and more particularly its condition in the spring of the year, should be investigated. A sufficient number of test holes should be put down to determine the character and depth of the stone and provision made for proper under and side drainage. It will usually be necessary to rebuild the road in a number of places and in most instances the crown must be reduced.

Old pavements of brick, granite, etc., should not be used as a base if it is first necessary to re-set them. In their original condition they are satisfactory if the traffic is not too heavy. Relaid blocks, until bedded by traffic, are not rigid, and have a tendency to rock, and asphalt pavements laid on such foundations in New York City have rapidly disintegrated wherever they were exposed to heavy traffic.

Portland cement concrete foundations vary according to conditions from 4 to 9 inches in depth, and in every case, before laying them, the subsoil should be thoroughly compacted and drained. In certain localities in the northwestern portion of the United States and Canada very heavy clay soils are found, which in winter frequently develop cracks 4 to 5 inches in width and heave very badly. In such cases cross trenches should be dug every twenty-five or thirty feet, and filled with coarse broken stone and connected with longitudinal trenches at the side of the street, similarly filled and draining to catch basins. Concrete should not be laid directly on such a soil. Sand or gravel should first be spread upon it to such a depth that when rolled it will form a layer 3 to 4 inches in thickness and the concrete should be placed on this.

Mineral Aggregates

Having briefly considered the questions of foundation and subgrade, we now pass to the wearing surface. This is composed of mineral aggregate and bituminous binder. The mineral aggregate constitutes from 80 to 90% of the pavement, and takes practically all the wear resulting from traffic. It must therefore be selected with great care. It must be hard enough to carry the traffic; it must have clean grains or particles to insure the bitumen adhering to them, and these grains or particles must be graded from coarse to fine so as to make a pavement of the maximum density, with the smallest sized voids obtainable and with sufficient inherent stability to resist displacement under the shoving action of traffic. The surfaces of the grains or particles must be of such a character that the bituminous cement will adhere satisfactorily to them. Earth, sand, gravel, broken stone or slag, and finely ground limestone or Portland cement or combinations of them, are the materials used in the type of pavements under discussion.

Earth. This is used in a special type of pavement which has been developed within the past five years. It should be of such fineness that at least 50% of it will pass a 200-mesh sieve and it should contain from 15 to 70% of clay, depending upon its character. This material requires a special kind of plant to handle it.

Sand should be clean grained, hard and moderately sharp. The grains should be chiefly quartz and should have rough pitted surfaces. Where necessary, the proper grading of the different sized grains must be obtained by mixing several sands or in certain cases by the addition of unweathered crushed screenings. When using the ordinary type of bituminous mixing plants the presence of clay is undesirable, either as a coating to the grains or disseminated throughout the mass. For medium or heavy traffic pavements all particles retained on a 10-mesh screen should be discarded. For light traffic, 3 to 5% of 8-mesh particles can be incorporated in the pavement with advantage or broken stone of the sizes and in the amounts described under "Topeka Mixtures." Sands containing a large amount of flinty grains should be avoided as bitumen does not adhere well to flint.

Gravel should be clean grained, hard and free from adhering clayey particles. It is lacking in stability owing to its roundness and is usually considerably improved by passing it through a crusher. Gravel with a rough pitted surface is to be preferred and gravel containing a large percentage of flinty particles is to be avoided. It is unsuitable for the construction of pavements carrying heavy traffic and inferior in all respects to crushed stone.

Broken Stone should be freshly crushed, preferably in cubical shaped particles. The size and hardness required depend upon the traffic which the pavement is to carry. Dense hard limestone will carry medium and light traffic satisfactorily. Where the traffic, even though comparatively light in volume, is composed of heavy iron-tired units, a dense hard trap is required. Trap is now commonly used in the manufacture of asphalt block, although in the past a large number of asphalt blocks made from limestone gave excellent service under light traffic. Granite is not usually satisfactory as it is too coarse and uneven in texture and much of it is friable and it is liable to shatter in crushing. Mesh composition or grading of the various sized particles is just as important as with sand. It is not suitable for use in pavements carrying very heavy traffic.

Slag: Hard, dense basic slag is to be preferred. It should be stable when exposed to the weather and not show any tendency to slack or disintegrate. It is only suitable for light traffic and should preferably be coated with a very fluid bitumen.

Filler:—This should be finely ground limestone or Portland cement, the latter being preferable for mixtures designed to carry extremely heavy traffic. For light traffic the writer prefers the limestone dust as it does not have such a marked drying effect. Whichever is used, it should be ground so that at least 65% of it will pass a 200-mesh sieve. Pulverized clay also makes an excellent filler but is difficult to handle owing to its tendency to ball and cake if it becomes the least bit damp.

Bituminous Binder, or asphalt cement as it is termed in the sheet asphalt industry, must possess such properties that it will firmly bind together the mineral particles and resist the disintegrating action of traffic and the elements. The necessary tests for determining whether or not it is possessed of these properties are fairly well standardized and are embodied in most standard specifications. The consistency of the bituminous binder varies somewhat with the type of mineral aggregate, but otherwise its general characteristics are about the same for all types of the pavements under discussion.

Types of Hot Mix Pavement

Out of the raw materials which we have discussed, four distinct types of hot mix pavement are laid. They are as follows:—

Sheet Asphalt, in which the mineral aggregate contains no particles which would be retained on a ¼-inch screen.

Topeka Pavements, which usually consist of a standard sheet asphalt mixture to which has been added from 15 to 25% of stone passing a ¼-inch screen and retained on a 10-mesh screen and approximately 10% of stone passing a ½-inch screen and retained on a ¼-inch screen.

Bituminous Concrete Pavements—(Bitulithic, Warrenite, etc.)—having a mineral aggregate consisting largely or wholly of stone of varying sizes from 1½ inches down.

Pulverized Earth Pavements—(National Pavement)—having a mineral aggregate composed wholly of pulverized clayey earth of such fineness that at least 50% of it will pass a 200-mesh sieve.

The following are typical analyses of the foregoing types of pavements:—

	Sheet Asphalt, Light Traffic. Per Cent.	Sheet Asphalt, Heavy Traffic. Per Cent.	Topeka Mixture. Per Cent.	Bituminous Concrete. Per Cent.	Pulverized Earth Pavement. Per Cent.
Bitumen	11.0	10.5	8.5	7.0	17.5
Passing 200 mesh ...	14.0	10.5	8.5	5.0	55.5
" 100 " ...	14.0	10.0	6.0	4.0	12.0
" 80 " ...	13.0	10.0	6.0	2.0	6.0
" 50 " ...	19.0	14.0	6.0	5.0	5.0
" 40 " ...	11.0	14.0	10.0	4.0	3.0
" 30 " ...	10.0	13.0	10.0	4.0	1.0
" 20 " ...	5.0	10.0	9.0	3.0	...
" 10 " ...	3.0	8.0	6.0	5.0	...
" 8 " ...	...	...	6.0	3.0	...
" 4 " ...	...	...	14.0	7.0	...
" 2 " ...	...	...	10.0	20.0	...
" ¾" " ...	...	...	...	14.0	...
" 1" " ...	...	...	...	12.0	...
" 1½" " ...	...	...	...	5.0	...
	100.0	100.0	100.0	100.0	100.0