

MODERN BITUMINOUS SURFACES AND BITUMINOUS PAVEMENTS.*

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ALTHOUGH bituminous pavements have been in use in American municipalities for nearly fifty years, the introduction of modern bituminous surfaces and bituminous pavements in the construction of highways outside of built-up districts is of comparatively recent origin in America, dating from about 1906. This point is well illustrated by the fact that in 1908 the total yardage of bituminous surfaces and bituminous pavements constructed under the jurisdiction of the eight leading state highway departments in the eastern part of the United States was only 416,700. Since that period the growth of the use of bituminous materials in the construction and maintenance of roads and pavements has been exceedingly rapid.

In order to avoid misunderstandings, the various methods of using bituminous materials referred to in this paper will be explained by the following definitions:—

Bituminous surfaces are those consisting of superficial coats of bituminous materials with or without the addition of stone or slag chips, gravel, sand or materials of a similar character.

Bituminous macadam pavements are those consisting of broken stone and bituminous materials incorporated together by penetration methods.

Bituminous gravel pavements are those consisting of gravel and bituminous materials incorporated together by penetration methods.

Bituminous concrete pavements are those having a wearing surface composed of stone, gravel, sand, etc., or combinations thereof, and bituminous materials incorporated together by mixing methods.

The definitions of bituminous surfaces and bituminous concrete pavements quoted above have been advocated for adoption in the reports of the special committee on "Bituminous Materials for Road Construction and Standards for Their Test and Use" of the American Society of Civil Engineers, whereas the fundamentals of the above definition of bituminous macadam pavements are embodied in the following quotation from the 1913 report of the association for standardizing paving specifications: "If the stone is spread in place and the bituminous cement or binder applied afterwards, the resulting product is bituminous macadam." As sheet asphalt pavements have been in use for many years and as the essentials of good construction have been well established, this type of bituminous pavement will not be dealt with in this paper.

Bituminous Surfaces—Since the formulation of the fundamental principles of the successful construction of tar surfaces by the engineers of the Department of Roads and Bridges of France in 1903, bituminous surfaces have been used extensively in Europe. As an illustration, might be cited the construction of five million square yards of tar surfaces in one county of England, in 1911, under the supervision of the county surveyor of Kent, H. P. Maybury, M.Inst.C.E. During the past eight years American engineers have used bituminous materials in this method of construction and maintenance of roads and pavements.

In the case of broken stone and gravel roads, the most efficient method of procedure is to thoroughly clean

the surface by sweeping with hand brooms or horse sweepers and hand brooms, the final sweeping being done with bass or other fine fibre brooms. The bituminous material, which is generally heated, is applied to the surface in amounts varying from one-quarter to one-half gallon per square yard with the aid of pouring cans, hose attached to tanks, hand-drawn gravity distributors, horse-drawn or motor truck gravity or pressure distributors. Some kind of mineral coating is generally applied to cover the bituminous material. The degree of cleanliness of the surface obtained by sweeping will depend to a large extent upon the details of the original construction. It has been found that a road with a thoroughly rolled and well puddled broken stone wearing surface composed of road metal from one inch to two and one-half inches in longest dimension may be easily cleaned and the essential adhesion of the bituminous surface readily secured. This method is characteristic of the modern practice of many of the foremost English and French engineers.

Considerable development has taken place in the use of different kinds of bituminous materials. Tars, both of the water-gas and coal-gas types, continue to be used to a large extent. Without doubt the most comprehensive specifications for the construction of bituminous surfaces with tar are those adopted by the Road Board of England. There has been noted a growing objection to the use of certain asphaltic oils which require from two to three weeks to "set up" to such an extent that tracking will not occur.

Bituminous Macadam and Bituminous Gravel Pavements.—Bituminous macadam and bituminous gravel pavements are of many types, one of the primary differences in construction being the use of one or two applications of the bituminous material. The efficacy of many of the types depends upon the combinations of sizes of broken stone or gravel and the combinations of bituminous materials used when two applications are employed. Variations in types also exist dependent upon the manner in which the different courses may be filled and the treatment of the filled course prior to the application of the bituminous material. The one-application method is very similar in its simplest form to the construction of a bituminous surface except that the bituminous material is applied upon a much more open surface. In the case of the two-application method in certain instances an attempt is made to build up a two-course pavement, while in others the second application is in reality used as a seal coat.

Two of the main difficulties in the construction of bituminous macadam pavements have been to secure a thoroughly compacted wearing course of non-segregated broken stone and the uniform application of the bituminous cement so that the broken stones of the wearing surface would be uniformly bound together. In connection with the above statement should be noted the following excerpt from the 1914 report of the special committee of the American Society of Civil Engineers:—

"An important factor for successful results (in the construction of bituminous pavements by the penetration method) is the thorough compaction by rolling of the road metal before the spreading of the bituminous material."

Two methods which have given satisfactory results will be cited as examples of modern practice.

When the metalling in the wearing course consists of a naturally graded aggregate ranging in sizes from one-half inch to an inch and one-quarter, it has been found unnecessary to further fill the voids by the application of a finer product before the first application of the bitu-

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