

crown can be secured without detriment to the surface drainage.

The above report will hereinafter be designated as the "Am. Soc. C.E. 1912 Report."

Sizes and Shapes of Broken Stone for Bituminous Bound Surface Crust.—Bituminous surfaces have proved more efficacious when constructed on macadam roads composed of well compacted and thoroughly bonded broken stone ranging from $\frac{3}{4}$ in. to 2 ins. in the wearing surface than when the stone is of smaller dimensions. This size of stone is usually obtained by passing over a screen having $1\frac{1}{4}$ -in. holes and through a screen having $2\frac{1}{4}$ -in. holes.

Bituminous concrete pavements. Type A.: The best results have been secured by using a mineral aggregate composed of broken stone varying in size from stone passing a $1\frac{1}{4}$ -in. laboratory screen to a small amount passing a $\frac{1}{4}$ -in. screen. This product is usually obtained from the ordinary type of crushing plant from stone passing over a $\frac{1}{2}$ or $\frac{3}{8}$ -in. screen and through a section of a screen having holes $1\frac{1}{4}$ -in. in diameter. A typical analysis of such a product follows:

Per cent. passing $\frac{1}{4}$ -in. screen	5.4
Per cent. passing $\frac{1}{2}$ -in. screen	34.7
Per cent. passing $\frac{3}{4}$ -in. screen	40.6
Per cent. passing 1 -in. screen	17.3
Per cent. passing $1\frac{1}{4}$ -in. screen	2.0

The following excerpt from the "Am. Soc. C.E. 1912 Report" bears especially upon the construction of Type A.:

Your Committee recommends that trap rock in sizes greater than that passing a 2-in. screen should be used with caution in the construction of the upper course, unless the voids of the same are properly reduced, because of the liability of the individual stones to rock under traffic.

Type B.: The mineral aggregate has been composed of a combination of one size crusher run broken stone and one or more grades of sand or stone screenings. The mechanical analysis of a typical combination covered by the description, two parts trap rock passing a $1\frac{1}{4}$ -in. ring with a maximum of 5 per cent. dust and one part sand, follows:

Per cent. passing 200-mesh screen	3.3
Per cent. passing 80-mesh screen	6.9
Per cent. passing 10-mesh screen	29.7
Per cent. passing $\frac{1}{4}$ -in. screen	25.1
Per cent. passing $\frac{1}{2}$ -in. screen	24.3
Per cent. passing $\frac{3}{4}$ -in. screen	10.7

Type C.: One class of mineral aggregate which has been used to a considerable extent during 1911 and 1912 is known as the "Topeka" grading and is usually composed of broken stone and sand with or without a filler of fine material. The grading for this mixture is covered by the following limitations in the mechanical analysis:

Per cent. passing 200-mesh screen.....	from 5 to 11
Per cent. passing 40-mesh screen.....	from 18 to 30
Per cent. passing 10-mesh screen.....	from 25 to 55
Per cent. passing 4-mesh screen.....	from 8 to 22
Per cent. passing 2-mesh screen....	less than 10

Many bituminous pavements of Type C with proprietary names are laid in the United States. Among these may be mentioned "Bitulithic" and "Warrenite."

Use of Partially Worn Materials in Bituminous Bound Surface Crust.—The universal practice has been to

condemn the use of materials, which have been previously employed, for the mineral aggregate in the construction of bituminous concrete pavements.

Thickness and Composition of the Strength Crust and of the Super or Wearing Crust Under Different Conditions.—Bituminous surfaces: A thin coat of the proper kind of bituminous material has given better satisfaction than the formation of a comparatively thick carpet, especially when the surface is subjected to excessive horse-drawn vehicle traffic.

Bituminous Concrete Pavements: Type A is usually laid upon a foundation course of broken stone having a thickness varying from 4 to 8 ins. Type B is laid on a broken stone foundation course as indicated for Type A or a cement concrete foundation, 5 to 6 ins. in thickness. Type C is laid on a broken stone or a cement concrete foundation as mentioned for Type B. It is being recognized as a fundamental principle that where Type C is used under conditions which render it economical and suitable, only the cement concrete foundation should be employed. The necessity for constructing strong foundation courses due especially to the rapid development of motor truck traffic is apparent. For Types A and B the thickness of the wearing surface has varied from $1\frac{1}{2}$ ins. to 3 ins., the average being 2 ins. For Type C, when a fine mineral aggregate is employed, $1\frac{1}{2}$ to 2 ins. has been used, the best practice favoring 2 ins. Pavements with mineral aggregates having larger broken stone are generally laid 2 ins. in thickness, although 3 ins. has been used in some cases.

Life of Surface Crust Under Different Conditions of Traffic, Weather, Subsoil, etc.—Bituminous surfaces: The life depends primarily upon the character of the material and the amount and kind of traffic. Bituminous surfaces on macadam roads have a life of from one to three years and on bituminous concrete pavements from one to five years.

Bituminous Concrete Pavements: As with all types of bituminous pavements, the life of the wearing surface depends, to a large extent, upon the character of maintenance. Granted proper construction, including adequate foundations and drainage, and continual maintenance, which includes the use of seal coats applied periodically, the life of bituminous concrete pavements, based upon such information as is at hand, may be estimated at from 20 to 35 years. This estimate is based upon the supposition that the various types of bituminous concrete pavements are used under conditions for which each is suitable. More definite information is at hand covering the life of pavements which have not been maintained. The following estimates cover average life without maintenance: Type A, 4 to 10 years; Types B and C, 7 to 15 years.

Relative Importance of Patching, Repairs and Periodical Renewals of Surface Crust. Extent of Wear Permissible Before Renewal of Surface Coating.—All types of bituminous surfaces and pavements are liable to develop weak spots. Patching in these cases is found to be economical and practical as it is comparatively simple to replace a portion of a bituminous concrete pavement or a macadam road. Likewise periodical renewals of bituminous surfaces are efficacious. This method of repairing will be economical until such time as the pavement begins to generally wear out or disintegrate.

Measurement of Wear and Appliances Used for This Purpose.—Work of this character on bituminous concrete pavements has been limited to that of a few investigators,