as repair of highways. This fund derived from the state gas tax is used for the above-mentioned township road improvements, but I seriously doubt the economy of the practice and I seriously question whether the real intent of the law was to supersede the present laws providing ways and means to establish and improve roads in counties and townships. It may be reasonable and sensible to use some of the gas funds in certain cases, for instance, where there remains an open and unimproved gap in a road and the township has reached its bonded debt limit. But even so there remains the county unit law which can be applied in such cases. It is my opinion that it was the intention of the county unit law to provide for the use of county funds to construct roads connecting improved roads where the township funds are not available or in townships not having a great sum of taxable valuation.

I find that the mileage is increased in improving township roads with county funds but that this is done at the expense of the roads already built in the regular way which are entitled to the necessary repair and replacement of metals for which the repair fund was created. The gas tax is a part of the repair fund. It is very noticeable in the above-mentioned case that the other roads are suffering for lack of material and attention because of the depletion of funds caused by the county's using its repair money for placing metal on roads taken over from the township. How much benefit does a road receive from a layer of gravel or stone $1\frac{1}{2}$ to 2 inches in thickness when wet weather comes? This is the usual amount of metal which I observed on these roads.

SECURING LOWER CONSTRUCTION COSTS THROUGH THE MEDIUM OF COMPLETE, ACCURATE PLANS AND SPECIFICATIONS

By W. E. Morthland, Porter County Surveyor

Plans and specifications are an attempt on the part of the engineer to express his idea of proper construction. They are an attempt on his part to provide the construction he would do himself if, instead of being a designer, he were a builder turned loose to do the building and had no other consideration than the needs of the community and a regard for its ability to pay. It is the dream of some that this would be the ideal of municipal building but, sad to relate, many a good engineer might prove an extravagant builder. On the other hand if all designing was attempted by some worthy and reputable contractor, according to his ideas of good construction, we would find that many a good builder is a poor designer.
If the contractor's interest was removed from personal cost, his efficiency and frugality would soon suffer.

Our system of having an engineer prepare a plan setting up certain standards which must be followed, and then having different builders compete against each other in securing the contract, is fundamentally sound. A common difficulty is, however, that the engineer's plans and specifications are sometimes loose, permitting unscrupulous builders to bid too low to deliver the kind of construction contemplated. This deprives the public of the benefit of low prices and demoralizes the construction industry by encouraging the unworthy as against the worthy builder.

Economy in construction embodies both quality and price. The engineer's intention is to secure quality, durability, beauty, completeness, and general utility in his structures. To demand these qualities he must first determine in his own mind just how far he may go in his desires and still have the cost warranted by, and within, the paying power of his clients, and then so definitely to outline his ideas in his plans and specifications that there can be no compromises on quality. To receive less than is specified is as serious an extravagance as letting one's work at a higher price than is necessary.

There are those who contend that a given quality in construction can be secured only by choosing those contractors whose known reputations for skill, integrity, and responsibility are good. Without question, better work can be obtained from a contractor having these qualifications. However, even among our most highly rated contractors these qualifications are comparative. I am not sure that I have ever found perfection in one man. It is common to find men rating high in certain of these qualities, but falling down somewhat in others. Also these qualities are constantly being unearthed in men who have no known reputation. I would not advocate tolerating a contractor who had established a reputation for failure in these qualities, but, excluding this type, competition is the stimulus upon which economy is built. This economy can never be realized if the price received may be construed as permitting inferior work. The plans and specifications should definitely eliminate this tendency.

Recognizing the desirability of competition among worthy contractors and that economy of construction can never be realized where sacrifice in quality is allowed, we have the problem to face of extras, items not covered in the plans and specifications. If awards are to be made on price, and the successful bidder figures his costs on the plans and specifications before him, what is to be done about his bill for extras? On our county work, provision is not made for extras. However, to stand on the statutory safeguard provided our county administrators, and flatly to disallow extras where the proper completion of our job in hand requires their use, is hardly to
the benefit of our communities. If we recognize that the needs of our communities are not properly served by strictly refusing to order extras, and that to order extras a contractor must be paid, generally at no competitive unit figure, it is not hard to see that sometimes their use may become a means of raising our costs of construction. In fact we know that in certain branches of construction where competition is keen and jobs are being let at unit prices that do not permit of a profit to the contractor, his sole hope of profit is based on extras. Our plans and specifications to promote economy must be complete and accurate to eliminate extras so far as possible.

In the construction industry as elsewhere we have men of high calibre, honest, true, skillful, and responsible. This type is an asset to our communities. Only through the tactics exercised by such men is true economy of construction ever to be realized. If our plans and specifications are loose and incomplete, allow substitution, short weight, slovenliness, and other forms of price cutting, our action in their preparation is a direct blow at the worthy contractor, whom we should foster and encourage, and allows an opening for the unscrupulous. The lower price which we might obtain from the unworthy contractor is invariably offset many times over by the cheapened product of his creation. It is our duty to protect our communities against this type of economy.

The dishonest, cunning, and careless contractor with his apparently lower prices should have no opportunity to exercise his accomplishments; and the only way to see that this is the case is to make it impossible for him to work his tricks. Open competition by worthy contractors on a definite, accurate, and complete plan is the ideal toward which we should constantly strive. This ideal is sometimes within reach, but my experience of nearly fifteen years as an engineer has never yet quite yielded the apple.

HANDLING INSPECTION ON COUNTY ROADS

By Adolphus Cameron, Rush County Surveyor

In order that an inspector may be most efficient, he must be able to read, understand, and interpret the plans and specifications correctly. He must necessarily be intelligent and honest. But before the inspector can be expected to assume his responsibility as such, plans must be made plain and specifications must be written in intelligent, clear, definite, and complete form with no details lacking. Even before desirable plans and specifications can be prepared, the engineer should have every possible detail of construction clearly in his own mind.