

3. Select materials for resurfacing that will make maintenance easier and cheaper.
4. Don't resurface until you are sure that the drainage has been well taken care of.
5. Don't resurface until the old road surface has been properly prepared to receive the new material.
6. Don't expect that the new surface will not require maintenance.

THE INDIANA SECONDARY ROAD PROGRAM

M. R. Keefe,
Chief Engineer, Indiana State Highway
Commission, Indianapolis

What is the secondary road system in Indiana? Can the state system now be divided into a primary and a secondary system; and if so, on what basis should such a division be made? On the basis of surface types, the system cannot be so divided, for on some of our most heavily traveled roads, there now exist secondary-type surfaces. On studying our traffic records it soon becomes apparent that one cannot divide the existing system into primary and secondary roads on the basis of traffic. On many roads one section will be carrying light traffic, say 100 to 150 vehicles per day, while on another adjoining section the count may run from 750 to 1,000 per day or even higher.

The highways in the state system have never been classified into primary or secondary roads, as was done in many of the states. In several of the states of the Mississippi Valley, the law establishing a state highway system designated a primary and a secondary system of roads and provided for the sequence of improvement of the two systems.

The first Indiana Highway Act passed in 1917 provided that the commission should designate the main roads of the state, which were to be known as "Main Market Highways," and that a report thereon should be made to the governor. In designating these main roads, the commission was obligated to take into consideration the lines of travel connecting main market centers, as well as the kind and volume of traffic.

This law was declared unconstitutional, and at the session of 1919 the legislature passed a new law with changed provisions for laying out a system of state roads. The "Main Market Highways" as selected under the 1917 act were to remain in the system, and in addition it was provided that the state system of highways was to reach every county seat and every city or town having a population of 5,000 or more, as well as to connect with all improved trunk highways of adjoining states. This selection of a state highway system was to be completed by the highway commission before April

1, 1920, at which time it was to receive the approval of the governor.

The system of state highways as selected by the highway commission in 1919 consisted of 3,210.6 miles and covered all counties of the state. Marion County had the largest mileage, 58.3 miles, and Ohio and Brown Counties the smallest mileage, 9.1 and 9.8 miles respectively. The total amount spent for maintenance of the state system in 1920 was \$716,244.45, or \$233.10 per mile. Compare this with the fiscal year of 1935, when the Maintenance Department expended \$3,974,732.27 or \$474.00 per mile.

Our state highway system at present comprises 9,289.14 miles of roads. Of this mileage, 3,827.25 are paved with the higher-type surfaces such as concrete, brick, or rock asphalt; 574.25 miles are paved with intermediate-type bituminous surfaces such as bituminous concrete, bituminous macadam, surface-treated waterbound macadam, and retreads; 2,349.28 miles are surfaced with mulches and road-oil mats; and the remainder, 2,538.26 miles, are stone, gravel, or other low-type surfaces.

EFFECT OF THE NRA ON THE SECONDARY ROADS

When the National Industrial Recovery Act was passed on June 16, 1933, by the 73rd Congress, there was authorized, under Section 204 of this act, the appropriation of \$400,000,000 to be granted to the several state highway departments for the construction of public highways and related projects on the federal aid highway system, and on extension thereon through municipalities and on secondary or feeder roads.

The regulations for the expending of this \$400,000,000 defined secondary or feeder roads as "those roads which are not now included in the approved system of federal aid highways, but which may be either part of the state highway system or are important local highways leading to shipping points or which will permit the co-ordination or extension of existing transportation facilities including highway, rail, air, and water".

These same regulations also provided that not more than 50% of the apportionment should be applied to the federal aid highway system outside municipalities, that not less than 25% of such funds should be applied to projects on extensions of the federal aid highway system into and through municipalities, and that not more than 25% of such funds should be applied to secondary and feeder roads until provision had been made for the satisfactory completion of at least 90% of the limiting federal aid highway system of the state.

This was the first federal road appropriation which made it mandatory for the highway commission to expend a portion

of the grant on the development of secondary or feeder roads. All previous federal grants had required that all expenditures must be made on the federal aid system. It provided Indiana's chance to begin the development of her secondary or feeder-road system.

Our allotment from the NRA funds amounted to \$10,037,843. The state highway commission selected eleven projects to be included in the feeder-road program, projects located in thirteen counties of the state. The preliminary estimate of cost of these eleven projects amounted to \$598,851.27 and provided for the improvement of 84.2 miles of county roads not in the state system, at an average estimated cost of \$7,112.00 per mile. There were also included in this feeder-road program two roadside improvement or landscaping projects, both on state highways.

Since the federal grant provided that no part of the funds appropriated could be expended for right-of-way or property damage, and since these feeder-road projects were all on county roads where no state funds could be legally expended for right-of-way, it became necessary for each of the counties in which a project was located to acquire the necessary right-of-way for the improvement. The highway commission requires, as a minimum, an eighty-foot right-of-way for reconstruction on all state highways, and following this requirement, requested each county to provide eighty feet of right-of-way on each of these projects.

The projects constructed under this program are listed in Table 1.

In addition to these construction projects, there were developed two landscaping projects, one in Marion County and one in Porter County, at a total cost of \$24,305.00, making a total cost for the eleven feeder-road and the two landscaping projects of \$563,373.85. The average cost per mile for the feeder-road program of 1934 was therefore \$6,691.00 against an estimated cost of \$7,112.00 per mile.

After the completion of the construction of these feeder roads, they were by resolution of the commission taken into the state highway system and now form the first unit of secondary or feeder roads in the Indiana State Highway System.

HAYDEN-CARTRIGHT ACT

In June, 1934, the 73rd Congress made another appropriation for highway work to be carried out by the highway organizations of the several states. This appropriation of \$200,000,000 was known as the Hayden-Cartwright Act. It was provided again that each state must allocate not more than 25% of its appropriation to the construction of secondary or feeder roads, an amount which could be decreased if a satis-

TABLE 1
INDIANA FEEDER-ROAD PROJECTS UNDER 1933 NIRA ACT

County	Location	Road-way	Surface	Length Miles	Total Cost	Cost Per Mile
Lake	Hobart S. through Ainsworth to junction with S.R. 30.	42'	20' concrete	3.12	\$78,053.84	\$25,017.00
Boone	Zionsville E. to junction with S.R. 29.	40'	6" stab. base, 2" bit. mulch surface 18'	1.08	9,080.00	8,460.00
Steuben	Freemont S.W. to Angola junction with S.R. 27.	42'	Gravel base to 6", 2" bit. surf. 20'	6.89	42,128.89	7,260.00
Steuben	Ashley N. & E. to Pleasant Lake junction S.R. 27	40'	Gravel base to 6", 2" bit. mulch 18'	5.57	35,461.33	6,380.00
Jackson	Medora N. to jet. S.R. 50	30'	6" crusher-run base, tar mat 18'	3.51	28,655.03	8,164.00
Jackson	Ewing S. to junction S.R. 50	30'	Crusher-run stone 18'	0.32	2,644.96	8,260.00
Harrison-Floyd	New Boston N. to jet. S.R. 62 W. of New Albany	26'	6" crusher-run stone 14'	26.4	169,727.11	6,450.00
Clinton-Boone	Kirkland on S.R. 29 S.E. to Terhune	40'	Gravel base to 6", 2" bit. mulch surface 18'	4.13	28,046.32	6,790.00
Marshall	S.R. 10 in Culver to S.R. 31 in Plymouth	40'	Gravel base to 6", 2" tar mat 18'	12.5	58,768.89	4,781.00
Madison	From S.R. 67 S. of Anderson to Middletown	40'	Stone base to 6", oil mat	7.37	39,620.12	5,369.00
Morgan	Eminence on S.R. 42 through Wilbur to jet. S.R. 39	32'	6" gravel 16'	10.28	56,892.66	5,534.00

factory showing could be made to the Secretary of Agriculture that the state had not been able to improve its state system with adequate types of construction to accommodate traffic.

Because of difficulties in finding feeder roads off the state system where counties were able and willing to provide the necessary 80 feet of right-of-way, the commission allocated but 4% of the Indiana allotment of \$5,018,920 to the feeder-road program.

The construction program as submitted to Washington for approval provided for the expenditure of \$210,000 for secondary and feeder roads and called for construction of two projects off the state highway system, four projects on the state system, and three landscaping projects on the state system.

One of the two projects off the state system connected the county seats of Hamilton and Tipton counties. Neither county being in a position to furnish the minimum width of right-of-way, namely 80 feet, the project had to be abandoned and the funds allocated to other construction.

The second project off the state system was in Harrison county and provided for construction of 0.82 miles of unimproved gaps in the county road between Mauckport and Elizabeth. The estimated cost of this construction was \$7,302.00.

PROVISIONAL ADDITION TO STATE SYSTEM

In October, 1934, the State Highway Commission provisionally took into the system approximately 825 miles of county roads in 60 of the 92 counties of the state. The provisions under which these roads were taken into the system required that the counties must furnish an eighty-foot right-of-way before maintenance would be started on these roads by the state highway organizations.

Survey parties were placed in the field to make center-line surveys of each of these roads, and plans were developed to show the center line and all existing buildings, trees, etc. Plans were placed in the hands of the county commissioners just as soon as they were finished, and those counties which so desired began negotiations for the required right-of-way. More than half this mileage has now come into the state system with adequate widths of right-of-way. Construction contracts have been let on a number of these roads, and others are being placed under maintenance. Many counties, because of lack of funds, could not acquire the necessary right-of-way, and a number of counties made no attempt to obtain the right-of-way.

When these roads were provisionally taken into the system, our commission had received information that a new federal grant was to be made to the highway departments of

TABLE 2
INDIANA FEEDER-ROAD PROJECTS UNDER 1935 ERA ACT

County	Location	Road-way	Surface	Length Miles	Total Cost	Cost Per Mile
Stauben.....	Freemont E. to Mich. State Line	34'	Gravel surface to 6", 18'.....	7.34	\$36,675.75	\$5,000.00
Whitley-Noble...	Columbia City N. to Wolf Lake..	42'	Gravel base to 6", bit. mulch surf. 20'	11.78	101,412.71	8,600.00
Whitley.....	South Whitley to Columbia City..	42'	Gravel base to 6", 2" bit. mulch surf. 20'	9.51	98,326.51	10,345.00
Gibson.....	Owensville to State Road 41.....	34'	Stone surf. to 6", 18' wide.....	7.70	78,824.97	10,300.00
Perry.....	Cannelton N. to S.R. 37.....	34'	Crusher-run stone 6", 18' wide....	4.32	44,403.07	10,278.00
Pike.....	From S.R. 64 to S.R. 56.....	28'	Crusher-run stone surf. 6"x16'....	12.42	112,644.39	9,072.00
Boone.....	Thorntown to Jamestown.....	34'	Gravel surf. 6" to a width of 18'....	14.29	36,728.37	2,570.00
Wells.....	Montpelier N. to S.R. 224.....	42'	Crushed stone to 6" x 20'.....	18.0	90,012.54
Monroe.....	Bloomington to Whitehall.....	34'	Crushed stone to 6"x18'.....	6.90	57,178.20	8,280.00
St. Joseph-Elkhart	S.R. 2 to S.R. 20 along County line	42'	To be high-type pavement 20' wide	1.51	†54,749.71	†8,280.00
Noble.....	S.R. 3 to Albion.....	34'	Gravel surf. 6"x18'.....	9.23	39,765.63	4,310.00
Martin-Greene...	Burns City to Little, Cincinnati..	36'	Crushed stone 6"x20'.....	19.34	319,675.23	16,530.00
Harrison.....	S.R. 135 N.E. to Crandall.....	34'	Crushed stone 6"x18'.....	6.00	†55,728.60	†9,266.00
Jay*.....	Resurfacing Main St. in Redkey..*	4,559.00

* Damaged while being used as detour and could not legally be resurfaced with state funds.

† Estimated.

the state. Advance information indicated that a large part of the grant would necessarily have to be expended on feeder roads, and we felt that we would be ready with plans on a major portion of this 825 miles of feeder roads to take quick advantage of any monies allotted to our state.

EMERGENCY RELIEF ACT

The Emergency Relief Act was passed by Congress on April 8, 1935. This act carried an appropriation of 4 billions of dollars for relief, and, among other allotments to relief work, authorized the President to make allotments for highways, roads, streets, and grade-crossing eliminations up to \$800,000,000.

On June 4, 1935, allotments of \$200,000,000 for highways and \$200,000,000 for grade-crossing eliminations were made by the government. Indiana's allotments from these funds amounted to \$4,941,255 for highways and \$5,111,096 for grade-crossing eliminations and were only half of the amounts authorized by Congress.

The regulations governing the expenditure of these funds were issued in July, 1935, but were amended in August and again in September. The regulations for highway work as well as for grade-crossing eliminations provided that at least 25% of the state's allotment should be expended on secondary or feeder roads.

Indiana's feeder-road program as now approved by the federal government allots 27.9% of the highway funds to feeder or secondary roads, involving an estimated expenditure of \$1,378,000.

The projects included in the secondary or feeder-road program to be constructed under the funds allotted under the Emergency Relief Act are listed in Table 2.

RIGHT-OF-WAY WIDTHS

In construction of the feeder-road program, the first requisite was an adequate width of right-of-way. There are many who criticize the 80-foot minimum right-of-way requirement of the commission. Even in the flattest country where the minimum width of roadway was constructed, namely 28 feet, there is required an additional width of 4 feet on each side for ditches in cuts, which gives us a width of 36 feet. Few, if any, of our roads can be constructed without cuts and fills, requiring additional width for slopes, which on an average demand at least another sixteen feet or a total width of fifty-two feet. This leaves from our 80 feet but 28 feet, or 14 feet on each side, for utility poles, trees, etc. There was a time in the not-far-distant past that 35-foot and 40-foot rights-of-way were adequate, when there were but few

utility poles on our roads and automobiles were built with a maximum speed of fifty miles an hour; but the picture of today changes all this. With the speed and number of cars and trucks increasing yearly, and with rural electrification being sought by all our rural population, thereby giving us another line of poles to provide for and making it necessary to build more safety into our highways, secondary as well as primary roads necessarily must be built with more width of right-of-way.

In the design of all these feeder roads, safety to the motorist was uppermost in the minds of our engineers. Maximum horizontal curvature was fixed at 10 degrees, vertical sight-distance at 500 feet, and roadway width with a minimum shoulder width of 8 feet. Surfaces were designed for stage construction, and bituminous surfacing was used only on roads where the traffic count at present indicated the necessity. All traffic-bound surfaces have a minimum thickness of six inches, which provides sufficient foundation for higher-type surfaces in the future when the traffic becomes such as greatly to increase maintenance costs. Experience has shown us that as soon as a road is constructed with adequate width of roadway, sufficient safe sight-distance, and easy curvature, the traffic begins to increase and soon requires a higher-type surface than traffic-bound gravel or stone. For this reason our engineers have designed the 16-, 18- and 20-foot surfaces for a depth of 6 inches of aggregate. On this foundation there can be applied a bituminous prime coat, followed by bituminous surface treatment of $1\frac{1}{2}$ or 2 inches that will carry up to 1,000 vehicles per day with very low maintenance costs. This bituminous type of surfacing can be built for an average cost of \$800 per mile in the state of Indiana. Our state is fortunate in having either stone or gravel in all parts of the state, and this goodness of nature has been responsible for the high mileage of all-weather roads.

CONCLUSIONS

Upon completion of the construction now under contract, there will have been added to the state highway system 215 miles of improved secondary or feeder roads, located in 21 counties, at a total cost of \$1,659,197, or an average cost per mile of \$7,717. These 215 miles are all improved on the standards of the state highway system, using adequate width of right-of-way, maximum gradients of 7%, maximum curvature of 10 degrees, adequate surface width and thickness to permit the building of higher-type surfaces as the future demands, structures of state highway standards, and all at an average cost of only \$7,717 per mile.

There are now in the state, county, and township highway systems of Indiana approximately 79,000 miles of roads,

70% of which have gravel or higher-type surfaces. As before stated, the present state highway system consists of 9,289 miles of roads and should eventually be increased to not more than 20,000 miles, or about one fourth of all roads of the state. This increase in mileage will have to be very slow because of the limited funds now available to the state highway commission.

If each of the 92 counties would improve, yearly, 6 miles of county highways along the same standards as the 215 miles of feeder roads which are now being built, the state could well afford to absorb this 550 miles each year and thereby build up the state system and relieve the counties of the maintenance of that mileage. Petitions are continually being presented to the highway commission to take in more roads—hundreds are now on file in the central offices—but until the counties improve along higher standards those roads which petitioners are asking to have incorporated in the state system, it will be impossible, because of the lack of funds, for the commission to take any more mileage.

WHAT HAPPENS WHEN COUNTY ROAD MAINTENANCE FUNDS ARE EXCESSIVELY CURTAILED

Todd Stoops, Secretary-Manager,
Hoosier Motor Club, Indianapolis

This subject can be discussed from two different points of view. One phase of the subject is what actually happens to roads through the lack of proper maintenance which would naturally follow the curtailment of funds. The other phase, a much broader subject, would be the motoring public's reaction to inferior roads due to lack of proper maintenance.

Curtailment of county road maintenance funds—as with any other public fund—can be brought about in two ways: one, by the actual curtailment of the amount of money to be spent, and the other, by unwise and wasteful spending of the fund. In my talk this morning I am assuming that the curtailment is brought about through actual reduction of the amount to be spent.

If the amount of money set aside for county road maintenance has been wisely and judiciously spent and yet is not sufficient to complete the work properly, its expenditure can only be classed as false economy. Any road that is not properly maintained rapidly deteriorates to such an extent that it is only a short time until the road is beyond repair and complete rebuilding is necessary. To allow a road system to get into this condition is obviously false economy.

The majority of roads in this state are now county roads; and, generally speaking, these roads are rapidly deteriorating from lack of proper maintenance. You will find gravel roads