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Surface Preparation

Learning Outcomes:

- List the steps involved in preparing bases and existing pavements for overlays.
- Understand how base surface properties impact paving decisions
- Recognize drainage considerations in creating lasting pavement structures

Surface Preparation

The performance of AC under traffic is directly related to the condition of the surface on which the pavement layers are placed. For a full-depth asphalt pavement, if the condition of the subgrade soil is poor (particularly if it is wet and rutting under the haul trucks), then the ultimate life of the roadway may be significantly reduced. For AC layers placed on top of a new, untreated granular base course, that base material should be stable, the surface should be dry, and the base should not be distorted by the trucks carrying mix to the paver. For mix laid on top of existing asphalt layers, that surface should be properly prepared – potholes filled, cracks sealed, and the surface cleaned. A tack coat shall also be used to ensure a bond between the existing pavement surface and the new asphalt overlay unless exempt per specification

Base Preparation for New Flexible Pavements

Subgrade Soil

If the asphalt pavement is to be placed directly on the subgrade soil, that subgrade material should meet all applicable specifications for moisture content, density, structural support, grade and uniformity. After the subgrade soil has been determined to be ready for paving and before paving is allowed to commence, the subgrade should be checked to ensure that it will be able to support the weight of the haul traffic. The subgrade must provide a firm foundation before the asphalt paving begins. If distortion of the subgrade soil occurs during the paving operation, placement of the mix should be stopped until the condition of the soil can be corrected.

Unless required in the contract, there is no need to place a prime coat of asphalt emulsion or cutback asphalt on the subgrade soil. This is especially true when the soil is a silty clay or clay material because the prime coat material cannot be absorbed into that subgrade material. The use of a prime coat on sandy subgrade soils is also questionable. If the sandy material displaces excessively under the wheels of the haul trucks, it should be stabilized with some type of binding material before paving to achieve the required load-bearing properties. In such cases, the application of a prime coat will generally not be enough to hold the sandy soil in place during paving operations. A prime coat should not be used as a substitute for proper preparation of the subgrade soil.

BEST PRACTICE

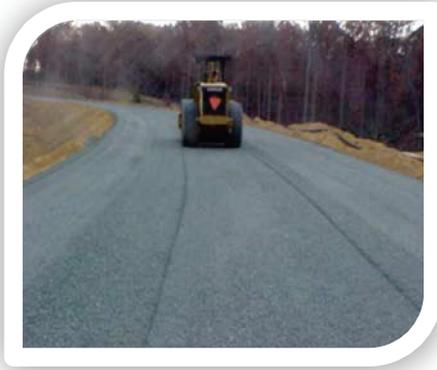


The subgrade material and/or granular base layer should meet all the specifications for moisture content, density, structural strength, grade and uniformity.

Describes a best practice to be utilized when possible.

Granular Base Course

If the asphalt layer is to be constructed directly on a new or existing untreated granular base layer, that base material should meet all the specifications for moisture content, density, structural strength, grade



and uniformity. As a final test of the base layer, proof rolling should be done, on top of the granular base material, and the amount of deflection of the base and the amount of indentation of the truck wheels in the granular base course material should be noted. If the base material is stable and dry and does not deflect and indent significantly under the wheels of a loaded tandem-axle truck, placement of the prime coat or the new asphalt mix should be permitted to start. If the

condition of the granular material is not satisfactory, the base course should be reworked or stabilized until it is in the proper condition for overlaying.

DEFINITION



Proof Rolling

A physical compaction test performed with a rear tandem axle dump truck with a gross weight of 50,000 pounds. The loaded dump truck will roll over the soil subgrade where the proposed concrete curb or asphalt concrete is to be placed. As the proof roll truck at two to five miles/hour rolls over areas being tested and does not yield or pump, it is considered passing and suitable for curbing and asphalt placement.

Describes and/or defines terminology.

When required, the prime coat acts as a temporary waterproofing layer that protects the base course and prevents it from absorbing excess moisture during rain before paving. It also allows the base course to be used for light traffic, binds together any dust on the surface of the granular base layer, promotes the bond between the base-course material and the new AC overlay, and prevents slippage of thin overlying pavement layers. Prime coats are only required by specification under stabilized open graded drainage layers, unless otherwise noted on the plan. Some contracts require the use of prime coats on secondary roads and subdivision streets.

AWARENESS/IMPORTANT

Use cutbacks carefully because they pose an environmental risk. These materials are primarily composed of different fractions of petroleum oil, and can be washed into nearby creeks and streams if applied before a heavy rain.

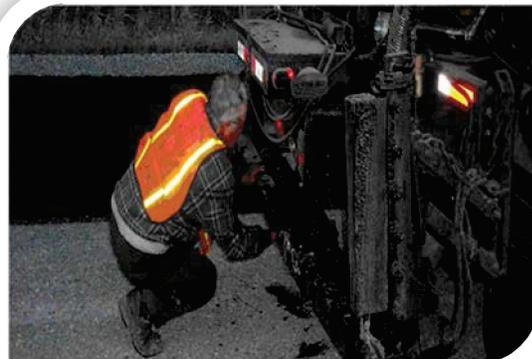
Highlights a step in the procedure which is either unusual or very particular to this procedure. May also indicate awareness (additional information) or a cautionary concern in the procedure.



When a prime coat is used, the prime coat material should be applied to the base course with a pressure distributor at least 4 hours before paving is to begin. Typically, cutback asphalt (MC-30 or MC-70) is used as the prime coat material. An inverted asphalt emulsion (emulsion containing limited amounts of cutter stock material) also has been applied successfully. The application rate should vary with the

openness (porosity) of the base course material. Typical application rates range from 0.15 gal/yd² for a very tight surface to 0.40 gal/yd² for an open surface.

No more prime coat material should be applied than can be absorbed completely by the granular base course in 24 hours. If all of the prime coat material is not completely absorbed, the excess should be blotted with sand and removed.

**AWARENESS/IMPORTANT**

A prime coat is not required on aggregate subbase or base materials prior to the placement of asphalt base, intermediate or surface layers, unless it is specified in the contract documents.

Highlights a step in the procedure which is either unusual or very particular to this procedure. May also indicate awareness (additional information) or a cautionary concern in the procedure.

Preparation of Existing Surfaces for AC Overlays

AC over AC

The degree of preparation needed for an existing asphalt pavement depends on the condition of that surface. At a minimum, failed areas should be removed and replaced; potholes properly patched; cracks cleaned out and sealed; and ruts filled in or, preferably, removed by cold milling.



Pavement Replacement and Patching – Removal

and replacement should be carried out on all existing pavement areas where severe load-related distress has occurred. Subgrade distortion should be repaired by undercutting and replacement with suitable backfill material. Proper sub-surface drainage should be installed as necessary. New granular base course material, stabilized base course layers, or AC mix should be placed in order to bring the strength of the pavement structure in each failed area to the same level as the surrounding good pavement layers. Localized failed areas should be patched properly.

BEST PRACTICE



Each distressed area should be cut back to sound pavement and squared up, with the sides as vertical as possible, the loose material and water in the hole removed, a tack coat applied to the sides and bottom of the hole, the mix placed in the hole, and the new material adequately compacted, preferably with a roller. If the pothole is deeper than 4 inches, the mix should be placed in more than one layer and each layer compacted properly.

Describes a best practice to be utilized when possible.

Crack Filling

Badly cracked pavement sections, especially those with pattern cracking (e.g., map or alligator), must be patched or removed. If the cracks are narrow, less than 1/8 inch wide, it is doubtful that the crack-sealing material will actually enter the crack instead of pooling on the pavement surface. If wider cracks are present, they should be blown out with air and cleaned of debris. The crack-sealing material should be inserted when the cracks are clean and dry. If that pavement structure contains a great number of cracks, consideration should be given to applying a surface treatment instead of filling individual cracks.



Leveling/Scratch Courses

Common practice in the past has been to place a leveling course on the existing pavement surface to improve the rideability of the pavement structure. This leveling course, sometimes called a wedge course or a scratch course, is designed to fill in the low spots on the pavement surface. This leveling action is accomplished using the floating screed on the paver, with more AC being placed in the low spots than on the high spots in the existing pavement surface since the areas with thicker mix typically compact more than areas with thinner mix.

This problem, termed differential compaction, requires that multiple courses be constructed over a pavement surface that is badly out of shape before a smooth surface can be obtained. As the mix passes from under the paver screed, it is in loose condition. Compaction by the rollers reduces the thickness of the newly placed layer. The rule of thumb is that conventional mixes will compact approximately $\frac{1}{4}$ inch per 1 inch of compacted thickness. Thus to achieve a compacted course 1 inch thick, about $1\frac{1}{4}$ inch of mix would have to be placed by the paver. Similarly, approximately $3\frac{3}{4}$ inches of mix would need to pass from under the paver screed to construct a layer with a compacted thickness of 3 inches. With gap graded mixes (i.e., SMA) and open graded mixes (i.e., porous friction course and open graded drainage layer), the amount of compaction is much less – approximately $\frac{1}{8}$ inch per 1 inch compacted thickness.



When a leveling course is placed, the AC placed in the low areas (in the wheel paths if the pavement is rutted) will be thicker than the mix placed over the high points in the surface (between the wheel paths). The thicker mix will compact more under the rollers, particularly if a pneumatic tire roller is used, than will the mix that is thinner. Thus, low spots will still exist in the wheel paths where the mix has been compacted to a different degree (and thus a different air void content) than the mix between the wheel paths. Because of the problem of differential compaction on very rough roads, multiple layers of mix are usually needed to completely eliminate the roughness in the existing pavement surface.

BEST PRACTICE

A rule of thumb is that one layer after compaction will remove approximately 80 percent of a low spot. Two layers, each being compacted separately, will remove approximately 95 percent of a low spot.

Describes a best practice to be utilized when possible.

Milling

Milling, also called cold planing, can be used to remove the high points in the existing surface in lieu of placing a leveling course (filling in the low spots) and to remove deteriorated pavement layers. Milling can be accomplished in any width necessary, from 6 inches to more than 13 ft. Equipped with automatic grade and slope controls similar to



those used on an asphalt paver, the milling machine is capable of producing a level surface in one pass over the existing surface. In addition, if the milled surface is properly cleaned, its texture can enhance the bond between the new



and old asphalt mat and may reduce the possibility of slippage of the overlay on the existing surface. The RAP produced by the milling process can be hauled back to the asphalt plant for future recycling.



A pavement surface that has been milled is typically very dusty and dirty. Once the pavement has dried, multiple sweepings with a mechanical broom are usually needed to remove all of the residual grit from the milled surface. In some cases, it may be necessary to dampen the milled surface before sweeping or

to air blow or flush the milled surface with water to remove dust and very fine material completely.



Also watch for “scabbing” where the milling machine leaves patches of uneven pavement. These areas may pop loose under traffic and take part of the new overlay with it.

AWARENESS/IMPORTANT



By milling and putting back the same lift thickness, bridge and guardrail clearance are properly maintained as well as providing the necessary interface with adjoining curb and gutters.

Highlights a step in the procedure which is either unusual or very particular to this procedure. May also indicate awareness (additional information) or a cautionary concern in the procedure.

AC over Concrete Pavement

When AC is placed over a Portland cement concrete (PCC) pavement, the PCC surface should likewise be properly prepared. Any severely distressed areas in the concrete slabs should be cut out, removed, and replaced with either PCC or AC using full-depth slab repair techniques. Corrective work should also be completed on the underlying sub-base or subgrade material. Any severely spalled areas at joints should be repaired using partial-depth slab replacement methods, AC or PCC may be used for partial-depth repairs. Rocking slabs should be stabilized. Depending on the condition of the PCC pavement, procedures such as crack and seat, break and seat, or rubblization of the existing pavement can be used before the overlay is placed, particularly if the slabs are rocking under traffic loading. Consideration can also be given to the use of a crack-relief layer between the existing PCC pavement and the new overlay.

For joints that are poorly sealed, the old seal material – particularly rubberized, should be removed and the joints cleaned. When dry, the joints should be resealed with appropriate joint-sealing material. Care

should be taken not to overfill the joints, particularly in cool weather when they are open wide. In all cases, as with crack sealant, the final level of the joint-sealing material should be below the top of the surrounding pavement surface. Once the patching and resealing have been accomplished, the surface of the PCC pavement should be cleaned completely using mechanical brooms and air blowing or water flushing, or both, where needed.



Tack Coat

The purpose of a tack coat is to ensure a bond between the existing pavement surface and the new asphalt overlay. The tack coat should not be used in lieu of cleaning the existing surface – removing accumulated dust and dirt by mechanical brooming or by flushing with air and water. If a good bond is not formed between the existing surface and the new overlay, slippage and delamination may occur.

The new overlay may be shoved in a longitudinal direction by traffic, particularly at locations where the traffic accelerates or where vehicle brakes are applied. Delamination occurs when the two layers are no longer bonded. This creates a failure plane in the pavement structure and reduced the AC materials life. Thus the pavement surface must be clean before the tack coat is applied.



AWARENESS/IMPORTANT



Remove dried, caked mud and other foreign material. Spilled asphalt should be shoveled or picked up (especially if placing a thin overlay).

Highlights a step in the procedure which is either unusual or very particular to this procedure.
May also indicate awareness (additional information) or a cautionary concern in the procedure.

The tack coat material – which is normally asphalt emulsion but can also be asphalt cement – shall be applied by a pressure distributor. All nozzles on the distributor should be fully open and functioning and should be turned at the same angle to the spray bar, approximately 30 degrees. In addition, the spray bar should be at the proper height above the pavement surface to provide for a double or triple lap of the liquid asphalt material. The result will be the proper amount of overlap between the nozzles and a uniform application of the tack coat to the road surface. The tack coat material should be heated to the proper temperature so that it is fluid enough to be sprayed uniformly from the nozzles instead of coming out in strings.

Application Rate Versus Residual Rate

Uniformity of application and a proper application rate are keys to achieving a successful tack coat. If the correct amount of tack coat is sprayed on the surface, some of the existing surface will still be visible through the tack coat; not all of the existing pavement surface will be covered. Use of a diluted asphalt emulsion tack coat (slow-setting asphalt emulsion diluted 1:1 with water) will result in complete coverage and a very thin residual asphalt film on the pavement surface. In general, proper tack coat application will leave a residual asphalt cement content of approximately 0.04 to 0.06 gal/yd² on the roadway. The amount of residual tack coat needed will depend on the condition of the pavement surface and the tack coat material used. An open-textured surface requires more tack coat than a surface that is tight or dense, and a dry, aged surface requires more tack coat than a surface that is “fat” or flushed.

It is essential to differentiate between the residual tack coat rate (the amount of asphalt cement remaining on the pavement surface after the water has evaporated) and the application rate (the amount of emulsion sprayed from the distributor). Most asphalt emulsions contain 60-65 percent residual asphalt cement and 35-40 percent water, plus a small amount of emulsifying agent. For ease of calculation, it can be assumed that an asphalt emulsion is approximately two-thirds asphalt cement and one-third water. The amount of asphalt cement left on the pavement surface after the water has evaporated from the emulsion is the most important factor in obtaining a bond between the existing pavement surface and the new overlay. To determine the application rate for the tack coat material, start with the amount of residual asphalt cement required on the pavement surface and work backward.

If the amount of water in an asphalt emulsion is not taken into account when determining the application rate from the distributor, the correct degree of adhesion may not be achieved. Too little tack coat will not provide sufficient bond between the old and new pavement layers. On the other hand, too much tack coat may contribute to slippage of the overlay on the existing pavement surface and bleeding of the tack coat material through a thin overlay. If asphalt cement instead of an asphalt emulsion is used as the tack coat material, the residual amount of asphalt on the pavement surface should be the same as the applied amount. Thus if 0.04 gal/yd² of residual binder material is desired, the application rate from the distributor should also be 0.04 gal/yd².

Breaking and Setting Time

When an asphalt emulsion is applied as a tack coat, it is brown in color because it contains both asphalt cement and water. After a very short period of time, the emulsion will break – change color from brown to black – and the water will begin to evaporate. The rate of evaporation will depend on the type and grade of the emulsion used, the application rate, the temperature of the existing pavement surface, and environmental conditions. Once all the water is gone, the emulsion is said to have “set.” The rate of set depends on the same conditions that control the rate of break of the emulsion. Under most circumstances, a conventional emulsion will set in 1-2 hours. For non-tracking emulsions, the set time may be as short as a few minutes.

New AC can usually be placed on top of an unset tack coat and even over an unbroken tack coat emulsion with no detrimental effect on pavement performance/ the bond will still be formed. While it is believed that the asphalt emulsion can be properly paved over before being fully set, and even before being broken it is also important that the tack coat material remain on the pavement surface to create the bond between the layers. If the tack coat material is not set and a significant amount of haul truck traffic runs over the unset material, much of the tack coat may be picked up by the truck tires and tracked down the roadway. Thus either the tack coat should be allowed to set before haul truck traffic is permitted to run over it, or the amount of truck traffic should be minimized.

If asphalt cement is used as the tack coat material, it will cool to ambient temperature very quickly. Further, because there is no carrier material (water) to evaporate, paving may immediately follow the asphalt cement tack coat application.

If the overlay is to be constructed under traffic, the tack coat is normally placed only a short distance in front of the paver – within the lane closure and far enough ahead for the tack to set properly before the AC is laid on top of it. Traffic is kept off of the tack coat at all times. If the roadway being paved is closed to traffic, the tack coat can be placed as much as 24 hours ahead of the laydown operation. Under unusual circumstances, if traffic must travel over the tack coat before the overlay is placed, a light layer of sand can spread on top of the tack coat to prevent its pickup by traffic. The application rate of the sand should be in the range of 4 to 8 lb/yd², depending on the application rate of the tack coat material and the gradation of the sand.

If equipment problems (plant or paver breakdowns) prevent tack coat material that has been applied from the distributor from being paved over before traffic must use the roadway, it is suggested that posted speed limits on that section of roadway be significantly reduced until the overlay operation can take place. It is not good practice to place the tack coat one day, permit traffic to run over the tack coat for a period of time, and then place the overlay at a later date. Depending on the amount of residual asphalt cement on the pavement surface and environmental conditions, the level of friction available for traffic at the pavement surface may be greatly reduced by the presence of the tack coat material. The excess tack will also be thrown on vehicles, creating a major public relations problem. In addition to lowering the posted speed limits, it may be advisable to apply sand to the tacked surface.

If a tack coat is used on a recently placed AC layer, the residual asphalt content could be minimal – in the range of 0.05 gal/yd².

AWARENESS/IMPORTANT



The application of tack coat material is essential when an overlay is being constructed on and old existing pavement surface – either AC, PCC or surface treatment.

Highlights a step in the procedure which is either unusual or very particular to this procedure. May also indicate awareness (additional information) or a cautionary concern in the procedure.

Drainage Considerations

AWARENESS/IMPORTANT



Drainage is an important part of the process of placing a long-lasting, high-quality pavement. Water is the enemy of all good pavement structures. It can weaken the subbase and/or base materials causing them to lose their structural stability and can result in failure of the overlying asphalt layers. Similarly, if water is able to enter the asphalt pavement itself either due to poor density or other factors, it will strip away the binder that provides the stone-to-stone bond. Aggregate particles that lose their asphalt coating will no longer be able to hold together and the asphalt mix falls apart, a phenomenon called raveling on the surface and stripping within the pavement structure.

Highlights a step in the procedure which is either unusual or very particular to this procedure. May also indicate awareness (additional information) or a cautionary concern in the procedure.

Correcting Drainage Problems Before Overlay

Keep roadside drainage systems clear of vegetation and other foreign material to allow rainfall to quickly be carried away from the pavement structure.

Proper Crown and Slope

Avoid creating “birdbaths” or low spots on the asphalt surface. This prevents water from quickly moving to drainage systems such as curb and gutter or roadside ditches. Give pavement an effective crown and an adequate slope to assure rapid transit of water off of the pavement surface.

Pavements built adjacent to a hillside that slopes toward the pavement structure should have a ditch or buried interception trench to keep water from working its way under the pavement layers. Significant damage can result from such water intrusion.



Curb and Gutter Elevations

Gutter systems that are higher than the adjoining asphalt surface serve little purpose. Water is allowed to collect on the asphalt surface and at the gutter joint instead of being conveyed away from the pavement to drop inlets or other parts of the drainage system.

Significant damage can result from failures to properly match the asphalt pavement to the curb and gutter system.



Chapter Two Knowledge Check

1. A prime coat on aggregate base is required on all state jobs.
 - a. True
 - b. False

2. The purpose of a tack coat is to ensure a bond between the existing pavement surface and the new asphalt overlay.
 - a. True
 - b. False

3. The material taken off the roadway when milling may not be used again.
 - a. True
 - b. False

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