

careful performance of duty on the part of the engineer and his representatives, the work on the contract should proceed with little friction and few arguments between the contractor and engineer, and reach final inspection, acceptance, and final payment with the best of feelings by all parties to the contract.

## FUNDAMENTALS OF SPECIFICATIONS

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A specification of which the plans are a part has for its objective a finished or completed project; therefore, it should contain only such information as will insure the best results under a given condition. Quite often too much space is used for unnecessary stipulations; especially is this true of county construction.

Specifications for state highway work must be of the highest type as to clarity and intent, and the best evidence of the value of such specifications is the completed work which is accepted by the state from year to year. However, there is a vast amount of construction work done in the state which does not come under the authority of the state highway commission, and such work also must be adequately specified and planned.

The great bulk of this latter type of work falls to the several counties of the state. Unfortunately, these units of government do not have the strength of organization or the facilities at their disposal to specify or plan as thoroughly or with such exactness as the state. This is because of the different nature and types of the road, bridge, and miscellaneous construction which is handled by these units.

At the present time, about the only revenue that the several counties have from which to construct roads, bridges, etc., is from the gasoline tax and the motor-vehicle-license fees. The counties' share of these funds is much less per mile than is the share of the state. Because of this lack of adequate revenue and since the counties are dealing with only secondary types of road and bridge building, they cannot emulate the state in the production of more detailed plans and specifications.

## USE OF LOCAL MATERIALS AND CONDENSED SPECIFICATIONS

Under the present law, any county contemplating the building of a road or bridge costing more than \$1,500 per mile or per unit must file plans and specifications therefor with the State Highway Commission for its approval. With the limited funds allocated to the average county engineer's office, it is practically impossible to turn out such a complete

set of plans and specifications as the state prepares for its projects. However, it would be an injustice were the state to refuse approval of such plans and specifications because they do not exactly meet the state's standards, assuming, of course, that such plans and specifications submitted to the state implied sound engineering practice.

For instance, it may be necessary for the engineer to utilize the natural resources of the territory surrounding the project, such as gravel, sand, or stone. For the uses contemplated, such natural resources may not require such accurate gradation, or other more costly treatment, as required by the state. After being inspected and adjudged of sufficiently good quality by the engineer and with a minimum amount of preparation, probably they could be used in the work and produce a road or structure well worth its cost and at the same time facilitate practical construction operations.

In our county, we constructed a bridge using the state highway specifications. However, several paragraphs were omitted from these specifications, covering such items as false-work, centering, the use of ply wood or metal composition forms, metal ties, placing of bars on metal chairs, and the hand picking of coarse aggregate from hand rails. We added a paragraph permitting the use of a one-bag mixer. I do not believe this affected the utility of the job in any way, but I do believe it produced a suitable structure at a lower cost than would have been possible under the complete standard specifications.

A few years ago at this Road School the Surveyor of Jasper County showed pictures of roads in his county that he had built with crusher-run stone compacted by rolling. These roads were built at a very low cost and serve the traffic of those rural districts quite satisfactorily. This stone probably would not have been acceptable had it been under rigid specifications.

#### CO-OPERATION OF CONTRACTOR AND ENGINEER

I am not attempting to say that rigid specifications are not desirable, but I do believe that a common-sense view is needed in regard to county work. No one appreciates a well-defined, concise, clear set of plans and specifications more than does the engineer of construction or the contractor. They should agree that the plans and specifications set forth adequately what is expected in regard to qualities, quantities, and final product. Most contractors have for their object a better project than the one they finished last. It is essential to their profession, since their future depends upon satisfactory completion of each project. They welcome and highly approve a common-sense, workable set of plans and specifications.

If the contractor will give as much attention to the spirit and intent of the specifications as he does to the letter, a better job will be produced for the taxing unit.

Upon the shoulders of the engineer and the contractor, both of whom may be considered public servants, rests the burden of producing the finished job, for which the public pays. Neither should look with disfavor upon the other merely because his title is different. But they should make every effort to achieve a "meeting of the minds" in order to solve many of the intricate problems which arise during the execution of any contract.

No set of specifications can be so closely drawn that every minute detail or requirement is covered by a clause. The specifications must be considered as a guide containing the rules that a contractor must follow, but it must be remembered that almost any set of specifications may contain clauses that will require the mutually unbiased interpretation of both the contractor and the engineer. If the intent is clearly expressed, the mechanical work of planning properly done, and the contractor and engineer work in a common cause, then will a well-completed job be had.

## INDIANA STATE AND COUNTY CO-OPERATION ON ROAD CONSTRUCTION AND RECONSTRUCTION

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Before we can intelligently discuss the present highway system in Indiana, we must have a clear understanding of the highway system in the past; and so I will review briefly the highway industry in Indiana.

The Indiana highway tradition is essentially a local tradition. It should not be forgotten that Indiana was the third from the last state in the Union to set up a state highway department, and even then the highway department was created primarily because such a department was required in order to get Federal aid. Indiana was so late in establishing a state highway department not because the state was backward in its highway development, but on the contrary, because it was so far advanced through the construction of good roads by the counties and townships. The counties had good standards of construction and all work was built by contract. Force account work was not sanctioned by the laws governing local construction.

Our state highway department was established in April, 1919. The construction and maintenance forces began work one year later. The more important county roads connecting county seats and all cities of 5,000 population or over were