

The shoulders and berms should always be compact and conform to the crown and grade of the road so as to take the surface water off the highway as quickly as possible. They should be compact enough to serve as a curb to the edge of the pavement. A great deal of trouble has been experienced in what is known as ravelling on the sides of the highway. This can be eliminated by putting down a heavy base on both sides of the road and rolling into the berm coarse aggregate of stone.

Not every superintendent can qualify himself as a road superintendent by being just a democrat or republican. In order to improve himself for this position he should school himself to the requirements of his work, because I honestly believe that sooner or later road superintendents will be licensed and called upon to pass a regular examination. In maintaining county roads, a superintendent has in his power perhaps the greatest investment in his county. I don't believe you can show me where any one single institution in your county has the capitalization that the combined capitalization of the county roads would be. Therefore, why shouldn't the county demand even greater qualifications from its manager, i. e. the superintendent, than the private institution would demand of its general manager or general superintendent?

CONSTRUCTION OF BITUMINOUS MACADAM ROADS AND STREETS.

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There are five distinct steps in the construction of the bituminous macadam surface, which substantially are as follows:

1st. A layer of coarse aggregate is spread upon the foundation. This coarse aggregate may consist of broken stone, mine tailings or slag, but preferably broken stone should be used. The stone must be clean and free from dust or an excess of flat or elongated pieces. It should have a percent of wear of not less than six (6). When tested by means of laboratory screens, it should be uniformly graded between the following limits: passing two and one-half ($2\frac{1}{2}$) inch screen 95 to 100%, passing one and one-quarter ($1\frac{1}{4}$) inch screen 0 to 15%. This layer of crushed stone should have a thickness of $2\frac{1}{2}$ inches after rolling.

2nd. After the coarse aggregate has been spread to the required thickness, it should be dry rolled with a three wheeled roller weighing not less than 10 tons. The rolling should start longitudinally at the sides and proceed towards the center of the pavement, overlapping on successive trips by at least one-half

the width of the roller. The rolling should be continued until the compacted coarse aggregate possesses a firm surface true to the specified grades and cross-sections and presents a texture which will allow uniform penetration of the bituminous material. If any irregularities appear during or after the rolling, they must be remedied by loosening the surface and removing or adding coarse aggregate, after which the area disturbed including surrounding surface must be rolled until satisfactorily compacted to a uniform surface. Care should be taken to prevent the earth berms from being mixed into this stone along the edge of the pavement and should earth or dirt get into this course before the bituminous material has been applied, the dirty stone should immediately be removed and replaced as described before. As much mechanical bond should be given this course as is possible by rolling without grading up the stone.

3rd. The first application of bituminous material should then be made by means of a motor pressure distributor. This application may be made with hand pouring pots but more satisfactory results can be obtained by a pressure distributor. The air temperature in the shade should not be less than 50 deg. F. The stone should be absolutely dry for its entire depth. The nozzels on the spraying apparatus should be perfectly clean. The bituminous material, if a tar product, should be heated to approximately 250 deg. F.; if an asphalt, to approximately 350 deg. F. The heated bituminous material should then be evenly applied at the rate of one and one-half ($1\frac{1}{2}$) to one and three-quarter ($1\frac{3}{4}$) gallons per square yard and at a uniform pressure of about 60 pounds per square inch. The contractor should provide all necessary facilities for determining the temperature of the bituminous material, both during the heating period and the period of application. A stationary thermometer and a pressure gauge should be located so as to be easily observed by the inspector while walking beside the distributor.

The pressure distributor should be so designed that the bituminous material will be applied uniformly to a normal width of not less than 6 feet, with provision for applying lesser widths when necessary. To prevent lapping at the end junction of two applications, the distributor should be carefully watched and shut off the moment the application begins to thin just before the tank becomes empty. Then before starting to apply a new load, a heavy tar paper should be spread over the newly treated portion of the road for a short distance back from the point where it is intended to start applying the new load so that the distributor will be going at full speed when it arrives at this point.

As soon as the bituminous material has been applied, the inspector should carefully inspect every foot of the surface to locate portions that have been missed, "fat spots," or points of

improper penetration. The missed portions should be carefully covered with a pouring can. If fat spots or points of improper penetration appear, they should be picked loose, new stone applied, rerolled and treated again.

4th. The next step is the filling of the surface voids with intermediate aggregate. This should be applied and rolled in while the bituminous material is still warm. The intermediate aggregate or key stone should possess the same qualities as specified heretofore for the coarse aggregate and when tested by means of laboratory screens, it should be uniformly graded between the following limits: passing one and one-quarter ($1\frac{1}{4}$) inch screen, 95 to 100%; passing one (1) inch screen, 25 to 75%; passing a three-quarter ($\frac{3}{4}$) inch screen, 0 to 15%. This aggregate should be perfectly dry when applied and should be evenly broadcast over the treated surface in such quantities as to fill the surface voids and just cover the treated surface enough to permit rolling without "picking up." The surface should be thoroughly rolled and compacted. After the rolling is finished all loose, surplus material, which remains on the surface should be broomed off and the final or seal coat applied.

5th. The fifth step is the application of the seal coat, which is put on for the purpose of completely sealing the surface of the road. This second application of bituminous material is applied under the same conditions and in the same manner as the first application, except that the rate of application should be one-half ($\frac{1}{2}$) gallon to each square yard of surface. While the bituminous material is still hot, dry fine aggregate should be broadcast over the surface and rolled until it is thoroughly bonded to the road. Extra care should be taken in applying the fine aggregate to prevent it from bunching under the roller. Only enough to take up all excess bituminous material should be applied.

The fine aggregate for this course should meet the same requirements as set out heretofore for the other aggregate and when tested by means of laboratory screens should be uniformly graded between these limits: passing a three-quarter ($\frac{3}{4}$) inch screen, 95 to 100%; passing a one-half ($\frac{1}{2}$) inch screen, 25 to 75%; passing a one-quarter ($\frac{1}{4}$) inch screen, 0 to 15%.

The rolling of this course should be complete and thorough in every respect. Final rolling should be, if necessary, continued from day to day, the rolling being done during the period of the day when the temperature is highest, until the finished surface is uniform, free from ruts or irregularities in contour, and true to the established crown and grade.