THESIS

INVESTIGATION OF THE CONCRETE HIGHWAYS OF WAYNE COUNTY

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Investigation of the Concrete Highways of Wayne County.

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Introduction.

With the aim of placing every resident farmer within three miles of a good concrete road, Wayne County began its campaign for highway improvement, and is now prominent among the counties of Michigan which have been building good roads according to a comprehensive system. This county has built more concrete roads than any other county in Michigan, and is the center of observation for men who have to deal with road improvements.

The principal feature of the structural system is a one course concrete pavement with expansion joints every twenty-five feet. This type of pavement seems to be best suited to existing conditions. The two-course pavement was tried, but was not equal to the one course, so was abandoned.

To secure the data for the discussion herewith presented in this Thesis, "Investigation of the Concrete Highways of Wayne County," the authors traveled over all the concrete roads of Wayne County in an automobile, taking photographs of failures in the various concrete pavements. The traffic conditions, defects in pavements, and culvert data were obtained from the State Highway Department. The cost data was obtained from the County Engineers.

The automobile used on the trip.

The buildings where the road equipment is kept.

METHODS USED IN THE CONSTRUCTION OF THE CONCRETE HIGHWAYS IN WAYNE COUNTY.

When the County Road Commission was created in Wayne County in 1906, a definite, systematic plan involving the improvement of certain logical routes was outlined covering a period of years. They do not take over a road as a county road until they are ready to rpoceed with its actual construction. At the October session of the Board of Supervisors they make their recommendations as to the Roads they desire to take over as county roads, together with the amount of the tax they desire levied which cannot legally exceed fifty cents on a thousand dollars of the equalized valuation of the county for the preceeding year. The cities and villages of the county contribute their proportion according to their assessed valuation, although no money can legally be spent in any city; money can be spent in the villages, but only after the village authorities have relinquished their jurisdiction over the road to be improved, and turned it over to the Board. The Board of Supervisors accept, amend, reject or alter the recommendations of the County Road Commission both in the matter of the roads to be improved and of the tax to be levied.

After action by the Board of Supervisors determining upon the roads to be improved a record is put into the minutes of the County Road Commission by an aye and nay vote setting forth their determination to take over the

the road as a County road; the road is given a name, usually the one by which it has been commonly known; that portion of their minutes showing their determination to adopt the road is published for three successive weeks in some newspaper circulating in Wayne County, and notice is served upon the officials of the township setting forth the above facts in which the road is located. When this action has been properly taken the jurisdiction over the road passes into the hands of the Board of County Road Commissioners which involves the authority to improve regulate and maintain it.

A survey of the road is then taken, plans and profile prepared, and these together with spectifications and application for state reward are filed with the State Highway Department. Following the provisions of the County road law bids are asked for by advertisement for the construction of the road (a purely perfunctory proceeding, as they have not contracted nor have any proposals been received for the construction of any road for several years past). When the bids are received, they have the option of accepting the lowest one and awarding the contract for the work to that bidder, or of rejecting all the bids, and doing the work themselves under the day labor plan.

As soon as weather conditions permit in the spring, and after the road has been staked out, they prepare and shape the subgrade, doing the major portion of such work

with scarifiers and graders, the hauling power for which is furnished by steam tractors or rollers. Careful attention is given the grade to eliminate soft spongy places, and a ten ton roller is used to roll it hard. To produce a good concrete road, thorough drainage is necessary in addition to a good subgrade. Both proper grade and drainage are difficult to cope with in Wayne County as the County for the most part is flat and situated in a valley not easily drained. The subsoil is largely of heavy, sticky clay with some loose, deep sand.

Their great problem has been in getting the materials on the subgrade, and various plans are followed on the different roads, due to varying conditions. On long hauls they use an industrial railway to transport all materials from the point of receipt to the point of construction. This outfit consists of a seven ton, 30 H.P. locomotive, sixty- one thousand pound double side V-shaped steel dump cars, all of two foot gauge. The track is furnished in built-up units, fifteen feet in length, consisting of steel rails fastened to steel ties. A turnout may be laid wherever needed by replacing a section of track by a switch or curve, as this is also furnished in fifteen foot lengths and of such radius that locomotive and cars will readily pass through. Two men can handle a section of track weighing 275 pounds. (They have two outfits of this character.)

Of course it is not necessary to turn the engine around as it pushes as well as pulls the load. The average train consists of thirty loaded cars, though as many as fourty-two cars have been hauled.

Materials for the work begin to arrive before actual concreting is in progress. These are immediately unloaded by a clamshell bucket and thrown into stock piles. After concreting has been in progress, the materials are unloaded directly from the railroad cars to the steel dump cars and transported to place. The unloading crew consists of four laborers, an engineer, team and teamster. The team hauls seven loaded cars to the siding where trains of thirty cars are made up. Whenever shipments are delayed the stock pile is resorted to for materials. Work is s started at the end farthest away from the railway switch. Five miles per hour is the average set speed including time for coaling and watering. The actual running speed enroute is from eight to ten miles per hour.

There is no danger of dumped materials falling back upon the track, as the center of the pile is about three feet from the edge of the nearest rail. Two men are able to tip a loaded car body. Materials are readily measured in the cars and distributed along the road at such intervals as to best meet the requirements of the mixer. The aggregates are loaded into the dump cars, the cement in any available cars, and expansion plates, asphalt filler and other necessities on the flat cars. Coal for the mixer is likewise brought to the site over the railway. As concreting progresses the haul becomes shorter and the track

is taken up. These rail sections are transported to the loading point on the return trips of the train.

The tracks for their industrial railway can be laid on any surface over which transportation of any kind is at all possible. Rainy weather and muddy roads do not impair the efficiency of rail haulage, nor is the load too heavy for the ordinary highway bridge. A factor of much importance is that very little hauling space is required. When necessary the track can be laid on the berm of the road, so that it is possible to haul material either in the same direction as the concreting is proceeding or else in the opposite direction. The railway, too, is practically independent of labor conditions, as one engineer and two brakemen make up the entire crew. Although the unit rail sections provide an easy method of crossing highways and steam and electric lines, and the clearing of these when necessary by removing the rail se sections, it is not always possible to obtain permission to make such crossings.

Where the use of an industrial railroad is not feasible they use a combinations of team and engine hauling. Teams work economically on short distances, but weather conditions at times are a handicap, and at certain seasons of the year the demand is so great for them generally that they are difficult to secure. Their traction outfits are also handicapped by bad roads, rainy weather and the limited speed which they are capable of attaining. Road rollers furniah the motive power largely for hauling

wagons, each of which holds seven tons of material. Over earth roads one wagon is usually all that can be drawn. When, however, a concrete road is available for hauling, six wagons containing a total of forty-two tons of material are made up into a train and hauled by one tne ton roller. The crew of one of these trains consists of an engineer and a fireman. Their hauling operations involve the use of two industrial outfits, eight traction outfits and from one hundred to one hundred fifty teams.

One man on the grade has charge of the dumping af material and he is furnished with the following table in order that the material may be properly placed to minimize rehandling.

MATERIALS TO BE PLACED PER 100FT. STATIONS.

Width of Metal	Bbls. Cement	Yards Gravel	Yards Sand	Wagon Loads Cement	Wagon Loads Gravel	Wagon Loads Sand
12 ft.	45	26	13	4	20	10
15 ft.	56	33	16	5	25	12
16 ft.	60	36	17	6	27	13
18 ft.	68	39	20	6	29	15

The foreman in charge of the yard is also furnished with a table of quantities showing amounts required on different widths of roads so as to avoid surplusage at a given point.

Cement--45 sacks to 1 load
Gravel--1 1/3 yds. to 1 load
Sand----1 1/3 yds. to 1 load
} When team hauling is used.

1 cu. yd. Pebbles...	1.4 Tons	1 Carload Pebbles..	35 Tons
1 cu. yd. Sand.....	1.25 "	1 " Sand.....	44 "
1 Bbl. Cement.....	0.19 "	1 " Cement...	36 "

Amounts for one mile of road.

Width of Road	Pebbles			Sand			Cement		
	Cu. Yd.	Tons	Car Loads.	Cu. Yd.	Tons	Car-Loads	Cu. Yd.	Tons	Car Loads
12 ft.	1369	1919	55	684	855	20	2396	455	13
15 ft.	1711	2395	69	855	1069	24	2995	569	16
16 ft.	1825	2555	73	912	1140	26	3194	607	17
18 ft.	2053	2874	82	1026	1383	31	3594	682	20

Stock piles are also established in the fall at various unloading points so that breakdowns, car shortages, intermittent or irregular deliveries will not interfere with the work after getting underway in the spring.

During the past year they have encountered long hauls very generally. On the Huron River Drive the farthest point of haulage was 7 1/3 miles; on the Canton Center road the farthest point of haulage was 7 1/2 miles; on the Seven Mile Road the shortest point of haulage was about 4 1/2 miles.

The transportation of water of which they use large quantities in mixing and curing concrete, and supplying the mechanical equipment such as concrete mixers, traction engines, road rollers, etc., has often been a serious problem. They have solved this by laying two inch pipe along the road from the nearest source of supply, and pumping the water along the route either by gasolene engines or electric motors. They have pumped water a distance of 10 miles, the nearest source of supply. They have also piped water from the water-works system of Detroit, Plymouth and Grosse Pointe.

Their standard width for secondary roads is concrete 16 feet wide with a minimum width over all of 24 feet. The concrete is 6 inches thick at the sides and 8 inches in the center built on a flat subgrade. Six inch channels 12 feet long are used instead of wooden forms along the side. As these forms are subsequently used to support the templet and bridge from which the finishers work, great care is exercised to get them true and rigid. Expansion joints consisting of two thicknesses of asphalted felt (about one-fourth of an inch) inserted between two Baker Armor Plates, are placed in the road 25 feet apart.

They use a concrete mixer which travels under its own power, from which a 20 foot boom projects which swings over a 180 degree arc. The dumping bucket is carried out on this boom under power and eliminates much hand labor. One batch consists of three sacks of Portland cement, four and one-half feet of sand and nine feet of gravel. The specification that the batch shall receive sixteen complete revolutions and remain in the mixer for fifty-five seconds is resulting in producing an excellent quality of concrete. Batches are discharged at intervals of about two minutes. On a sixteen foot road the crew of thirty-two men is capable of laying approximately 450 linear feet of concrete during a ten hour day. As high as 525 feet have been laid when conditions were at the best.

Before any concrete is placed in order to prevent absorption of the water from the mixed material, the subgrade is thoroughly wet down. The mix is fairly wet, and of such consistancy that men working in the concrete sink

four or five inches. Clean material is an absolute requisite to securing good concrete. Their pebbles are washed and screened so as to be free from loam, clay, and other foreign substances. The pebbles range from one-fourth to one and one-half inch and are graded as to reduce the voids to a minimum. Their sand is bank sand, washed and screened, free from loam, clay, etc., and ranges in size from one-fourth inch to dust with the coarser particles predominating. Wayne County has no stone hard enough for their purposes, and all stone and sand used are shipped from outside points.

When the mixer is close to the stock piles, congestion is avoided by having six men load the barrows and six men wheel the material to the skip. Wheelers and shovelers alternate in their work for each successive block of concrete, a scheme that has proved efficient because the variety of work tends to prevent its becoming monotonous. When the stock piles are a relatively great distance from the mixer, each of the twelve material men loads and wheels his own barrow so that a continous stream of material is always enroute.

The concrete is brought to grade and shape by the use of a templet. This templet or strike board is made of two-inch plank, preferably in a single piece, the curvature of the under edge being made to exactly conform to the finished surface of the concrete road which is crowned approximately one-fourth of an inch to the foot. On each side of each end is an iron handle for drawing the strike back and

forth. The curved edge is shod with one inch angle irons bent to the curvature of the strike, giving it a metal wearing surface. The length of the strike exceeds the width of the road metal by one foot. A twelve inch plank is suitable for widths of road metal up to 18 feet. If the road is wider than this, a built-up form of strike is necessary, which is trussed to prevent a sag of flattening the crown. The strikeboard is sawed back and forth on the side rails, and moved slightly forward at each stroke, giving the concrete its initial shape. After this operation no workman is permitted to disturb the concrete in any way either by stepping in it or by throwing anything upon it. The rule is imperative, as a violation of it means a road with waves and depressions by causing the neat cement and finer particles to rise to the top. They aim to have the stone take the wear as it is the hardest part of the aggregate.

The final finishing up of the road is done by two men whom they term "floaters", who work from a bridge which rests on the side rails, having no actual contact with the concrete. A wooden trowel of home manufacture is used for this purpose. The use of a trowel of this nature prevents the road from becoming slippery.

One crew used a finishing machine during the entire season, for shaping and finishing the road with very satisfactory results as regards the quality of work produced, but up to date the cost has been greater. The better results secured in eliminating depressions and irregularities, however, justifies this small increase in cost and they will undoubtedly add this device to theis standard mechanical

equipment.

When the concrete will stand of its own weight, the side rails are removed and a small bevel is made by cutting off the edge with a shovel, and allowing the surplus thus cut off to fall to the side. This prevents a sharp division line between the concrete and the shoulders. Each day's work is finished up to an expansion joint, and no more than twenty minutes is permitted to elapse between batches during the day. The day following the laying of the concrete it is covered with a couple of inches of sand or loose soil such as is available, and is sprinkled during the day for ten continuous days. This prevents the road from drying out and is an inportant factor in properly curing the concrete so that it will attain its maximum hardness and strength. Plenty of water is vitally essential in producing good concrete.

Roads are not opened for traffic until from four to six weeks have elapsed after the last batch of concrete is laid; the length of time depends upon the season of the year as concrete sets much more slowly in cold weather than when it is hot and dry.

Shoulders of crushed stone or gravel, whichever is the more available, are built three to seven inches thick and three to four feet wide on each side of the concrete; on many roads additional width of earth shoulders are built. This work is not started until after the road is at least four weeks old.

During the past year most of their work has been car-

ried on well away from towns where suitable quarters could not be obtained for the men, so they provided sleeping and eating quarters in tents along the road. The men obtained food from the nearest town and cooked their own meals, while the water supply for the roads usually serves as well for the men. The mixers crew quarters are kept at sites a convenient walking distance from the work, and the men unloading and transporting materials live in tents pitched close to the railroad siding.

Three concreting crews were maintained in the field during the past summer and to each of these crews is attached a grading crew. An additional bridge and culvert crew was also kept busy building bridges and culverts over roads previously improved. All work is specialized and machinery is used wherever possible since man and horse labor are scarce and expensive in the country districts during the road-building season. Many little economies and labor-saving devices have been worked out which increase both the quantity and quality of their work, and their whole aim is to produce a durable, dustless road at cost for the people of Wayne County.

The hauling of materials upon country roads is a serious problem and as the length of haul increased it became proportionately harder to obtain teams to do the hauling and grading. Since all the materials used in road construction are heavy and the bulk a team can haul is limited, the Board purchased traction engines and automatic dumping and spreading wagons.

The best that one team could haul on Grand River Road for example, was 1.5 tons making 5 trips each day or about 60 cents per ton. With the traction engine and automatic spreading wagons 3 wagons were hauled in a train making 4 trips and each car loaded with 6 1/3 tons of stone or a total of 76 tons per day at a cost, exclusive of interest on investment and depreciation, of $3.00 per day for an engineer, $2.50 for fireman, $2.00 per day for coal, oil, waste, etc., or $7.50 per day or a cost of 10 cents per ton.

The spreading by automatic dump wagons was much better than by hand and smaller crews were necessary.

In 1914 the haul on the Huron River Drive was over a sandy loam road and it would have been almost impossible to haul with traction engines so the Board bought an industrial railway outfit on 60 days' trial the rental to apply on purchase price. At the end of 60 days the

outfit was procured and the following data is given showing costs.

Tail Huron River drive.

Average	)	7.96 miles
	)	1.3 miles
	)	
	)	
Lot	)	60.282 miles
	)	0.752 miles

Total net haul for 2 roads 73.010 tons

Net cost per ton mile .175

This covers laying of track in 6 sections operating crews, and 18% depreciation and repairs for one year.

It appears from this that this method is an economical one for long hauls.

MAINTENANCE.

MAINTENANCE.

The maintenance of the concrete roads until this year was merely a matter of cutting weeds and cleaning ditches twice each year and tarring of all cracks and joints.

The cost for tarring all cracks in all roads is given as $1,450, a rather small amount when mileage is considered.

Repairing and grading shoulders dragging with split log, resurfacing Plymouth road, 6 miles repairing, 21 mi. of gravel road, resurfacing tar macadam roads still in use, and grading road, getting ready to lay industrial railroad is given as $30,533.68.

To this must be added this year the cost of re-surfacing Grand River which is purely a maintenance proposition. The method of resurfacing is as follows:

The road is swept clean and 12 inches of hot tar asphalt laid on old surface, over this while tar is hot 3" of 1-2-3 cement, sand, and trap rock is poured.

This road has not been opened for traffic as yet and no cost data could be secured. Since the corners of each section cracked badly the road had to be widened 2 feet so that a new foundation for the edge would be given.

The moneys spent for tar macadam roads will have to

be forgotten by the tax payers of Wayne County as they were unsatisfactory from the start, being spongy in hot weather and slippery in wet and frosty weather and generally unsatisfactory at all times

FORT STREET ROAD.

The conditions upon this road were similar to those upon Gratiot and the Road is also identical.

The road is of tar macadam 6" to 7" deep at the sides and 8¼" deep in center. 16' of metal and 24' over all with gravel shoulders.

The contract was let to F. Prath and Sons, who agreed to build 4,300' for $9,000. The Board had to build a bridge but did not have to do the drainage.

The following is a summary of the cosr for 4300 ft.

Contract	$9,000.00
Bridge Labor	663.13
Bridge Material	210.39
Inspection	57.00
Miscellaneous	26.42
Total	$9,947.94

$\frac{4300 \times 16}{9}$ = 7050 sq. yds.

$\frac{9947.94}{7050}$ = $1.41 per sq. yd.

Total road improved	6425 feet.
Let by contract	4137 "
Built by commissioner	2263 "
Bridge	25 "

Part Built by Contract.

Conctact	$8,282.14
Inspection	177.00
Open ditch	32.97

FORT STREET ROAD. (Con't.)

Tile drains labor	$ 65.93
Tile drains material	147.36
Other labor and miscellaneous	42.01
Total	$8,747.41

This section is 15' metal 24' over all 6½" deep at sides and 8¼" deep at center. Laid on a curved Subgrade.

$\frac{15 \times 4137}{9} = 6890$ $\frac{8747.41}{6890} =$ $1.27 per sq. yd.

Section built by Commission - 2263 ft.

Labor or road proper	1,500.31
Lime stone 3"	348.63
Limestone screenings	122.78
Cobble stone 2"	386.21
Tar	123.12
Open ditch (Labor)	41.80
Tile drains (Labor	18.90
Tile Drains (Material	41.15
Culvert (Labor & Material)	56.45
Coal	104.78
Waste, Lubrication, Etc.	24.25
R. R. Siding	200.00
Repairs to road before improved	17.55
Total	$2,985.93

Road is 12' metal 23' over all.

FORT STREET ROAD (Con't.)

$\frac{2263 \times 12}{9}$ - 3.017. sq. yds.

$\frac{2985.93}{3.017}$ = $.99 per sq. yd. for 12' road.

Total of road	$11,733.34
Bridge	1,252.49
Grand total 6425 feet	$12,985.83

At the time of printing this report the commission had started the laying of concrete and were laying it on this road but had only gotten started. Road is to be of 1 course of concrete, 12' of metal, 23 ft. over all. 6" deep. Mix is 1-2-5 Portland cement washed sand and washed gravel.

"To date we have spent on Fort Road $188.77."

Same Spec. as above - 2640 ft.

On account of the unsatisfactory condition of this road upon its completion it was not accepted and paid for until Sept. 1911.

One reinforced culvert was also constructed.

Costs:

Roadway proper. (Contract)	$4,461.60
Inspection	205.53
Yard & Siding	42.99
Expansion joints	55.55
Lumber and stakes	14.65
Express, etc.	16.27
Blue prints	15.72
Liability Insurance	4.40
Hardware & Repairs	19.25

FORT STREET ROAD. (Con't.)

Miscellaneous	13.78
Total	$4,849.75

Drainage

Open ditch	147.20
Tile drains	24.42
Culverts	275.00
Total cost	$ 446.62
Total cost	$5,296.37
Less State Reqard	500.00
Cost to Wayne County	$4,796.37

$\frac{12 \times 2640}{9}$ = 3520 sq. yds.

$\frac{5296.37}{3520}$ = $1.69

Roadway Proper.

Teams	$4,700.00
Other labor	10,540.57
Lime stone	850.04
Pebbles	4,265.53
Sand	1,998.63
Cement	8,469.40
Coal	10.40
Expansion joints	1,068.03
Lumber	255.86
Blue prints	7.50
Hardware and repairs	169.46
Board of men	45.00
Camp equipment	94.95
Liability Insurance	7.49

FORT STREET ROAD. (Con't.)

Miscellaneous	$ 111.03
Total (Including preceding page.	32,676.63

Drainate.

Open ditch	1,257.14
Tile drain	90.84
Culverts	1,161.34
Grand Total	$2,509.32

Length of road is 2.637 less .5 = 2.137 miles

$\frac{5280 \times 2.137 \times 15}{9}$ = 18,800 sq. yds.

$\frac{35186}{18800}$ = $1.87 per sq. yd.

Pay Roll.

Teams	$ 10.00
Other labor	277.69
Limestone	468.46
Pebbles	263.28
Sand	146.14
Cement	2,604.32
Coal	117.15
Lumber	2.88
Blue Prints	12.50
Repairs & Hardware	7.42
Miscellaneous	15.00
	$3,924.84

Drainage.

Tile drains (Material)	487.83
Culverts (")	136.78
	$ 624.61

FORT STREET ROAD. (Con't.)

	$459.45
Less credit on joints	70.28
	$4478.77

An additional 3.19 miles of Fort Road has been taken over as a county road. Extending from the present concrete construction on Fort Street to connect with Eureka Road west of Wyandotte. To date 5 reinforced concrete culverts have been built and surceys, plans and profiles made, together with application for State Reware. It will be constructed of concrete 16 ft. metal 24 feet over all. The excessive rainfall of the past summer has retarded the work on other roads so that the Board have been unable to construct anything except culverts on the Fort Road.

The expenditures to date on the Fort Road are as follows:

DRAINAGE.

Culverts	
Teams	$ 302.50
Men	1,298.82
Material	601.91
Total	$2,203.23

MT. ELLIOT ROAD.

County took over 1.37 miles.

Road is of tar macadam construction with 15' of metal and 4' shoulders making 23' over all. This season only 5600 feet were finished. The cost of construction on this road was much higher than on Grand River although conditions were similar due to the fact that hauling was done by team while upon Grand River it was done by traction engine with the haul road on Mt. Elliot the better.

Roadway Proper.	
Labor	$3,666.69
Material	4,282.61
	$8,049.30
Culvert.	
Labor	119.55
Material	117.00
	$ 236.55
Drainage.	
Labor	278.70
Material	356.90
	635.60
Miscellaneous	64.75
Grand Total	$8,976.20
Less State Reward	1,066.67
	$7,911.53

MT. ELLIOT ROAD. (CON'T.)

Total road improved this year, 1000 feet.

Same type of construction as last year.

Laobr	$ 609.77
Limestone	179.43
Cobble stone 2"	329.94
Tar	93.30
Cobble screenings	46.35
Coal, Lubrication, Etc.	43.25
	$1354.36

4800 feet.

This road is a continuation of the tar macadam previously constructed but this year's work is of concrete.

Built of concrete 12' of metal and 23' over all. Laid in 2 courses total depth of 6". Bottom course is 1-2½-5 mix of Portland cement, washed sand and concrete limestone 4" deep. The top course is 1-2-3 mix of Portland cement, washed sand, and crushed cobble stone 2" deep.

This road is secondary and carries a lighter traffic than the main roads.

Costs include a necessary concrete culvert.

MT. ELLIOT ROAD. (Con't.)

Following is a statement of costs:

Roadway Proper.

Teams	$ 438.50
Other labor	2,971.73
Limestone 717 tons	434.74
Crushed cobble 564 tons	1,041.38
Sand 432 yards	582.25
Cement 1502 bbls	2,332.23
Coal	102.80
Board of men	240.57
Tar paper	17.24
Engineeres stakes	21.09
Water supply	14.91
Lubrication, Waste, Etc.	27.87
Blue prints	13.07
Miscellaneous	19.07
	$8,260.63

Drainage.

Open ditch labor	108.25
Culverts (Material only)	26.50
Total.	$8,395.38

2400 feet (455 miles)

This road was continued 2400 feet from point where work ended last year. Same construction as

MT. ELLIOT ROAD. (Con't.)

last year.

Cost is as follows:

Teams	$ 867.50
Other 1 bor	1,884.64
Limestone 11 tons	10.95
Pebbles 1326 tons	1,324.48
Sand 456 tons	529.60
Cement 1305 bblw	1,879.20
Coal 17 tons	55.03
Expansion joints	29.79
Lumber	3.06
Water supply	7.74
Blue prints	6.71
Board of men	86.92
Liability Insurance	18.07
Hardware and repairs	28.14
	$6,742.81
Drainage	10.68
	$6,753.39
Less State reward	435.00
Cost to Company.	$6,318.37

Roadway Proper - 1912

Labor	64.00
Exp. joints	101.08
Lumber	36.29

MT. ELLIOT ROAD. (Con't.)

Blue prints	18.47
Hardware & Repairs	10.08
Lubrication & Waste	25.73
Liability Insurance	32.64
Miscellaneous	5.15
Total	$293.44

The rest of Mt. Elliot is built in connection with Van Dyke, and 7 Miles of roads and itemized account of costs are not given. This total will be found in the 7th report under 7 Mile Road.

CANTON CENTER ROAD.

The Canton Center Road is a link in the outer Belt line and will connect Michigan Ave. with the village of Plymouth. It is a continuation of Belleville Road north of Michigan Ave. It is built of concrete of standard construction 15' of metal 24' over all and is built on alternate stretches of heavy clay and light loam. One of the dinky railroad outfits was used on this road with a maximum haul of 7½ miles. The surface of this road was finished with a Baker finishing machine.

This road is not yet completed.

Teams	$3,579.50
Sand 1890.5 tons	1,122.44
Gravel 3883.9 tons	1,618.74
Cement 5716 bbls	8,935.53
Coal 43.5 tons	171.46
Lumber	26.43
Water Supply	63.44
Blue prints	49.94
Lubrication	65.53
Damp	178.66
Expansion joints	2,232.78
Hardware	266.27
Miscellaneous	737.28
Yard & Siding	387.67
Industrial Equipment	993.24
	$36,837.69

CANTON CENTER ROAD. (Con't.)

Total from preceding page.	$36,837.69
Drainage	646.37
Grand Total	$37,484.06

PHOTOGRAPHS OF CANTON CENTER ROAD.

#1 shows the deep ditches required for proper drainage, also the gravel shoulders used on this road.

#2 same as #1 except that a culvert is shown at the extreme end of the ditch.

#3 shows a general view of this road.

PHOTOGRAPHS TAKEN OF CANTON CENTER ROAD.

Photograph No. 1.

Photograph No. 2.

Photograph No. 3.

MACK ROAD.

This road was previously a macadam construction although in a very poor state of repair. The county took over 2000 feet and did not get it all completed at the time of this report. There was some trouble with the village of St. Clair Heights, which delayed the work to quite an extent. The county did not pave through the village.

Cost as follows in 1907:

DRAINAGE.

Labor	2.25)	
	)	109.50
Material	107.25)	

ROAD.

Labor	547.70)	
	)	667.78
Material	120.08)	
Miscellaneous	3.00	3.00
Total		$780.28

The work in this road starts at the City Limits of Detroit. The construction is tar macadam in 3 courses 6½" deep 23' over all with 15' of metal.

The 1st course is limestone, second, crushed, cobble and the third, cobble chips and tar.

DETAIL OF COST.

Labor on roadway proper	$2,012.34
Limestone 3"	467.67
Lime screenings	212.01
Cobble stone 2"	715.55

MACK ROAD. (Con't.)

Cobble stone screenings	56.51
Cobble stone chips	121.05
Tar	154.63
Drainage labor	47.87
Drainage Material	187.31
Coal	163.08
Lubrication and waste	35.27
Rental machinery	96.00
Total	$4,210.29

$\frac{2200 \times 15}{9}$ = 3300 $\frac{4210.29}{3300}$ = $1.27

Completed 1630.5 feet.

This road was finished to the county line and this year's work is concrete construction 15' wide with 24' over all 6" deep in one course using 1-2-4 of Portland cement washed sand and washed gravel. The sub-grade was of a stiff clay nature and very sticky in wet weather.

Cost To Date.

Contract	3,456.66
Inspecting and Engineering	78.65
Extra cement	87.48
Blue prints	10.89
Miscellaneous	& 9.87
	$3,643.55

$\frac{1630 \times 15}{9}$ = 2720 yds.

$\frac{3643.55}{2720}$ = $1.34 per sq. yd.

MACK ROAD. (Con't.)

1400 feet.

Metal is 15' wide 24' over all with gravel shoulders. The mix is 1-1½-3 Portland cement, washed sand and washed pebbles 7" deep on a flat sub-grade.

An experimental section of 75' in length was built of reinforced concrete leaving out all expansion joints to see if any cracks developed.

Steel triangular mesh wire was used for reinforcing.

Cost as follows:

Teams	$ 48.50
Other labor	382.83
Pebbles 638.6 tons	677.66
Sand 160.00 tons	137.02
Cement 519 bbls.	783.69
Coal 203 tons	10.50
Lumber and stakes	1.53
Water supply	10.00
Blue prints	4.71
Board of men	12.00
Hardware and repairs	6.65
Total cost to date	$2,075.99

BELLEVILLE ROAD.

The Belleville Road connects the billage of Belleville with the Michigan Ave. road. It is part of the Trenton line System of the state and is also a link in the outer belt line of the county. This road complies with the state regulations covering trunk line roads by being built of concrete 16' wide and 24' over all where as the secondary roads of the county require only 15' of metal. For this road the state pays $3,400 per mile which is double the ordinary regard. Maximum grades in this road are 6%.

Expenditures in 1913.

Teams	291.50
Other labor	1,247.80
Expansion joints	360.35
Blue prints	3.00
Yard & Siding	75.00
Miscellaneous	119.85
	$2,097.50
Tile drains	55.00
	$2,152.50
Teams	10,259.25
Other labor	27,957.20
Gravel 15,455 tons	14,541.17
Sand 6,485.9 tons	4,705.27
Cement 19252 bbls	28,200.32
Coal 269.2 tons	841.60
Expansion joints	2,314.46

BELLEVILLE R.D. (Con't.)

Lumber	1.39
Express	1.24
Water Supply	129.44
Blue prints	6.00
Lubrication, waste, etc	113.14
Camp	123.46
Hardware & Repairs	358.95
Liability Insurance	189.15
Miscellaneous	145.53
Total	$89,980.39
Drainage	3,036.09
Grand Total	$93,016.48

WEST ROAD.

West Road is the main highway leading west out of the village of Trenton. During the past season the road was completed from the villages to the Telegraph Road, a distance of 4.2 miles. It is 18' of metal 24' over all. The road passes through a rich farming section and the subsoil is a heavy clay.

The materials were hauled nearly 5 miles using Trenton as a base of supplies. Long hauls are developing into a serious problem on these roads as the farther out they get the greater the haul is.

Six reinforced concrete culverts and one 40' open bridge are being constructed.

COST.

Teams	$ 6,257.00
Other Labor	18,163.32
Pebbles	12,542.99
Sand	4,676.06
Cement	21,485.23
Coal	692.91
Expansion joints	1,214.05
Lumber	253,45
Water Supply	109.95
Blue prints	26.08
Lubrication	153.17
Hardware & Repairs	406.17
Miecellaneous	951.11

WEST ROAD. (CON'T.)

Total of other page	$66,171.49
Drainage	2,154.62
Grand Total	$68,326.11

RIVER ROAD.

This road is of tar macadam construction 15' metal and 23' over all.

The stone has a minimum thickness of 6½" laid upon a curved subgrade.

The only work done at the time of this report was to build a bridge over Monguagon Creek to replace two old boiler shells used as culverts.

The new bridge is of steel concrete construction 31 ft. by 18 ft,, 27 ft. in the clear. Its cost was as follows:

Labor	$ 423.21
Material	722.71
Night Watch	95.60
	$1,240.52
Drain Labor	171.58
Road Labor	405.70
Miscellaneous	27.10
Total.	$1,844.38
Less Reward	776.50
	$1,067.88
Cost of old boiler shells	2,300.00
Cost of concrete bridge	1,240.52
Balance in favor of concrete.	$1,059.48

This shows how badly some township boards are beaten in the matter of bridges.

RIVER ROAD. (Con't.)

Total improved 10,080 feet.

This work was begun at the city limits of Wyandotte and is of macadam construction, limestone and crushed cobble 23' over all with 15' of metal 6½" deep. Cost to date:

Labor on roadway proper	$ 2,350.75
Limestone 3"	561.23
Limestone screenings	138.82
Cobble 2"	1,352.36
Cobble screenings	279.07
Open ditch labor	276.50
Tile drains labor	40.18
Tile drains material	160.74
Rental machinery	421.00
Coal and waste	207.50
Miscellaneous	14.75
	$5,802.90
30 feet bridge	1,237.07
Total	$7,039.97

3,909 feet -- .74 mile.

This year's work is built of concrete 23 feet over all with 15' of metal 6" deep of a one course mix of 1-2-3 Portland cement washed sand and washed gravel and is a continuation of the 2 miles of macadam previously built by this board and makes a thru line road from Macomb County line to the village of Trenton, or a distance

RIVER ROAD. (Con't.)

Total expenditures.

Concrete	$20,091.95
Macadam	3,224.69
Total	$23,316.64

Concrete construction 15' metal 23' over all. One course 2-3-6 mix of cement, washed sand and washed pebbles with limestone shoulders. Cost to date as follows:

Teams	$12,155.25
Other labor	24,214.19
Limestone	221.41
Pebbles($1.00 per ton)	6,641.84
Sand (.85 per ton)	4,253.16
Cement	21,269.46
Coal	73.27
Expansion joints	3,976.95
Lumber	528.11
Water Supply	31.28
Blue prints	37.35
Lubrication	126.20
Board of men	10.40
Liability Insurance	297.85
Camp equipment	332.29
Miscellaneous	279.93
Hardware & Rapairs	685.75
	$75,134.69

RIVER ROAD. (Con't.)

of 30 miles.

Expenditures to Date.

On macadam	3,270.24	from last yr. on concrete.
Teams	561.75	
Other labor	2,582.31	
Pebbles	895.58	
Sand	433.99	
Cement	806.37	
Coal	4.44	
Lubrication Waste, Etc.	15.24	
Tar paper	27.54	
Blue prints	9.77	
Stakes	16.25	
Miscellaneous	16.00	
	$5,369.24	
	3,270.24	
Grand total	$8,639.48	

18460 feet -- 3.5 miles.

Built of concrete 15' wide 24' over all 7" deep using a single course 2-3-6 mix of cement, washed sand and washed pebbles. Four reinforced concrete culverts are also being built. In addition to the amount spent for River Road last year, $3,224.69 was spent in completing the work.

To date of this report there has been spent $20,091.95 on the concrete south of Trenton

RIVER ROAD. (Con't.)

Drainage	
Open ditch	$2,065.79
Tile drains	478.81
Culverts	1,052.18
	$3,596.78
Total from preceeding page	75,134.69
Grand total	$78,731.47

The River Road is also finished to the Monroe County line and connects with the trunk line road thru Monroe county at South Rockwood. This finishes Wayne County's share of the Detroit to Toledo route.

River Road is built of concrete 15' wide and 24' over all. As on all the work of this year long hauls were the rule over rough sticky clay.

Expenditures as follows:

Teams	$ 4,084.25
Other labor	11,881.65
Limestone	1,184.78
Pebbles	8,261.33
Sand	1,729.94
Coal	54.76
Expansion joints	553.00
Lumber	122.00
Water supply	6.75
Blue prints	10.25
Lubrication, waste, etc.	22.65

RIVER ROAD. (CON't.)

Repairs and Hardware	$ 504.97
Miscellaneous	225.72
Yard and Siding	101.00
Camp	42.00
	$28,785.05
Drainage and Culverts	2,467.20
Total	$31,252.35

1914.

Gives further expenditures on River road of $219.62.

PHOTOGRAPHS OF RIVER ROAD.

#1 shows muddy condition existing beyond concrete road.

#2 shows the type of turns used by Wayne County.

#3 shows longitudinal cracks caused by expansion of the concrete. It also shows the method of using Tarvia filler if the cracks.

PHOTOGRAPHS OF RIVER ROAD.

Photograph No. 1.

Photograph No. 2.

Photograph No. 3.

SEVEN MILE ROAD.

The seven mile road is now concreted from Cadieux Road, (see 1913 report) to Woodward Avenue, a distance of 9.7 miles. It corsses Gratiot, Van Dyke and Mt. Elliot Roads and comprises a part of an inner belt road around the city.

This section of road is of concrete 12' wide and 24' over all, the road built in 1913 was 15' metal. The long hauls and many moves made this work expensive.

Teams	$14,536.50
Labor	35,233.33
Pebbles	17,179.18
Sand	6,945.11
Cement	17,738.65
Coal	692.69
Crushed stone	462.10
Expansion joints	1,095.05
Lumber	331.32
Prints	56.04
Lubrication	272.18
Hardware	1,305.56
Yard & Siding	1,391.45
Water Supply	332.23
Miscellaneous	486.66
	$ 98,968.01
Drainage & Culverts	3,946.71
Total	$102,914.72

SEVEN MILE ROAD. (Con't.)

This year's report was for work unfinished when Last report went in.

Teams	$ 2,385.25
Labor	117,244.31
Crushed Granite	655.54
Gravel	7,280.82
Sand	3,598.97
Cement	6,208.33
Trap rock 94.30 tons	254.93
Coal	350.36
Joints	1,310.88
Lumber	286.89
Water supply	358.23
Express	4.65
Prints	1.16
Lubrication	80.55
Camp	16.50
Hardware	542.68
Miscellaneous	357.22
Liability Insurance	1,607.79
Yard & Siding	295.00
Industrial Equipment	731.26
	$43,531.32
Drains & Culverts	3,201.08
	$46,741.40
Cost of 9.7 miles of road	102,914.72
Total	$149,656.12

PHOTOGRAPHS OF SEVEN MILE ROAD.

#1 shows general view at intersection of Ackley Road.

PHOTOGRAPHS OF ACKLEY ROAD.

#1 shows general view of road.

#2 shows conditions existing at Macomb County line.

#3 shows type of signs used on the roads.

PHOTOGRAPHS TAKEN OF SEVEN MILE ROAD.

Photograph No. 1.

PHOTOGRAPHS TAKEN OF ACKLEY ROAD.

Photograph No. 1.

Photograph No. 2.

Photograph No. 3.

VAN DYKE ROAD.

The construction of Van Dyke started from where the old macadam left off and extends toward the county line 5280 feet.

It is built of concrete 15' of metal and 24' over all 6" deep in 2 courses bottom course 1-2½-5 cement, washed sand and concrete limestone, top course, cement, washed sand and crushed cobble 1-2-3.

Costs.

Teams	$ 468.50
Labor	3,250.79
Limestone	1,116.00
Crushed cobble	1,562.09
Sand	673.38
Cement	3,498.25
Coal	62.70
Tar paper	27.54
Board of men	221.06
Stakes	27.12
Lubrication	38.52
Prints	19.34
Miscellaneous	21.50
	$11,201.78
Drainage	76.46
	$11,278.24

This section is built of concrete 15' of metal 23' over all. One course 1-1½-3 mix using Portland cement, sereened sand and screened pebbles 7" deep.

VAN DYKE ROAD. (Con't.)

Costs:		
Teams		$ 1,983.75
Labor		4,012.66
Pebbles	3080 tons	3,082.00
Sand	1056 tons	893.75
Cement	3020 bbls.	4,371.86
Coal		110.58
Expansion joints		66.56
Lumber		8.37
Express		5.00
Water		10.75
Prints		6.71
Board of Men		200.00
Liability Insurance		39.00
Hardware		112.29
		$14,911.28
Drainage		308.48
		$15,219.76
State Reward		1,052.00
		$14,167.76

Continuation of Concrete.

Teams	23.00
Labor	575.34
Cement	64.65
Expansion joints	525.66
Lumber	46.09
Express	1.45
Water	12.84

VAN DYKE ROAD. (Con't.)

Prints	$ 13.47
Lubrication	24.36
Board of men	22.27
Hardware	42.18
Miscellaneous	30.00
Liability Insurance	59.35
Total	$1,915.25

Rest of Van Dyke in connection with 7 Mile & Mt. Elliot.

Costs:

Teams	14,993.75
Labor	41,251.00
Bebbles	18,128.80
Cement	24,526.77
Sand	5,866.23
Coal	1,057.83
Expansion joints	3,014.36
Lumber	374.22
Express	43.50
Water	124.55
Prints	20.50
Lubrication	24.94
Board of men	5.60
Repairs	960.44
Miscellaneous	475.73
Yard & Siding	20.00
	$110,897.82
Drainage	3,871.44
	$114,769.26

VAN DYKE ROAD. (Con't.)

It is an impossibility to tell how much money was spent on each road this year.

PHOTOGRAPHS TAKEN OF VAN DYKE ROAD.

#1 shows conditions existing at Macomb County line.

PHOTOGRAPHS TAKEN OF VAN DYKE ROAD

Photograph No. 1.

DIX ROAD.

The Dix Road has been completed from the city limits to River Rouge. It is of concrete construction 15' wide 24' over all. This price includes a reinforced concrete culvert.

The old road was of a heavy clay subsoil very sticky in wet weather.

The cost is as follows: (1913)

Men	$ 236.44
Photographs	5.00
Culverts' steel	40.39
	$281.83

(1914)

Teams	2,686.25
Labor	7,768.49
Pebbles	5,219.78
Sand	1,953.29
Cement	6,830.26
Coal	8.56
Expansion joints	800.38
Lumber	100.68
Water supply	4.01
Hardware & Repairs	45.82
Blue prints	6.16
Miscellaneous	121.19
	$25,544.87
Drainage	401.20
	$25,946.07

DIX ROAD. (Con't.)

(1915)

Teams	$ 79.25
Other labor	100.39
Expansion joints	179.10
Lumber	1.32
Liability Insurance	425.61
Total	$745.67

HURON RIVER DRIVE.

This road forms a part of the trunk line road system and also a part of the outer belt line. It begins at the River Road in the village of Rockwood and connects with Flat Rock. Another stretch of this road was built south of Romulus. This road will eventually connect Flat Rock, New Boston and Belleville with Michigan Avenue.

It is built of concrete 15' and 16' wide 24' over all. 4 culverts were built.

Deep loose sand, long hauls over bad roads, long distance from adequate water supply and an excessive grading cost increased the expenditures on this work. This road opened up one of the finest farming sections in Wayne County.

Expenditures to date as follows:

Teams	$ 15,243.85
Other labor	25,660.98
Pebbles	15,148.27
Sand	6,626.97
Cement	21,317.53
Coal	460.25
Expansion joints	1,389.16
Lumber and stakes	240.20
Water supply	310.86
Blue prints	8.32
Lubrication	77.44

HURON RIVER DRIVE. (Con't.)

Board of gen	13.50
Repairs and hardware	365.30
Miscellaneous	329.58
Camp equipment	20.67
Yard and siding	50.00
	$37,282.13
Drainage	274.59
Total	$37,556.72
Teams	537.50
Labor	4,011.78
Pebbles	910.19
Sand	126.37
Cement	14.30
Expansion joints	264.84
Water	25.20
Blue prints	20.83
Hardware and repairs	22.41
Yard and Siding	160.00
Miscellaneous	77.88
	$6,141.30
Drainage	230.65
	$6,371.95
Total reward on this road	$15,358.00

HURON RIVER DRIVE. (Con't.)

This year's work completes the Huron River Drive. The road is of standard construction and 16 ft. of metal 24 ft. over all.

The haul was about 7 miles and was made by industrial locomotive working 16 hrs. per day to keep the mixers working steadily. Road is a splendid example of concrete road construction.

Teams	$ 4,901.44
Labor	32,283.35
Limestone 54.80 tons	58.63
Gravel 25,612.32 tons	28,661.80
Sand 12,326.08 tons	10,472.19
Cement 32.303 bbls	41,703.58
Coal 13.265 tons	348.10
Expansion joints	2,338.62
Water	561.24
Blue prints	57.04
Lubrication	162.64
Hardware	1,431.09
Lumber	105.27
Miscellaneous	559.59
Yard & Siding	221.18
Industrial equipment	1,119.72
Liability Insurance	283.72
	$125,353.60
Drainage & Culverts	3,078.41
	$128,432.01

PHOTOGRAPHS TAKEN OF HURON RIVER DRIVE.

#1 shows muddy condition existing in Flat Rock with concrete road down center of road.

#2 shows conditions existing at railroad crossings.

PHOTOGRAPHS TAKEN OF HURON RIVER DRIVE.

Photograph No. 1.

Photograph No. 2.

WOODWARD AVENUE.

5280 Ft. of Concrete.

This is the 1st mile of concrete road in the State of Michigan. The traffic on Woodward was so heavy that the Board thought a concrete road would be a better paying proposition.

The road is of 2 course construction 18' wide and 6½" deep. The first course is 1-2½-5 sand and limestone 4" deep. The second is 1-2-3 mix of sand and crushed cobble 2½" deep in 25' sections.

For joints between sections 3 ply of tar paper was used in some. A composition of still wax and pitch in some, 2 ¼" southern pine board in some and in other places to "L" irons, the idea being to see which was best.

The cost of this mile was:

Contract	10,200.70
Open ditch	153.05
Tile drains	376.62
Tile	312.41
Inspection and Shoulders	2,494.81
	$13,547.59

(1910)

1.21 miles - 6407 feet.

The work on this road is a continuation of the mile of concrete built last year extending to the county line. Laid in 2 courses 18' wide and 6½" deep, using a specially prepared tar paper for expansion joints.

The cost was as follows:

Teams	$ 881.75
Other labor	6,042.62
Limestone 1702 tons	1,703.32
Crushed cobble 110.75 tons	1,154.13
Sand 1046 cu. yds.	822.30
Cement 3214 bbls.	3,486.94
Tar paper	40.75
Coal	154.89
Lumber	31.45
	$15,294.15
Drainage	1,584.41
Total	$ 17,513.18
State Reward	1,213.00
	$16,300.18

PHOTOGRAPHS OF WOODWARD AVE.

#1 shows a mud hole caused by the sinking of one twenty-five foot section.

PHOTOGRAPHS TAKEN OF WOODWARD AVE.

Photograph No. 1.

MICHIGAN AVENUE.

Owing to the fact that a street car track runs down the center of Michigan Avenue and also that the traffic was very heavy the Board decided to pave the first 5300 feet with brick. The township bonded itself for $25,000 to pave its share and paved 3100 feet for $25,000, the Board paving 2,200 feet for $16,334.10 by contract. An additional 1347 feet were paved by the Board making a total of 1.259 miles. The complete cost is shown as follows:

Contracts	$32,679.80
Inspection	566.87
Open ditch	20.27
Tile drains (labor)	55.70
Tile drains (material)	127.22
Drains by contractor	427.71
Miscellaneous	143.34
Total	$34,050.94

This report is included to show the cost of brick paving in comparison to concrete.

1910 - 12.736 feet.

Michigan is one of the longest pieces of road constructed this year. It was the original intention to build the road 6_2 inches deep but owing to the nature of the subgrade it was built 7½". The road is built of concrete in one course 18' wide, 24' over all

MICHIGAN AVENUE. (Con't.)

using 1-2-4 mix of cement, washed sand and washed gravel.

Two reinforced concrete culverts were constructed and one 45' span bridge.

Cost is as follows:

Teams	$ 3,099.75
Other labor	10,778.51
Pebbles	5,061.66
Sand	2,110.78
Bank run gravel	115.70
Cement	10,234.86
Coal	339.85
Tar paper	76.82
Yard rental	30.00
Lumber	169.77
Lubrication, Waste, Etc.	215.11
Miscellaneous	139.75
Blue prints	18.55
	$32,491.11
Drains	3,015.12
Bridge	780.09
Total	$36,286.32

1911 - 39723 feet or 7.523 miles.

This road was constructed of concrete again this year but the mix was changed from 1-2-4 to 1-1½-3 of a minimum thickness of 7". Two reinforced culverts

MICHIGAN AVENUE. (Con't.)

were built.

Starting from the Reckner Road to Dearborn to Wayne 16 ft. excepting in passing the poor farm where it is 20', the Poor Commission paying the additional width.

Cost Roadway Proper.

Teams	10,460.35
Other labor	32,078.93
Pebbles 18850 tons	20,760.37
Sand 8198 tons	7,734.23
Bank Run 3603 tons	1,485.36
Cement 23909 bbls	36,747.61
Coal 305 tons	907.18
Expansion joints	2,614.78
Express	147.96
Lumber	456.33
Water supply	128.55
Blueprints	101.94
Lubrication,waste	354.16
Yard and Siding	88.00
Hardware & Repairs	1,177.62
Rental machinery	96.00
Miscellaneous	285.93
	$115,625.30

MICHIGAN AVENUE. (Con't.)

Total from preceding page.	$118,823.50
Drainage	9,615.02
Piling at rouge	4,818.56
Total cost of road	$130,058.88
Due from villages, etc.	8,531.18
Cost to County	$121,527.70

1912 - 12.018 miles.

Concrete construction 1-3-6. Single course 16' wide, 24' over all.

Costs:

Teams	$ 6,755.62
Other labor	29,545.03
Crushed stone	605.33
Pebbles	14,086.14
Sand	5,630.21
Cement	27,639.07
Coal	310.54
Expansion joints	2,798.67
Lumber	861.16
Express	.35
Blueprints	35.97
Lubrication	712.38
Hardware & Repairs	1,110.83
Yard and Siding	131.00
Liability Insurance	534.92
Miscellaneous	1,115.83
Total	$92,073.05

MICHIGAN AVENUE. (Con't.)

Total from preceding page.	$98,072.05
Drainage	743.94
Total	$92,815.99

(1913)

This year's work completes Michigan Ave. to the County line and at this time is the longest continuous stretch of concrete in the world. The road is 16 ft. in the country and thru the villages of Dearborn and Wayne the villages agree to pay for all road in excess of 16' and also an amount equal to the State Reward.

The subsoil is a heavy clay excepting thru Wayne where it is of sandy loam nature.

Teams	$1,818.75
Other labor	10,362.23
Pebbles	7,407.05
Sand	1,364.39
Coal	1,192.80
Expansion joints	2,052.57
Lumber and stakes	21.05
Express	5.62
Water supply	3.10
Blueprints	19.50
Lubrication	153.35
Board of men	21.56
Hardware & Repairs	542.93
Miscellaneous	345.61
Yard and Siding	2,661.46
	$27,871.97

MICHIGAN AVENUE. (Con't.)

Total of preceding page	$27,871.97
Drains	756.66
Pile driving	5,259.87
	$33,130.94
Owed by Dearborn	17,519.74
Owed by Wayne	20,689.09
	$71,339.67

(1914)

Men	6.05
Pebbles	1,561.65
Sand	1,058.27
Cement	9.11
Expansion joints	298.42
Lumber and stakes	38.34
Lubrication	7.90
Miscellaneous	1.11
	$2,974.75
Drainage	54.65
Total	$3,029.40

Photographs taken of Michigan Ave.

#1 and 2 show general views of this road.

#3 shows the muddy condition existing at the Washtenaw county line.

#4 shows water running accross pavement in order to drain the water away from the car tracks. This was done by track men.

#5 shows hole in concrete pavement.

#6-7-8-9 show flood pictures taken on this road this spring.

PHOTOGRAPHS TAKEN OF MICHIGAN AVE.

Photograph No. 1.

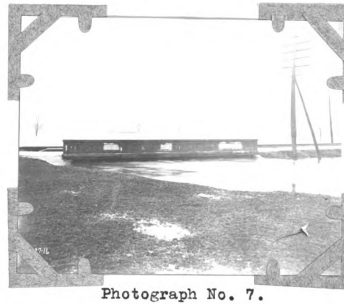
Photograph No. 2.

Photograph No. 3.

Photograph No. 4.

Photograph No. 5.

Photograph No. 6.



Photograph No. 7.

Photograph No. 8.

Photograph No. 9.

WARREN AVENUE.

This road is of concrete, 12' metal with macadam shoulders 7' wide and an additional width of dirt shoulders to make 24' over all. The subsoil is a heavy clay; at the city limits is an unpaved section which somewhat nullifies the beneficial effect of the improvement beyond. This road was laid by 2 crews working 14 hrs. a day on account of the impassable condition of the road after a rain. A .95 freight rate on the bulk of the material, bad roads to haul over made this an expensive job.

The cost is as follows:

Payroll.	
Labor	$ 89.00
Expansion joints	55.06
Lumber	9.28
Blue prints	14.47
Lubrication	14.06
Hardware & Repairs	16.11
Liability Insurance	4.55
Total to date	$202.53
(1913)	
Teams	$1,544.25
Other labor	11,718.62
Pebbles	6,240.08
Sand	1,152.70
Cement	5,268.54
Coal	450.07

MARION AVENUE. (Con't.)

Expansion joints	$966.75
Lumber	305.23
Express	46.00
Water Supply	50.00
Board of men	167.65
Blue prints	8.00
Hardware & Repairs	90.14
Miscellaneous	41.60
	$28,051.63
Drainage	1,679.25
Total	$29,730.88

(1914)

Teams	942.75
Other labor	1,669.08
Pebbles	968.48
Limestone	1,007.30
Cement	17.17
Coal	69.94
Expansion joints	92.12
Lumber	3.50
Blue prints	12.00
Miscellaneous	4.99
	$5,477.32
Credit	50.00
	$5,427.32
Drainage	371.78
Total.	$5,799.10

GRAND RIVER ROAD.

This was the first road upon which the Board started work. It was one of the worst roads in Wayne County and is called upon to bear a heavy traffic. The original road is of a sandy loam mixture in which we ran across many sink holes and spongy places, The disposal of which added materially to the cost of our work. We were confronted with a very long haul, the average length of which was 3 miles for the entire work. We also found plank placed there by the toll road company three and four tiers deep, the removal of which added very materially to the cost of construction.

This work, dates from July 18,1907 to Dec. 31, '08.

Work done as follows:

2 miles surveyed and taken over.

Plank for a distance of 2 miles removed and carted away. 4 miles ditches were dug. 11,642' of cement block were laid, 183 tons of coal used by engines. 6596 tons of stone spread on road 2 miles road graded. 22 cu. yds. sand and 40½ bbls. cement used in culvert. Weeds cut for 2 miles. 1152' lumber used. 4 cars cinders. 80,000 brick. 2 wells dug and stand pipe constructed. 11 car railroad siding built. Storage shed built. Acre of dumping ground tiled. Road of haul graded. 14,000 gallons tar used in veneer.

Road is of:

GRAND RIVER ROAD. (Con't.)

16' metal.

4' shoulder on each side making 24' over all.

The edges of road are 6" deep of metal and 8" deep in center covered with a tar carpet with lime stone screenings rolled in.

(8500' finished road)

Cost of Roads.

Culvert.

Labor	78.26
Material	156.97
Total	$235.25

Drain.

Labor	587.68
Material	387.48
Total	$975.16

Road Proper.

Labor	6,377.02
Material	9,706.47
Total	$16,083.49
Miscellaneous	218.24
Total	$17,512.14
State Reward	1,609.85
Cost per yd. of macadam roadway.	15,902.29

$\frac{16 \times 8500}{9}$ = 15,100 sq. yds.

$\frac{15,902.29}{15100}$ = $1.05 per sq. yd.

GRAND RIVER ROAD. (Con't.)

The Commissioners Report says:

The macadam road showed rutting and holes with one year's wear so concrete was tried upon a stretch 1500' long.

The roadway proper is 18' wide with shoulders of gravel making 24' over all.

Layed upon a slightly crowned sub-grade 7" thick in center and 6" at edges of the following mix:

First course 4" deep of 1-2½-5 of cement - clean sand, and crushed limestone 3".

Second course 3" deep of 1-2-3 mix of cement, sand and crushed cobblestone.

COST OF ROAD

Roadway Proper.

Labor	1609.72
Limestone	358.33
Cobblestone	669.75
Sand	186.96
Cement	985.45
Open drain labor	110.00
Tile drain labor	84.07
Tile drain material	74.25
Rental mixer	156.18
Rental of yard	75.00
Coal	38.50
Lubrication, Water, Etc.	74.69
Total	$4483.81

GRAND RIVER ROAD. (Con't.)

No State Reward Mentioned.

Sq. ft. laid = 1500 x 17 or 27,000

Sq. yds. laid = 3,000

Cost per sw. yd. is $1,471

It will be seen that the cemtnt road costs very little more to lay than the tar macadam.

Third re ort from October 1, 1909 to September 30, 1910.

Amount built this year 8,331.

This year's expenditure includes 2 reinforced concrete culverts.

The report of the commissioners states that the cost of the work was considerably increased by the scarcity of water and the railroad strike.

Road Built by Owosso Construction Company.

Expenditures.

Roadway Proper.

Contract	16,422.10
Inspection	540.70
Extra price of cement on account of G. T. Strike	721.44
Rental of yard	75.00
Blue prints, Photographs and Advertising	21.72
Engineers'stakes	15.01
Miscellaneous	54.00
Total	$17,655.94

GRAND RIVER ROAD. (Con't.)

Drainage.

Open Ditch	249.62
Tile draining labor	747.32
Tile for ins...terial	150.10
	1,146.04

Culverts.

Reinforcement for same	11.10
Snyder Road Culvert	237.30
	248.50
Total	19,052.60

Sq. ft. laid equals 16 x 8551 equals 136,500

sq. yds laid equals $\frac{136500}{9}$ = 15,160

Cost per yd. equals $\frac{19052.61}{15160}$ = $1.25 per yd.

This figure show that the cost of construction was much mower than the previous year even though things were against a speedy construction.

This was the beginning of the ... type of concrete construction on Grand River.

The road is 16 ft. of metal at its narrowest point. 24' over all.

The mix is 1-1½-3 of cement, washed sand and pebbles.

The cost of work done is as follows:

Roadway proper.

Teams	3273.20
Other Labor	11271.49

GRAND RIVER R.D. (Con't.)

Pebbles 5730 tons	8,713.65
Sand 3649 tons	4,701.74
Cement 7033 bbls.	10,216.97
Coal 49 tons	188.45
Expansion joints	1,160.05
Lumber and stakes	73.24
Express messenger	20.00
Water supply	325.05
Blue prints	42.46
Lubrication, waste, etc.	110.54
Board of men-	648.11
Yard and fitting	100.00
Hardware	,245.15
Miscellaneous	96.15
Total	41,099.91

Drainage.

Open ditch	136.27
Tile drains	133.46
Culverts	1,513.50
Total	42,000.14
Also extras from 1910	1,872.34
Grand total	44,822.48
State Reward	2,510.00
	42,312.48

GRAND RIVER ROAD. (Con't.)

Road laid 13,255 x 16 = 212,000 sq. ft.

$\frac{212,000}{9}$ = 23,555 sq.yds.

$\frac{22312.46}{215.20}$ = $6.80 per sq. yd.

The extra cost of this road as stated by the Commissioners is due to the fact that hauls were extremely long and long detours were necessary to get around the work to the sidings.

OCTOBER - 1911 to September - 1912.

Roadway Proper.

Teams	1,109.50
Other labor	20,414.31
Pebbles	11,223.48
Sand	4,303.45
Cement	16,786.64
Coal	63.26
Expansion joints	1,727.83
Lumber and stakes	202.89
Express and messenger	16.00
Blue prints	56.52
Lubrication, waste, etc.	100.50
Board of men	1,428.10
Hardware and repairs	616.44
Yard and siding	50.00
Liability insurance	168.13

GRAND RIVER ROAD. (Con't.)

Miscellaneous	401.40
Total (Including preceding page.)	$38,870.68

Drainage.

Open ditch	804.22
Tile drains	300.55
	$39,801.43

Pebbles 1.42½ to 1.87 per ton D.L....

Sand 1.27½ to 1.70½ per ton D.L....

No yardage given.

Road completed to the county line width of 15' and 16' with mix of 24' over all.

Costs.

Roadway proper.

Teams	589.60
Other labor	7,189.72
Pebbles	14,079.80
Stone	2,254.89
Cement	3,381.56
Coal	186.95
Expansion joints	833.22
Lumber and stakes	231.48
Express	8.00
Lubrication, waste, etc.	3.15
Board of men	971.87

GRAND RIVER ROAD. (Cont.)

Repairs and hardware	219.53
Miscellaneous	71.40
Camp equipment	40.70
	$20,081.08

Drainage.

Tile drains	88.82
Culverts	117.96
Grand total	$20,287.86

In this year the section of road from Joy road to a point one mile west wes concreted over an old macadam base. This will give an idea of the cost of concreting over such a base. Section is of 18 metal with crushed stone shoulders to make 24' over all. The concrete is composed of washed sand and pebbles with 6½ inches of concrete at the edges and 8½ inches in the center on a flat sub-grade.

Cost of work is as follows:

Teams	928.50
Other labor	6,098.60
Pebbles	4,398.01
Sand	1,709.11
Cement	3,346.73
Coal	150.87
Blue prints, etc	20.81
Expansion joints	366.19

GRAND RIVER ROAD. (Con't.)

Lumber	23.04
Water supply	56.10
Lubrication	35.85
Hardware and repairs	216.92
Yard and Siding	25.00
Miscellaneous	75.26
Total	$17,550.99

Drainage.

Open ditch	56.00
Teams	56.00
Other labor	169.00
	$17,775.99
State Reward	2,400.00
Amount paid by county	$15,375.99

$\frac{18 \times 5280}{9}$ = 10,560 sq. yds.

$1.66 per square yard.

Road expenditures for Construction.

Total cost as follows:

1907 to 1908	Macadam	17,512.14
1908 to 1909	Cement	4,483.01
1909 to 1910	Cement	10,052.61
1910 to 1911	Cement	44,822.48
1911 to 1912	Cement	30,801.45
1912 to 1913	Cement	30,387.86
1913 to 1914	Cement	17,775.99
Total cost		$193,796.54

PHOTOGRAPHS TAKEN OF GRAND RIVER ROAD.

#1-2-3-4-5-6 shows the result of quick-setting cement.

#6 shows the conditions existing at the Oakland Co. line.

#7 shows muddy conditions existing at railroad crossings.

#8 general view of Gd. River.

#9 shows the deep ditches which are necessary for proper drainage.

#10 shows a sewer being placed in one of the ditches.

PICTURES TAKEN OF GRAND RIVER ROAD.

Picture No. 1.

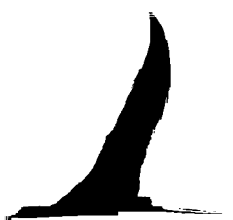
Picture No. 2.

Picture No. 3.

n Picture No. 4.

Picture No. 5.

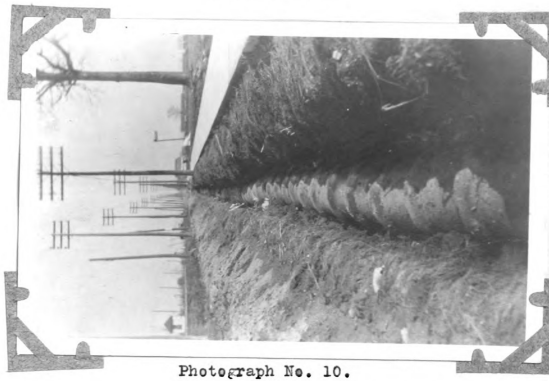
Picture No. 6.



Photograph No. 7.

Photograph No. 8.

Photograph No. 9.



Photograph No. 10.

GRATIOT ROAD.

The work on this road was started in 1907 and since the Wayne County Commissioner wanted to get in idea of what a private contractor could do, the same line of work for the first years work was let by contract. The conditions were very similar to Grand River Road and offer a good comparison. In letting this contract bids were advertised for widely and the contract was finally let to a Detroit firm, Ferdinand Porath and Sons, who offered to build 3,500 feet (linear) for the sum of $10,000.

The road built was of tar macadam 6" to 7" deep on sides and 8½", deep in the center, 16' of metal and 24' over all.

Since the contractor did only the actual construction of the road, the county had to supply the drainage system so that the total cost of this 3,500 feet of road was:

Contract	$10,000.00
Drainage	1,301.53
Total	$11,301.53

Square Yards metal laid $\frac{3550 \times 16}{9}$ = 6320

$\frac{11301.53}{6320}$ = $1.79 per sq. yd. of metal.

The Commissioners say in their report that they can lay the road cheaper themselves than to hire it done.

Jan. 1 '09 to Dec. 31 '09.

Built by Commission. 2450 Feet.

This year's work is of tar macadam construction 24 ft.

GRATIOT ROAD. (Con't.)

over all and 16 ft. of metal. It is of three course construction 8" deep when finished. The bottom course is 3" limestone, the middle course 2" crushed cobble stone and the top course cobble stone chips and tar.

The cost for this year's work is as follows:

Labor on roadway proper	$2,200.77
Limestone 3"	580.85
Screenings (Limestone)	37.00
Cobble stone 2"	971.28
Screenings (Cobble stone)	215.65
Chips (" ")	344.41
Tar	473.03
Open ditch labor	58.55
Tile ditch labor	262.53
Tile	445.21
Guard rail	40.00
Coal	110.89
Lubrication	34.83
Miscellaneous	3.50
Total	$5,777.70

Sq. Yds. Laid:

$$\frac{2450 \times 16}{9} = 4,360$$

$$\frac{5777.70}{4360} = \$1.33 \text{ per sq. yd.}$$

$1.33 by Commission $1.79 by contract the year before.

GRATIOT ROAD (Con't.)

October 1, 1909 to September 30, 1910.

No work on this road was completed this year but the tar macadam construction was abandoned and concrete construction started. The expenditure upon this road in this report was 4,638.13 and is carried forward into the next report.

SEPTEMBER 30, 1910 to OCTOBER 1, 1911.

17090 feet or 3.26 miles.

This section of road was built to the county line and is of concrete construction 16 feet at its narrowest point and 24 feet over all with gravel shoulders.

It is built of 1, 1½, 3 mix of Portland cement, screened sand and screened gravel. On one mile steel expansion joints were used between 25' sections and by the results secured it was decided to use these joints exclusively. 3 reinforced culverts were built also.

Cost as follows:

Roadway proper	
Teams	6,581.01
Other labor	12,196.83
Cobble stones 40 tons	93.84
Pebbles 6648 tons	6,636.37
Sand 2995 tons	2,466.65
Bank run sand 286 tons	177.44
Cement 9825 bbls.	9,830.16
Coal tons 118	330.20

GRATIOT ROAD (Con't.)

Expansion joints	$ 588.85
Lumber	199.60
Express	41.28
Water supply	133.33
Blueprints	32.02
Lubrication, Waste	137.11
Board of Men	410.24
Yard & Siding	37.86
Liability Insurance	107.62
Hardware and repairs	121.50
Miscellaneous	112.45
Total	$41,113.38
Drainage	493.75
Open ditch	1,389.12
Tile drains (labor)	562.24
Tile	2,445.11
Cost of road	$43,558.49
State regard	3,236.00
Cost to County	$40,322.49

This includes the money reported under the 4th report.

Up to the time of this report the work done upon the roadway of Gratiot is 3,236 miles of concrete and 1,137 of tar macadam.

OCTOBER 1, 1913 to September 30, 1914.

Gratiot road at the city limits for a distance of 550

GRATIOT ROAD. (Con't.)

feet is being paved with brick. This section contains 1,775 sq. yds. and is being done under contract. It is the only mileage improved with material other than concrete this season, and replaces the bituminous macadam laid by us in 1907. This section has been a constant source of expense on account of resurfacing and maintenance necessary and it was deemed a real economy to replace it. The balance of the macadam on this road will be replaced with concrete.

The contract price complete is $5,806.20.

Beside this the county paid as follows:

Teams	23.00
Other labor	1.13
Total	$24.13
Contract and extras	$5,830.33

$\frac{2830.33}{1775}$ = $3.29 per sw. yard.

This given an idea of what it would cost to pave these roads with brick and is put in here for that purpose.

OCTOBER 1, 1914 to SEPTEMBER 30, 1915.

The old bituminous macadam construction built in 1907 with an 18' concrete road, 24' or wider over all with the enormous growth of traffic on this road, it was a continuous source of heavy expense to maintain in even a fair condition.

It is of a 2 course construction using washed and screened pebbles 1-2-4 mix 4½" thick for the bottom course and trap rock ranging in size from ¼ to 1½ inches of 1-1½-2½ mix 2½"

GRANITE ROAD. (Con't.)

thick for the top course. Baker armor plater, spaced 25' were used in the expansion joints and a Baker finishing machine was used to strike off, float and finish the road. Crushed stone shoulders were built on each side for a distance of 4'.

EXPENDITURES AS FOLLOWS:

Teams	1,577.80
Other labor	6,690.27
Sand 1,634.04 tons	1,318.26
Gravel 2,214.6 tons	2,150.80
Trap rock 956.95 tons	2,600.27
Crushed granite 336.81	468.84
Cement 4,609 bbls	5,021.13
Coal 96.25 tons	252.94
Lumber	162.71
Water supply	10.32
Camp equipment	26.46
Expansion joints	401.57
Hardware and repairs	129.66
Miscellaneous	213.56
Lubrication, waste, etc	42.64
Total	21,081.33
Drains, Tile.	
Material	100.47
Culverts	
Men	84.98
Grand total	$21,266.78

GRATIOT ROAD. (CON'T.)

Culverts	35.00
Teams	201.00
Men	447.25
Material	683.25
Grand total as on preceding page	21,206.78
	$21,950.01

PHOTOGRAPHS TAKEN OF GRATIOT AVE.

#1 shows general view of this road.

#2 shows conditions existing at Macomb county line

#3 shows one of the uses of a concrete pavement.

#4 shows the condition of the "Dollarway Top" which was placed by a contractor and lasted for about two years.

PHOTOGRAPHS TAKEN OF GRATIOT AVE.

Photograph No. 1.

Photograph No. 2.

Photograph No. 3.

Photograph No. 4.

WAYNE ROAD SOUTH. 2652 feet.

(1910)

Wayne road south is a leading road out of Wayne village connecting up Romulus and other small centers of population in Wayne County.

It is built of concrete 10 ft. wide with 3 ft. of gravel on one side and 3 ft. limestone on the other with dirt shoulders making 24 ft. over all. This type of construction was used to determine the feasibility of lowering the initial cost of construction on roads with light traffic.

This road is built of one course 6 inches deep of Portland cement, washed sand, and washed pebbles in proportions of 1 - 2 - 4.

The following is a summary of the cost:

Roadway Proper

Labor		$1852.13
Pebbles (1014.35 cu. yds.)		818.64
Sand (597.65 cu. yds.)		402.23
Limestone (190.12 cu. yds.)		193.76
Cement (665. bbls.)		790.82
Protection from frost		28.00
		$4085.58

Drainage

Labor	$47.93	
Material	64.37	112.30
Prop. of general expense		204.07
Rental and repairs		146.60
Coal and wood		32.20
Miscellaneous		48.08
Total charge		$4629.83
State reward		502.00
Cost to County		$4127.83

WAYNE ROAD SOUTH. (Con't.)

1911.

The construction for this year was 2 - 3 6 mix. One course cement, washed sand, and washed pebbles. 15 feet metal, and 23 feet over all.

Cost as follows:

Teams	$ 440.50
Other labor	1443.94
Pebbles (1100 tons)	1090.38
Sand (589 tons)	481.85
Cement (1267 bbls.)	1538.80
Blue prints	18.08
Hardware and repairs	75.82
Miscellaneous	11.69
Drainage	15.00
	$5056.06
State reward	500.00
Cost to county	$4556.06

1912.

Construction same as in 1911. Total concrete road built to date in three seasons 1.002 miles:

Cost this year as follows:

Roadway Proper

Teams	$ 176.75
Other labor	686.54
Limestone	67.93
Pebbles ($1.00 per ton)	197.00
Sand (85¢ per ton)	342.03
Expansion joints	365.28
Lumber	25.14
Lubrication, waste, etc.	39.50
Hardware and repairs	44.56
Yard and siding	15.00
Liability insurance	35.91
	$2090.19

WAYNE ROAD SOUTH. (Con't.)

1913

This road is completed from Wayne village to Romulus which in turn is connected with the trunk line road going toward New Boston. It is built of Concrete with a minimum width over all of 24 ft. Seven re-inforced culverts were built.

Subsoil is largely of sand.

Expenditures to date:

Teams		$3098.75
Other labor		6248.18
Pebbles		3746.51
Sand		2080.52
Cement		5169.67
Coal		33.70
Expansion joints		1945.00
Blue prints		2.50
Board of men		15.00
Repairs		53.01
Miscellaneous		20.83
		$22413.67

Drainage:

(Culverts) Teams	$414.00	
Labor	824.56	
Material	489.51	1728.07
		$24141.74

1914

Payroll

Teams	$2703.00
Labor	9133.23
Pebbles	4883.95
Sand	650.79
Limestone	378.23
Coal	161.21
Lumber	266.85
Water	111.33
Am't. to be carried forward	$18288.59

WAYNE ROAD SOUTH. (Con't.)

1914

Amount carried forward	$18288.59
Blue prints	18.07
Hardware and repairs	219.40
Yard and siding	50.00
Miscellaneous	29.43
	$18605.49
Credit on cement	1373.22
	$17232.27
Drainage	99.50
Total	$17331.77

State reward on this road not given before this $3243.00

PLYMOUTH ROAD. (Gravel) (5280 ft.)

1910

Plymouth road is one of the few stretches of gravel built by the commission and will eventually connect up the village of Plymouth with the City of Detroit. Greenfield township had already built 2 miles of the state reward road and Redford 6 miles, getting the money by direct taxation.

The material was obtained for next to nothing, making a low cost for this road.

Plymouth road starts at the town line of Plymouth and is coming toward Detroit. It is 24 ft. wide over all with 12 ft. of metal. The grades are cut down to a maximum provided by the State Highway Dep't. making a fine type of gravel road.

Following is cost in detail:

Roadway Proper:

Labor		$1502.50
Gravel		207.03
		1709.53

Drainage:

Labor	$200.40	
Material	67.39	267.79
Gaurd rail		84.07
Proportion of general expense		205.44
Lumber		73.85
Rent of driveway		25.00
Coal		53.66
Lubrication and waste		12.05
Miscellaneous		23.35
		$2454.74
State reward		500.00
Total cost for one mile for county		$1954.74

PLYMOUTH ROAD. (Con't.)

This road is of same construction as last year and extends one mile toward Detroit.

Cost as follows:

Teams	$1389.50
Other labor	1540.50
Screened gravel (171 tons)	172.80
Bank run gravel (2961 tons)	975.07
Coal (34 tons)	169.20
Lumber	57.66
Express etc.	6.67
Blue prints	15.57
Miscellaneous	85.63
Drainage	103.53
Total cost	$4516.13
State reward	500.00
Total cost to county	$4016.13

Through Redford township five miles. Same construction as above. Two re-inforced culverts built, but work is not entirely finished. Total expenditures to date are $2022.51.

1912

Roadway proper:

Teams	$18103.34
Other labor	17148.98
Pebbles	12136.13
Limestone	11320.41
Coal	232.72
Lumber	213.01
Express	34.75
Blue prints	39.46
Lubrication	128.88
Board of men	1784.60
Liability insurance	120.99
Rental of machinery	104.00
Miscellaneous	414.96
Camp equipment	331.59
Yard and siding	86.32
Hardware and repairs	666.78
Amount carried forward	$40866.92

PLYMOUTH ROAD. (Con't.)

Amount brought forward		$40866.92
Drainage		
Open ditch	Teams and men	3312.02
Tile drains		456.37
Culverts		$ 2546.46
		$69181.77

1913

This road is completed its entire length from Detroit to the village of Plymouth. It crosses Greenfield, Redford, Livonia, and Plymouth.

Cost this year as follows:

Payroll

Teams	$8003.00
Men	7973.42
Bank run gravel	1115.85
Pebbles	7933.38
Crushed limestone	10544.06
Hardstone	1238.21
Coal	74.52
Lumber	631.88
Express	152.78
Lubrication, waste, etc.	41.30
Board of men	280.60
Repairs and hardware	164.35
Camp equipment	57.88
Miscellaneous	156.11
Rental of yard	3.00
	$38370.34

Drainage:

Open ditch	
Teams	40.00
Men	677.84
Culverts, payroll of men	44.88
Material	863.62
	1626.34
Total of payroll	38370.34
Total cost for 1913	$39996.68

PLYMOUTH ROAD. (Con't.)

1914

Teams		$150.00
Other labor		161.35
Pebbles		445.92
Limestone		306.42
Coal		53.84
Water		25.00
Blue prints		6.00
Hardware and repairs		2.15
Miscellaneous		35.92
		$1186.62
Drainage:		
Teams	$55.00	
Other labor	433.50	
Material	40.26	528.76
Total		$1715.38

PHOTOGRAPHS OF PLYMOUTH ROAD.

#1-2 shows conditions existing on gravel roads in the Spring.

PHOTOGRAPHS OF PLYMOUTH ROAD.

Photograph No. 1.

Photograph No. 2.

MICHIGAN BRIDGES AND CULVERTS.

By Edward N. Hines.

County Road Commissioner, Wayne County.

Good roads are receiving more attention today than ever before in the history of the state, but there is one phase of the movement that is not receiving the thought its importance warrants, and that is the question of bridges and culverts. Here proper methods used in the construction of permanent bridges and culverts in this state, many thousands of dollars that are now being spent annually on their maintenance, might be used for better highways.

In 1907 the State Highway Department attempted to get a complete statement of the cost of bridges and culverts built in Michigan during the year, and the total amount reported was $657,388.15. At the convention of the American Roadmakers' Association, the Deputy Highway Commissioner of Michigan, in an address, gave it as his opinion that the total would reach $1,000,000 for the year.

A large proportion of the existing bridges and culverts, as well as many of those now being built, are only temporary structures; and because of this fact, our present expenditure for bridges and culverts is largely one of maintenance. This vast sum spent in 1907 was largely used to renew or repair existing structures.

The great bulk of the bridges in this state have

span lengths of less than 50 feet, and the cost of guilding permenent structures for such spans is reasonable. So it is evident that this large expenditure might eventually be materially reduced, and the money so saved put elsewhere on the roads, by adopting a policy of renewing bridges with structures as nearly permenent as may be possible under the circumstances.

Practically permanent bridges and culverts may be obtained by builling them of reinforced concrete. This material is now being extensively used for building construction, and is recognized as a good and cheap material for permanent works of all kinds.

The problem of bridges is different from that of roads, as no matter what the character of the road may be or how little travel may go over it, it is necessary to have bridges that will sustain the loads that come upon them; and a bridge in a sparsely settled community may be called upon to carry quite as heavy a load as the bridge upon the road were traffic is frequent; so that the requirements of construction for a bridge are more nearly the same for all localities.

In a great majority of cases in this state, the present method of contracting for a bridge is uneconomical, unbusinesslike and unsound. Bids are usually asked for, and the contractor submits his own design, plans and specifications, and in many instances bases his price on

the cheapest possible design which he thinks he can get accepted. This procedure has a marked tendency to lower the standard of highway bridges.

In order to secure a well designed bridge it is necessary to make rigid specifications as to loading, and details of designs under which a bridge is to be planned. After proposals are submitted, careful examination should be made of the plans to determine whether or not the conditions imposed have been carried out. Copies of the plans, specifications and contract should be made in duplicate, and one set kept by the responsible officer of the Township, and a competent inspector should supervise the work.

The detail of a design, such as thenumber and spacing or rivets, thickness and size of splice plates and pin plates, the methods of making connections at the joint, etc., are rarely if ever, shown. The capacity of the structure to carry safely the load for which it is designed depends upon the strength of details as well as upon the main members. The whole bridge may thus be rendered unsafe by the faulty construction of a single detail. And yet the planning of the details is left to the contractor without restriction of any kind.

The contract entered into is also frequently vague and misleading. It is usually written on a blank

furnished by the bidder, and often contains clauses which operate to release the contractor from responsibility of any kind. Often plans which appear attractive to the commissioners may call for a strong, heavy structure, but the contractor, taking advantage of the substitution clause in the chntract and the lack of training of the commissioners and inspectors, actually builds a much lighter, weaker and consequently cheaper bridge.

If there are any legal difficulties in the way they should be remedied by legislative enactment, to place the bridge work of the state under the direct supervision of the State Highway Department. This department at the present time is small,,and the force is pretty well over worked, and in taking up the details of this question provision should be made for the employment of a competent bridge engineer so as to secure skilled supervision of this branch of the work.

Satisfactory results may then be obtained by requesting competitive plans which are to conform to rigid specifications prepared by such engineer, who would also pass upon the plan submitted, to determine whether or not they conformed to the requirements previously outlined. The contract should then be awarded to the lowest bidder whose plans are made in accordance with the

specifications. A uniform system of proposals should be furnished by the State Highway Department, together with a contract blank.

Local officers should notify the State Highway Department that they contemplate undertaking the construction of a bridge, asking at the same time that engineering services be rendered in connection therewith. Upon receipt of such an inquiry the State Highway Department should set a date for its engineer to meet with the local officer and view the site of the bridge. Definite recommendations in regard to the length of span and character of the structure should then be made.

Plans and specifications should then be prepared in the office of the State Highway Department, and forwarded to the local officers for their approval, after which time and place of letting should be set. This date should be set far enough in advance of the return of the specifications, and the place should be preferably in some public building located in a town or village conveniently reached by railroad.

Upon the return of the plans and specifications, duplicate copies should be sent to the commissioners, and notices of the letting sent by the State Highway Department to all bridge companies known to be in a position to do the work, and as complete data as possible

in regard to governing conditions so that bidders could in many cases mail their bids, eliminating the expense of sending a man to inspect the site and attend the letting.

Some such plan as is outlined above would save expense to the bidders, and therefore reduce the cost of the structure to the township, and secure actual competition at the letting.

The State Highway Department could also prepare an estimate of the cost, and from time to time inspect the work during its construction to see that it is properly carried on in accordance with the plans and specifications; and upon its completion a final inspection should be made, and a certificate awarded to the local officer. Only in some such way will the townships secure well designed, permanent and properly constructed bridges.

Michigan cannot be considered as being thoroughly up-to-date on the good roads problem until some such action as is outlined in the foregoing is taken.

PHOTOGRAPHS OF CULVERTS.

#1 shows typical culvert used throughout Wayne County.

#2 shows method of drainage through fills in the ditches.

CULVERTS.

Photograph No. 1.

Photograph No. 2.

SYNOPSIS OF [illegible]
RELATIVE HIGHWAY AND RAILWAY LAWS.

The last session of the State legislature made a number of important changes and additions to the Road Laws of the State, and we are presenting herewith a synopsis of same:

Section 7, Chapter 1, Act 283, provides that whenever any freeholder considers himself aggrieved by the determination of a highway commissioner in laying out, altering, or discontinuing any highway, he may within ten days after such determination or refusal, appeal to the Township Board. But the law provides that with this appeal there shall be deposited with the Township Clerk the sum of $25.00 to cover the cost of the appeal, and if the appeal is sustained, this fee shall be returned to the person making the appeal,,but if the appeal is not sustained, this fee will be used to defray the cost.

Section 27, Chapter 1, Act 283, provides that before laying out any highway over a track of a railroad company, steam or electric, application shall be made to the Michigan Railroad Commission to make such a crossing. The Michigan Railroad Commission is then required to make a strict examination to find out if the crossing at grade would be reasonably safe, but if on examination the Commission does the proposed location extra hazardous, then they shall notify the State Highway Commissioner, and the State High-

way Commissioner with the Railroad Commission shall act jointly and shall examine the proposed crossing in Company with the parties interested, and shall have power, if in their judgment it is necessary, to cause the relocation of the proposed highway. If, However, the Michigan Railroad Commission and State Highway Commissioner after examination determine that it is impracticable to secure a reasonable safe crossing by relocating the same, they may order a separation of the grades, or may deny the application for a crossing. The separation must be constructed according to plans which shall be submitted to the Railroad Commission and the State Highway Commissioner for their joint consideration and approval. If the plans meet with their approval and permission is granted for the crossing, either at grade or otherwise, the same proceedings in relation to acquiring the rights of way for the highway across the land of the railroad company, including the right of way across the tracks, shall be the same as in other cases.

The Railroad Company shall furnish a competent man to superintend the work, to be paid by the township, good roads district, or county, as the case may be, a per diem compensation not to exceed $4.00 per day, this amount to be paid for time actually and necessarily spent in superintending the construction.

Whenever the Michigan Railroad Commission and State

[illegible] 13, 1913. (Cont't.)

highway Commissioner in their judgment think it would be in the interest of public safety and convenience to separate the grades at any existing crossing, they shall prescribe the manner of construction and the terms upon which such separation shall be made, and also determine what apportionment of the expense of alteration shall be born by the railroad corporation, the City, County, Road District, or Township. The disposition of this matter shall be made until all parties interested shall have been afforded an opportunity to be heard.

The State's apportionment of the cost of such changes as may be ordered, shall in no case exceed 25 per cent of the total cost of such improvement, and shall be paid from any State highway funds not otherwise appropriated.

Section 15, Chapter 111: An act was passed changing the moving load that all highway bridges should sustain from ten to fifteen tons.

Section 7, Chapter 111: This section as amended provides that the road commissioners of good roads districts shall on the first day of October of each year determine the amount of tax that shall be raised during that year for every thousand dollar valuation of the district according to the last assessment roll of the last preceding year. This amendment changed the maximum amount which may be raised from two to three dollars for each one thousand

SECTIONS, 120. (Cont.)

dollars worth of valuation.

Section 10: This section provides that whenever the Board of Supervisors of the County by a majority vote proposes to contract indebtedness or issue bonds to raise money for the construction and maintenance of district and county roads, they shall submit the question to a vote of the electors at a general or special election called for that purpose. The Board of Supervisors shall not submit this question to the electors of the district unless they have received a petition from at least ten per cent of the resident freeholders of each of the several municipalities comprising the good roads district, this amendment changing the number of petitioners from twenty-five residents to ten per cent of the total resident freeholders.

COUNTY ROAD LAW

Chapter 4, Section 6, has been amended so that the Board of Supervisors has authority to determine how many County road commissioners up to a maximum of three, shall be elected. It further provides that the commissioners can first be elected or appointed, as the supervisors shall designate. If they are appointed, they shall hold office only until the first day of January in the year in which the next regular session of the Legislature is held. The time of election of county road commissioners has been

change to the regular Fall Election. The election of county road commissioners is not mandatory in any county which contains 20 surveyed townships or more. In such counties the Board of Supervisors may appoint the County Road Commissioners.

Section 7 provides that if the Board of Supervisors designate that there be only one commissioner, he shall hold office for 2 years; and his successors shall be elected every two years at the regular Fall Election. If the number of commissioners be designated as 2, they shall hold office for two and four years respectively, from the first day of January, and thereafter one commissioner shall be elected or appointed biennially for a full term of four to six years. If the number of commissioners be designated at three they shall hold office two, four, and six years. If the Board of Supervisors wish to reduce the number of commissioners, it can be done only by directing that no commissioner be elected to succeed the commissioner whose term soonest expires.

Section 10 has been amended to provide that the Board of County Road Commissioners must employ a county road engineer who shall make all surveys, prepare plans for roads, bridges, and culverts, and exercise such supervision over all construction work as will insure fulfill-

ment of all plans and specifications.

Section 18 has been amended to provide that the County Road Commissioners shall file with the State Highway Commissioner for his approval, a map of the county showing the location of the proposed system of county roads. This system may be extended from time to time if the extensions are also approved by the State Highway Commissioner. It is hoped that a more connected system of county roads can be secured through this amendment to the law, and that all county roads can be brought together at county lines. This section also provides that the County Road Commission can improve roads within a village or city if they are on through roads, provided that no improvements shall be to a greater width than 18' nor with a material more expensive than concrete or brick. This proviso does not allow state reward on such county roads and the state reward will still stand as before, no reward being paid upon any road, the center line of which borders or lies within the corporate limits of any village or city.

Section 20 of the County Road Law has an amendment which allows the raising of a one mill tax in counties whose valuation does not exceed forty million.

Section 21 of the County Road Law has an amendment which allows the Board of County Road Commissioners to borrow not to exceed three-fourths of the county road tax voted before the tax is collected, to complete

roads under construction, as well as to pay upon contracts.

Section 3, Chapter V, has been amended so that the State Highway Commissioner can call a road institute annually at such place as he may designate. It also provides that county and township road commissioners can collect their per diem for attending this meeting the same as for actual road work.

Section 9 has been amended so that the State Highway Commissioner may refuse to accept applications for state reward on roads which are not leading public roads and the location of which does not meet with his approval. It further provides that the date of completing a road gives priority for the payment of reward rather than the application number which is given the road when the application and profile are filed with the Commissioner.

Section 19 of the State Reward Law allows the payment of $900 state reward on a concrete or brick road 8' wide with $100 additional for each additional foot in width up to and including 16' wide. It also provides that a road may be built with a central track of one class and with shoulders of a different class, and when so built it will be entitled to state reward upon the central track as specified, plus a reward for each extra foot in width for the shoulders according to the class built. The total limit of the rewarded surface is 16'. Plans of this construction must be approved by the State Highway Commission before the construction work begins.

Section 11 of the State Reward Law provides that

money paid to townships, counties, or good roads districts for state reward, shall be credited to the road fund of that township or county.

Section 12 provides that the State Highway Commissioner may order repairs upon any old state rewarded roads which are not kept in proper repair by the local officials. If they refuse or neglect to repair the roads, the State Highway Commissioner may take any moneys which may be due their county or township, and use it to repair the road. If there is no money due them, the State Highway Commissioner may make the necessary repairs and pay for them out of any funds which may be available for that purpose and render a bill to the proper officials where the work was done in repairing old state rewarded roads, and the bill must be paid upon the warrant of such officers and the amount returned to the State Treasurer to reimburse the state funds expended, and the local supervisors must incorporate the amount of this bill in their next regular tax toll.

Section 17 was added to Chapter V, which provides that the State Highway Department shall construct and maintain all bridges greater than 30' clear span on any state reward road, if the township, good roads district, or county expends as much on the roads as will equal the cost of the bridge and state reward combined.

SYNOPSIS. (Con't.)

Section 13 provides that there shall be no bridge or culvert built on any public highway which is not of sufficient strength to safely carry a 15 ton moving load. This is raised from 10 to 15 tons.

Section 2 provides that whenever a drain crosses a highway, the drain commission shall build the first bridges and culverts which shall have a capacity of a 15 ton moving load, charging them to the drain. It also provides that such a culvert shall be of a permanent nature and that it shall be constructed on the center line of the highway as located by a survey, in accordance with plans and specifications which shall be approved by the road officials having jurisdiction. It further provides that when a drain passes along a highway with each enclosed field and with each farm entrance, which bridge or passage way shall also be charged in the first instance to the drain.

Section 3 provides that before any drain can be laid along the highway, written permission must be secured from the highway officials having jurisdiction stipulating that no excavation shall be made nearer than one rod to the center line of the highway, and stating what disposition shall be made of the material excavated.

TRUNK LINE HIGHWAYS.

The trunk line highway act was amended so that local road officials acting jointly with the State

SYNOPSIS (Con't.)

Highway Commissioner, may establish additional trunk line highways up to a limit of 3 miles per surveyed township in each county. The trunk line highway act was further amended so that the State Highway Department has authority to repair and maintain trunk line bridges as well as to construct them. Authority is given the State Highway Commissioner to pay repair reward on trunk line highways. He is further given authority to insist on the repair of old trunk line roads in any township or county, and if the local officials fail or neglect to repair the roads as directed, he may withhold payment of state reward and if there is no state reward due said county or township, then he shall have authority to make the necessary repairs and render a bill to the officials of said township or county, which bill must be paid upon their warrant, the amount to be spread upon the next regular tax roll by the supervisors to reimburse the State.

Sufficient appropriations were made to take care of a state reward deficiency from the previous year, and a reasonable amount to take care of all state reward and trunk line roads to be built the next two years.

SENATE ENROLLED ACT NO. 68.

This act was introduced by Senator Norford and provides that owners of isolated lands where the same are platted and subdivided into lots for residence purposes or lake resort homes, and where the plat or

SYNOPSIS (Con't.)

subdivision has been properly recorded in the office of the Register of Deeds of the County where the lands are located, shall have the right to acquire in the same manner as covered in Act No.283, Public Acts of 1909, establishment, opening, and maintenance from the nearest public highway. This road shall not be less than 2 rods wide, and when so acquired shall be dedicated to the public for use as a highway by the owner or owners of the sub-division.

[illegible] ENROLLED ACT NO. 169.

This act was introduced by Representative Robertson under House Bill No. 352 and provides that all state reward roads not designated and named at the time this act shall take effect, shall be given an appropriate name in their entirety by the State Highway Commissioner and County Road Boards or the Boards of Supervisors in counties not operating under the county road system.

The Board of County Road Commissioners or Boards of Supervisors in counties not operating under the county road system, shall cause to be placed at every branch of state reward road or cross road, a suitable sign board. This sign board shall have printed thereon the name of the road and the distance to the nearest important town, village or city. The expense of the erection and keeping in repair of all such sign boards is to be paid out of the general fund of the county where sign boards are erected.

SYNOPSIS. (Con't)

The design of the sign board is to be made by the State Highway Commissioner.

TWO COUNTY BILL OR ACT P. 310.

This act is an additional method of constructing and improving highways not located in the incorporated limits of a city or village. It provides for the assessment of a district for a part of the cost of road improvements in the same manner as county drains of this State are taken care of. This method has been tried out very successfully in Ohio. It seems that both the counties under the county road system and the townships in counties not under this system will be benefited by this additional means of financing road improvement work.

This bill was introduced by Senator Covert and is known as Senate Enrolled Act No. 30, or Act. No. 310, Public Acts 1915.

Whenever the majority of frontage owners along any highway not less than 3 miles in length, decide to improve the same, they shall file a petition with the Board od County Road Commissioners, asking that the highway be improved. Upon receipt of this application, the Board of County Road Commissioners shall examine the highway and determine whether the improvement is necessary. If they consider the petition favorably, they shall cause a survey to be made, specifications to be drawn showing an improvement suitable for the highway, and estimates of the cost. This is to be done by a competent engineer.

They shall also have a plat made of the highway showing the lands that will be benefited by the proposed improvement. All the bridges, road drains, and culverts shall be figured in as a part of this proposed improvement.

If after the survey, specifications, and estimates of cost have been made and filed, the Board of County Road Commissioners are of the opinion that such improvement is necessary, they shall make their first order of determination. Attached to this order should be the specifications, together with a description of the boundaries of the proposed assessment district. The Board of County Road Commissioners shall then hear objections to the proposed improvement at a time and place to be fixed by them within the proposed special assessment district along the line of road to be improved. At this meeting all parties or persons interested are required to present their objections, if any, to the new improvements. This meeting is to be well advertised in the local district, township and county where the road is located. At this hearing the Commissioners may make any changes in the specifications which they consider advisable, provided such changes do not increase the original estimates more than ten per cent. If the increase is more than ten per cent, then a new hearing must be advertised and held. If after hearing the objections, the Board of County Road Commissioners feel

that the new improvement is necessary for the benefit of the public welfare and convenience and decide to construct the same, they shall determine the following:

1st. The number of installments in which the money for the improvement shall be raised. This number shall not exceed ten installments.

2nd. The special assessment district and the apportionment of the total cost of construction which the county at large shall pay by reason of the benefit of improving the highway, and the apportionment of the cost of construction that the township traversed shall pay. They shall also determine the apportionment of per cent of benefits to be paid by the assessment district. The district apportionment shall not be less than 25 per cent not more than 75 per cent of the total cost of the improvement.

After the completion of the apportioning of per cent of benefits to be paid by the prospective parties, the County Road Commissioners shall give notice by advertising and posting of the review of the roll. At this hearing the Board of County Road Commissioners shall appear and hear all objections to the proposed apportionment of benefits and equalize the same and make such changes and correftions that they shall deem just and equitable.

County Road Commissioners may divide the proposed

SYNOPSIS. (Con't.)

improvement into three sections. One of the section proposed to be improved the first year, the adjoining section the second year, and the last section the third year. In all cases where the improvements to be made spread over two or three years, the people interested should be given notice at the time of the first hearing. In case the proposed improvement is to be divided into sections for letting separate years, then the assessment roll shall be made for the first section only and the new roll shall be prepared for each succeeding year for each succeeding section.

After the time for appeal from the assessment roll has expired, or after the appeals have all been decided, the Board of County Road Commissioners shall then prepare a tax assessment roll for the first year for the collection of taxes, and shall certify the same to the Township Board and to the Township Clerk in plenty of time to be acted upon at their annual meetings.

The special taxes for this work shall be collected in the same manner and by the same officers as the State, County, and Township taxes are collected.

The Board of County Road Commissioners may advertise for bids for the construction or improving of the road, and borrow money in an amount not to exceed the money raised or collected by assessment roll referred to.

In townships or counties not under the county road

system, the abutting property owners may petition the State Highway Commissioner, who shall file the same steps and take action that would be taken by the Board of County Road Commissioners, except that the tax shall be spread on the county at large, and only on the township or townships directly benefited by the improvement. The petition is also made to the State Highway Commissioner when the assessment district includes parts of more than one county.

Recommendations of the authors in the Construction of Concrete Highways.

A study of the crack count table in this thesis shows that the concrete roads crack each year and that the number of defective slabs increase each year. This shows that it is not a particular section of the road that develops new cracks but new slabs or sections crack as well. It will be noticed that the main traveled roads, or those carrying a heavy traffic are more subject to holes and cracks as would naturally be expected, Woodward leads with 80.9% defective slabs, Grand River next with 74.8% defective slabs and Michigan 3rd with 73.6%. The first two are 2 course roads and the third 1 course. The road built upon Grand River in 1909 of same mix and same subgrade shows 15.8% less cracks than that built in 1910, but the road built in 1911 and 1912 of washed sand and pebbles shows a marked decrease in defective slabs. Both these roads are on a sand loam subgrade which is naturally more porous than clay and more easily drained.

The table shows that on the River road the percentage of defective slabs on sections built of 1-2-4 mix washed sand and pebbles has a defective percentage of 55.0 and the next year's work of 1-1½-3 mix shows a defective percentage of 54.6. Since this is on same subgrade it would go to show that the difference in mix had very little to do with the defective slabs.

On side hills and fills the Board have used triangular reinforcing with marked success yet think that

it does not pay to reinforce these roads since interest on the investment at 4% will more than pay for the filling of cracks with a mixture of Tarvia X and A and sand.

The Board during the first three years laid the wash on a crowned subgrade but during the last years they have been laying upon a flat subgrade. The reason for this is that they think the outside of the concrete slab (or the edges) settle first and the crown supports the center of the slab causing a cantilever action and a consequent longitudinal crack.

The fact that the older pavements laid upon a curved subgrade show very little higher percentage of cracks than on the flat subgrade would disprove this theory since the early roads were mixed from a dirty sand and gravel while the later roads were built of washed sand and gravel.

Along Grand River Road for a stretch of 1000 feet the contractor used Huron quick setting cement. This pavement had to be resurfaced this Spring at a large expense. This would show that quick setting cement was no good for pavements.

Along Michigan Avenue in the village of Dearborn one side of the car track was laid by a contractor and the other side by the Board. The contractor was careless about letting the blades of his mixer get clogged up and a spalling off of the surface of the pavement requiring

renewal of the surface in a few years. The other side of the street, laid by the Board, is in good condition still. This shows what a little carelessness will do in a concrete pavement.

As mentioned before, roads laid with unwashed sand and gravel are much more subject to holes and cracks than the roads where washed sand and gravel were used.

We would recommend from our data and observations a two course road of 1-2½-5 cement, washed sand, and washed gravel 4" deep for 1st course and 1-2-3 cement, washed sand and trap rock 3" deep for second course with 18' of metal and limestone shoulders 24' over all. The road to be laid upon a curved subgrade with drain tile running down the center of the road about 2' under the cement and with sufficient laterals leading out so that the surplus water would be drained into side ditches in a very short time. The pictures we have shown of water seeping up through the cracks in the pavement showing that it is frost action and not the cantilever effect of the slab that causes the majority of the cracks.

We would also recommend the use of a triangular mesh reinforcement throughout, for the results shown by its use on fills and steep grades would, in our estimation, justify its use altho the first cost would be slightly greater but since a concrete road with 15' of metal will average, $15,000 per mile a slight additional first cost would be a wise investment in the long run.

We would advise circular curves with super elevation at all turns, thus getting away from the corners, such as are shown in pictures of road at Trenton and vicinity.

We would also recommend that rail road crossings be paved with brick on a cinder foundation, instead of planked as now is the custom, forming a smoother and safer crossing.

With this road and the limiting grades that are now fixed by the State Highway Department we believe that we would have a road that would be almost non-cracking, very little more first cost than roads now constructed and less cost of maintanence.

For resurfacing we would recommend that the old road surface be swept as clean as possible, chipped with a pick or similar tool and then given a wash of weak hydrochloric acid and a new top course laid upon the old foundation filling all holes and broken places with the same material.

We do not believe it practical to resurface the old foundation with brick as it would require a curb and this type of road is not adapted to curbing.

In places where water is likely to run over the concrete in the Spring we would recommend a small protecting wall to be built upon both sides of the concrete at the time the road is built to protect the roadway from under mining and washing out.

The bridges as now constructed are of a fine type and could not be improved upon from an esthetic or

efficiency point of view. Greater care should be used in their foundations, however, for the Michigan Avenue bridge at River Rouge has settled 10" at the center piers and the Dix Avenue bridge over the same stream has settled 6".

The first bridge is concrete arch and the second bascule and both were very costly and more care should have been taken in the foundations.

Considering that Wayne County were pioneers in this work we believe their roads were built the best they knew how at the time and that the tax payers' money was handled as care-fully as tho it had been their own.

SPECIFICATIONS.

For a Concrete Road on----------Road

Township of.....Wayne County Mich.

Edward N. Hines, Chairman

John S. Haggerty

William F. Butler.

DESCRIPTION OF ROAD

PARTIES

For the sake of brevity, the Board of County Road Commissioners for the County of Wayne will be referred to in these specifications as the Board; the person, firm or corporation to whom the contract shall be awarded will be referred to as the Contractor; and the engineer employed by the Board will be referred to as the Engineer.

PLANS AND DRAWINGS

The plan, profile and cross sections on file in the office of the Board show general locations, profile, details and dimensions. The work will be constructed in all respects according to the above mentioned plans, profile and cross sections, which form a part of these specifications.

Any variation of location, profile, size and dimensions from that shown on the plans, which may be required by the exigencies of construction, will in all cases be determined by the Engineer; and the Contractor shall not on any pre-

SPECIFICATIONS. (Con't.)

tense, save that of the written order of a majority of the Board deviate from the intent of these plans and specifications.

On all drawings, figured dimensions are to be taken in cases of discrepencies between scale and figures.

COMMENCEMENT OF WORK

The work embraced in these specifications shall be begun not later than....., and carried on regularly and uninterruptedly, unless the Board shall otherwise direct, and with such force as to insure its completion within the time specified in the contract. The Contractor will give the Board ten days' notice before commencement of the work, and also notice that he has on hand or available the necessary material to uninterruptedly carry on the work to completion.

After the work shall have been commenced, if the same shall be interrupted and delayed by the Contractor from any cause whatever the Board shall have the right to hire an inspector or watchman and put him in charge of the road during the interruption, and deduct the wages paid such employee from the amount due the Contractor.

ORDERS TO BE OBEYED

Whenever the Contractor is not present on the work, orders will be given to the superintendents or overseers who may be in immediate charge thereof, and shall by them

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be received and strictly obeyed. And if any person employed on the work shall refuse or neglect to obey the directions of the Board or its duly authorized agents, in anything relating to the work, or shall appear to the Board to be incompetent, disorderly or unfaithful, he shall upon the order of the Board, be at once discharged, and not again employed on any part of the work.

TILING.

If the work is to be constructed alongside a street railway track, the first work to be done will be the laying of a course of four inch land tile on the side of said road next to said track, distant four feet from and parallel with the nearest rail, and at the depth shown on plans. Before the filling back is permitted, the tile must be covered their entire length and one-half their circumference with a layer of tar paper, to keep sand and other material from washing through the joints.

Each proposal must state the price per lineal foot at which the bidder will undertake to do the tiling as above indicated; but the Board reserves the right to reject that part of the proposal relating to tiling and to do that part of the work by day labor, and to accept that part of the proposal relating to roadway proper only, on those parts relating to roadway proper and open ditching; in either of

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which cases the work of tiling at any given point must be completed before the work on the roadway proper is begun.

OPEN DITCHING

If the work to be constructed is not along side a street railway track, an open ditch must be dug along both sides of said road beyond the earth shoulders, location and dimensions of said ditches being shown on plans. This work may be done either before or after the roadway proper; but if done before the ditches must be kept free and clear from rubbish and refuse during the construction of the roadway proper, and left in as good condition in every way as if the work had been done after the concreting and building of the shoulders. If the work to be constructed is along side of a street railway track then an open ditch will be dug only on the side of the work opposite the street railway track.

Each proposal must state the price per lineal foot at which the bidder will undertake to do the open ditching as above indicated; but the Board reserves the right to reject that part of the proposal relating to open ditching and do that part of the work by day labor and to accept that part of the proposal relating to roadway proper only or those parts relating to roadway proper and tiling.

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GRADING.

The term grading shall include all cuts, fills, ditches, borrow pit, approaches and all earth moving for whatever purpose, where such work is an essential part of or necessary to the prosecution of the contract. When, to bring the surface to grade, a fill of one foot or less is required, the area shall be thoroughly grubbed. All soft, spongy or yielding spots and all vegetable or other objectionable matter shall be removed and the space refilled with suitable material.

Stakes will be set by the Engineer for the center line, side of slopes, finished grade and other necessary points properly marked for the but of fill.

Excess material shall be disposed of as directed by the Engineer, the free haul not to exceed.....feet.

Materials hauled a greater distance than the free haul from the place of excavation shall be paid for at the rate of.....cents per cubic yard for each additional.... .....feet.

Embankments shall be formed of earth or other approved materials and shall be constructed in successive layers, the first of which shall extend entirely across from the toe of the slop on one side to the toe of the slope on the other side, and successive layers shall extend entirely

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across the embankments from slope to slope. Each layer, which shall not exceed one foot in depth shall be thoroughly rolled with a roller weighing approximately ten tons before the succeeding layer is placed. The roller shall pass over the entire area of the fill at least twice.

The sides of the embankment shall be kept lower than the center during all stages of the work and the surface maintained in condition for adequate drainage. The use of muck, quicksand, soft clay or spongy material which will not consolidate under the roller is prohibited.

When the material excavated from the cuts is not sufficient to make the fills shown on the plans, the contractor shall furnish the necessary extra material to bring the fills to the proper width and grade. When the earth work is completed, the cross section of the road shall conform to the cross sectional drawings and profile attached hereto.

All Slopes must be properly dressed to lines given by the Engineer.

When the grade line is approached the final grade stakes will be set, for which sufficient notice must be given to the Engineer.

Note: In excavating cuts, it is considered advisable, when the line of the subgrade is approached, to compact the remaining material by rolling.

The depth of material left in the cut to be

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compressed to the finished grade by rolling will depend upon the character of the material.

SUB- GRADE.

The bottom of the excavation or the top of the fill when completed shall be known as the subgrade and shall be at all places true to the elevation as shown on the plans attached hereto.

The roadway shall be graded to the proper subgrade to permit of the specified thickness of paving materials being laid to bring the finished surface of the pavement to the lines and grades as shown on the plans.

The subgrade shall be brought to a firm, unyielding surface by rolling the entire area with a self-propelled roller weighing approximately ten tons, and all portions of the surface of the subgrade which are inaccessible to the roller shall be thoroughly tamped with a hand tamp weighing not less than fifty pounds, the face of which shall not exceed one hundred square inches in area. All soft, spongy or yeilding spots and all vegetable or other objectionable matter shall be entirely removed and the space refilled with suitable material.

Where considered necessary or of assistance in producing a compact, solid surface, the subgrade before being rolled shall be well sprinkled with water.

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When the concrete pavement is to be constructed over an old roadbed composed of gravel or macadam, and the concrete is to be wider than the old gravel or macadam road, the latter shall be entirely loosened and the material spread for the full width of the roadbed and rolled. All interstices, shall be filled with fine material, and rolled to make a dense, tight surface of the roadbed.

No concrete shall be deposited until the subgrade is checked and accepted by the Engineer.

Upon the subgrade thus formed shall be laid the concrete as shown in the plans attached hereto.

CEMENT

The cement to be used has been contracted for by the Board at.....per barrel, cloth sacks, delivered in carload lots at any railroad siding in Wayne County, on 30 days' time, subject to a discount of....cents per barrel if paid within ten days after the car is placed on the siding to which originally ordered. Cloth sacks will be charged at 10 cents each (included in above price) and when returned to the factory of the company furnishing same, freight prepaid, in good condition, subject to factory count and inspection, will be credited at the same price as charged.

The Contractor must order and pay for the cement as per contract referred to, and must take care of and return

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to the factory all sacks, freight prepaid, in order to be entitled to the credit for same. The contract referred to is on file in the office of the Board, and may be seen upon request.

FINE AGGREGATE.

The fine aggregate to be used has been contracted for by the Board at $.....per ton, f. o. b. .....Siding, delivered in carload lots. The contractor must order and pay for the fine aggregate as per contract referred to, which is on file in the office of the Board and may be seen upon request.

Note: Fine aggregate shall consist of washed sand or screenings from hard, clean, durable quartz, trap rock or granite, graded from fine to coarse with the coarse particles predominating and pass when dry a screen having one-fourth inch openings. It shall be clean and hard, and free from dust, loam, vegetable or other deleterious matter. Not more than 20% shall pass a sieve having fifty meshes per lineal inch, and not more than 5% shall pass a sieve having 100 meshes per lineal inch. In no case shall the fine aggregate contain frost or lumps of frozen material.

COARSE AGGREGATE.

The coarse aggregate to be used has been contracted for by the Board at $.....per ton, f. o. b.....

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Siding, delivered in carload lots. The Contractor must order and pay for the coarse aggregate as per contract referred to, which is on file in the office of the Board and may be seen upon request.

Note: Coarse aggregate shall consist of washed gravel or clean, hard, durable crushed quartz or trap rock, graded in size, free from dust, loam, or vegetable matter, and shall contain no soft, flat or elongated particles. The size of the coarse aggregate shall be such as to pass a one and one-half inch round opening, and be retained on a screen having one-fourth inch openings. In no case shall the course aggregate contain frost or lumps of frozen material.

NATURAL MIXED AGGREGATE

Natural mixed aggregate shall not be used as it comes from the deposits, but shall be washed and screened and used in the proportions specified.

WATER

Water shall be clean, free from oil, acid, alkali or vegetable matter.

REINFORCEMENT

Concrete pavement twenty feet or more in width shall be reinforced with metal fabric. All reinforcement shall

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be free from excessive rust, scale, paint, or coatings of any character which will tend to destroy the bond. All reinforcement shall develop an ultimate tensile strength of not less than 70,000 pounds per square inch and bend 180 degrees around one diameter and straighten without fracture.

JOINT FILLER

Joint filler shall consist of prepared felt or similiar material of approved quality having a thickness of one-quarter of an inch.

JOINT PROTECTION PLATES

Soft steel plates for the protection of the edges of the concrete at transverse joints shall be two and one-half inches in depth and three-sixteenths of an inch in average thickness. The plates shall be of such form as to provide for rigid anchorage to the concrete. The type and method of installation of joint protection plates shall be approved by a majority of the Board.

FORMS

The forms shall be free from warp of sufficient strength to resist springing out of shape, and shall be equal in width to the thickness of the pavement at the edges. Wooden forms shall be of not less than two inch stock, and shall be capped with two inch angle iron.

The forms shall be well staked or otherwise held

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to the established line and grade, and the upper edges shall conform to the established grade of the road.

All mortar and dirt shall be removed from the forms that have previously been used.

PAVEMENT SECTION.

The concrete pavement shall be.....feet wide .....inches in depth at the center, and..... .....inches in depth at the sides. The finished surface shall conform to the arc of a circle, as shown on the plans attached hereto.

Note: Crown shall be one one-hundredth of the width. The thickness of the concrete at the edges shall be not less than six inches.

JOINTS.

Transverse joints shall be not less than one-quarter inch not more than three-eighths inch in width and shall be placed across the pavement prependicular to the center line and twenty-five feet apart. When a curb is specified or where pavement abuts a building a joint one-quarter inch wide shall be placed between it and the pavement. All joints shall extend through the entire thickness of the pavement, and shall be perpendicular to its surface.

The concrete at transverse joints shall be protected with soft steel joint protection plates which shall be rigidly anchored to the concrete. The installation of the

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metal protection plates shall meet with the approval of the Engineer. The surface edges of the metal plates shall conform to the finished surface of the concrete, as shown on the plans attached thereto.

All joints shall be formed by inserting during construction and leaving in place, the required thickness of joint filler which shall extend through the entire thickness of the pavement.

CONCRETE.

Concrete shall consist of two parts cement, three parts of fine aggregate and six parts course aggregate, evenly and thoroughly mixed; parts of cement, fine aggregate and course aggregate to be determined by measurement.

MATERIALS AND MIXING CONCRETE

The method of measuring the materials for the concrete, including water, shall be one which will insure separate and uniform porportions of each of the materials at all times. A sack of Portland cement (94 lbs. net) shall be considered one cubic foot.

The materials shall be mixed to the desired consistency in a batch mixer of approved type, and mixing shall continue for 55 seconds and at least sixteen complete revolutions after all materials are in the drum. The drum shall be completely emptied before mixing successive batches.

Retempering of mortar or concrete which has partially

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hardened, that is, mixing with additional materials or water, shall not be permitted.

The Engineer shall compare the calculated amount of cement required according to these specifications and plans attached hereto with the amounts actually used in each section of concrete between successive transverse joints, as determined by actual count of the number of sacks of cement used in each section. If the amount of cement used in any three adjacent sections (between transverse joints) is less by two percent, or if the amount of cement used in any one section is less by five persent, than the amount hereinbefore required, the contractor agrees to remove all such sections and to rebuild the same according to these specifications at his own expense.

The materials shall be mixed with sufficient water to produce a concrete which when deposited will settle to a flattened mass, but shall not be so wet as to cause a separation of the mortar from the coarse aggregate in handling.

PLACING CONCRETE.

Immediately prior to placing the concrete, the subgrade shall be brought to an even surface. The surface of the subgrade shall be thoroughly wet when the concrete is placed, but no concrete shall be deposited in pools of

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water on the subgrade.

After mixing, the concrete shall be deposited rapidly in successive batches upon the subgrade prepared as hereinbefore specified. The concrete shall be deposited to the required depth and for the entire width of the pavement, in a continuous operation, between transverse joints without the use of intermediate forms or bulkheads.

In case of a breakdown, concrete shall be mixed by hand to complete the section or an intermediate transverse joint placed as hereinbefore specified at the point of stopping work. Any concrete in excess of that needed to complete a section at the stopping of work shall not be used in the work.

FINISHING

The surface of the concrete shall be struck off by means of a template or strikeboard which shall be moved with a combined longitudinal and crosswise motion. When the strikeboard is within three feet of a transverse joint it shall be lifted to joint and the pavement struck by moving the strikeboard away from the joint; any excess concrete shall be removed. Concrete adjoining the metal protection plates at transverse joints shall be dense in character and any holes left by removing any device used in installing the metal protection plates shall be immediately filled with grout.

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After being brought to the established grade with the template or strickeboard, the concrete shall be finished from a suitable bridge, no part of which shall come in contact with the concrete. The concrete shall be finished with a wood float in a manner to thoroughly compact it and produce a surface free from depressions or inequalities of any kind.

The edges of the pavement shall be rounded as shown of the cross sectional drawings attached hereto.

PROTECTION.

Excepting as hereinafter specified, the surface of the pavement shall be sprayed with water as soon as the concrete is sufficiently hardened to prevent pitting, and shall be kept wet until an earth covering is placed. As soon as it can be done without damaging the concrete, the surface of the pavement shall be covered with not less than two inches or earth or other material which will afford equally good protection, which cover shall be kept moist for ten days. When deemed necessary or advisable by the Engineer, freshly laid concrete shall be protected by a canvas covering until the earth covering can be placed.

Under the most favorable conditions for hardening in hot weather the pavement shall be closed to traffic for twenty-eight days, and in cool weather for an additional

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time, to be determined by the Engineer.

If at the time the pavement is laid, or during the period of curing, the temperature during the daytime drops below 50 degrees Fahrenheit, sprinkling and covering of the pavement shall be omitted at the direction of the Engineer.

The contractor shall erect and maintain suitable barriers to protect the concrete from traffic and any part of the pavement damaged from traffic or other causes, occuring prior to its official acceptance, shall be repaired or replaced by the Contractor at his expense, in a manner satisfactory to the board. Before the pavement is opened to traffic the covering shall be removed and disposed of as directed by the Engineer.

Concrete shall not be mixed or deposited when the temperature is below freezing.

If at any time during the progress of the work the temperature is, or in the opinion of the Engineer will within twenty-four hours drop to 35 degrees Fahrenheit, the water and aggregates shall be heated, and precautions taken to protect the work from freezing for at least ten days. In no case shall concrete be deposited upon a frozen subgrade.

SHOULDERS

After the pavement is laid, gravel of a quality that

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will pass the standard specifications of the State Highway Department, or crushed stone shoulders must be built three feet in width on each side thereof, and an additional amount of earth shoulder must be built to bring the total width of the road from berm to berm up to .....feet, as shown on plans. These shoulders must be built in layers not exceeding three inches in depth, and each layer must be well rolled before the next layer is placed.

When completed, the shoulders must be rolled as directed by the Board with a roller to be approved by the Board; but such rolling will not be permitted until the concrete has thoroughly hardened; and in any event not until at least four weeks have elapsed after laying the concrete opposite.

OBSTRUCTING TRAFFIC.

Travel upon the road, and upon intersecting roads and alleys, shall not be inconvenienced needlessly; nor shall any portion of the roadway be opened up, nor shall the same be wholly obstructed except as directed by the Engineer; in which case the Contractor shall cause plain and properly worded signs, "Road Closed, by Order of the Board of County Road Commissioners, " by day and lanterns by night, plainly indicating the nearest route around the obstructed portion, at the nearest cross road beyond each end of such obstructed portion, and upon intersecting roads,

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So that travel can pass around same in the shortest and easiest way.

LIABILITIES OF CONTRACTOR

The Contractor must provide a watchman at each end of the road continuously, day and night, and also red lights by night, to effectively keep travel off the pavement, until relieved therefrom by the Engineer in writing; and the former must assume, and will be held liable for, any and all damage which may arise from his neglect to do so, or from any omission on his part.

INSPECTION

The work shall at all times be subject to inspection by the Board and its agents; but such inspection shall not relieve the Contractor from any obligation to perform said work strictly in accordance with these specifications; and the work not so constructed shall be removed and made good by the Contractor whenever so ordered prior to final acceptance, without reference to any previous oversight in inspection.

DEFECTS BEFORE ACCEPTANCE

All depressions, defects and imperfections in any portion of the pavement, whether due to public travel, rain, snow, ice, frost, or other causes, before final acceptance of the work by the Board, shall be repaired and made good by the Contractor at his own expense. All rubbish

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which may accumulate during and by reason of the work herein provided shall be removed by the Contractor as fast as the pavement is laid, and the road left clean and in good condition.

PAYMENTS

The Engineer will, on or about the first day of each calendar month during the progress of the work, make and deliver to the Board an estimate, showing as nearly as he can approximate the same the number of lineal feet of roadway that have been completed; from which estimate the Board will compute the amount due the Contractor on a pro rata basis, and, after deducting 20% of the whole amount earned, and the sum of all previous payments, will draw its voucher in favor of the Contracotr for the balance of the amount found to be due.

When the work is completed and accepted, and final estimate is made the Board will draw its voucher in payment of the balance due the Contractor.

DRAINAGE, OVERHEAD, ETC.

Inasmuch as all material must be ordered by the Contractor, and unloaded and handled by him, he will be expected to order only so much thereof, respectively as is required for use on the work, and in such quantities as can be conveniently taken care of by him. Any demurrage or storage charges accruing on any material ordered or shipped, and any additional freight or switching charges accruing by reason of his failure to give proper shipping directions as above required, and

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charges for any overshipment made, must be assumed and adjusted by the Contractor; and the Board reserves the right to hold back a sum sufficient to cover same until they are properly adjusted. And if it shall appear to the Board after a reasonable time that the Contractor intends to disregard, or may be unable or unlikely to arrive at a speedy adjustment of any or all of such charges, the Board reserves the right to pay them, and deduct the amount so paid from any amount found due the Contractor.

PROPOSALS

All proposals must be made upon forms prepared by the Board, and must give all the information called for or indicated by such forms; and must be on the basis of the Contractor furnishing all materials, tools, machinery, appliances and labor, except as herein otherwise expressly provided, necessary for the efficient and proper carrying on of the work.

All proposals must be made on the basis of a given price per lineal foot, and must state separately, the price of tiling, open ditching, and all other work. The Board expressly reserves the right to accept the proposal for a greater or less distance than that given in the description of the road above, based upon the amount of money available for use on the road, probably cost of inspection, and other

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considerations.

All proposals must be sealed; addressed to Edward N. Hines, Chairman; endorsed, "Proposal to build..... .....Road;" and accompanied by a certified check on some solvent bank, payable to Wayne County, in the sum of.....Dollars; which check of the successful bidder is to be forfeited as liquidated damages and placed to the credit of the Wayne County Road Fund in case such bidder shall fail to execute a contract to construct the pavement in accordance with the specifications and his proposal, and furnish the bonds herein required, within five days after presentation of draft of same.

Proposals will be received up to 10 a.m., standard time, of.....191.. and not later, and then publicly opened. The right to accept any or reject all proposals is expressly reserved.

ENGINEER'S ESTIMATE.

A copy of the Engineer's estimate of the quantities of material required is attached hereto. The quantities given are the result of calculation, but are to be considered only as approximate. The Contractor is expected to satisfy himself as to the nature, character and quantity of the labor and materials required by a personal examination of the work contemplated.

ASSIGNMENT OF CONTRACT OR MONEYS.

The Contractor shall not assign nor transfer the con-

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tract, nor sublet any portion of the work embraced in it, nor give an order for the payment of any moneys due or to become due by virtue of the contract or of work done under it, without the consent of the Board in writing, being first obtained.

WORK AND FORFEITS.

If the Contractor shall fail to complete the work within the time specified in the contract, a sum sufficient to pay for inspection and other expenses of the Board, not, however, exceeding in all fifteen dollars per day for each and every day thereafter (Sundays and legal holidays included) shall be deducted from the amount due under the contract, as stipulated damages for failure to complete the work within the time specified therein; provided, however, that all days on which work is suspended by order of the Boary or the Engineer shall be deducted from overtime, if any there be.

BILLS FOR EXTRAS.

No bills for extras, for labor or material furnished, shall be considered or allowed under any circumstances after the final estimate has been allowed and the pavement duly accepted; nor will any bills for extras, labor or material furnished, be considered or allowed unless said work or materials furnished shall have been agreed upon in writing, stating price indetail or aggregate, signed by a majority of the Board and the Contractor, before such

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extra work is done or materialsfurnished; and upon completion of such extra work, the Contractor shall immediately file with the Board a statement or bill of items, in duplicate, showing the full amount of the claim for work or materials furnished under the agreement; otherwise he shall be deemed to have waived his claim.

BONDS OF CONTRACTOR

The Contractor will be required to execute and furnish, contemporaneously with the execution of the contract, a surety bond in the sum of.....Dollars, conditioned on the faithful performance of the contract, to indemnify and save harmless the Board from all suits and actions of any name description brought against them on account of any act or omission of the Contractor or his agents.

Any change in the plans, specifications, agreements or quantities, whether made with or without the consent of the surety company, shall in no way vitiate said bond; the right of the Board to make such changes as it sees fit being expressly reserved.

The Contractor must further agree that so much of the money as may be due him under and by virute of the contract and work performed thereunder as shall by the Board be deemed prudent, may be retained by them until all suits and claims for damages as aforesaid, shall have been settled, and satisfactory evidence to that effect furnished to the

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Board.

The Contractor shall also furnish bond in the penal sum of.....Dollars, provided for by sections 10743 and 10744 of the Compiled Laws of 1897, and amendments thereto.

The Contractor must also furnish surety bond in the sum of.....Dollars, conditioned upon the maintenance and proper repair of said road for a period of two years from and after the date of its completion.

Approved and adopted by the Board of County Road Commissioners for the County of Wayne, this.....day of.....

BOARD OF COUNTY ROAD COMMISSIONERS,

EDWARD N. HINES, Chairman

JOHN S. DOHERTY

WILLIAM F. BUTLER.

CONCLUSION.

In carrying on our work for the year we have received material assistance and the hearty co-operation of the Board of Supervisors, Board of County Auditors, the State Highway Department, The Prosecuting Attorney, and other County officials which we gratefully acknowledge.

We also feel that it is fitting to express a word of appreciation to our clerical and engineering staff and to our workmen from the waterboy up. They have served Wayne County loyally and enthusiastically and have taken a just pride in

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the results secured by their efforts.

We have done and are doing everything which, in our judgment and experience, will give Wayne County a well-built, well-maintained system of highways; all of which is submitted for your consideration.

Yours truly,

BOARD OF COUNTY ROAD COMMISSIONERS,

EDWARD N. HILLS, Chairman

JOHN S. HAGGERTY

WILLIAM F. BUTLER.

LIST OF PRINTS IN HOLDER.

Map of Wayne County.

2 Culvert drawings and data.

Defects in the concrete pavements.

Traffic Count.