like to interest state highway departments in the construction

of drained experimental granular subbases. Drainage within the pavement area would be accomplished by extending the subbase beyond the edges of pavements for distances of 2, 4, 6, and 8 ft and all the way through the shoulders. The type of shoulder material used would be a part of this study.

Good shoulders, well maintained, make a substantial contribution toward controlling pumping of fine-grained soil subgrades or blowing of granular subbases.