TRAFFIC STRESSES PRODUCED IN CONCRETE ROADS

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There have now been accumulated a number of strain gage readings taken on a number of sections of concrete pavements of several designs and thicknesses and laid on different kinds of subgrade materials. The purpose of such measurements is to show what deformations are produced by traffic in various parts of a concrete pavement slab and, from an analysis of these deformations, to determine the proper thickness of the slab in its different parts properly to support heavy wheel loads.

In all of these tests the method of procedure has been quite similar. The strain gage employed was of the recording type and was especially designed for measurements of deformations in concrete pavements. The instrument consists essentially of a bell crank lever with a ratio of approximately 70 to 1. The long arm of the bell crank lever carries a needle which scratches a mark on a smoked glass plate. The length of this mark is roughly 70 times the actual deformation which takes place within the gage length of the instrument.

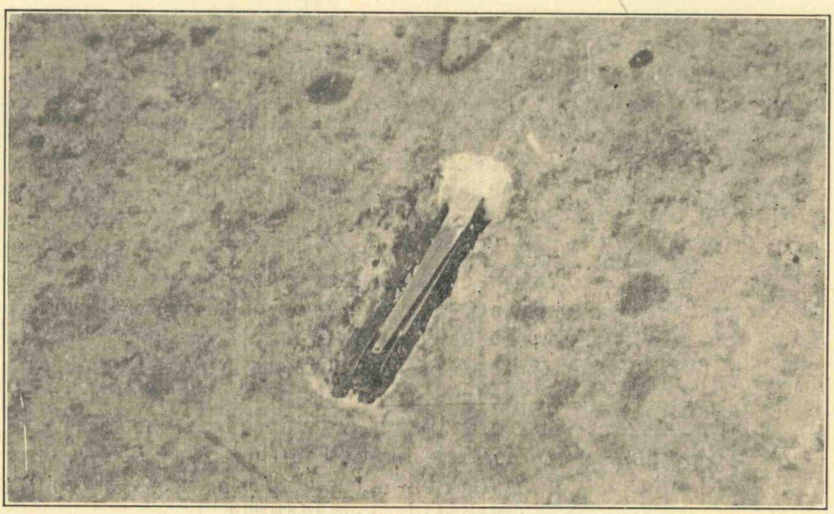

Figure 1.
Strain Gage in Road Surface.

A number of these devices are set in positions that have been selected to include the maximum stresses in the slab. Generally, narrow slots are cut in the surface of the road and the instrument set just beneath the surface and protected from traffic by means of a thin steel cover plate. A motor truck whose wheel loads have been determined is then run over the slab in a number of different positions so selected as to create the maximum possible stresses in the slab. After each test run the smoked glass plate of each instrument is moved forward slightly in order to place it in position for another record. Finally, the smoked glass plate records from all of the instruments are treated with a thin solution of the Kopal varnish in acetone, thus fixing the record for handling without danger of deletion Each record is then either examined under the microscope or enlarged by projection, and the deformations in particular spots in the pavement are thus determined and reduced to unit deformation

In many cases it has been possible to install the instruments only in the top surface of the slab In other cases by molding slots in the pavement at the time of its construction it has been possible to install what has been termed a scissors attachment, by means of which deformations at the bottom of the pavements are likewise determined

Absolute conclusions cannot be drawn from an analysis of the deformation readings thus far obtained The following, however, may be stated as very strong indications

1. The highest tensile stresses exist along the edges of a slab of uniform thickness
2. High tension also exists at the corners on the top of the slab but the value of this tension is not as high as that along the edge.
3. At an unsupported transverse joint, comparatively high tension can exist either on the top or bottom of the slab when the wheel load passes over the joint.
4. It is noticeable that the stress in the interior portion of a plain slab at some distance away from a transverse joint is considerably less than the stress along the outer edge.

These readings point directly to the necessity for increasing the thickness of a slab along the edge as compared with its interior thickness in order that it may be affected in like amount by wheel loads. Ordinarily a unit extension in concrete of 0001 to 0002 of an inch per inch of length might result in the formation of a crack. It will be noted that these values have been exceeded in a number of slabs upon which deformation measurements have been taken It is quite apparent that a number of variables such as modulus of elasticity, condition of subgrade, loading, etc , have affected the magnitude of the deformation readings in the various test sections

SKEW ARCH INVESTIGATIONS

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The design of skew arches has not in the past been based on well-established theory. Several failures of skew arches have occurred, and in several instances such arches are showing signs of distress at the obtuse angle end of the abutment. The inference to be drawn from the physical behavior of such arches is that higher stress exists at the obtuse angle end than at the acute angle end of the abutment. For the purpose of discovering the law of distribution of these stresses, a series of tests is being performed at the U S. Bureau of Public Roads These tests, although not complete, are sufficiently complete to indicate a certain, well-defined trend.