2:3:B Surfacing and Pavements (Plant Mixes)

Note: Weighmaster's signature is not required for asphalt pavement tickets on projects using the department's eTicketing portal. Only the weighmaster's name is required.

Description of Work

Hot Mixed Asphalt Concrete plant mix (HMA) is a mixture of fine and coarse mineral aggregate and liquid asphalt binder heated and mixed in a central-mix plant. Aggregates used in plant mixes consist of crushed stone, gravel, slag, sand, and mineral filler. The central plant mix method permits removal of almost all moisture content, and close control of temperature and mixture composition resulting in a completed product of high uniformity. Hot Mixed Asphalt Concrete may be used on all types of roads and streets and when constructed properly will serve satisfactorily under the heaviest traffic. Heavy traffic applications may require polymer or other additives to be mixed with the liquid asphalt and fibers mixed with the aggregates. HMA may be used as a base layer, leveling layer, binder layer, surface layer or wearing surface placed on most any type of properly prepared surface.

Mix Design

The contractor will take available aggregates, Reclaimed Asphalt Pavement (RAP), and liquid asphalt binder and blend them to meet the specified mix. The contractor submits the completed mix design to the Bureau of Materials and Tests where the Bituminous section reviews the Job Mix Formula (JMF) for specification compliance. The JMF is then approved by the HMA Engineer or the Bituminous Engineer and returned to the contractor.

Plant Operations

Although asphalt plant operations will basically be controlled by the contractor's Quality Control Manager with the advice of the Division Quality Assurance Manager, Project field personnel should be aware of the principle functions of the plant since certain irregularities in plant functions can seriously affect the plant mix "lay down" operations on the road. Plant irregularities in such areas as moisture removal and uniformity of the mix (in both gradation and temperature) can cause difficulty in obtaining a smooth riding surface and may result in early deterioration of the plant mix layer.

Batch Plants

It is very important that complete separation of each of the materials be maintained in the stockpile and at the cold aggregate bins and feeders, if the benefits of aggregate control are to be realized. If the coarse and fine aggregates intermingle in the stockpiles, cold bins, or over the tunnel or feeder trap, control of the cold aggregate gradation will be lost.

A reasonably accurate calibration of the rate of feed of each of the cold aggregate feeders should be made so that the proper proportion of each size fraction will be fed into the plant. Although proportioning of the aggregates in the mix is actually accomplished from the hot aggregate bins, the cold aggregates must be fed in the same proportion, if a smooth balanced operation is to be achieved.

After passing from the cold bins through the cold feeders onto a belt or elevator the aggregates are fed into the dryer. In this unit the aggregates are heated to the required temperature, and moisture is

removed from the materials. The fuel used to fire the dryer is usually natural gas, liquid propane gas or less frequently fuel oil. Fuel oil is atomized and oxidized at the burner nozzle by steam or low pressure air, and the flame and hot gases are drawn through the length of the dryer drum by the exhaust fan. The aggregates are heated and dried as they pass through the drum, entering at the exhaust end and traveling toward the burner end of the dryer. The dryer drum is set on a slope so that the aggregates will travel rather slowly down the length of the drum as it revolves. Flights, or lifting troughs, are attached to the inside of the drum to lift the aggregates from the bottom of the revolving drum and spill them in a thin curtain through the hot gases.

It is important that these flights be in good condition. If the troughs are warped, bent, or missing entirely, the efficiency of the dryer is seriously impaired.

As mentioned before, the exhaust fan creates a draft through the dryer to remove the moisture vapor as the material is heated. The exhaust gases and vapor, along with the quantity of the very fine portions of the aggregate are discharged through the dust collector, or cyclone, where most of the dust is reclaimed and reintroduced into the mixing plant through an auger. Means should be provided at the auger to waste a portion of the reclaimed fines, if required to maintain gradation limits.

The temperature of the dried materials is measured at the discharge chute of the dryer by a pyrometer or thermometer. This heat indicator is necessary to maintain control of the temperature of the heated aggregates. Variations in temperature of the material will affect the quality of mixing, and overheated aggregates will result in excessive hardening of the thin asphalt coating during the mixing operation. The accuracy of the pyrometer or thermometer should be checked periodically against results obtained with a thermometer of known accuracy.

The dryer has been, in many cases, the most important unit in the plant setup. That was because the total output of the plant depended on how fast the material could be dried and heated to proper temperature. If the capacity of the dryer was less than that of other plant units, this slowed down total production. This condition has been recognized and dryer design is being improved to increase capacity. The dryer, therefore, should receive close inspection, both before starting and after being put into actual use. Our specifications require continuous movement of the plant mix spreader at the project site. If the plant has to slow down or stop to permit the hot bins to fill up, the Contractor must remedy the situation at once in order to maintain this continuous movement. Such irregularity causes a poor surface when the trucks do not arrive on the road and unload with uninterrupted continuity. The Contractor, if he/she so elects, can run material through the dryer to drive off moisture at times when the mixer is not operating, and then run the dry material through again at a faster rate during mixer operation. Thus the Inspector must keep check on the pyrometer to insure proper uniform heat, and on the hot bins to insure adequate output. If slag is being received on the job while still hot from the blast furnace heat, this may affect the dryer temperature, and the Inspector must watch out for overheating. Fine materials hold more moisture than coarse, and a surge of wet sand through the cold feed can overtax the dryer and lower the temperature. On the other hand more time is required to drive all the moisture out of larger sizes; the surface of the coarse aggregate may be dry and hot while at the same time moisture is retained in the interior of the particles. This moisture later will come out and condense, thus giving trouble. Speed through the dryer therefore must be slow enough to eliminate this condition. Usually, the plant fireman will try to correct this condition by increasing the amount of fuel fed to the burner. This can be done satisfactorily until incomplete combustion of the fuel occurs. A reduction in

the amount of cold aggregate fed to the dryer will usually correct the situation and allow proper heating and drying of the material.

The heated aggregates are elevated to a screening unit, which separates the material into the required number of size fractions and deposits the various sizes into separate compartments. The screens must be clean and unbroken to function properly. A plugged screen cloth will result in carryover of fine material into the coarse aggregate bins, and control of gradation will be lost. During the preliminary inspection of the plant the Inspector should note the sizes and condition of the screens. Also during the course of operations, trouble that develops in the mix can often be traced to clogged or torn screens.

Therefore, they must be examined periodically to insure that they are functioning properly.

From the hot bins the aggregates are next combined in the proper proportions and mixed with the proper proportion of asphalt. There are two methods of proportioning, (1) batch method, and (2) continuous mix method. Currently, there are no continuous mix plants being used for state work in Alabama.

With batch-type mixing plants, the separate sizes of aggregates and the asphalt cement are proportioned by weight before mixing. The weighing scales must be checked for accuracy before beginning production and should be rechecked periodically during the life of the job. Test weights are required and kept on the job for this purpose. If any question develops concerning accuracy and adjustment of the scales, the Contractor must have them checked and adjusted by a competent commercial scale testing service, or calibrated with a State-certified scale.

The scales may be either a multiple-beam type (separate beam for each bin) or a spring less dial type. The weigh box is suspended from the scales, over the Pug Mill, and the proper weight from each bin, beginning, for example, with No. 1, is dumped one at the time into the weigh box. The dial scale will have pointers at the proper points to show the cumulative weights of the proper proportion from each bin. Multiple beam scales will be used in the same manner. Now, even though the scales are accurate, and the pointers on the dial or the poises on the beams are set exactly at the proper points, in operation of the bin gate levers by hand there is a tendency to overshoot the correct weight. Then if the asphalt weight is correct, the result is a lean mix. In extreme cases this could cause pavement failure. When truck weights consistently exceed the sum of batch weights, this situation likely is the cause and must be corrected.

The Inspector must periodically check the batching and mixing operations, making sure that the proper batch weights are being obtained, and that the aggregate hopper and asphalt weigh bucket are completely emptied into the Pug Mill after weighing each batch. If one bin tends to overflow and another run empty, some operators are prone to try to correct this situation by drawing more material from the overflowing bin and less from the bin that is running low. This practice must not be allowed, and the Inspector should be very firm in insisting that the correct batch weights be measured. Any batch or truckload should be rejected without hesitation whenever the Inspector finds irregularities in the weighing of aggregates or bitumen. Close contact between the plant Inspector and road Inspector should help in detecting such irregularities.

The Inspector should be especially watchful to see that the asphalt scale is correctly adjusted from time to time during the day to compensate for accumulation of asphalt and other matter on its sides. A small error in the bitumen weight in each batch can result in serious loss of bitumen.

Automatic controls are now rapidly supplementing or replacing the manually operated batch controls. One type of automatic control is arranged so that the timing and proportioning devices are all controlled by the single operation of a switch or starter for one complete batch cycle. Another automatic operation arrangement is as follows:

The automatic process control in conjunction with the timing unit will automatically dump preset weights of the materials into the Pug Mill or mixer in proper time sequences.

In case one of the materials is low in supply, the entire process will automatically wait until all the supply requirements have been filled.

After all the materials have been dumped into the mixer, the mixer cannot be emptied until the end of the preset mixing time.

It will not be possible to introduce mix ingredients to mixing hopper while the dump gate is open. The materials to be mixed will automatically be weighed in preset proportions.

The bitumen and the aggregate weighing processes will be controlled by separate sets of components contained within the automatic unit, but it will be capable of performing both processes simultaneously.

This type of automatic control is very good. Another type will shut down the whole operation if there is an interruption in the bituminous feed. There is also an automatic control at the dryer that adjusts the oil or gas feed to increase or reduce the heat to produce an even flow of material at the specified heat.

In many automatically controlled batch plants, an automatic weight printer that prints the weights of aggregate, bitumen and total batch weight as components are introduced will be utilized. The automatic printer thus eliminates the need of separate weighing on the truck scales.

The Pug Mill or mixer is located directly below the weigh box, and the batch components, proportioned either by manual or automatic controls, are then dumped into the mixer. Frequent inspections of the condition of the mixture leaving the plant should be made, noting the consistency of the mix, the distribution of asphalt and aggregate throughout the mixture, and the temperature of the mixture. If the quality of the mixture varies from batch to batch, an immediate check should be made to locate the source of trouble. Uniform distribution of the asphalt throughout the mix is extremely important. If portions of each batch vary from rich to lean, the Inspector should look for uneven distribution of the asphalt across the mixer as it is introduced. It may be necessary to increase the mixing time to correct this situation. By examining the mixture in bright light, the experienced Inspector can quickly detect non-Uniformity in the mixture.

The Inspector must make periodic checks of the temperature of the aggregates and the asphalt, as well as the mixture produced. Generally, the temperature should be as low as will permit moisture removal, good mixing, and proper spreading and compacting. It will be noted from Item 410.02(b)2 that the temperature at which the mixture must be delivered to the spreader will be specified in writing and that the mixture must be within 30 degrees of this specified temperature. The plant Inspector must insist that the temperature be kept as uniform as possible, as well as within required limits. At this point it

might be well to remind the Inspector that truck beds may not be oiled with any petroleum based release agent to prevent the mixture sticking. Asphalt truck bed release agents that have been approved by Materials & Tests may be used on the truck bed.

Drum Plants

A drum mix plant has two major differences from a batch plant. First, the gradation is controlled by the rate of flow from the cold feed bins, not by a screening deck. Second, the aggregate is mixed with the liquid asphalt binder in the drum, not in a pugmill.

A drum mix plant is composed of cold feed bins, a cold feed elevator, automatic weighing systems, liquid asphalt binder storage tank and pumps, a drum mixer, a dust collector (baghouse or wet washer), a hot elevator, and an HMA storage (surge) silo. Most HMA plants have five cold feed bins. The cold feed bins have slanted sides and usually have a vibrator attached. Typically an adjustable gate and a variable speed feeder (connected to the weighing system) are used to attain the JMF gradation. The cold feed elevator brings the aggregates to the drum mixer. An automatic weighing system on this conveyor continually weighs the aggregate and moisture entering the drum mixer. The moisture correction is made by determining the moisture content of the aggregate (in the stockpiles or on the conveyor) and programming this information into the automatic weighing system. The automatic weighing system corrects the total weight for the moisture so that the asphalt proportioning system can pump the proper amount of liquid asphalt binder into the drum mixer.

Some drum mixers are parallel flow, where the aggregate moves through the drum the same direction as the exhaust gases. Some drum mixers are counterflow designs, where the aggregate moves through the drum in the opposite direction as the exhaust gases. The liquid asphalt binder is pumped into the drum mixer about 2/3 down the drum length from the burner, just after the RAP (if any) has been added. When baghouse fines, mineral filler, or fiber are added to the mix, they are introduced in close proximity to the liquid asphalt binder. This is so they will be captured by the asphalt cement and not removed by the dust collector. Exhaust gases from the plant are passed through a dust collection system so that the plant shall meet emission requirements. The coated and mixed HMA is then conveyed to a surge or storage silo for loading into transport vehicles. A batch plant does not require a storage or surge silo, as the trucks may be loaded from the pugmill.

After plant mix has been mixed and discharged into the hauling vehicle, It must be weighed on a truck scale for documentation of pay quantities. For a batch type plant, weights that are documented with the automatic weight printer will not require weighing on the truck scales. Our Specifications now require the truck scales to be equipped with a digital recorder that eliminates hand printing of weights by the scale operator. A State Inspector will observe the weighing operation and sign the weight ticket as part of the double validation procedure for plant mix weights.

Road Operations

It should be emphasized that close contact between the plant and road inspectors must be maintained. Some defects in the mix that cannot be seen at the plant will show up when the load is on the road behind the spreader. The road Inspector must get word promptly to the plant Inspector so that corrections can be made before a lot of poor quality material is on the road. Close contact is also

necessary on routine matters, of course, such as starting time, last load out temporary shutdowns, any mix-up in sending out and taking up load weight tickets, etc.

Just prior to placement of the pavement, an inspection of the base or old surface upon which the pavement is to be placed should be made, noting all soft or weak areas, small depressions or potholes and any area which require cleaning or extensive leveling. The Contractor must be required to remove and repair all soft areas, and to clean and prepare any existing surface to be paved or resurfaced. The requirement for a firm and unyielding base is of utmost importance, as the successful performance of a bituminous pavement depends greatly on the stability of the foundation**. The Inspector must never allow the Contractor to cover a soft or failing base layer** regardless of the Claims of the Contractor that the base layer has already been previously accepted.

The Contractor will generally employ the use of a power broom in the cleaning of a previously primed base layer. Existing paved surfaces may require the clipping of grass from the pavement edges as well as the use of hand shovels and brooms for removing caked dirt and other foreign material.

After the surface that is to receive the plant mix has been cleaned of all foreign material, it should be properly tacked if required by the Engineer. In general, a tack coat should be used over bituminous plant mix bases, old surfaces and between other layers of plant mix, when some time elapses between placement. Tack coat, if applied, will usually be at a low application rate on a freshly constructed surface treatment, on a freshly primed base, on freshly uncontaminated plant mix surfaces, layers or patches.

The Department is presently using Liquid Asphalt Binder , PG 58-22, PG 64-22, PG 67-22 or PG 76-22 or Emulsified Asphalt, Grade CRS-2, CRS-2h, CSS-1, CSS-1h, CQS-1h, or CQS-1hp for tack material. The Contractor will generally lightly spray the surface through the use of the distributor bars or use the hand hose of his/her asphalt distributor to "fog" the tack coat over the surface. Surfaces, such as the curbs, gutters and existing pavements, against which fresh plant mix is to be placed, should also be painted with tack material to aid in bonding and sealing of the joint. Tack is usually applied to these type surfaces with a hand paintbrush. Emulsified tack material must be allowed to "break" prior to covering with plant mix.

Tack coat should not be applied too far in advance of the paving operation, normally not in excess of one day's operation. If the surface being covered is under heavy traffic, an additional application of tack may be necessary before the end of the day. However, considerable judgement is necessary in not applying excessive tack such that bleeding through the overlying layer will result. Equipment used in the actual laying of the bituminous plant mix will usually consist of an asphalt spreader, rollers for compaction, and tandem dump trucks. Certain specific requirements for this equipment are given in Subarticle 410.03(a) but basically it is the responsibility of the Contractor to furnish equipment that will produce, deliver, spread and compact the plant mixed material to the specified density, thickness and smoothness requirements.

Prior to spreading the roadway plant mix layer, any required leveling of the existing surface should be performed. The Contractor should be given as much advance notice as is possible of the intent to place a leveling course, so that he/she can plan his/her operations in an efficient manner. In some instances, the most satisfactory leveling results are obtained by spreading the mix with a motor patrol due to the longer wheel base of the patrol as compared to the asphalt spreader. Provisions for the use of the motor patrol will be covered by Special Provision. Smooth tires must be used on the patrol when this method

of leveling is allowed. For thin layers of leveling material, adjustments in the bituminous plant mix gradation can be made as allowed by Item 4l0.03(c)3. Patching and leveling must, in all cases, be done ahead of, and separately from the spreading of the pavement layer. Patches and leveled areas must be thoroughly compacted prior to placing the overlying plant mix layer of uniform thickness. This is necessary since compacting of the extra depth leveling or patching material concurrently with the overlying uniform layer will result in a more compactive decrease in thickness of the leveled or patched areas and consequently a rough riding surface.

Prior to beginning each day of operation of bituminous paving, the Contractor and Inspector should check the asphalt spreader for proper cross slope adjustment. The Inspector must see that guidelines are set for the day's work, that the underlying surface is properly prepared and that the tack coat has been applied through the area to be paved within the first few hours.

In the construction of bituminous plant mix pavements, it is extremely important that the spreader be in good adjustment and that the machine and screed operators be experienced and capable. Item 4l0.03(a)4 requires that asphalt spreaders be equipped with automatic grade and slope controls. These automatic controls normally operate from a ski of not less than 30 feet in length riding on the underlying surface. Thus little adjustment should be required of the “screed man" during proper operation of the spreader and automatic controls.

Some spreader operators like to operate the spreader at speeds in excess of that required to handle the quantity being produced at the plant, and then stop until the next load arrives. This must not be allowed. Subitem 410.03(f)2a requires that the asphalt spreader be operated at a speed as uniform and continuous as practical. In some cases this will mean that the spreader must operate at speeds of 9 or

11 feet per minute. This is a rather slow rate of speed but generally the slower the spreader is operated, the smoother the finished surface will be. The ideal speed of the spreader will be that which will result in a smooth, continuous process with no waiting period between trucks. Waiting between trucks is a cause of both gradation segregation (when the wings on the spreader are closed) and temperature segregation (the mix on the road cools faster than the mix in a hauling vehicle).

The Inspector should periodically check for difficulties while dumping loads of mixture into the hopper of the spreader. Trucks must not be allowed to back into the spreader in such manner that they bump it, nor should trucks which bear against any part of the machine other than the pushing rollers be permitted to dump. Any mix spilled onto the pavement in front of the spreader must be shoveled into

the hopper or back into the truck before moving ahead with the spreader. The Inspector should be especially watchful to see that mixture spilled in the paths of the tracks or wheels of the spreader is removed before the spreader reaches it.

During the spreading of the plant mix, periodic checks should be made by the Engineer with the use of an engineer’s level and level rod or with the string line and ruler to determine that the plan specified cross slope is maintained. It is the Contractor's responsibility to place the specified average weight per square yard of plant mix. The Engineer should emphasize to the contractor the need to make every effort to place the specified rate and to avoid placing material on either the low side or high side of the allowable tolerances. If it becomes obvious that the contractor is attempting to place material at the

extremities of the tolerances, written instructions concerning the desired placement rates should be given.

It is the contractor's responsibility to assure himself/herself that he/she is placing the required amount as shown on the typical section unless the amount is changed in writing. Any changes to the amount specified in the plans should be covered in writing to the contractor.

The specified rate is calculated from the design strengths required and it is obvious that should the contractor consistently place material in each layer at the lower extremity of the tolerance, the desired strength will not be maintained.

Following the spreading of the bituminous plant mix to the required thickness and specified poundage per square yard, the rolling of the plant mix will be performed. Compaction rolling should begin while the mix is still at the highest temperature that will allow rolling to begin without damage to the plant mix surface. All compaction rolling should be completed prior to the mix cooling below a temperature of 180° F. Where vibratory rollers are to be used, lift thickness and roller and pave speeds should be taken into consideration when selecting the roller. The vibrating frequency should be high (above 2000 vpm preferable) in order for the impacts to not exceed one inch longitudinal increments. To determine the proper roller speed to provide a one-inch impact spacing, divide the frequency by 12. Thus a roller with a frequency of 2400 vpm should have a maximum operating speed of 200 ft./min. The frequency vibration is controlled by engine speed, not roller speed. Amplitude should increase with lift thickness to provide proper density; however, the use of too high an Amplitude will cause the roller to bounce and produce a rough surface. The total applied force required to obtain density on high type mixes with a minimum number of passes should normally be between 325 and 400 pounds per inch of roller width. The total applied force is the sum of the dynamic force and the static weight force. For most rollers the static force is 125 or 250 pounds/inch and the dynamic force 200 to 400 pounds/inch. Extreme caution is urged when rollers are operated in the dynamic mode while compacting thin layers.

The pneumatic-tired roller should begin compacting the mixture as soon as the mixture cools sufficiently to prevent picking up of the mix on the tires. If the mix has high stability, the roller should be operated with ground contact pressures in the range of 50 to 80 psi. In general, the roller should be operated with tire pressures as high as practicable without rutting, shoving, or otherwise displacing the mixture.

Before compaction begins, the outside edge of the spread material should be tamped, generally with a lute, to an approximate 1:1 slope. This firms up the edge and the slight ridge permits the full weight of the roller to bear to the extreme edge with less tendency to shove the edge out of shape.

Roller wheels must be kept moistened by mats fastened to the wipers on each wheel, without using an excessive amount of water, which might harm the surface of the pavement. Considerable judgement must be used in the timing of compaction, taking into consideration the temperature of the mix, characteristics of the mix, thickness and weather conditions. Under certain circumstances, rolling may be completed an hour after the mix is laid, while during the hottest part of the season for thick layers some hours may elapse before the pavement is in condition for the finish rolling. The roller drive wheel should be nearest the paver.

During periods of hot weather for the thick layers a delay in initial rolling may be necessary to prevent "hair-checking" of the mat or to avoid picking up of the mix on the wheels of the roller. The Contractor

and Inspector must be very observant to begin the rolling of plant mix layers as soon as possible with the desired level of compaction effort to avoid any delays in achieving the specified density. Density tests should be performed on the completed layer as soon as practical after placement so that correction of deficient areas can begin immediately.

On each trip the roller should move straight into the fresh mixture and return straight back beginning at the edge and moving to the center. The roller wheel should not be angled over the next overlap until the roller is back on the compacted, cooled pavement. This method will produce a smoother surface. When not actually compacting the pavement, rollers should not be allowed to stand on the partially compressed surface. The Inspector should require that they be moved off the warm surface until further rolling is required.

In order to establish a minimum required rolling pattern or number of passes for the various types of rollers being used in the compaction train to obtain specified density, the Contractor and Engineer may perform a test strip for comparison of density results to number of passes, etc. during the rolling by each roller. The test strip will not necessarily guarantee that density will always be obtained but will give guidance to the Contractor and Engineer of the minimum effort necessary to approach required density. With the modern density devices now available, this type test strip can be easily accomplished.

Surface smoothness and density are both accomplished by rolling; therefore the testing for smoothness and density must begin before rolling is completed and while the mixture is still warm enough to be manipulated. Straight edging by contractor personnel with observation by the State Inspector should be kept up behind the initial rolling. Smoothness deficiencies such as short choppy waves should be corrected immediately, usually by cross rolling.

Clipping of high spots with a motor patrol has been allowed on plant mix layers below the wearing layer, but is usually not very successful and hopefully can be avoided with expeditious straightedge checking of the warm plant mix.

The construction of transverse joints at the beginning of each day's operation and after breakdowns is probably one of the most crucial steps in obtaining a smooth riding surface. At the completion of the day's operation, the contractor will normally place heavy wrapping paper on the underlying surface across the joint and place plant mix on top of the paper. The paper between the two surfaces will facilitate the expeditious removal of the plant mix joint at the beginning of the next day of operation.

Regardless of the temporary means used in the forming of the joint at the end of the day, Item 410.03(h)3 of the Standard Specifications requires that a vertical" joint "be constructed in the previously laid material by cutting prior to beginning the days operation.

In moving off of the vertical transverse joint, some contractors will utilize a board of the desired thickness placed across the top of the previously "laid material. When the spreader screed is let down on the board and moves ahead, the fresh plant mix will be at the desired level above the previously laid mix such that when it is rolled a smooth joint will be formed. The spreader should proceed only a short distance ahead of the joint, and not proceed at full speed until hand finishing of the joint is completed. The Contractor should be required to check this work closely, using the straightedge to see that the requirement for surface smoothness is met across the "joint”. When hand raking is performed on a joint,

all segregated coarse aggregate should be removed and discarded, to avoid a coarse, porous surface at the joint.

Particular attention must be given to the construction of the longitudinal joint when paving adjacent to a cold, previously laid lane. The Inspector must insist that hand raking be held to a minimum, by adjusting the screed so that the freshly laid pavement is of the proper depth, allowing for compaction, to meet the grade of the previously laid lane. The non-compacted mixture immediately adjacent to the joint should be left slightly high so that the roller can compact the mixture thoroughly at this point. The individuals raking must not be allowed to cast excess mixture over the non-compacted, freshly spread lane. All segregated course particles of mix remaining after shaping the joint must be removed and wasted, to avoid construction of a coarse, porous joint.

If there is to be more than one bituminous plant mix layer the longitudinal joints should be staggered so that they will not be directly over each other. Thus, for a pavement on a binder layer on a base layer, the joint in the base layer should be at least six inches off center toward one side, the joint in the binder should be at least six inches off center toward the other side, and the joint in the wearing layer should be on the centerline as outlined in Item 4l0.03(h)2.

Engineering and Inspection

The Contractor is responsible for providing alignment control for each plant mix layer. This control usually consists of measurements that can be taken from the previously established "prime line" in order for the Contractor to set his/her guide string line.

The location, type and pounds per square yard of mix to be placed, width of each layer and cross slope will be indicated on the Plan Typical Section Sheets. In some cases, width transitions will be indicated on the Paving Layout Sheets. On projects that provide Base and Paving, as well as Grade and Drain in the same contract, the poundage per square yard may be changed from that shown on the Typical Section Sheet due to pavement re-documentation during the course of the project and the Engineer must be aware of these changes.

Asphalt Plant checkout and control will basically come under the direction of a Materials Engineer furnished by the Division Materials Section and will be under the supervision of the Division Materials Engineer. The plant mix material shall be measured by a qualified Weighmaster using acceptable mass tickets. As a minimum the mass ticket shall contain the name of the producer, name of Contractor, Project Number and County, truck number, contract item number, date, gross weight, tareweight, net weight and Weighmaster signature. The remaining responsibilities of project personnel will be at the "lay-down" site and the following checklist is provided as a guide for the Inspectors in the performance of their duties:

(1) Is a copy of the approved plant checkout sheet as completed by the Division Materials Section on file? Is a copy of the job mix formula for the type material being placed on file? When component sources or quality changes is there an updated job mix formula on file?

(2) Is the supplier, which is shipping liquid asphalt to the plant, on the Department's MSDSAR? Is each shipment accompanied by Certificate of compliance**, BMT-146**? If not, are job control samples being taken on each shipment? Are Certificates of Compliance, **BMT-146**, on file for the tack material being used or are job control samples being taken.

(3) Are weigh tickets for commercial aggregates stamped with **BMT-10**? Is weigh ticket for aggregates delivered to project that are being paid for by weight signed by a qualified Weighmaster and is it being validated with the signature of the project field inspector?

(4) Are copies of the asphalt plant inspector's daily extraction tests**, Form BMT-20** on file?

(5) Is each truck load of plant mix delivered to the project accompanied with appropriate weight ticket signed by a qualified Weighmaster and is it being validated with the signature of the project field inspector?

(6) Is the temperature of the mix being checked periodically at the point of delivery and recorded on the weight ticket? Is temperature within specified delivery range? (Suggest at least five checks per day and more frequently if temperatures are not uniform. A small hole should be provided in the side of each truck bed to accommodate the Inspector's Thermometer.)

(7) Is the underlying surface properly prepared, tack material in good shape and guide string in- place prior to spreading plant mix? Are edges not confined by curbing or other structures being tamped and shaped immediately behind the placement operation?

(8) Is the asphalt spreader maintaining a continuous forward movement by coordination of speed of spreader movement with plant production?

(9) Is the rate of spread being appropriately checked periodically? Suggest a minimum of five checks per day utilizing a taped distance for a load of plant mix. Rate of spread should be continuously checked with depth measurements. No recorded documentation of these checks will be required other than a statement in the Daily Inspector's Report that they are being made. **Form BMT-4** is to be completed for each 5000 square yard unit or day of operation and this form will serve as documentation of the average rate of plant mix placed.

An example of checking the rate of spread utilizing a taped distance is as follows:

Assume:

Lbs. of Plant Mix on truck =40,000 Width of spread = 12 ft.

Rate per sq. yd. = 300 #/sy.

Solution:

$\frac{(L)\ (12)}{9}$ X 300 #/sy = 40,000 Ibs.

$L = \frac{40{,}000 \text{ X } 9}{3600} = \frac{40{,}000}{400} = 100$

L = 100 feet (This measurement to be made ahead of spreading the truckload of plant mix.

If truck does not go the pre-measured distance, rate is too heavy or if it goes beyond the 100 feet, rate is too light.)

(10) Tack records will be documented on **Form BMT-4**. It will also be necessary to record individual shots in a field book set up as follows:

Sta.	Sta.	Hot Gals. Before	Hot Gals. After	Hot Gals. Used	Gals. @ 60°F	Sq. Yds.	Rate

(11) Is the Contractor using good workmanship in the construction of transverse joints to obtain a smooth riding joint?

(12) Is the Contractor beginning his/her straight edging operation immediately after initial rolling and continuously correcting deficiencies behind the placement of the fresh mix? An Inspector must be present during the straight edging and mark all areas for correction that are not within the tolerances of Article 410.05. A comment should be made in the Daily Inspector's report concerning the general areas requiring correction and how the correction procedures are progressing. During the placement of the fresh plant mix, the Engineer should also periodically check the cross section of the pavement with the use of a template, engineer's level and/or string line.

(13) Is the plant Inspector submitting information on the mixture's maximum theoretical density?

(14) Are cores being cut or nuclear gauge density checks being taken as soon as practical (While mat is still warm) after placement so that any necessary corrective measures can begin immediately? Have nuclear gages been calibrated for the layer being placed?

(15) Have trucks, used for hauling, been checked to verify compliance with specifications? Are truck bodies being treated with an approved release agent?

TROUBLE SHOOTING GUIDE FOR PLANT MIX PAVEMENTS

CAUSES

PROBLEM	Fluctuating Head of Material	Feeder Screws Overloaded	Finisher Speed Too Fast	Too Much Lead Crown in Screed	Too Little Lead Crown in Screed	Overcorrecting Thickness Control Screws	Excessive Play in Screed Mechanical Connections	Screed Plates Worn Out or Warped	Screed Riding on Lift Cylinders	Moldboard or Strikeoff Too Low	Running Hopper Empty Between Loads	Cold Screed	Screed Plates Not Tight	Kicker Screws Worn Out or Mounted Incorrectly	Feeder Gates Set Incorrectly	Incorrect Nulling of Screed	Screed Extensions Installed Incorrectly	Screed Starting Blocks Too Short	Grade Control Mounted Incorrectly	Vibrators Running Too Slow	Grade Control Hunting (Sensitivity Too High)	Grade Control Wand Bouncing on Reference	Sitting Long Period Between Loads	Improper Mat Thickness for Max. Agg. Size	Improper Joint Overlap	Trucks Bumping Finisher	Improper Base Preparation	Improper Rolling Operation	Truck Holding Brakes	Reversing or Turning Too Fast	Parking Roller on Hot Mat	Improper Mix Design (Aggregate)	Improper Mix Design (Asphalt)	Mix Segregation	Moisture in Mix	Variation of Mix Temperature	Cold Mix Temperatures
Wavy Surface - Short Waves(Ripples)	0	0	0				0	0		0												0	0	0	0					X	X			X	X	X	
Wavy Surface - Long Waves	0					0	0	0					0	0								0			0	0			X	X	X		X	X			X	
Tearing of Mat - Full Width			0						0		0																X					X	X	X	X	X	X
Tearing of Mat-Center Streaks					0				0		0			0	0																						X
Tearing of Mat-Outside Streaks				0					0		0	0		0						0																	X
Mat Texture-Non-uniform	0	0	0					0	0	0	0		0							0	0					0		X				X			X	X	X
Screed Marks							0																					X	X								
Screed Not Responding to Correction			0				0	0		0												0					X									X	X
Auger Shadows		0																																	X	X	X	
Poor Pre-Compaction			0					0													0						X				X						X
Poor Longitudinal Joint	0	0				0		0														0	0	0		0					X						X
Poor Transverse Joint		0					0	0		0								0	0												X						X
Transverse Cracking (Checking)																															X	X			X	X	
Mat Shoving Under Roller																															X	X	X		X	X	
Bleeding or Fat Spots in Mat																																			X	X		X	X	
Roller Marks																															X	X	X	X			X	
Poor Mix Compaction																															X	X	X	X	X	X	X	X

Zeros (0) indicate causes related to the paver.

X's indicate other problems to be investigated.

NOTE: Many times a problem can be caused by more than one item, therefore, it is important that each cause listed is eliminated to assure the problem is solved.