VI. Preparation of Grade and Base

Cleaning & Preparation of Base

(Specification 2212)

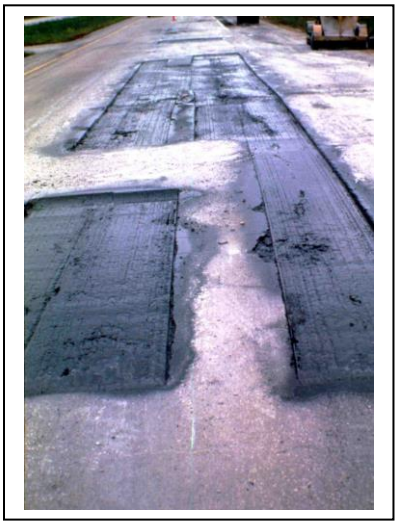
This item consists of cleaning and preparation of the base pavement prior to resurfacing with HMA. The contractor is typically required to do the following:

- Remove loose, spalled, and scaled material.
- Remove old patch and joint material, debris, and all other loose material that can be removed with hand tools.
- Clean cracks and joints by brooming and/or blowing out with forced air.

At the time of HMA placement, the entire base shall be free of any foreign material removed by scraping, air hose blast, or brooming. All materials removed from the pavement become the property of the contractor and should be taken off the project.

Base Repair

(Specification 2212)



In many cases, repairs to the existing base pavement are necessary prior to HMA resurfacing. Base Repair generally consists of surface patches, partial depth repair patches, and full depth repair patches.

Surface Patches

Surface patches occur where spalled concrete or patching material is removed for a depth greater than one

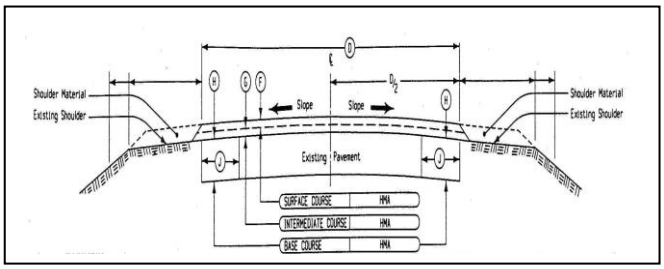
inch but less than the total thickness of the old pavement. The areas are cleaned, tacked and filled with hot mix in lifts not to exceed three inches. A weighted pneumatic tire or mechanical tamper may be used to compact the mix. The final compacted surface shall be level with to ¼" above the surrounding surface.

Partial Depth Patches
Partial depth patches are designated areas where the existing pavement is removed to a specified depth, usually by milling, and replaced by specified patching material to provide a new pavement surface.

Full Depth Patches
Full depth patches are designated areas where the entire pavement section is removed, subbase or subgrade is restored if necessary, and specified patching material placed to provide a new pavement surface.

Patching locations are tabulated in the plans, along with such information as: type of patch, patch dimensions, quantities, and jointing requirements. Thickness, materials, and other specification requirements are based on the type of patch designated in the plans.

Base Widening
(Specification 2213)



Base Widening is necessary when the existing pavement width is less than the design width of the proposed resurfacing. The work involved may consist of excavating the shoulder material, removing existing curb or

flumes, and constructing widened portions of base. The contract documents may designate PCC base widening, HMA base widening, or a contractor's option of these types. The plans will show the required total thickness of base widening to be placed. When the contractor's option is designated, payment will be based on square yards.

Application of Tack Coat

(Specification 2303.03, C, 2)

The purpose of tack coat is to ensure a bond between the existing pavement surface and the new hot mix asphalt overlay. A good bond can increase the overall structural strength of the pavement and prevent intrusion of water between the layers. If a good bond is not formed between the existing surface and the new overlay, a slippage or sliding-type failure can occur. The pavement surface must be completely clean and free of moisture before the tack coat is applied. The tack coat material, which is normally asphalt emulsion, should be heated to the proper temperature so that it may be sprayed from the nozzles and not come out in strings. Tack coats shall not be applied when the temperature on the surface being covered is less than 25 degrees F.

The amount of tack coat applied to the surface to be overlaid is very important. Too little tack coat can result in no bond between pavement layers. Too much tack coat promotes slippage or sliding between layers and bleeding of asphalt emulsion to the pavement surface. A pavement that is scarified (milled) requires more tack coat than other

surfaces since this process creates more surface area to cover. Rates of application and other requirements for tack coats are given in the contract documents.

Tack coat must cure or “break” before it is covered with hot mix asphalt. As water evaporates from the asphalt emulsion, the tack coat becomes “tacky” and changes from a brown color to black. The rate of water evaporation will vary depending on the type and grade of emulsion used, the application rate, the temperature of the existing pavement surface, and other environmental conditions.

Treatment of Fixtures

(Specification 2303.03, C, 7)

All manholes, intakes, valve boxes, or other fixtures encountered within the area to be covered by HMA shall be adjusted to conform to the final adjacent finished surface. All such fixtures should be identified on Tabulation 104-10 in the plans. Make sure the plan locations match field conditions. Tie out, to known reference points, the location of all fixtures that will be covered. This will minimize the search to uncover them later.

Unless indicated otherwise in the plans, the Contractor has the option of adjusting fixtures prior to placing the final surface course, or after placement of surface course using a composite patch or PCC patch. If the second option is used, the elevation of the adjusted fixture and patch shall not be higher than or more than ¼ inch below the surrounding pavement surface.

Fabric Reinforcement

(Specification 2303.03, C, 2)

Fabric reinforcement is sometimes specified between an existing pavement and overlay to prevent cracks, joints, or other defects from reflecting through the resurfacing layer. When fabric reinforcement is required, the locations and dimensions will be tabulated in the plans.

The method of application of fabric reinforcement varies with the type of fabric specified. Some fabrics have an adhesive backing, some use an adhesive binder specified by the manufacturer, and some are applied with a heavy coat of asphalt binder. Specific requirements are included in the contract documents.

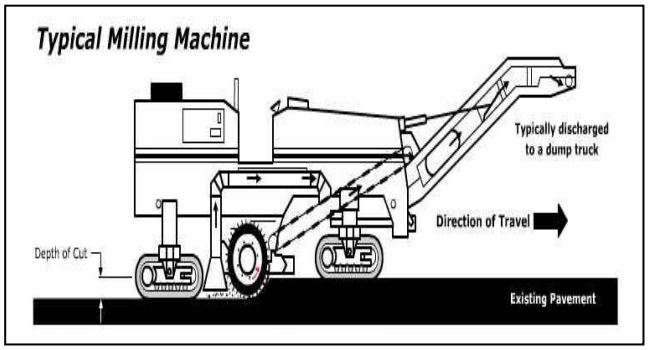
Do not place fabric on wet or damp surfaces, or when the road surface is less than 50 degrees F. Precautions must be taken to avoid wrinkles in the fabric and to insure that air bubbles are removed without breaking the fabric. A broom and/or squeegee is typically used to work out these imperfections. Wrinkles or folds that can't be removed by brushing are to be cut and lapped to provide a smooth surface. Normal traffic should not be allowed on the fabric during application and curing of binder material.

Fabric reinforcement may be placed up to two calendar days prior to being covered by an HMA overlay. Fabric that is soiled or damaged during this period must be repaired. Also, sanding may be required if the area is opened to traffic prior to overlay.

Scarification

(Specification 2214)

Scarification is the removal of pavement surface by milling with cold planing equipment in preparation for resurfacing. This is generally done to improve the surface profile and cross section of the underlying pavement. The texture produced has the added benefit of enhancing the bond between the existing surface and the new overlay. The location and depth of the scarification is tabulated on the plans. Debris from scarification shall be removed from the pavement surface immediately and handled as specified in the contract documents. The HMA overlay operation shall start within 10 working days after completion of the scarification operation. Once started, HMA placement shall occur on each working day until the scarified surface is completely covered with HMA. The contractor is subject to penalty for failing to comply with these requirements, and is responsible for repairing damage to a scarified surface that occurs during the time period for which penalties are assessed.



Heater Scarification

(Specification 2309)

This work consists of recycling the existing asphalt pavement surface and resurfacing with HMA. This multi-step rehabilitation process involves preparing the existing asphalt pavement surface, softening the surface with heat, scarifying the surface, and thoroughly stirring or tumbling and leveling the mixture in preparation for an HMA surface course overlay.

The process is typically used in situations where the existing pavement has surface irregularities, such as minor rutting, oxidation or raveling, but is structurally sound.

Surface Preparation
The existing pavement surface must be cleaned of all debris, earth, etc. that would interfere with the work to be performed.

Heating and Scarifying
The pavement surface is evenly heated and scarified for the full lane width as a continuously moving operation. The equipment must be capable of producing at least 10 million BTU's per hour and process a minimum of 1500 square yards per hour without charring or otherwise damaging the existing pavement material. The surface temperature of the old pavement can not exceed 475 degrees F during heating, and the heated material shall be in the range of 220 – 260 degrees F, measured immediately behind the heater scarifier. The heating operation shall be controlled, by enclosure or shielded hood, to prevent open flame from exiting from under the heater. The operation should be stopped if wind velocity creates either a hazardous situation (flame and smoke) or results in an ineffective heating and scarification operation.

Scarification shall be accomplished with pressure-loaded rakes or scarifiers. The minimum depth of scarification is ¾ inch at the highest points, such as between wheel paths, and ½ inch at the lowest points, such as in the wheel paths.

Leveling
Following scarification, the surface is leveled to provide a uniform cross slope. The method used to redistribute and level the scarified material must follow the scarifier as closely as practical and be capable of windrowing excess material to one side for removal when necessary.

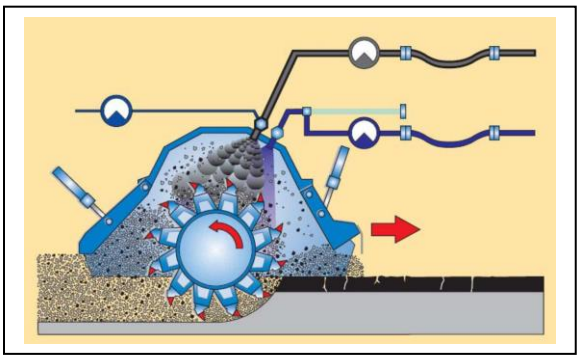
HMA Surface Course Overlay
After reshaping the scarified mix and before the temperature drops below 170 degrees F, a uniform layer of new surface course material is placed at the rate shown in the contract documents. The overlay may either be placed with a non self-propelled paver attached to the heater scarifier, or a conventional self-propelled paver within 400 feet of the scarification operation.

Cold In-place Recycling
(Specification 2318)

Cold In-place Recycling (CIR) is a method of reconstructing an HMA pavement that has typically suffered some type of surface or minor structural failure. These failures may include thermal (transverse) cracking, wheel rutting, stripping, or a combination of these distresses.

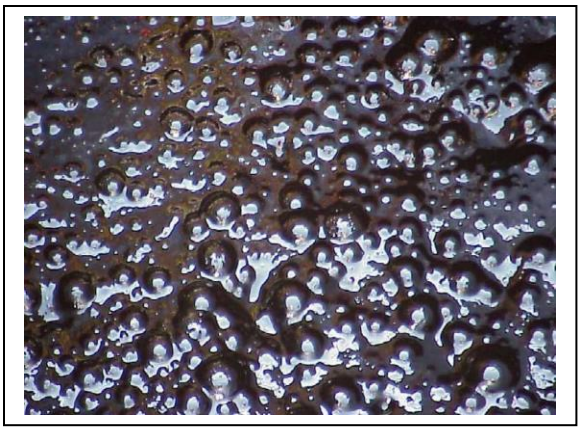
The work consists of milling the existing pavement to the width and depth specified, resizing and mixing the milled material with an asphaltic rejuvenating (stabilizing) agent, and placing and compacting the mixture to an accurate grade and profile. The resulting mat provides a flexible base to be utilized as a paving platform for subsequent overlay or surface treatments.

Preparation
All vegetation and debris within the width of the pavement to be recycled must be cleared.



Milling Existing Pavement
The existing pavement is milled to required depth and width in one pass. The pulverized material must then be processed to the required gradation.

Mixing Recycled Material
The Contractor shall apply the asphaltic rejuvenating (stabilizing) agent to the pulverized material at the design rate specified. The Engineer may vary the rate as required by existing pavement conditions. Water may be added to facilitate uniform mixing, either prior to or concurrently with adding the rejuvenating (stabilizing) agent.



The contract documents will include applicable design rates and additional specification requirements if “foamed asphalt” is to be used in lieu of asphalt emulsion as the rejuvenating (stabilizing) agent in the recycling process. Foamed asphalt is made by adding a small amount of water to hot liquid asphalt binder, causing the water to boil, which in turn causes the binder to foam (much like a pot boiling over). The increased volume of the foam allows more pulverized material to be coated with less water added. This can result in faster cure times and a wider working temperature range versus using emulsions.

Placement of Recycled Material
The recycled material is deposited in a windrow, spreader, paver, or loaded into trucks, without segregation. The material is placed and finished in one continuous pass, using a paver or

approved spreader, to lines and grades established by the Engineer.

Compaction and Density
A pneumatic tired roller (25-ton or greater) is used for initial rolling. Some contractors feel a 30-ton model is necessary to achieve required density. Final rolling with a steel tired roller, operating in either vibratory or static mode, follows to eliminate roller tire marks. Additional rolling may be required, within two calendar days of initial compaction, to achieve target density. Minimum field density shall be 94% for Interstate and Primary roads, and 92% for all other roads. The Contractor must perform ten daily nuclear gauge moisture and density tests at locations determined by the Engineer, as per Materials *IM 204*.

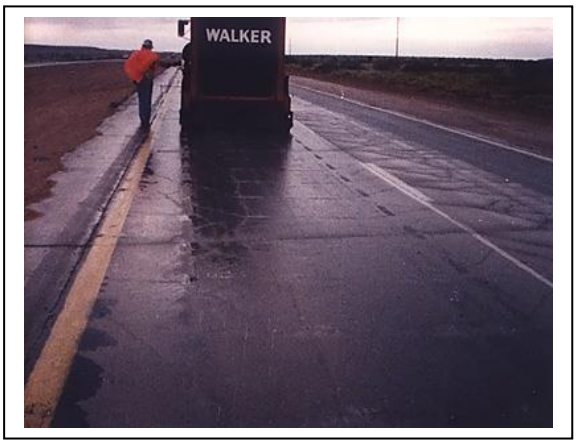
CIR is typically performed between May 1 and October 1, and is followed by an overlay or surface treatment. Any subsequent treatment or overlay cannot take place until the in-place recycled pavement is fully cured and the moisture content is within specifications.

The contractor has 14 calendar days, after the CIR is complete and initially achieves allowable moisture content, to place the first lift of HMA overlay or specified surface treatment.

Slab Fracturing Processes
(Specifications 2216 & 2217)

Slab Fracturing processes are used to stabilize an existing PCC pavement prior to HMA resurfacing. The slab fracturing rehabilitation technique involves two stages: the “fracturing”

process and the “seating” (compaction) process. There are three main types of slab fracturing processes – Crack and Seat, Break and Seat, and Rubblization.



Crack and Seat

The objective of the Crack and Seat technique is to minimize/eliminate reflective cracking in the HMA overlay by reducing the effective slab length of the PCC pavement. With a small effective slab length, horizontal slab movement is reduced. The cracking process is intended to produce tight cracks that permit load transfer with minimal loss of structural value. Seating of the broken slabs after cracking is intended to re-establish support between the base or subbase and the fractured slab. The Crack and Seat technique is applicable to jointed plain concrete pavements.

Break and Seat

The objective of the Break and Seat technique is essentially the same as Crack and Seat. However, the amount of effort required to reduce the slab size is normally greater. The increased effort is necessary because the original pavement typically contains steel reinforcing bars or wire mesh reinforcement. In order to reduce horizontal slab movements, all slab reinforcement in the PCC pavement must be broken and/or the concrete to steel bond must be destroyed for this technique to be truly effective in eliminating reflective cracking. The Break and Seat technique is considered applicable to jointed reinforced concrete pavements.

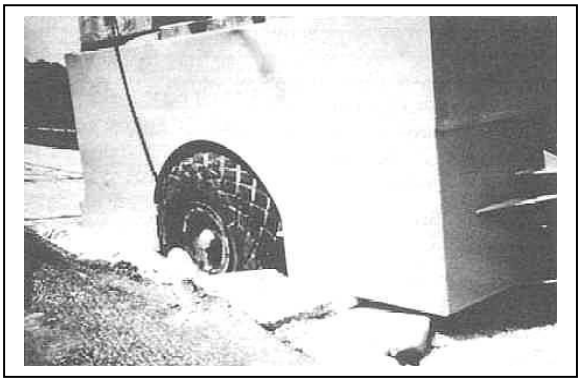
Rubblization

The objective of the Rubblization technique is to eliminate reflective cracking in the HMA overlay by the total destruction of the existing slab action of the PCC pavement. This process is normally achieved by rubblizing the slab into fragments of nominal 4 inch size and less. This is often referred to as "full" rubblization. Existing site conditions may warrant larger maximum particle dimensions, not to exceed 12 inches (also known as "modified" rubblization). This is to ensure adequate structural support for the overlay, in areas with disintegrating PCC and/or high subgrade moisture.

Reinforcing steel, if present in the PCC pavement, is generally fully debonded from the concrete by this approach. The Rubblization technique is applicable to all types of existing PCC pavements.

Fracturing Equipment & Techniques

A variety of equipment can be used to accomplish the preparation of the fractured slab for eventual placement of the tack coat and HMA overlay. Equipment typically used for cracking, breaking, and rubblizing PCC pavements include resonant pavement breaker, guillotine, and hydraulic / pneumatic hammers. The most effective type of equipment for a particular process may vary with existing pavement and other site conditions. A water system may be necessary to suppress dust caused by these operations, especially rubblization, and to verify slab-cracking effectiveness by better revealing the crack pattern.



Seating Equipment & Techniques

The purpose of seating during the construction process for Crack & Seat and Break & Seat projects is to ensure complete contact of the fractured slab with the subgrade, and to provide a compacted fractured slab upon which the HMA overlay may be placed. For both Crack & Seat and Break & Seat projects, this is usually accomplished with a 50-ton rubber tired roller. In addition to seating the slab fragments, the heavy rubber tired roller also effectively serves as a "proof roller" for locating soft spots or existing voids under the fractured PCC pavement. For Rubblization, several passes with a 10-ton vibratory roller are typically employed to compact and prepare the rubblized slab fragments for placement of the HMA overlay.

Slab Fracturing Process Considerations:

1. Existing HMA overlays must be totally removed prior to the slab fracture process.
2. Use a test section to establish the desirable impact energy and impact spacing for the particular pavement system / fracture equipment combination to be used.
3. The resulting crack pattern is dependent on the type of equipment used.
   - Hydraulic / pneumatic hammers produce map-cracking pattern.
   - Guillotine produces a series of parallel transverse cracks.
   - Sonic (resonant) breakers result in a large size graded granular base/subbase quality.
4. Crack spacing is dependent upon the type of fracture equipment used and the type of existing PCC pavement to be fractured.

As a general rule, the smaller the crack spacing and/or fragment size achieved, the greater the likelihood that reflective cracking will be eliminated in the HMA overlay.

5. Any soft spots and/or void areas located by the heavy proof rollers used in the seating process should be removed, replaced with comparable material, and then recompacted.
6. In general, traffic should not be allowed on seated (compacted) fractured slab layers. At least one lift of HMA overlay should be placed prior to having traffic operate on the rehabilitated lane.
7. Care should be exercised to avoid exposing the fractured slab layer to rains, which tend to saturate and weaken the existing fractured slab pavement system. In general, the HMA overlay should occur within 24 hours of the seating process.

Special Backfill

(Specification 4132)

Material used for special backfill shall be a uniform mixture of coarse and fine particles of crushed concrete, crushed limestone, or a mixture of gravel, sand, and soil, or a mixture of crushed limestone, gravel, sand, and soil. The requirement for this material is that it must meet a certain gradation: Gradation No. 30 of the Aggregate Gradation Table for crushed limestone or crushed concrete, and gradation No. 31 when mixed with gravel, sand, and soil. Since the materials vary, different behaviors may be expected.

Previously used as a subbase for full-depth HMA pavements, Special Backfill was intended to provide stability and allow construction traffic to run on the base during the paving operation. This is important in the delivery of hot mix to the paver. However, the drainability (permeability) of the layer often varied with the type of material used.

Modified Subbase

(Specification 2115)

A relatively new material gradation has replaced Special Backfill in some applications. Modified Subbase was developed to address unacceptable stability and drainage characteristics of some sources of Special Backfill. Modified Subbase is typically specified under full-depth HMA pavements. Other uses for the material include pavement subbase under ramps and bridge approaches. This material has shown to provide the benefits of being stable enough to support construction traffic, while still providing acceptable drainage characteristics with pavement in place.

The existing subgrade must be properly prepared prior to placement of modified subbase. This consists of disking to a depth of six inches, aerating, and recompacting. The subgrade is then proof-rolled with a loaded truck (as discussed in the next section), and any unstable areas corrected.

The following requirements must be adhered to when constructing Modified Subbase:

- Modified Subbase material shall be uniformly moist prior to and during compaction.

- Modified Subbase shall be placed in uniform lifts of not more than six inches.
- Modified Subbase shall be compacted with a minimum of six roller passes.

The specifications provide gradation and other material, equipment, and construction requirements for Modified Subbase.

Unstable Subgrades and Subbases

(Specification 2109.03; Construction Manual section 8.41)

Inspectors shall not permit HMA to be placed over any distorted subgrade or subbase. Whenever trucks or other paving equipment cause rutting of subbase or subgrade in the HMA placement area, such that the layer being placed does not conform to design dimensions, inspectors shall immediately stop construction. Construction shall not be permitted to resume until distorted subbase or subgrade has been repaired.

Locating wet or soft spots in advance can be accomplished by proof rolling the finished subgrade or subbase with a loaded truck. The amount of indentation of the truck wheels into base material should be noted, and compared with recognized limits. When excessive distortions are observed under the truck, the unstable areas must be dried and reworked or stabilized, as necessary.

Areas of deep instability may require additional treatment, including coring out of unstable material and replacing it with

a more stable material, adding subdrains, or over-depth paving.

Paving should not proceed unless testing gives a reasonable indication that distortions will not occur during construction of overlying pavement.