joints and to use an asphalt which is properly adapted to the climatic conditions which prevail

Cobbling or rounding of the edges of the individual brick is shown to be almost entirely due to tire chains or steel-tired traffic The amount of cobbling under chain-tired traffic was found to be directly affected by the distance between bricks, wide joints causing marked increase in the rounding of the edges It would seem, therefore, that the proper spacing between bricks would be the minimum which will allow the proper penetration of the bituminous filler

SOME PRINCIPLES INVOLVED IN BITUMINOUS MACADAM CONSTRUCTION

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In order to build a bituminous macadam road of lasting integrity and whose riding qualities will be excellent, attention must be given to each detail of construction from the bottom to the top In all cases proper drainage should be provided, while in localities where considerable frost action prevails foundations must be provided through heavy retentive soil or the integrity of the pavement will be seriously threatened It is conceded that a layer of granular material directly beneath the pavement proper serves to break up capillarity and to lessen in a great measure the detrimental effect of frost action The depth of foundation to be provided varies with the tightness of the soil encountered

Through ledge sections where water seepage may be expected it is good practice to construct a stone foundation with sub-drains at least on one side of the road and frequent taps from the stone fill into the stone or gravel filled subdrain trench Through particularly bad mucky soil a blanket course of sand or fine gravel laid directly on the subsoil will serve to hold the muck down and prevent its rising and filling the interstices of the foundation above

Considering only the integrity of the pavement and its riding quality, several factors enter into successful construction Of prime importance, of course, is the preparation of the subbase upon which the base course of crushed stone is to be placed Whether the subgrade is of natural soil or a subgrade prepared by using gravel, coarse stone or any other granular material, it should be thoroughly compacted and made hard over the entire width of the pavement and preferably for at least twelve inches outside of the pavement Any soft spots that are allowed to remain in the subbase will finally work injury to the riding qualities of the pavement

Soft spots are not always caused by pockets of poor material constituting the subgrade Often it is a case where the material in the soft pockets, while not bad in itself, is of such different nature or grading from the surrounding material constituting the subbase that it is soft in comparison If proper steps are not taken to eliminate soft spots in the subgrade, it is only a question of time before a depression in the finished pavement will occur at these spots The little inherent strength in the constructed macadam may bridge the spot for a while, but eventually it will let down

Another essential in good construction is the placing of sufficient shoulder along the sidelines to hold the crushed stone courses If care is not given to this detail, insufficient shoulder material may be placed to properly sustain the crushed stone at proper grade during the process of rolling Where an insufficient amount of shoulder material is placed, the crushed stone during the rolling process pushes out to a greater or less extent, with the result that the outside edges of the finished pavement are uneven in contour or inclined to be scalloped

The construction of the pavement proper calls for considerable care in the details While the stone in the base course may be comparatively low in quality, the crushed stone in the wearing course should be durable, cubular in shape and run uniform as to size Uniformity in size is particularly essential in order to secure, when spread, a uniform distribution of voids for the penetration If stone low in wear and toughness must be used in the wearing course, it is good practice to screen to larger sizes than is customary when using high-grade rock and to increase the depth of the wearing course Of prime importance, also, is the size of the filler or keystone The use of too small stone or screenings as a filler is not deemed good practice The filler stone should be large enough to key in the larger stone in the wearing course

As in the case of a uniformly rigid sub-base, it is essential that the first course of stone after completion should be uniformly hard and true to contour The penetration course of stone should be uniform in depth to insure the best results

The base course of crushed stone should be filled with sand or crusher dust The sand or dust is applied in light coats as the stone is rolled, more being added until the bottom course no longer creeps or depresses appreciably under the roller If heavy trucks are to be used on the base course for a considerable period before the top course goes on, a layer of sand or dust up to an inch in depth is sometimes spread over the bottom course to protect it Before the top course of stone is spread this excess sand or dust should be

swept off of the bottom course to expose the stone in the bottom course and to permit a bond with the top stone

Except in cases where extremely wide shoulders are available for traffic, before spreading the top stone it is essential that the key stone and cover stone be stacked in piles along the shoulder of the road It is poor practice to allow trucking through the top course of stone

In the application of the asphaltic binder, considerable finesse is involved The quantity of asphalt in the first application may vary with the quality or size of the stone and the depth of the wearing course For the second application, or sealcoat, three-quarters to a gallon has proven satisfactory Needless to say, an even distribution of the asphalt is essential and also that the asphalt should penetrate the full depth of the stone This can be obtained only by having the stone clean, by having evenly distributed open voids in the stone, by having the asphalt hot enough, and by having the pressure distributor in perfect condition mechanically

When possible it is preferable to penetrate the left-hand side of the road first as the driver generally sits on the left side of the car and is better able to secure an even line of distribution On a standard 18-foot road it is good practice to spread ten feet on the first half of the road and eight feet on the second half This system permits the spreading of the key stone and the rolling on the entire half of the road Where the first penetration covers a 10-foot strip on the left-hand side of the road, a 10-foot strip on the sealcoat is applied on the right-hand side of the road In this manner the sealcoat and the penetration applications are staggered

Streaks in the penetration course of stone should be penetrated with a hand hose and not left for the sealcoat to cover up When the streaks are not taken care of and are covered by the sealcoat, raveling often takes place after the sealcoat has been applied Too heavy an application of binder is to be avoided as it may be the direct cause of corrugations which develop after the pavement has been opened to traffic

After the first application only enough keystone should be spread in order to permit rolling A strip eight to twelve inches wide should be left unfilled until the second half of the road is penetrated This avoids the spreading of excess keystone along the dividing lines of penetrations and prevents a ridge developing along the center After the initial rolling enough keystone is spread evenly to fill the voids in the top course of stone and the road is then rolled to its final cross-section All excess stone over and above that needed to fill the voids is cleaned off before the sealcoat is applied The

keystone is not a separate course of stone but only a filler, and after it is applied the surface of the pavement should be mosaic in appearance After the sealcoat application the pea stone is spread in sufficient quantity to completely cover the sealcoat

In addition to skilful rolling required in the construction of a good bituminous macadam, it is essential that the pavement secure sufficient rolling to thoroughly compact the stone It is not believed possible to overroll a bituminous macadam after the binder has been applied It is good practice to require the rolling of the top course of stone to a firm set before the first application of the binder, although this practice demands more durable stone Back rolling for several days after the pavement is completed is essential In cold weather back rolling should be confined to the warmer part of the day

In conclusion, it may be said that a successful bituminous macadam generally follows when the essential details of construction are adhered to, while the slighting of these essential details of construction often spells failure In other words, constant care during the whole construction process should be taken and faults corrected as they occur

PROGRESS REPORT ON A FIELD EXPERIMENT ON INTRODUCTION OF PLANES OF WEAKNESS IN CONCRETE SLABS

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The first report on this experiment appears in the Proceedings of the Fifth Annual Meeting of the Highway Research Board, December, 1925, pages 122 and 123, and was made by W D Somervell It states the nature of the experiment which, briefly, is the introduction of transverse planes of weakness, 2 inches deep, spaced at 40-foot intervals on tangent and curve

The experimental section is a portion of a 9-mile concrete pavement, 16 feet wide, 7 inches-6 inches-7 inches cross section, and reinforced 2½ inches from the top The steel fabric used was No 3 gage metal across the pavement spaced 6 inches and No 3 gage spaced 12 inches lengthwise of the pavement The 4 outer members on each side parallel to the edge of pavement were increased in size to No 0 gage The reinforcement was stopped at each plane The concrete was 1½-minute mix with proportions of 1 1½ 3 using gravel as coarse aggregate Pavement cores taken at age of 7 months