computed. The plans department of the State Highway Commission has a table of earthwork volumes which is valuable in that it saves much labor in computing these volumes.

With the amount of earthwork determined you will know whether it is desirable to leave the grade line as located or to raise or lower same for more economical construction. After the earthwork quantities are finally determined they should be entered on the profile between balance points and the engineer is ready to prepare his cost estimate and write the specifications.

It will be readily understood that in a paper of this sort no attempt can be made to go far into the details of surveys, preparation of plans or specifications. I have endeavored merely to sketch an outline of the procedure in the field and office. Each surveyor will have to work out his own details in accordance with local conditions and the type of improvement. Too much care cannot be taken, however, in any of the steps and the carefulness and accuracy of the surveyor will be reflected in the completeness and therefore usefulness of the plans as prepared. The cost estimate should be carefully prepared so that it will be useful to guide the contractor in preparing his proposal. Good plans and sensible estimates attract reputable contractors and result in satisfactory workmanship, thereby giving the public a proper return for the investment.

TEST ROAD IN ST. JOSEPH COUNTY

By A. C. Mangus,
St. Joseph County Highway Superintendent.

No highway improvement can be considered as permanent—forever enduring. The period of useful life of any highway improvement is limited. The time will come when the pavement must be reconstructed. This period of useful life may be longer; under like conditions, with one type of construction than with another. In any case the period of useful life is lengthened by careful attention to the maintenance of the improvement. By proper maintenance the day of reconstruction may be delayed and the period of useful life lengthened, permitting us to have the use of the pavement at a lesser cost per year by distributing the first cost over a greater number of years. However, the time will come when the
yearly cost of maintenance will be as great as the yearly cost of the added investment for reconstructing the improvement—then reconstruction is advisable.

This is true of the Lincoln Highway west of South Bend, a section of pavement in the neighborhood of 13 miles in length constructed in 1915-16. The three miles adjacent to the city were completed in December, 1916, during freezing weather.

Traffic from Chicago to Toledo, Cleveland and Buffalo pass over this section of the Lincoln Highway. Traffic from Detroit, Lansing and Jackson enter South Bend over the Ear Trail and there converges with west-bound Lincoln Highway traffic, all passing over this particular section. This traffic separates again at Rolling Prairie, a part taking the Dunes Highway through Michigan City to Chicago, the remainder following the old route through Laporte and Valparaiso. This is evidence in itself that this particular section carries the greatest amount of traffic of any section of the Lincoln Highway between Chicago and Toledo.

In the spring and summer of 1925 this section began to deteriorate in alarming proportions. Steel in the expansion joints began to raise out of its moorings to such an extent that it became a menace to traffic, such that in a great many instances it was necessary to pull them out with trucks. This caused a spalling of the concrete back from the joint six inches to three feet. Especially did this occur in that section that was installed during adverse weather conditions of the winter of 1916. During the summer a force of from six to eight men were patching practically half of the time. It became apparent to the board of commissioners and myself that the time had come when the cost of maintenance was greater than the added investment for reconstruction would be.

What material to use, what sort of top to put on this old pavement became a mooted question. Material men naturally recommended a top that would require their material. Contractors urged that material that would require the use of their particular equipment in installing the pavement. This diversity of opinions and the fact that the state was building a concrete road on the Division Highway from South Bend to Rolling Prairie, thereby shortening the distance between these two points by two miles, and that the building of that road would have a tendency to divert the heavy traffic from the Lincoln Highway to this new route, influenced us in building a test road as the logical way out of this difficulty.

Accordingly, the county engineer was instructed by the board of commissioners to prepare plans and specifications for six different types of road: concrete, penetration macadam,
sheet asphalt, asphaltic concrete, rock asphalt and emulsified asphalt. The contracts were let in August and the last section was completed in September, 1925.

The first section of five inches of reinforced concrete was built by Reed and Sons of Mishawaka at a cost of $2,150.

The second section was of penetration macadam rolled to three inches, built by the Highway Improvement Co., of South Bend, at a cost of $1,100.

The third section is sheet asphalt rolled to a thickness of three inches, built by the Williston Construction Company, at a cost of $1,430.

The fifth section is rock asphalt rolled to two inches, built by the Highway Improvement Company at a cost of $1,400.

The sixth section of emulsified asphalt rolled to one inch was built by the Emulsified Asphalt Company of Indianapolis, at a cost of $1,150.

In mentioning cost, we refer to the contract price, each section being let by contract. The several sections were each 500 feet in length. In choosing a location, we took a section of highway that was devoid of cross and side roads, thus compelling all traffic to traverse each and every section.

What the ultimate outcome will be, we are unable to say. Time alone will enable us to determine what type of reconstruction will be the best and most practical for future traffic on this particular road.

THE CITY'S SHARE IN OUR TRAFFIC PROBLEMS

By W. P. Cottingham,
City Engineer, Gary, Ind.

From New York to Los Angeles—from Duluth to Jacksonville—the people are clamoring for a solution to the traffic problem, and none of them are willing to be prevented from building up congested high value districts. Buffalo, Detroit, Toledo, Cleveland, Chicago, St. Louis, New Orleans, Indianapolis—all our great commercial cities are paying the price for congestion. Many are hopefully watching the experience of Washington, D. C., where precedent was recently upset and the traffic problem placed in the hands of an engineer. A great many accomplishments have been recorded in the past year, but the weak spot was found to be the lack of oppor-