

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

taken into the state system for maintenance. The counties retained jurisdiction over all other improved roads, and the townships controlled all other unimproved roads, using funds raised therefor by a tax levied on property.

This system of maintenance and construction on rural roads continued until the special session of the state legislature in 1932. This session of the legislature eliminated the property tax for road purposes, placed a moratorium on the issuing of bonds for road construction, eliminated the townships as road administration units by placing all their roads in the county system, and distributed one half of the gas tax money and one half of the motor vehicle license fees collected by the state to the counties and cities for road and street construction and maintenance.

Thus the state highway department received 50% of the net gasoline tax and 50% of the net motor vehicle license fees. The counties received 40% of the gasoline tax and 40% of the license fees. The cities and towns received 10% of the gasoline tax and 10% of the license fee.

The cities' and towns' shares of these funds were allocated on the basis of population. The counties' share was allocated on the basis of one-eighth according to population of the counties and seven-eighths according to the proportion which the county highway mileage bore to the total mileage of all county highways in the state.

The 1933 legislature changed the distribution of the license fee fund, placing 25% in the state general fund, 50% in the state highway fund, 20% in the county highway fund, and 5% in the cities' and towns' fund. The basis of allocation to the various counties, cities, and towns was left as in the 1932 law.

The argument on the basis of distribution started with the passing of these laws and will always be a debatable question which will never be solved to the satisfaction of everyone. The method of distribution was immediately objected to by the more populous counties, their contention being that volume of traffic, vehicular registration in the counties, or population should be the basis for the distribution of the gas tax. Our public officials began receiving demands from the groups who wish to put all roads into the state system. These groups do not base their demands entirely on facts, but more on the theory that, once the state assumes control, it will assume the county and township outstanding road-bond obligations, thus relieving real estate of taxes for this purpose.

#### HIGHWAY SURVEY COMMISSION

The 79th Indiana General Assembly (1935) was faced with these two demands and, because of lack of definite information, decided that a study should be made of all highway conditions before any legislation pertaining thereto should

be formulated. By joint resolution it created the Highway Survey Commission, consisting of three members of the senate, five members of the house of representatives, three citizens-at-large, the chairman of the state planning board, and the chief engineer of the state highway commission. This commission made an intensive study of the highway industry of the state and made a very commendable report to the 80th General Assembly (1937). The portion of the report dealing with county roads follows:

The inventory shows a total of 75,400 miles of roads, of which amount 11.83% or 8,926 miles are in the state highway system and 88.17% or 66,475 miles are county highways. In the state highway system 56.28% of the roads are improved with a high-type pavement. Two per cent of all county highway mileage is improved with a high-type pavement; 4.94% of the county mileage is bituminous surfaced; 69.4% of the county mileage is improved with gravel or stone, of the type of construction which we know commonly as a gravel or a stone road; 22.13% of all county highways are unimproved; and 1.53% represent highways closed to traffic but legally open.

The length of bridges inventoried is 892,700 lineal feet, of which amount the state highway system has 20.49% or 182,930 lineal feet, and the counties have 79.51% or 709,770 lineal feet.

School bus routes travel a total of 30,185 miles of highways, and mail routes travel a total of 34,428 miles of highways in Indiana; 81.57% of the school bus mileage and 83.15% of the mail route mileage is on county highways.

The Commission recognizes that the citizens of Indiana have made sacrifices to create the excellent system of county highways which they now enjoy; the users of our highways should be responsible for the payment therefor. In view of the above facts, the Commission recommends that the construction of county highways be continued as a local problem and that the cost thereof be provided through the use of funds allocated to the counties from the Motor Vehicle Highway Fund; furthermore, the Commission recommends that the use of such funds for construction be under the supervision and direction of the State Highway Commission and the relationship between the county and the State Highway Commission be similar to the relationship which the State Highway Commission now enjoys with the United States Bureau of Public Roads in the employment of Federal Aid Funds by the State Highway Commission, with respect to project statement, project agreement, plans and specifications and construction.

#### MOTOR VEHICLE ACT

The 80th session (1937) of the Indiana General Assembly, after studying the report of the Highway Survey Commission, passed the Motor Vehicle Act, changing the distribution of funds returned to the counties for road purposes and giving

the State Highway Commission the responsibility of supervising the expenditure of these funds spent by the counties for construction and reconstruction. That portion of the law dealing with the allocation of funds and the state supervision reads as follows:

**Counties—Allocation.** One-third of the remainder of the net amount in the Motor Vehicle Highway Account shall be set aside for the counties of the state and shall be allocated upon the following basis:

(1) **Basis of Allocation to Counties.** Six-tenths of the one-third shall be allocated among the counties on the basis that the total vehicular miles of traffic on all the county roads of each county, determined as herein provided, bears to the total vehicular miles of traffic on all the county highways of all counties, determined as herein provided.

(2) **Allocation to County—Basis.** Four-tenths of the one-third shall be allocated among the counties on the basis that the total vehicular registration of each county for the preceding year bears to the total vehicular registration of all the counties for the preceding year.

**Section 12—Years of 1938 and 1939—Motor Vehicle Highway Account—Method of Computation.** For the calendar years of 1938 and 1939 and each year thereafter, the distributive shares of the respective counties from the Motor Vehicle Highway Account shall be determined in the following manner: The Treasurer of State and the Auditor of State shall compute the share which each county would receive by virtue of the provisions of section 3 of this act, and this computation shall in this section be referred to as the "First Method," and also, shall compute the distributive shares each county would receive if the sum set aside for distribution to the counties by virtue of this act were divided among them in the proportions that the four-fifths of the "County, Cities and Towns Gasoline Fund" was divided among them under the provisions of law in effect in the calendar year 1936, and this computation shall in this section be referred to as the "Second Method." During such years, to each county which would receive a greater share by the first method than it would receive by the second method, the Auditor of State shall distribute a sum equal to the share computed by the second method plus a sum equal to fifty per cent of the difference between the share computed by the first method and the share computed by the second method. During such years, to each county which would receive a lesser share by the first method than it would receive under the second method, the Auditor of State shall distribute a sum equal to the share computed by the first method plus a sum equal to fifty per cent of the difference between the share computed by the first method and the share computed by the second method.

**Counties—Funds Remaining—Use.** All funds allocated or distributed to the respective counties which are not used for mainte-

nance shall be used for construction and reconstruction of the highways of the respective counties. Any surplus existing in the maintenance fund at the end of any year shall thereafter be used for construction and reconstruction of such highways by the respective counties.

**Section 6. (a) Counties—Roads Constructed—Reconstruction—Supervision—Commission.** The construction and reconstruction of the highways or parts of highways, subject to the jurisdiction of the respective counties and the Boards of Commissioners thereof, and the use and expenditure of all funds allocated and distributed to said counties from the Motor Vehicle Highway Account which are not budgeted for maintenance, and the use and expenditure of all funds paid to any county under any act of Congress of the United States which are allocated, through the Bureau of Public Roads, shall be under the supervision and direction of the Commission, as herein expressly provided.

**(b) Counties—Road Projects—Commission—Submission to—Approval—Commissioners—Procedure.** Any county proposing to construct or reconstruct any highway shall submit to the Commission, Project Statements, setting forth the proposed construction or reconstruction and, if it shall be approved by the Commission, the county shall furnish the Commission with such surveys, plans, specifications, and estimates therefor as it may require, and the same shall be subject to the approval or disapproval of the Commission. Upon approval of the plans, specifications, and estimates, the Board of Commissioners of the county shall advertise for, receive and open bids for the construction or reconstruction proposed. The award of the contract therefor shall be subject to the approval or disapproval of the Commission and the highway construction or reconstruction shall have final approval from the Commission before the final estimate is paid on the contract by the Board of Commissioners of the county. If the cost of any proposed construction or reconstruction does not exceed one thousand, five hundred dollars per mile of highway, it shall not be necessary for the Board of Commissioners of the county to furnish the Commission with surveys, plans, specifications, and estimates, but a summary statement thereof made in compliance with the rules of the Commission promulgated hereunder shall be sufficient to require the Commission to approve or disapprove the project.

#### DEVELOPING SPECIFICATIONS AND STANDARDS

Recognizing the fact that much education would be necessary to put this law in operation, we held six meetings throughout the state to explain the law to the different county officials. Immediately after these meetings, I began visiting the counties to assist them in developing standards on construction and reconstruction of highways.

In developing specifications and standards we have proceeded on the theory that education and somewhat lenient specifications at the start will lead to a more uniform specifica-

tion in the counties and not meet with so much opposition. As we gain more knowledge of the requirements, and the counties look more to the ultimate cost of their roads, we can gradually strengthen the specifications. We have set up some general standards in the counties and the following is a typical standard for county work. This is a general outline. A detailed set of specifications and plans are required on work costing more than one thousand, five hundred dollars per mile.

1. Right-of-Way Widths.
  - a. 1-lane, 40 feet.
  - b. 2-lane, 50 feet.
2. Roadway Cross-Section.
  - a. 1-lane.
    - (1) Width of metal, 10 feet.
    - (2) Width of berm, 6 feet.
  - b. 2-lane.
    - (1) Width of metal, 18 feet.
    - (2) Width of berm, 6 feet.
3. Slopes.
  - a.  $\frac{1}{2}$ " to 1' on berms.
  - b.  $1\frac{1}{2}$ ' to 1' from berm line to ditch.
  - c.  $1\frac{1}{2}$ ' to 1' on back slope.
4. Culverts and appurtenances (under 10' span).
  - a. No headwalls except in special cases.
  - b. Any type (V.C. to be triple strength).
5. Structures larger than culverts.
  - a. Loading, 15 tons.
  - b. Width of roadway, 20 feet.
6. Materials for structures.
  - a. State specifications.
7. Maximum grades.
  - a. 300-foot sight distance.
8. Horizontal sight distance.
  - a. 300 feet.
9. Earth work.
  - a. Sod to be used in berm only.
  - b. Fills to be constructed in 1-foot layers.
10. Surface materials.
  - a. Stone: State specifications.
  - b. Gravel: All passing 1" screen and 35 to 50% retained on a No. 4 screen with 5 to 15% clay or other binding material.
  - c. Black-top.
    - (1) Type names to be the same as used by the state.
    - (2) All bituminous material to be tested.
    - (3) Stone or gravel. Same as surfacing material.
11. Construction methods.
  - a. Separate specifications on each project.
12. Special cases.
  - a. Roads with little traffic will be treated as special cases and agreement on each project will be reached between the state and county.

So many different types of black-top construction are being used with good results in the counties that it is difficult to standardize this type of construction. The type of construction in use depends on the materials available in the county. Some counties are using stone meeting the state specifications. Others are using a waste product, or maybe I should say a by-product of the gravel companies, called "buck shot." The screen test on this material compares favorably to the screen test required on our No. 12 stone. Counties are using the so-called "processed gravel," that is, bank gravel screened with the oversize crushed. The results with all these types of construction have been, in most cases, favorable. We are more interested in the results obtained than in the type of construction being used.

#### ENGINEERING QUALIFICATIONS

The amount of state inspection on county projects will depend upon the cost of the project and the type of inspection available in the county organization. Engineering and inspection costs should be comparable to the cost of the project.

Care should be taken in picking men to supervise county work. The engineers who have had experience on both county and state work are especially valuable, as they not only understand the administrative setup of both the state and county, but, also, will not have the tendency to set up design and construction standards that are too high to be practicable on the majority of our county roads, and which would result in an improved mileage too small either to satisfy public opinion or to make satisfactory progress on a long-term construction program. Some engineers, trained only in county work, have a tendency to hold their standards so low that so-called stage-construction, which simply adds something to what was previously built, is impossible. The best type of engineer is the one who can strike a happy medium between these two extremes, who will keep the clamor for mileage fairly well in hand without sacrificing so much on design and construction standards that the original investment is largely lost when better types of surfaces and widths are needed in the future.

Next to a lack of continuity, the lack of a definite program is one of the most glaring faults of our present county road officials. The filing of project statements, summary reports, and plans will, by virtue of the time required for approval, encourage the development of some definite program. This program must cover as many miles as possible to satisfy the demands of the public and to assist the counties in determining the roads to receive priority. We have considered first, the traffic, then the roads serving both school bus and mail routes, and third, those serving either a school bus route or a mail route.

Much has been said about spending motor vehicle account funds according to the traffic counts on the roads. This theory is practical on our state primary system, but when you attempt to apply this theory to county roads, the social aspect of the rural roads makes itself felt; so we have tried to work the social and economic factors together in assisting the counties in working out their road programs. Any program which ignores the social side of rural roads will fail through lack of public support.

#### HELPFUL CO-OPERATION

You may wonder what course the state plans to take in putting this law in operation. First let me say that we are not setting up a police system over the counties. Another department of the state will take care of any policing necessary. Much misunderstanding can arise over the lack of agreement on definitions. One man's "control" or "supervision" may be another's "helpful state and county co-operation." It is this latter definition we are keeping before us in carrying out this law. The state has its testing department, standard specifications, standards of design, and specialized engineering forces to assist the counties in solving their problems, and we urge the counties to take advantage of these facilities.

We should all be interested in the success of the county unit for these following reasons:

1. It is the most economical unit in size.
2. The public will demand higher type roads if the state assumes control of all roads without providing any additional source of revenue.
3. Our state primary system would suffer to some extent while the demands of these rural roads were being satisfied, since \$400 per mile would be all the money available for maintenance, reconstruction, and construction if the state assumes control.
4. We would lose the assistance of the local units in any fight against the diversion or a reduction of funds available for road purposes.

To those who say this law is a violation of the home-rule principle, let me quote the Ex-county Engineer in *Better Roads*: "Intelligent control from above, grounded upon technical standards, may be the most effective protection for local self-government."

#### RESULTS TO DATE

Since the Motor Vehicle Highway Account Act became operative on January 1, 1938, 595 projects have been submitted by 53 counties. These projects may be classified in the following manner:



Type of Project	Cost	Number of Projects	Total Length	Total Cost
Bridges.....	Over \$1,500	16	633 feet	\$69,655.55
Bridges.....	Under \$1,500	21	359 feet	15,483.20
Roads.....	Over \$1,500 per mi.	14	28.35 miles	89,418.55
Roads.....	Under \$1,500 per mi.	536	987.87 miles	649,531.23
Total cost, not including WPA funds.....				\$824,068.53

I am glad to say that on projects undertaken to date, when we have passed on plans and specifications, we have had the fullest co-operation from the counties. I believe that those counties that have actually tried and experienced the requirements under this law will agree that our relationships have been marked with a spirit of co-operation.

This law may not be perfect—new laws often are not—but as we pioneer in this field, defects will be detected and corrected. I therefore ask this group to study the trends in highway administration and to help preserve the county as a unit in our highway program in the future.

### ROAD DRAINAGE

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Two primary sources of water are known—natural and artificial. For road drainage we are concerned mainly with the natural sources, i.e., precipitation in one of its forms: rain, snow, sleet, or hail. Some of this water will evaporate; some will run off over the surface of the ground; some will seep away or percolate through the soil to form a part of the underground supply; some may remain standing upon the surface of the ground in the form of pools until removed by natural or artificial means. Where needed, water has a value; but excess water is detrimental to property, perhaps to life, and should be drained away under control.

A good road must have a surface that is waterproof and a subgrade that is reasonably dry. Road drainage may then be defined as scientific directing of the removal of surface and ground waters, so as to safeguard the investment in the roadway structure. Some one has said, "You may not get any praise for the miles of smooth roadway, but you get blamed for every foot of rough road."

Protective measures may take the form of works upon the surface of the ground, or works adjacent to and parallelly