of you, in regard to our policy in approving plans and specifications sent to us for review, I could not refrain from outlining to you the reasons for the position we have taken in regard to specifications for these and other materials, which we believe is on the basis of equal opportunity to producers of each material, depending only on the economy with which they are able to produce and transport their material to the point of ultimate use and not at all upon any artificial differentiations between the two materials, none of which we believe to exist, so far as use in cement concrete are concerned. We hope that you will appreciate that we are not attempting to dictate to you as county officials any of the policies of your offices except as we are required by statute to set certain standards, to which requirement and standards we believe you can have no objection. We will always be glad to see you when you are in Indianapolis or near any of our district offices and to discuss with you, as I have today, any of our mutual problems.

ECONOMICAL DESIGN OF CONCRETE AND OTHER HARD SURFACE PAVEMENTS

By Frank T. Sheets,
Chief Engineer, Illinois Division of Highways.

(Note: Mr. Sheets did not present a paper. The following notes cover briefly the main points of his talk.)

Mr. Sheets emphasized that economy of design could be obtained only when pavements having a thickness adequate to carry maximum legal loads were built. He pointed to the folly of jeopardizing high class paving surfaces by inadequate foundations.

Mr. Sheets also pointed to the necessity of determining definitely by laws properly enforced the loads which may be expected upon highways or streets. He further explained the principles of design developed by the Bates Experimental road built and tested by the Illinois Highway Department, and pointed out how these principles, if properly applied, would produce pavements capable of carrying definitely determined maximum loads at minimum cost.

The great importance of building safety into highways was also discussed by Mr. Sheets. He emphasized the necessity of using curves of long radius and with proper super-elevation to obtain proper economy of operation and use. An-
other point which was discussed was the importance of location, and by a few striking illustrations Mr. Sheets showed the startling savings in operation cost which could be effected by proper location. In one specific case in Illinois where a road some 150 miles in length was relocated almost entirely throughout its length, 31 grade crossings and 30 miles of unnecessary distance were eliminated. The saving in operation to the motorists of that State resulting from the proper location of this one highway may be estimated most conservatively at $20,000,000 in a 20-year period.

ROAD DRAINAGE

By William Tonkel, Allen County Highway Superintendent.

The importance of good drainage in the economic maintenance of highways cannot be too greatly emphasized. There are two forms of road drainage—natural and artificial.

Natural drainage is that offered by the contour of the land and the condition of the sub-soil. Sub-soil such as sand and gravel will in places provide excellent drainage, and in some places such natural conditions afford so perfect a drainage system that very little artificial drainage will be needed beyond the customary crown and shallow side ditches.

Artificial drainage is secured by the crown of the road, side ditches and sub-drains. The crown and side ditches provide the surface drainage, and the side ditches and sub-drains serve to drain the roadbed.

Many auxiliaries are frequently necessary to proper drainage, such as culverts, catch basins, French drains, paved gutters, inlets, etc. The amount of artificial drainage required will at all times depend upon the existing natural drainage.

A road surface should have a crown sufficient to drain the surface water from the road to the side ditch. It should not be so excessive as to drain the water too rapidly, thereby eroding the shoulders. An excessive crown will encourage the traffic, in order to prevent slipping, to track in the center of the road. The crown should be slightly greater on grades of 5% or over than on level grades.

Side ditches should be deep enough so that the surface of the water is well below the base of the metal and should be kept absolutely free from any loose earth or other rubbish.