

served its purpose well as a cheap temporary pavement in a new and rapidly growing city. The character of the soil is, generally speaking, sand.

The required foundation for pavement is concrete, five inches thick; one part Portland cement, three parts sand, six to seven unscreened crushed limestone. The inspection work is in charge of general and sub-foremen. The material used, such as creosote oil, asphalt and cement, is tested by the city's chemist, who also sees that the required quantities of each are used. Contractors are held closely to specifications; for instance, creosoted blocks are required to be treated with fifteen pounds of the quality of oil specified, per cubic foot of wood; the city's chemist analyses the oil and sees that the quantity is used, measuring it from the storage tanks.

Work is paid for out of a permanent improvement and a permanent improvement revolving fund. The latter is a fund created for the purpose of advancing the amount assessable, which is paid back in five annual instalments with five per cent interest on deferred payment.

All assessable property is assessed for the cost of paving that part of the street on which the property abuts. The cost of paving all street intersections and parts along property exempt from special assessments is paid out of the permanent improvement fund, which is raised by general taxation, or bonds. Collections are made through the county treasurer's office, the same as regular taxes and then paid into the city treasury.

Wood block treated with creosoted oil is unquestionably the most satisfactory; it has the wearing qualities, it is noiseless and sanitary. In 1906 64,500 yards of this pavement were laid in Minneapolis at an average cost of \$2.70 per yard. In 1906, 111,500 yards of asphalt were resurfaced at \$1.50 per yard (contractors financing the scheme and receiving their pay, as far as assessable property is concerned, in five annual instalments with a ten-year guarantee surety company bond); 12,150 yards of brick on the same character of concrete as heretofore specified, were laid at an average cost of \$2.17 per yard; 3,000 yards of sandstone were laid on concrete, at \$2.74 per yard, and on sand, 12,000 yards at \$2.05 per yard; 20,000 yards macadam (about one and one-half gallons of asphaltic surface binder per yard, were laid at \$1.25 per yard. No cedar blocks were laid last year. The granite paving of last year was laid with old blocks removed from streets repaved with creosote blocks.

The United States Forestry Bureau, in conjunction with the city and interested paving contractors, laid on Nicollet Avenue, an experimental creosoted wood block pavement, consisting of various kinds of wood.

INDIANAPOLIS

By JACOB P. DUNN, Editorial Staff of *The Star*, Indianapolis, Ind.

Prior to 1888 the only street paving in Indianapolis was done with boulders, excepting a stretch of eight blocks on Delaware Street on which a trial was made of wooden blocks on a sand foundation; this soon became unsatisfactory and probably delayed a more general acceptance of modern paving. In 1888 about 20,000 square yards of tar macadam were laid, and in 1889 some

13,500 square yards more of this same material. It was known as "Filbert Vulcanite Asphaltic Pavement," and the standard was that laid on K Street, between Ninth and Nineteenth Streets, N. W., Washington, D. C. It was not very satisfactory, having such a tendency to soften in summer that it became popularly known as the "Yucatan" pavement. Nevertheless it was endured for ten years—part of it for twelve—and then resurfaced with asphalt. In 1890, 37,640 square yards were paved with Trinidad asphalt. In 1891 the new city charter was adopted, largely with a view to promoting public improvements, and since then street paving has progressed systematically. The results may be summarized as follows, up to January 1, 1907, the figures being for miles of streets and alleys in length, without regard to width:

Material	Mileage	Now under guaranty— Miles.	Cost.
Asphalt	47.86	17.5	\$2,817,086.35
Asphalt resurfacing	3.93	233,161.43
Vulcanite15
Brick	41.95	21.6	1,429,838.94
Creosoted pine blocks	14.84	15.9	1,134,143.59
Round cedar blocks54		
Creosoted cedar blocks	3.06		
Plain cedar blocks	1.86		
Macadam	8.03	4.34	268,594.17
Bitulithic	1.55	1.55	54,890.48
Total	123.77	60.89	\$5,937,714.96

The cost per square yard varied considerably. In 1903 the city engineer estimated it at \$2.10 for asphalt, \$1.70 for brick, \$2.80 for creosoted block, and \$1.30 for macadam. In 1906 creosoted block was about \$3.10, owing to the increased price of lumber. These figures do not include grading, but for asphalt, brick and block include a six-inch Portland cement concrete base. Up to 1896 all pavements were laid under a five-year guarantee. Since then the guarantee has been nine years, *i. e.*, the contractor keeps them in good repair for that period.

All contracts are made by the board of public works on sealed proposals, after due notice to property owners and advertisement. Specifications of advertisements must be strictly complied with and the bidder must deposit with his bid a certified check for two and one-half per cent of the estimated cost of the work, which is returned if the bid is not accepted, and held as security for contract if accepted. For repair guarantee the contractor deposits twenty cents per square yard during the continuance of the guaranty. The board reserves the privilege to reject any and all bids. Inspection is made by the city engineer's deputies, and is supposed to be strict. The time for completion varies with the contracts.

The cost of paving is paid by abutting property owners, including street intersections, except that the street railway company pays for paving between its tracks, and eighteen inches on each side. Assessments are made on front-

age, and are a first lien on the property. Under what is known as "the Barrett law" a property owner may take ten years to pay his assessment, in equal instalments, with six per cent interest on deferred payments. On taking the benefit of this law all legal objections are waived, and special improvement bonds are issued for the total amount of Barrett law claims on each improvement. These belong to the contractor, and are usually at a small premium, as they can be utilized for guaranty deposits and are treated as non-taxable.

For business streets brick has given the greatest satisfaction. Clay bricks are usually too soft, and shale brick too brittle, but the mixed clay and shale brick made at several points in Indiana is conceded to be very satisfactory. For residence streets preferences differ, though wooden block (creosoted) was generally favored until the price became so high. Asphalt and bitulithic also have warm advocates, especially among those who desire quiet. A comparatively small number prefer brick for residence streets, notwithstanding the noise. Macadam is used only on streets partaking of the nature of boulevards.

The total area of the city is 30.77 square miles, and the total length of streets and alleys 470.50 miles. The larger part of the streets and alleys are graded and graveled. The gravel streets are sprinkled in summer, and when kept in reasonable repair are very serviceable, the gravel of this vicinity being of excellent quality. The system of contracting for paving is fairly satisfactory, having been amended from time to time as cause appeared, and there is now no particular call for change in it.

HARTFORD

By FREDERICK LUTHER FORD, City Engineer, Hartford, Conn.

All contracts for city work exceeding in amount \$500 are required to be publicly advertised, and the contract awarded to the lowest responsible bidder, who must furnish a satisfactory bond for the faithful performance of his contract. Each advertisement is published in one morning and one evening local daily paper. Upon such publication, a short notice not more than one and one-half inches in length, single column, stating the general nature of the full notice, and referring to it by name and date of the newspapers in which the original advertisement appeared, is published in one other daily morning paper, and one other daily evening paper.

The city is represented by the board of contract and supply which has authority to advertise for and receive bids, and to award contracts for all work to cost over \$500, provided that the work is ordered by vote of the court of common council and if for improvements for which no assessment can be levied, provided any expenditure of over \$10,000 is voted by the electors at a city meeting.

Sealed proposals for the work, on forms furnished by the city engineer, are received by the board of contract and supply up to a certain date specified in the advertisement and usually about one week in advance of publica-