SECTION 454 Preparation of Foundation for Asphalt Pavement

454.1 General

The preparation of the foundation for an asphaltic pavement is a critical operation and the smoothness of the finished surface will depend, to a great extent, on the smoothness and firmness of the foundation on which it is placed. Modern asphalt pavers will tend to eliminate sags or bumps in the pavement, but the best course is to eliminate such deviations in the foundation when possible.

The shaping of an aggregate foundation or base is often neglected or only partially performed. A combination of proper application of water, scarifying, or deep blading and using adequate compaction equipment operated in conjunction with the shaping operation is essential.

454.2 Subgrade

During inspection of the subgrade, the inspector should look for areas of soft or yielding soil that are too weak to properly support the paving equipment. These areas should be corrected before paving. Checks should be made of both the cross slope and longitudinal grade of the subgrade. The crown should be checked at frequent intervals and should be held to within a close tolerance of the crown shown on the plans. Variations in crown or superelevation are bound to be reflected in the finished mat. Such variations frequently cause an uncomfortable ride, and they are dangerous, affecting the steering and path of the vehicle. A good blade operator can shape the base to within 1/4 inch of the crown or superelevation specified (per lane pavement) or 1 inch per 100 feet of grade. Greater variations should not be allowed.

Usually, it should not be necessary to set grade stakes to get an acceptable crown and profile. Crown or cross slope can be checked readily throughout the shaping operation with a level board (a board with a level attached and a leg on one side equal to the height of the crown in the length of the board). Driving the base course at reasonably fast speeds will reveal sags or bumps that need correcting.

454.3 Crushed Aggregate Base Course

All base courses are to be shaped to plan grade, elevation, and typical cross section using red top stakes, unless these criteria can be met by other measures for control.

The base course must be shaped and compacted to the proper crown or transverse slope and to a smooth, true profile. A combination of the proper application of water, scarifying, or deep blading and using adequate compaction equipment operated in conjunction with the shaping operation should incorporate all the coarse "float" material into the base in most instances. Any excess material can be spread on the shoulders. Generally, the tendency is to use an insufficient amount of water in the shaping and compacting of an aggregate base, but in the case of a layer of aggregate over an old pavement, it is possible to saturate the base material to the extent that it loses stability.

The inspector should check for a smooth profile. It is not uncommon to find that the required elevation at each red top stake has been met by the grader, with a sag in profile between stakes.

As mentioned previously, the crown and cross slope should be checked frequently by the inspector, and deficiencies corrected by the contractor before paving.

454.4 Old Concrete Pavements

When an asphalt overlay is to be placed over old concrete pavement, the old pavement should be inspected to determine the need for any patching before the new overlay is placed. Many old concrete pavements, when uncovered by salvaging existing asphaltic overlays, are found to be in much worse condition than when originally resurfaced, and in need of extensive patching. If the old concrete pavement is not scheduled for rubblizing and must carry traffic, the asphaltic material is generally removed by milling part of it and leaving enough asphalt pavement in place to carry traffic until resurfaced.

Pavement that has broken into pieces that are 3 inches or less on any side or chunks that rock or move under normal traffic loads should be removed and the pavement patched. If the patching is to be concrete, the area removed and replaced should be large enough to resist movement under traffic. Asphaltic patches or road mix mats placed over old concrete pavement should be carefully inspected before covering with hot mix and any material of questionable stability removed. Waviness, shoving, or rutting of the old mat are direct evidences of instability. A rich-appearing, soft surface indicates either excessive asphalt content or migration of the asphalt to the surface. Any of these conditions can result in failure of the new hot mix mat.

Any asphaltic mat or patch that does not appear stable and "cured out" from the surface should be examined internally by cutting or chopping out sections. In many old mats, especially those mixed with slow curing oils, the asphalt has stripped from the aggregate in the lower portions of the mat and oxidized or migrated to the surface leaving the aggregate loosely bound. Mats in this condition should be removed. Mats or patches that are stable and cured out may be covered with a new hot mix mat.

All surplus crack and joint sealing material must be removed from the old pavement. All protruding joint materials, including fillers and sealers, must be removed down to at least the surface of the old pavement. Ordinarily, it is not necessary to remove such joint materials below the old pavement surface unless the sealer characteristics are likely to cause bleeding or instability of the new surface over the joint areas.

Some contracts may require an existing concrete pavement to be cracked and seated before overlay. The intent of cracking is to create concrete pieces small enough to reduce joint movement and reflective cracking, yet still large enough and with enough aggregate interlock to maintain most of the pavement's original strength. The intent of seating is to set the cracked pieces firmly on the subgrade and to eliminate voids under the concrete. Refer to standard spec 340.

Equipment used to crack the pavement must consist of a vehicle-mounted spade or guillotine-type cracker, capable of exerting at least 12,000 ft-lb. of energy, and must not cause undue displacement of the concrete, damage to drainage structures or utility lines, or displace the base or subgrade. A vibratory roller is used to seat the pieces.

Cracked pieces are to be approximately 4 to 8 square feet in surface area, with the greatest dimension oriented at right angles to the road centerline. Breaking should not be done within 30 inches of a transverse joint. After being firmly seated and before use by traffic, the surface should be swept clean. Sweeping should be repeated before overlay.

454.5 Old Asphaltic Surfaces

The principles outlined in the section about old concrete pavement patches may also be applied to patches in old asphaltic surfaces. The asphalt in rich or uncured patches will soften under the elevated temperature of the hot mix and infiltrate the mixture, causing it to soften.

Some contracts may require the existing asphaltic pavement to be milled off for salvaging. The milling machine is to be self-propelled and specially designed and constructed for milling pavements without tearing or gouging the underlying surface. The teeth must be spaced on the drum to mill an acceptable surface finish. The drum must be shrouded to prevent discharge of any loosened material into adjacent work areas or live traffic lanes. An acceptable dust control system is required. The machine must also be equipped with electronic devices which will provide accurate depth, grade and slope control.

The milling operation is to be done in a manner to prevent damage to the remaining pavement. It should result in a reasonably uniform plane surface free of excessively large scarification marks, and with the uniform transverse slope required on the plans or directed by the project engineer. The sequence of the milling operations should be such that no exposed longitudinal joints two inches or more in depth remain during nonworking hours and one lane of the roadway is maintained for traffic at all times during actual construction operations. Windrowing or storing of the salvaged asphaltic pavement on the roadway should only be allowed in conjunction with a continuous removal and pick-up operation. Unless waived by the project engineer on a highway closed to traffic during nonworking hours, the roadway must be cleared of all materials and equipment. Shoulders adjacent to the salvaged asphaltic pavement area must be graded to provide positive drainage of the pavement by the end of each working day.

454.6 Tack Coats

454.6.1 General

Tack coat consists of the application of an asphaltic material to an existing pavement or to lower layers of asphaltic pavement before overlaying. Tack coats are intended to enhance the bond between existing pavements and new asphaltic surfaces and at the interface between layers of asphaltic pavements. Research has shown that the bond developed between the layers is critical in providing long-term performance of an asphalt pavement.

454.6.2 Applications

454.6.2.1 General

The surfaces to which the tack coat is to be applied must be clean and dry. The surface may be pre-wetted before applying tack coat material, though no standing water is allowed. The tack coat should not be applied before impending rain.

Normally, the road is kept open to all traffic during the performance of this work. Tacking operations must be planned and prosecuted so traffic will be adequately provided for without harm to the work.

The surfaces of structures, railings, curbs, gutters, and pavements designated to remain in place without resurfacing must be protected from being spattered or marred.

Care must be taken that the water from the emulsion has evaporated before paving over the tack coat. Otherwise, the resultant water vapor may inhibit the bond between the two surfaces and contribute to premature pavement failure.

454.6.2.2 Distributor

Tack coat is applied with a truck or trailer-mounted distributor that can evenly distribute the asphaltic material across a variable width surface at the typical rates outlined in CMM 454.6.2.5. A hose and spray nozzle attachment is provided for applying the asphaltic material around islands, radii, and other areas not accessible to the distributor spray bar. Areas may be protected with materials such as asphalt roofing felt to prevent areas from being sprayed inadvertently.

The spray bar of the distributor should be adjusted so that the nozzles are vertical. Nozzles should also be set at an angle of 15 to 30 degrees from the long axis of the spray bar to prevent the fan-shaped spray patterns of each nozzle from interfering with one another while still providing sufficient overlap. Each nozzle should be set at the same angle. The two outside nozzles should be set so their spraying pattern is parallel to centerline of the highway. The spraying pattern should be checked regularly for full and even coverage. The distributor should not be allowed to operate with clogged or improperly set nozzles.

Another key spray bar adjustment that is essential for uniform coverage is adjustment of the spray bar height. The fan-shaped spray patterns from the nozzles overlap to different degrees, depending on the distance between the spray bar and the surface to be covered. The spray bar should be set high enough above the roadway for the surface to receive double coverage. This height will vary according to the nozzle spacing of the spray bar and the angle at which the nozzles are set.

454.6.2.3 Asphaltic Material

The asphaltic material must be one of the emulsified asphalt types listed in standard spec 455.2.5 unless otherwise specified in the contract. Cutback asphalts are not allowed. In order to meet the 50% Residual asphalt content of as-placed material specified in standard spec 455.3.2.1, the following information must be provided to the department:

- Residual asphalt of the original emulsion on the bill of lading.
- Dilution rate of the original emulsion on the bill of lading.
- Any further dilution provided in writing to the department.
- Calculations of residual asphalt content provided in writing to the department following Example 1.

Example 1: Residual Asphalt Content of As-Placed Material

The residual asphalt in the original emulsion is 63.5% which means it has 36.5% water. The dilution rate of the emulsion is 80/20 (80% orig. emulsion / 20% water).

Residual Asphalt Content of As-Placed Material = 63.5% * .80 = 51%[1],

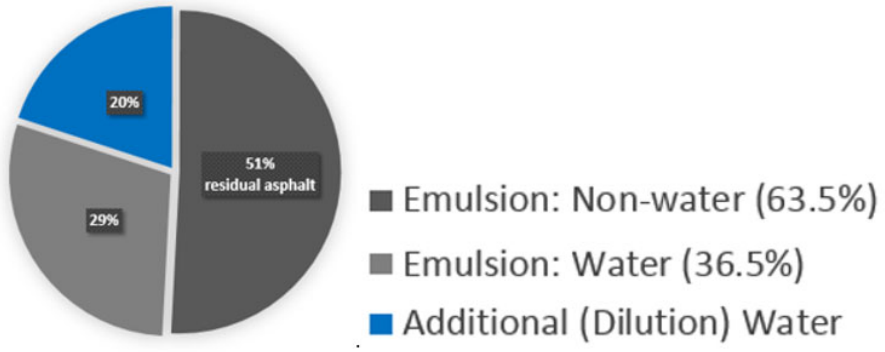
Water content in emulsion= 36.5% * .80 = 29%

Water added to emulsion = 20%

Total water = 29% + 20% = 49%

1. The As-Placed Materials meets the minimum requirement of 50% for Residual Asphalt Content

A graphical representation of this example is:



454.6.2.4 Temperature

The temperature of the asphaltic material at the time of application should be between 68 F and 158 F to allow ready application. The air temperature should be 40 F or more.

454.6.2.5 Rate

The tack coat is normally placed in a single application at a rate approved by the project engineer. The emulsified asphaltic material should be applied as a uniform fog spray which leaves a coat about as thick as a light coat of paint. A suggested initial application rate is 0.05 gal/SY on new surfaces and 0.07 gal/SY on older or milled surfaces. This rate may have to be adjusted after initial application and observation.

454.6.3 Measurement and Payment

Asphaltic materials for tack coat will be measured by volume in gallons or tons as provided in the contract. Emulsified asphalts required to be diluted will be measured after dilution and the volume measured for payment will include the volume of water required for dilution.

When measurement is by the gallon, the quantity determined by volumetric calibration of tanks must be corrected to a temperature of 60 F. A corresponding temperature should be recorded for each volumetric reading taken. Any amount wasted or otherwise not incorporated in the work should be deducted.

Example 1: Volume Correction for Emulsified Asphalt

2,000 gallons of emulsified asphalt at a temperature of 120 F were used.
Use the equation in standard spec 455.4.1 to determine the pay volume.
V =2,000/(0.985+0.00025*120) = 1,970 gallons

Measurement by the ton will be based on net weights of asphaltic materials shipments less the weight that is wasted or otherwise not incorporated in the work.

454.7 Drainage and Utility Fixtures

Street fixtures such as manholes, catch basins, and utility fixtures must be adjusted before or during an overlay or resurfacing operation.

It is difficult to anticipate final elevations before placing of the leveling layer and the first pavement layer, and thus to preset manhole covers and other castings encountered in municipal work to the proper elevations. To avoid unsightly patching in the surface course, the contractor may choose to reference the locations of the underground structures, pave over with the leveling or lower layer course, and then dig out and adjust the height just before placing the upper layer.

Adjustments of manhole, catch basin, or inlet covers or frames should be carefully performed and inspected. Observations of structures of various ages have disclosed numerous cases where the covers have settled below the adjacent pavement or gutter, and investigation has revealed that the materials used to support and adjust the cover have deteriorated to the extent that such materials could either be removed by hand or had already fallen into the structure. Such conditions are the result, at least in part, of the improper methods used in setting or adjusting the covers when they are installed. Covers are often observed temporarily supported on a variety of shims or wedges while the adjacent pavement is being placed. Later, a cosmetic layer of mortar is applied from the inside of the structure, with little, if any mortar getting under the flange of the casting. This practice is prohibited. Covers should be set on a full bed of mortar.

Adjustment castings or rings are often used to accommodate an overlay. Some rings are of the adjustable universal type while others must be ordered in depths to fit the individual manhole, etc. When covers are badly tipped, adjustment rings should not be used; instead, the frame should be adjusted or reconstructed. After they are raised and before the overlay, exposed fixtures should be marked with flags or barricades to denote a hazard.

454.8 Leveling Layer

On new base course, there should be no occasion for a leveling layer if the base has been properly prepared. When resurfacing old pavements, the foundation on which the surfacing is to be placed should first be checked for sags, bumps, changes in crown, and rate of superelevation. It is recommended all disclosed irregularities not corrected by milling or grinding be corrected so far as possible by placing leveling layers before starting the placement of the upper layer. Such irregularities cannot feasibly be corrected by varying the thickness of the new pavement layers, or by relying on the paving machine to automatically compensate for such irregularities. The leveling action of the paving machine will tend to smooth out short sags or bumps, but the longer undulations and sudden changes in crown, which are objectionable to fast moving traffic, generally cannot be corrected by the equipment alone. The ideal condition would be to correct all irregularities with the leveling layers so the upper layers could be placed without making any thickness adjustments. This is never entirely accomplished, so any remaining irregularities should be watched for and corrected with each successive layer.

Checking of the foundation can be accomplished in a variety of ways. One way is to drive the job at various speeds, taking note of places where corrective work is needed. Stakes or other markers can be thrown from the car to the shoulder in passing to indicate areas requiring further investigation. These locations can then be stringlined to locate the ends of the required leveling layer. These limits may be marked on the pavement, along with required depth of the lift, at frequent intervals not exceeding 30 feet. As an alternative, profiles may be taken at the centerline and pavement edges. After an acceptable grade line is established, it should be referenced to offset stakes, or a stringline reference should be erected for use with automatic controls.

The superelevation of curves on old pavements may need correction to current standards, either by increasing the rate of superelevation or removing the crown, or both. The depth of required wedging can be determined from observations at 60-foot intervals around the curve with a hand level or stringline level and comparing the slope in the old pavement with the slope of the new pavement. The thickness of the leveling layer required to correct the superelevation should be marked on the pavement at the edge and the centerline. The transition from normal crown to superelevation should be the distance indicated on the plans for the new pavement.

The specifications allow the leveling layer to be placed either by hand, by blade grader or by asphaltic paver. Hand methods will generally be limited to small areas where it is impossible or impractical to use mechanical means.

When using the blade grader to place the leveling layer, the asphaltic mixture is spread on the pavement in a thin layer directly from the dump truck. A roller, preferably pneumatic-tire, should work in conjunction with the blade at all times during this operation. The material should be shaped and compacted in thin layers. Additional material should be added as needed, but without dumping an excess of material that would be wasted. The surface profile and cross section should be checked throughout the operation. Profile can be checked with a long stringline stretched tight to detect sags or depressions. Crown can be checked with a straightedge and carpenter's level, line level, or hand level.

Better results are obtained when placing leveling layers with the asphaltic paver equipped with the automatic screed control system. When the stringline is used as a reference, great care is needed in setting the grade line to provide the proper minimum thickness of cover over the controlling high spots in the base while taking into consideration the predetermined cross slope.

When the automatic screed control system is not used, the amount of profile improvement depends largely on the ability of the screed operator to anticipate the required thickness of the course at any point and make the necessary adjustments far enough in advance, so it is obtained. If the variations in thickness or crown are small and gradual, acceptable results can be obtained by this method, but if the changes are extensive, complete correction of the irregularities may not be realized. Also, any attempt to visually follow a stringline or other reference set to the desired grade usually fails due to over-manipulation or under-manipulation of the screed controls.

Regardless of the method used to lay leveling layers, the maximum thickness placed at any time is not to exceed 3 inches in compacted thickness. Where the required thickness of the leveling layer cannot be placed in a single layer, the surface of each layer should be parallel to the finished grade starting with a short pass in the area needing the most correction. Each layer should be feathered out at the ends and each successive layer should overlap the ends of the previous layer until the desired surface profile is obtained. Unless each layer is feathered out, a bump will be reflected in the finished surface where the leveling course began and ended.

To obtain acceptable compaction, the minimum thickness of a leveling layer should conform to the thickness and gradation requirements of standard spec 460.3.2 and in no case be less than 1 inch. "Scratch Coats," which get their name from marks left by aggregate being dragged by the screed, should never be used as they cannot be acceptably compacted.

Between each successive layer or course, the job should be driven to locate areas where further improvement of the profile, crown, or superelevation can be accomplished. By stringlining the pavement ahead of the paver, sags are detected and can be marked for correction, either as a separate operation or in conjunction with placing the next layer or course.

Materials used to construct leveling layers will be measured and paid for under the pertinent contract items if the plan contains a quantity for leveling layer. In the absence of a plan quantity for leveling layer, it will be paid for as extra work in accordance with standard spec 104.2.

454.9 Milling Adjacent to Concrete Curb and Gutter

When milling pavement adjacent to curb and gutter the engineer and contractor will review the existing curb and gutter adjacent to planned milling operations prior to the start of the milling operations. The

engineer and contractor will agree on the existing curb and gutter to remain in place and the curb and gutter to be removed and replaced or repaired under the contract.

Typical urban rehabilitation projects include spot replacement of curb and gutter in addition to milling of the existing roadway surface followed by an overlay. To the greatest extent practicable, the contractor shall conduct work operations to avoid damage to curb and gutter. If project staging or traffic needs dictate milling work to follow curb and gutter placement, some minor damage to the new curb and gutter is expected.

In situations where milling cannot occur prior to curb and gutter replacements the engineer and contractor should consider:

- Prohibiting forming new curb and gutter against old pavement.
- When new HMA pavement or HMA patching is planned to be paved adjacent to new curb and gutter, leave the HMA pavement or patch below the flag-line of the curb and gutter equal to the depth of the proposed milling. The HMA may be tapered at a 4:1 slope to match the existing pavement.
- Consider paper joints in areas where new HMA pavement cannot be left down, i.e. at pedestrian ramps, etc.
- If project schedule requires milling existing pavement adjacent to new curb and gutter, minor damage to the flag and pan of the new curb and gutter may occur. The engineer and contractor shall review after milling operations and again after HMA paving operations are complete. Minor to moderate damage to the flag and pan of the new curb and gutter may be repaired with approved concrete surface repair materials where the damage would create significant drainage issues. Areas exhibiting significant damage will be removed and replaced.