FACTS

Everyone should know

ABOUT CONCRETE ROADS

"Concrete for Permanence"

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Facts Every One Should Know About Concrete Roads

CONCRETE roads are dependable every day in the year. They make driving easy and safe by daylight or dark, in winter or summer, in rain or sunshine. Being non-absorbent, the surface is cleaned by every rain, and dries quickly. There is no mud in wet weather, no dust in dry weather.

Concrete roads, when well reinforced, are good over swampy land. Concrete roads are not affected by periodical overflows.

The first cost of a concrete road is moderate, considering the fact that the materials used in its construction are of such lasting quality, that repair expense is lowest in comparison with other types of roads that approach it in permanence. The few slight repairs that may be necessary, are easily made by any careful laborer, with tar kettle and wagon.

Home products and labor are used largely in the construction of concrete roads. What they cost is spent in the community where the funds are raised.

Concrete roads have grown in public favor by leaps and bounds as their practical qualities have become more generally known. Prior to 1915 there were in the United States only 1,764 miles of concrete road, based on an average width of 16 feet. During 1915 alone 1,063 miles of such concrete roads were built, not to mention nearly 1,900 miles of concrete city streets and alleys.

Vermilion County, Illinois, started 1916 by letting contracts on March 17, for nearly 145 miles of concrete roads—the largest single contract ever awarded in point of concrete road mileage. Later, Georgetown Township, in the same county, voted to connect itself with the main highway system by building 5 miles of concrete road, making a total of practically 150 miles of concrete highway now to be constructed in Vermilion County.

Durability of Concrete Roads

STRENGTH

Weight of traffic is concentrated on very small areas of a road surface, therefore, a road must be strong enough at all points to support this weight, and to distribute the load to the subbase over a large area. Otherwise the weight of the load is concentrated and crushes the road.

Binder must be strong enough absolutely to prevent surface particles from becoming dislodged by the impact of horses' hoofs or the shearing action of automobile tires.

Portland cement holds the particles composing a concrete road firmly together to form a solid stone, so that the load is distributed over a large area.

Motor traffic and the impact of horses' hoofs do not dislodge the surface particles in a concrete road.

Concrete increases in strength with age; therefore, a concrete road grows stronger as it grows older.

PERMANENCE

Concrete roads are not affected by weather nor by material tracked upon them. Freezing and thawing have no effect on concrete after it has hardened. Heat does not soften the binder, permitting it to flow; cold does not make it brittle, causing it to chip. Water does not rot concrete but makes it stronger.

Properly constructed concrete roads rarely crack. Such cracks, when they occur, extend across the road because joints were not correctly placed. Longitudinal cracks occur where insufficient drainage, followed by freezing, causes heaving, and where the subbase is not properly prepared. Such cracks are unsightly, and if neglected, wear under traffic; but if kept filled with tar and sand, they are no detriment to the road. Wear at joints is prevented by protecting the edges with soft steel plates, or by a bituminous joint filler which is allowed to protrude about ¼ inch above the surface of the concrete and is "ironed" down by traffic.

The only relatively low first cost road material known to withstand combined horse-drawn and motor traffic under all conditions of weather is concrete.

Utility of Concrete Roads

EASE OF TRACTION

Hauling on a concrete road is easy because of the even surface. A horse can draw practically twice as much on a concrete road as he can on a macadam road; three times as much as on a gravel road; and five times as much as on a good clay road. Concrete roads are ready for use during all seasons of the year, in all kinds of weather.

SHAPE OF ROAD

Concrete roads need be crowned only slightly in the center to allow surface water to run off. The slight crown makes the entire width of

the road available for traffic. Roads of gravel and macadam require a high crown, thus increasing the danger of side slipping both of horses and automobiles. This danger is avoided on a concrete road because of its slight crown. High crown means personal discomfort and makes your wife nervous when you must turn out to pass another vehicle. Low crown means little strain on vehicle wheels, and easy driving.

Experiences in Driving on Concrete Roads

Horses are not injured from traveling on a concrete road, because there are no holes nor loose stones on the surface. A concrete road always presents an even surface, which prevents horses from wrenching their knees and shoulders.

Horses slip forward or backward, and sidewise. Veterinary surgeons say the side slip is by far the more harmful. The slight crown and the gritty surface of a concrete road prevent side slipping of horses and skidding of automobiles.

Minimum resistance to traction, firm foothold for horses, and non-slipperiness, are distinct advantages which a concrete road possesses in greater degree than any other type of road.

Concrete Pavements on Heavy Grades

The gritty surface of a concrete road, caused by the exposure of aggregates under wear, gives a secure footing. Concrete pavements have been built and are in successful use on heavy grades, as shown by the following examples:

Seattle, Washington	22 per cent
Kansas City, Missouri	18 per cent
Sioux City, Iowa	16 per cent
Hannibal, Missouri	15 per cent
West Union, West Virginia	15 per cent
Milwaukee, Wisconsin	15 per cent
Blue Earth, Minnesota	14 per cent
St. Joseph, Missouri	13 per cent
Rochester, Minnesota	12½ per cent
St. Paul, Minnesota	11 per cent
Lexington, Kentucky	11 per cent
Duluth, Minnesota	11 per cent
Lawrence Co., Indiana	11 per cent
Mason City, Iowa	9 per cent
Middletown, Connecticut	8 per cent
Petersburg, Illinois	8 per cent
Syracuse, New York	8 per cent

Average First Cost of Concrete Roads

Figures based on actual concrete road construction carried on under varying conditions and in many sections of the country, show that such roads, based on a 16-foot width, average in total cost $15,000 per mile complete.

Construction cost figures for 1915 compiled by the Portland Cement Association have been compared below with some figures for 1913, and show the average cost of concrete roads per square yard. These figures in some cases represent all cost incidental to construction, that is, they include cost of foundation, drainage and road shoulders; in other cases they represent the cost of placing concrete only.

Comparison of Average Cost Per Square Yard of Concrete Roads for 1913 and 1915

STATE	1913	1915	STATE	1913	1915
Connecticut	$1.32	$1.13	Missouri	$1.17	$1.09
Illinois	1.01	1.03	New Jersey	1.12	1.23
Indiana	1.23	0.98	New York	....	0.98
Iowa	1.11	1.19	Ohio	1.22	1.02
Kansas	1.08	1.28	Pennsylvania	1.16	1.01
Maryland	1.21	1.08	Texas	....	1.15
Massachusettes	1.29	0.95	West Virginia	1.32	1.03
Michigan	1.27	1.10	Wisconsin	1.06	1.02
Minnesota	1.05	1.11			

The per-mile cost of a concrete road will vary in proportion to length of haul, and availability of material and labor.

Average Maintenance Cost of Concrete Roads

Figures based on 1915 maintenance work on concrete roads, having an average width of 16 feet, show the cost of such maintenance to be less than ½ cent per square yard per year. This is less than $47 per mile per year.

Maintenance required on concrete roads is primarily dependent upon the quality and uniformity of the concrete used in their construction. Good construction means low maintenance. So great is the importance of proper construction that an increase in the life of the road and a great saving in maintenance cost will be secured if construction requirements are carefully and fully observed.

Reducing Maintenance Costs with Concrete

Michigan

With about 45 miles more of road to look after, part of it two years and part of it a year older, we have spent a smaller sum by $5,178.04 over our maintenance costs of 1913-1914. This has been brought about by the replacement of a number of miles of bituminous macadam with the more durable and less expensively maintained concrete. The wisdom of building of concrete, in our judgment, stands out conspicuously when maintenance cost involved in keeping other types of road under our jurisdiction in usable condition is compared with the actual cost of maintaining concrete.

From the Ninth Annual Report 1914-15 of the Board of County Road Commissioners, Wayne County, Michigan.

Wayne County now has over 130 miles of concrete roads.

Connecticut

The greater part of our roads are waterbound macadam. As long as we maintain waterbound macadam we shall have an annual expense of $1,000 or $1,200 a mile for repairs. If another 500 miles of waterbound macadam is built, the repair expense alone will be tremendous. Under present-day traffic, waterbound macadam is the most expensive road that can be built, if original cost and maintenance are both considered. A concrete pavement six inches thick laid on worn out macadam costs $10,500 a mile eighteen feet wide, not including grading or ditching. New waterbound macadam surface costs $7,400 a mile exclusive of grading and ditching. Maintenance of macadam is $1,000 to $1,200 a mile per year, while the cost of upkeep of the concrete road is not more than $50 a mile. At the end of five years the macadam, repairs included, has cost $12,400 a mile and you have nothing for it but a worn out road and growing cost of upkeep. The concrete road, on the other hand, has cost $10,750, upkeep included, and is still in good condition.

From the Annual Report (1914) of the State Highway Commissioner, Connecticut.

New York

There were under maintenance during the season 192 miles of graveled roads, upon which the average expenditure, including reconstruction to a different type, was $955 per mile, and the average expenditure, exclusive of reconstruction, was $577 per mile. Surface treatments have been given to gravel roads, but are not generally satisfactory.

There were under maintenance during the season 2,298 miles of so-called waterbound macadam highways, upon which the average expenditure, including resurfacing and reconstruction, was $1,055 per mile, and the average expenditure, exclusive of resurfacing and reconstruction, was $564 per mile. The maintenance is more expensive owing to the necessity of more frequent surface treatments and to the necessity of constant patching.

There were under maintenance during the past season 2,387 miles of bituminous macadam penetration method pavement, upon which the average expenditure, including resurfacing and reconstruction, was $510 per mile, and the average expenditure, exclusive of resurfacing and reconstruction, was $488 per mile.

There were under maintenance during the past season 84 miles of first class concrete pavement, and the average expenditures on highways of this class was $129 per mile. The expenditures were nearly all for labor and materials on the shoulders and gutters, a small expenditure only being required on the pavement.

From the Report of Fred Sarr, Second Deputy of New York State Highway Department, to Edwin Duffey, State Commissioners of Highways, January 1, 1916.

Wisconsin

Figures from the 1915 report of H. J. Kuelling, County Highway Commissioner of Milwaukee County, show an average repair and maintenance cost of $58 per mile per year. Out of this small sum approximately $23 per mile has been expended for the maintenance of road shoulders, etc., leaving the actual maintenance cost of the concrete only $35 per mile.

Ohio

The cost of maintaining concrete roads will vary inversely with the quality and uniformity of the concrete in the original construction. So great is the relation that the importance of a properly constructed road in the first instance cannot be overestimated. * * * The best available data seem to indicate, as a conservative estimate for roads that have been down from one to five years, a maintenance cost of less than ½ cent per square yard, (approximately $45 per mile) per year.

A. H. Hinkle, Deputy Highway Commissioner, Ohio State Highway Department.

Low Maintenance Cost of Knoxville, Illinois, Road

According to a statement made by P. C. McArdle, Assistant Chief State Highway Engineer, all concrete pavements on the Knoxville, Illinois, road, built prior to and including 1914 construction, have been maintained at a cost of 2 mills per square yard. This includes all charges.

Maintenance Cost of Concrete Roads in Maryland

Concerning the matter of maintenance, it may be said that no act of the highway department is of more importance than the adoption of concrete roads as a part of the system of State Highways. There are now about 180 miles of concrete roads. Thirty-two miles of new concrete road have recently been completed at a cost of $12,000 per mile The first of these roads was constructed in Cecil County, in 1912. The total outlay for maintenance on these roads to date (October 15, 1915) shows an average maintenance cost of about $100 per mile per year on the entire roadway, including shoulders, ditches, and embankments.

From a statement by H. G. Shirley, Chief Engineer, Maryland State Highway Department.

Maryland

The cost of maintaining macadam, gravel, sand-clay and bituminous roads is such that Chairman Weller and Chief Engineer Shirley, soon after their induction in office in 1912, made a careful study and investigation of a more substantial type of construction, especially of concrete, this including a personal examination of the concrete roads of Wayne County, Michigan. Several experimental sections of these roads, aggregating in length 3 miles, were laid in the summer and fall of that year on the Baltimore-Washington Boulevard, and in Charles and Cecil Counties. In 1913, 6 additional miles were constructed, 116 in 1914 and 65 in 1915, making a total to date of about 190 miles. These roads have been subjected to heavy traffic and the cost of maintaining them has been almost negligible. When the building of this type of road was started it was new to most of our contractors and bids on the concrete varied from $1.30 to $1.50 per square yard. However, with more experience in this class of work and better equipment facilities, contractors have become more familiar with the handling of concrete and the price has dropped from a maximum of say $1.50 in 1912 to a minimum of 90 cents in 1915. * * * The cost of maintaining these concrete roads has been so small that the Commission feels that the building of so many miles of them has been of great benefit to the State and will greatly reduce the burden of maintenance.

From the 1915 Report of the State Roads Commission to the General Assembly of Maryland.

On the next page will be found a table showing the Portland cement concrete pavements constructed in the United States during 1915.

Portland Cement Concrete Pavements Constructed in 1915

STATE	Square Yards STREETS	Square Yards ROADS	Square Yards ALLEYS	Square Yards TOTALS
Alabama	8,372	2,888		11,260
Arkansas	212,647		6,600	219,247
California	333,114	3,595,406		3,928,520
Colorado	23,450		40,000	63,450
Connecticut	121,020	96,783		217,803
Delaware		66,000		66,000
Dist. of Col.	36,755	1,990		38,765
Florida	14,070			14,070
Georgia	105,041			105,041
Idaho	5,067	4,280		9,347
Illinois	200,594	589,685	149,296	939,675
Indiana	249,389	427,077	2,599	724,066
Iowa	749,459	20,648	61,572	831,679
Kansas	192,238	18,942	23,321	234,501
Kentucky	1,300	21,186	478	22,964
Louisiana		3,100		3,100
Maine	4,480	74,172		78,652
Maryland	102,403	495,298	36,600	634,301
Massachusetts	75,470	138,660	261	214,391
Michigan	159,482	607,209	128,568	895,259
Minnesota	198,709	73,944	15,912	288,565
Mississippi	21,128	70,200		91,328
Missouri	437,133	622	15,037	452,792
Montana	9,390			9,390
Nebraska	125,882	18.777	939	145,598
Nevada	16,480			16,480
New Jersey	80,904	50,726	615	132,245
New Mexico	9,432			9,432
New York	209,192	1,156,553	5,074	1,370,819
North Carolina	32,684	14,092		46,776
North Dakota	29,173			29,173
Ohio	259,175	1,310,243	42,830	1,612,248
Oklahoma	51,250			51,250
Oregon	35,091	115,762		150,853
Pennsylvania	37,727	65,149	10,577	113,453
South Dakota	57,486		4,623	62,109
Tennessee	72,062	26.000		98,062
Texas	375,459	138,509	1,973	515,941
Utah	76,041	39,424	1,875	117,340
Virginia	29,289		983	30,272
Washington	174,098	221,493	4,087	399,678
West Virginia	34,412	140,746	7,009	182,167
Wisconsin	831,004	372,672	17,692	1,224,368
Wyoming	1,917			1,917
TOTALS	5,844,589	9,978,236	578,521	16,401,346