REPORT OF PROJECT COMMITTEE ON FILLERS AND CUSHION COURSES FOR BRICK AND BLOCK PAVEMENTS

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SYNOPSIS

Report of laboratory and field test covering the use of asphalt emulsions for filler and mastic for cushion courses Its quality as filler is measured by its lack of adhesivesness in the joints, as mastic by its rate of setting, as surface covering by its adhesiveness and ability to hold sand, chips, etc , for skid proofing Tests of bituminous joint fillers containing admixtures of fine material intended for stiffening the mixture show that the foreign material settles in warm weather Materials that have been found suitable for surface application to prevent adhesion of the filler are described A new rubber and asphalt solution and a bituminized cement grout that have been developed for joint fillers are also discussed

BEDDING COURSES

The customary bedding course for a brick pavement has been a layer of sand spread an inch or so thick over the concrete base An improvement on this is the mastic cushion This is a mixture of sand and bitumen, of such texture that it stays in place, does not shift, push, nor bulk, and so provides a permanent bed for the brick It has been the practise to use either asphalt or tar Experiments this year have been tried with asphalt emulsions

Asphalt emulsions may be divided roughly into two groups· (1) slow-breaking emulsions for mixed work, and (2) quick-breaking emulsions for penetration These may not be used interchangeably Penetration emulsions can be used only with coarse, clean sand, pebbles or crushed stone Certain types of slow-breaking emulsions are in the process of development, and show promise of mixing readily with ungraded sand containing considerable fine material.

The slow-breaking type seems to be a possibility as a binder for the mastic cushion. It has one decided disadvantage If the cushion course is laid barely in advance of the paving brick, then the emulsion, soon being covered and excluded from the air, apparently does not break, or else it breaks only in spots and not uniformly This tendency is accentuated if the joints are filled immediately after the brick are laid

On the other hand there is a decided advantage in the use of an emul-

sion, in that damp or wet sand may be used This advantage is immediately apparent to those who have tried to mix a mastic cushion when obliged to heat the sand to dryness Trouble was experienced in 1932 when the sand was made so hot that it drove the solvent from the asphalt cutback, which then became so much asphalt cement The resulting mixture of sand and asphalt was not workable, and could not be used as a bedding course

The sand for a mastic cushion should be reasonably sharp It has been found that if the sand is rounded there will be a tendency for the cushion to work up between the bricks, as rolling is carried on, and soon the joints are full of the cushion course Sharp sand does not act this way There will always be a slight amount of the bedding that works up but this can be kept to less than a half inch if the sand is sufficiently sharp

The mastic cushion should be rolled, if it is possible to do so without its picking up on the roller to such an extent that the surface is no longer smooth A slow-breaking emulsion does not cling to the roller But a fast-breaking emulsion is so sticky that rolling is impossible

Mastic cushions made with asphalt cutbacks are variable in their proclivity to pick up on the roller Weather conditions seem to have as much to do with it as the asphalt Generally, if the roller is oiled or sprayed with water the pick-up tendency is lessened Once in a while, however,the cushion will pick up in spite of all remedies

FILLERS

The ideal filler is yet to be produced

Numerous attempts have been made to improve the existent fillers by adding to them some stiffening agent in the form of finely divided particles of mineral matter, such as diatomaceous earth, flue dust, clay, coal, coke breeze, free carbon, and the like In order to learn whether or not these materials are beneficial Mr Francis Grant at the University of Illinois devised a testing machine to measure the settlement of the mineral ingredients The apparatus is a large funnel at the bottom of which is a removable cup About one liter of material is placed in the funnel It is then put in an oven and kept at pouring temperature for three hours After it has been removed and allowed to cool, small samples are taken from top and bottom The percentage of filler in each sample is then determined

From the tests run on eleven products it is evident that settling of the mineral ingredients occurs in all cases where the specific gravity of the mineral is greater than that of the asphalt in which it is supposed to be suspended Since the purpose of the investigation was to emphasize the fact that settlement does take place, the funnel shaped apparatus which tends to exaggerate the settling was justifiable

These tests show that bituminous materials containing mineral filler

need to be used as fast as they are heated, they should not be allowed to stand in the kettle, as settlement is sure to take place, which means that a layer of heat insulating material will be deposited on the bottom and will make subsequent batches costly to heat and will tend to burn out the bottom of the kettle They should not be stored in barrels of bulk where there is any appreciable amount of heat—even the sun's rays in summer—lest there be a difference in quality between the filler in the bottom and that in the top of the container

Observation of the Penetration of Joint Fillers in Pavements

Mr L D Walker, University of Illinois, became convinced that much of the asphalt filler that is applied to brick pavements, especially to those of the lugless type, never enters the joints at all, but is simply spread over the surface, much as butter is spread on bread As a matter of interest, rather than for the purpose of establishing definite values, some sections of brick pavement that he used for laboratory experiments were turned upside down and examined These sections had been poured with various bitumens including tar, heavy and light asphalts, and a mixture of asphalt and rubber Penetration to the bottom of the joints was not complete in any section

Another scheme of Mr Walker's was to lay the brick pavement against a piece of plate glass, as though the latter were another row of bricks. It was then possible to look through the glass and see exactly what happens when filler is applied to a brick pavement The results of this visual test were rather amazing With the lugless type of brick but little of the filler reached the bottom, and there were many areas that had no filler at all With lug brick the lighter fillers did their work well, but some of the heavier types, those with low penetration, would not flow to the bottom even when the bricks were heated

It was apparent that fillers do not flow alike at the same temperature A study was made of this It was found that some fillers flow readily through the orifice of the Engler viscosimeter, and that others will not flow through it at any temperature whatsoever Since lugless brick pavements have many joints that are no longer than this orifice it may be seen that there is scant chance of these sluggish fillers finding their way into these slight openings More study will be given this point

Brittleness

Samples of fillers were placed in a refrigerator maintained at 32°F to determine the action of the material at a temperature often reached or exceeded in winter in many sections of the country All of the samples except three were sufficiently brittle to break into several pieces when one end was bent quickly over to the other end The exceptions were Berry Jointing Compound, the same plus 4 5 per cent of rubber,

and Texaco 96 plus 4 5 per cent rubber The Berry Compound was not intended for a paving material, but for a sewer pipe joint filler The addition of rubber served to reduce the brittleness of some of the other fillers The rubber was introduced by means of a special process developed in the University of Illinois laboratory

A British proprietary compound, supposed to contain rubber, and advertised to be the ideal filler for brick pavements, was found to contain no rubber, but was highly impregnated with clay This filler would not flow into small cracks, even at high temperatures Heating to a temperature at which it would flow, caused a pronounced settling in the kettle, and started a coking action that soon burned out the kettle bottom

Asphalt Emulsions for Fillers

A study of fillers in laboratory and field proved that asphalt emulsions, as used at present, are unsuccessful Presumably in an attempt to open a new outlet for emulsions, certain manufacturers have recommended that the joints of a brick pavement be filled with fine sand, and that an emulsion be poured over it. This is supposed to form a well bound mixture, stable and waterproof. Mr Walker devised a simple apparatus by means of which the action of the emulsions and sand may be observed By suitable adjustments the apparatus can be made to simulate joints in a brick pavement, and the widths may be varied from $\frac{1}{16}$ to $\frac{1}{8}$ inch Sand, varying from fine to coarse, and graded or ungraded, was used with several emulsions The results were generally unsatisfactory Following the instructions of the makers of the emulsions sand was swept into the joints and the emulsion was poured over the bricks In the event that a penetration type emulsion was used, the sand was not coarse enough to allow it to penetrate to the bottom of the joint and coat the sand particles before it broke and set Where any kind of slow-breaking (or mixing) emulsion was used it ran unevenly through the sand, and disappeared in the cushion before any appreciable amount of sand in the joints had been coated with asphalt In the latter case, if the joints were sealed off at the bottom so that the emulsion could not run away, the sand was saturated with emulsion which remained an emulsion for months, because of the thin seal of asphalt that formed at the top of the joint Examination of some of the field jobs showed that this is what happens in practice The emulsion either lies in the joints unbroken, or it passes into the bedding course where, as stated before, it never sets up

The removal of a number of bricks in several jobs in Ohio during the past summer showed conclusively that, as there introduced, asphalt emulsion did not cling to the bricks, and did not set up in the joints, nor in the cushion, and therefore did not waterproof the pavement.

REMOVAL OF FILLER FROM THE SURFACE

Slipperiness of brick pavements is due to the film of asphalt that adheres to the surface of the brick when the joints are filled by the squeegee method Several ways have been suggested to remove the film These were discussed briefly last year Recently success has been achieved by whitewashing the brick surface before the filler is applied The bitumen may then be scraped off with steels scrapers Success has not been achieved yet with the filler used by the state of Illinois

Whitewash may be applied with a brush, or it may be sprayed on with a tree-spraying outfit With the latter it is important to have a nozzle that is capable of spraying a heavy solution without clogging Too much whitewash must not be applied as it is not desirable to slop it into the joints for fear that the filler may be pulled out or will not waterproof the pavement

Whitewash of the right strength is reasonably weather resisting, and calcium stearate or sodium chloride which are sometimes used to aid in water-proofing whitewash do not seem to aid in the least, although they are not injurious

Whitewash should be dry when the asphalt filler is applied It would be handy to have a material that could be added to whitewash (that is applied on a damp day) that would dry it up rapidly

After the whitewash had dried, or "set," the bricks may be exposed to any weather conditions for a reasonable time without injury to the coated surface

The consistency of whitewash is of extreme importance Five and one half pounds of lime to a gallon of water is the proportion recommended This is equivalent to three parts water to two parts lime, by weight

The salvaged asphalt film may be used over again if it is added to a relatively large amount of new asphalt in the kettle A small quantity of lime settles to the bottom of the kettle, but it may be removed from time to time with little trouble The small amount of lime that enters the filler in the kettle is not detrimental

Other materials have been tried in place of whitewash, and one of them, a proprietary material known as "B & B" Adhesive Preventing Compound is very successful

The cost of this operation of peeling the asphalt from the brick is more than offset by the saving in reclaimed asphalt, the saving in time involved in squeegeeing the asphalt to a thin film, and the saving in cover material which usually is spread over the film By whitewashing the brick surface the asphalt may be entirely removed, and the pavement requires no further attention Such insurance against trouble would be well worth additional first cost, but fortunately this is not involved.

Some very recent experiments in the field have been most interesting.

In Illinois an attempt was made to whitewash the brick with a spray nozzle outfit It was found that a special nozzle is necessary if whitewash of the correct consistency is used, because the oridinary tree spray nozzle clogs unless the whitewash is too thin to be of use On the same job the men operating the squeegee did a most commendable piece of work The film of asphalt that was left on the whitewash was so thin that it could not be peeled off After experimenting with it, the decision was reached that a rather heavy mat of asphalt should be left in place if the peeling process is to be used

Another method that has recently been tried in Illinóis to prevent the asphalt from remaining slippery is to heat coarse sand, mix it with a small quantity of kerosene and scatter the mixture on the surface of the pavement The results have been very satisfactory The oil cuts back the asphalt sufficiently to assure the bedding of the sand in it

Still another method has been to apply a surface torch heater to the asphalt film and follow this immediately with dry sand, rolled in with a light road roller This is expensive, and there is a danger of burning the asphalt It is stated that just as good results were obtained if the final rolling was omitted

It is probable that if whitewash or other such material is used and if a very thin film of asphalt is left on, so thin that it may not be economically peeled off, traffic will solve the problem by working it off during the winter months, especially if chains are used on the vehicles

A mixture of water and calcium chloride has been tried and it is stated that it is satisfactory The solution consists of 65 per cent water, 34 per cent calcium chloride, and 1 per cent starch It is applied until the surface has a damp appearance There is no apparent spillage of the solution into the joints Asphalt then is applied at once, and no trouble is experienced in its removal The appearance of the pavement is not marred whatever, as is the case with whitewash or other discoloring agents

It has been noted that the non-adhesive quality of some of the materials used is temporary In other words the asphalt film must be removed rather soon or it will stick to the bricks

The developments in the application methods for removing filler from the surface of pavements seem to be many and rapid It will, of course, take some time until the best method is determined and standardized

DISCUSSION

ON

FILLERS AND CUSHION COURSES FOR BRICK AND BLOCK PAVEMENTS

MR GEO F SCHLESINGER, *National Paving Brick Association* Prof Crandell has indicated in his paper that a satisfactory job can be secured with ordinary filling methods that is by squeegeeing the hot asphalt into the joints with a very thin film on top, and covering and rolling at once But, unfortunately, we do not always get the best workmanship on any type of pavement construction and there have been slippery brick pavements. The Paving Brick Association is very much interested in the filler removal method of application, and developing the correct technique for it Although the best coating material to be used has not yet been determined, I think the method is right and, as Professor Crandell has said, there is no additional expense As to whether the coating material should be permitted to dry before the asphalt is squeegeed in, I can testify that they were not permitting it to dry on the jobs I have witnessed and there has been no trouble with foaming There were a few bubbles in the joints but as the asphalt was heated very hot, up to 400°F , no harm was done There were more bubbles with the white-wash solution than with the calcium chloride solution On a recent project of this kind that I saw the material being used was a 35 per cent solution of calcium chloride It looked like plain water It was sprayed on in the form of mist The surface of the brick was merely dampened In my opinion with a light application of this material it is not at all necessary for it to dry The filler was squeegeed immediately and it came off very readily

MR M H ULMAN, *Pennsylvania Department of Highways* Referring to Prof Crandell's statement that Texaco 96 was the most elastic filler, I am of the opinion that not all of those present understand the type of asphalt cement marketed under this trade name I believe there is a representative present from the Texas Company and think it would be pertinent to have an explanation if Texaco 96 asphalt is not the type generally recommended by this Company for use in the construction of penetration macadam

MR F H GILPIN, *The Texas Company:* I have no previous knowledge of these data Did you say you put rubber in it?

PROFESSOR CRANDELL Yes, we put in 4½ per cent of rubber.

MR GILPIN The material we furnished does not have a very low penetration at 32°F. That fact might account for part of its action The added rubber probably had an additional effect.

PROFESSOR CRANDELL The rubber improved all asphalts we incorporated it with but the strange thing was that none of the other grades of asphalt except the 96 behaved that way Some of the others were softer but they broke.

MR. ULMAN. This is what I am attempting to have clarified, for an incorrect interpretation could be placed on Prof Crandell's statements I do not believe Texaco 96 asphalt is a blown asphalt cement.

The Paving Brick Association and the Society for Municipal Improvements have advocated the use of blown materials, so that a bituminous material will be obtained having a low ductility and consequently a low susceptibility factor The use of a penetration grade asphalt cement would be contrary to the recommended practice although I appreciate greater adhesion would be obtained than by the use of a blown product. I, therefore, do not feel that it is fair to make a comparison of these tests at the temperatures specified in view of the different type bituminous materials used

MR SCHLESINGER The National Paving Brick Association does not specify that the material be blown but it has to be to meet our requirements—a high melting point asphalt, one that will not run out or bleed in hot weather That means low ductility, of course We want a filler that will go in the joints and stay there, will not chip out in the winter, will not run out in the summer time, and one that has sufficient ductility to adhere to the brick And, of course, with the surface removal method the harder asphalts will be more successful in their use I do not believe Professor Crandell intended a 96 penetration asphalt for use as filler

PROFESSOR CRANDELL· I might say to Mr Ulman that all we were after was to find the perfect filler and if we can do that we are satisfied One of the tests was that at freezing temperatures to see if these would stand up—whether they would break out of the joints or not. Most of them do, as you know If we could devise some filler that is inexpensive to do the trick, that is what we are after By the addition of rubber to 96 asphalt, which otherwise was not satisfactory, we did produce a filler which has a number of good points to it, far better than the 96 by itself Where we introduced rubber the mixture doesn't flow apparently and, from the screen, you saw that it didn't break at freezing temperature Perhaps we are on the trail of the filler

MR ULMAN. Is it slippery under wet conditions?

PROFESSOR CRANDELL: We take it off the top of the pavement

MR. CONNER: I notice the statement was made that the emulsion

settled down into the cushion I should think a mastic cushion would be better

PROFESSOR CRANDELL Yes, I presume it would be unless that mastic cushion were made with a mastic filler and the brick laid immediately on it before it was set We found some samples in Ohio where the emulsion had run down into this sand cushion, and you could scrape out the bitumen with your hands and it was still an emulsion It had been in place for four months

MR F H BAUMAN, *New Jersey Highway Commission* I would like to ask Professor Crandell if he tried white-wash on granite block to prevent adhesion of the filler?

PROFESSOR CRANDELL No, I did not

MR SCHLESINGER I understand they have conducted some experiments on granite block in New York City Mr Litehiser have you anything to offer about Ohio's experience?

MR LITEHISER, *Ohio Department of Highways* Nothing other than to concur with you on the apparent satisfactoriness of placing the filler over white-wash or proprietary filler I likewise observed very little bubbling and the removal was just as satisfactory as where those materials had been permitted to dry However, I didn't pull out the bricks to observe whether or not the joints were improperly filled