

# Recommended Construction Guidelines For Full Depth Reclamation (FDR) Using Cementitious Stabilization FDR102

Revised: 09/12/2017



## NOTICE

It is not intended or recommended that these guidelines be used verbatim within a specification. Owner Agencies should use them to help establish their particular project specification. Owner Agencies should understand that all geographical areas and pavement rehabilitation/preservation projects are unique and the availability of materials and equipment may vary as well. ARRA assumes no liability for utilization of these guidelines by any individual or entity. Contact ARRA for answers to questions and for a list of ARRA member Contractors and Suppliers.

Asphalt Recycling & Reclaiming Association  
800 Roosevelt Road, Building C-312  
Glen Ellyn, IL 60137  
(630) 942-6578  
[www.ARRA.org](http://www.ARRA.org)

## 1. General

Full Depth Reclamation (FDR) shall consist of pulverizing (reclaiming) the existing flexible pavement and underlying materials (base and/or subgrade materials) to the length, depth and width as specified or as shown on the plans, blending with a cementitious stabilizing agent (either cement, portland or blended hydraulic, or Class C fly ash), water, other additives or corrective aggregate as required by the mix design, to produce a cementitious stabilized base. This material shall then be shaped, compacted, cured and protected in accordance with the plans and specifications.

## 2. Treatment Thickness

The existing flexible pavement, base and/or subgrade material shall be pulverized to a total depth of \_\_\_\_ inches (mm). The pulverized section shall then be re-graded, with excess material removed and hauled away as necessary, so as to allow for the net placement of \_\_\_\_ inches of new pavement material. A cementitious stabilizing agent, water, additives, and/or corrective aggregate shall be added and blended to a total depth of \_\_\_\_ inches (mm) in accordance with the plans and specifications.

User Note: FDR treatment thicknesses may vary between 4 and 14 inches (100 - 350 mm) per lift and should be dependent on structural capacity requirements and project-specific criteria such as original asphalt thickness and design life. Selecting the right FDR application for a particular project should be based on the judgment of those involved in the design process of the project after consideration of several key factors including: project location, existing roadway conditions, depth of current pavement layers, failure depths, reason for current failure (i.e. lack of maintenance, age, insufficient depth, lack of adequate drainage, etc.), traffic volume, available materials and project budget.

## 3. Preconstruction Personnel Training

Personnel involved with the construction of FDR from both the Contractor and Owner Agency shall have successfully completed Preconstruction Personnel Training (PPT) to ensure that proper quality procedures are followed to construct high quality FDR stabilized base. The PPT shall be conducted at a location convenient for both the Contractor and the Owner Agency. The PPT shall be completed not more than \_\_\_\_ days, not including Saturdays, Sundays or holidays, prior to the start of FDR operations. The training shall be held during normal working hours. In lieu of this training, proof may be provided showing successful experience has been obtained by the individuals performing the work for the materials and construction techniques to be used in the FDR construction.

The PPT trainer shall be provided by the \_\_\_\_\_ (*Contractor or Owner Agency*). The PPT trainer shall be experienced in construction methods, materials, and test methods associated with construction of FDR projects. The Contractor and Owner Agency shall mutually agree to the course instructor, course content and training site.

User Note: PPT is optional to the agency. PPT should be conducted for agencies and Contractors new to FDR. It is recommended that the PPT takes place within 5 days from the start of the FDR so that it is current and allows some time to address any issues that may be raised during the training.

## 4. Materials

FDR shall consist of a homogeneous blend of reclaimed asphalt pavement (RAP), base material and/or subgrade materials, cementitious stabilizing agent (cement or Class C fly ash), water and other chemical additives and corrective aggregate as necessary. The actual materials utilized and their respective usage rates are dependent on the mix design and project requirements.

#### 4.1 Reclaimed Asphalt Pavement and Underlying Material

RAP and underlying material shall consist of the existing asphalt material, existing base course material and/or subgrade material. The underlying materials shall be free of roots, sod, topsoil, weeds, wood or any material deleterious to its reaction with the cementitious stabilizing agent. The gradation of the processed (pulverized) material shall meet the requirements of Table 1.

<b>Sieve Size</b>	<b>Minimum Percent Passing</b>
3 in. (75 mm)	100
2 in. (50 mm)	95
No. 4 (4.75 mm)	55
No. 200 (0.075 mm)	5

Rubberized crack filler, pavement markers, loop wires, thermoplastic markers, paving fabric and other similar materials shall be removed as observed from the roadway during the reclaiming process. Residual materials that cannot be completely removed from the reclaimed material may be incorporated into the FDR mixture if the Contractor can demonstrate that those added materials will not adversely affect performance. Any such materials retained in the mixture shall be appropriately sized and blended so as to not adversely affect the appearance or strength of the FDR stabilized base.

#### 4.2 Cement

Cement (portland or blended hydraulic), in either dry or slurry form, shall be added to the reclaimed mixture as determined by the mix design. Slurry made from cement shall contain a minimum of 30% dry solids content. Cement used for full depth reclamation shall comply with the latest specifications for hydraulic cement (AASHTO M 85, AASHTO M 240 or ASTM C150, ASTM C595). The Contractor shall inform the Owner Agency of the process to be used for incorporating cement into the reclaiming process.

#### 4.3 Class C Fly Ash

Self-cementing Class C fly ash shall be added to the reclaimed mixture as determined by the mix design. Fly ash used for full depth reclamation shall comply with the latest specifications for Class C Fly Ash (AASHTO M 295 or ASTM C618). The Contractor shall inform the Owner Agency of the process to be used for incorporating fly ash into the reclaiming process.

#### 4.4 Corrective Aggregate

Corrective aggregate may be required to supplement the existing material gradation and to meet performance requirements of the mix design. Corrective aggregate may consist of crushed rock, RAP, crushed concrete or other types of aggregate approved by the Owner Agency. The corrective aggregate gradation may vary according to its size and distribution, depending on the desired effect to the FDR stabilized base. When required by the mix design, corrective aggregate shall meet the requirements of Table 2.

<b>TABLE 2 – CORRECTIVE AGGREGATE</b>		
<b>Tests</b>	<b>Method</b>	<b>Limit</b>
Los Angeles Abrasion Value, % loss	AASHTO T 96 ASTM C131	40 max
Sand Equivalent,%	AASHTO T 176 ASTM D2419	60 minimum
Washed Gradation	AASHTO T 11 & T 27 ASTM C117 & C136	As required

#### **4.5 Water**

Water shall be added to achieve the desired moisture content. Water added shall be free from deleterious concentrations of oils, acids, alkalis, salts, sugars, vegetation, as well as other organic, chemical or deleterious substances. The water shall not cause an adverse effect on either the cementitious stabilizing agent or the reclaimed mixture. If the water is of questionable quality, it shall be tested in accordance with ASTM C1602 or according to local standards and procedures.

#### **5. Preconstruction Sampling and Mix Design**

If not provided by the Owner Agency, a mix design shall be submitted by the Contractor for approval by the Owner Agency. The mix design shall be performed with representative materials to be encountered during construction of the FDR. When the in-place materials change significantly, additional mix designs shall be performed to establish representative mixtures for the entire job. Representative samples of the in-place materials shall be obtained directly from the project site by sampling in accordance with ARRA *FDR202 - Preconstruction Sampling and Mix Design Guidelines for Full Depth Reclamation using Cementitious Stabilizing Agents* and delivered to an AASHTO or Owner Agency approved laboratory experienced in full depth reclamation. The asphalt materials shall then be crushed and mixed with the underlying base and/or subgrade materials at the percentages to be encountered in the field. This blended material, which may also contain corrective aggregate or RAP, shall then be treated with a cementitious stabilizing agent at various rates and compacted and tested according to the project requirements to obtain the optimum addition rates as outlined in the mix design procedures of ARRA *FDR202*.

The mix design shall be the baseline measure for the rate of cementitious stabilizing agent, water, additives and corrective aggregate blended with the existing materials to construct the reclaimed mixture. The mix design shall indicate the allowable tolerance for application of stabilizing agent, water, additives and corrective aggregate so as to not jeopardize the performance of the mixture but allow the Contractor to adjust the mixture so that it may be placed successfully.

#### **6. Equipment**

The FDR equipment shall be capable of pulverizing the existing asphalt and underlying materials. The equipment used for blending/mixing the pulverized materials with stabilizing agent, water, additives and corrective aggregate, if used, shall be capable of producing a homogeneous and uniformly blended reclaimed mixture. The equipment used for placement of the FDR stabilized base shall be capable of placement to the lines, grades, and guidelines provided herein and shown on the plans and specifications. The equipment shall consist of the following major components:

### 6.1 Spreaders/Distributors

Spreaders or distributors used to apply dry powder stabilizing agents and/or additives shall be non-pressurized mechanical vane-feed, cyclone or screw type capable of providing a consistent, accurate and uniform distribution of material while minimizing dust during construction. Imported corrective aggregate may be placed by a mechanical spreader, a conventional paver, or by tailgating with end dump trucks and spread to a uniform thickness with a motor grader.

### 6.2 Additive Slurry Storage and Supply Equipment

Slurry shall be produced using onsite portable batching equipment or inline processed and fed directly to the reclaiming equipment. Additive slurry storage and supply equipment shall have agitators or similar equipment to keep the slurry in suspension when held in the slurry batch or storage tanks. Slurry shall be kept in suspension during transport using agitator equipment. The meter system controlling application of slurry shall apply the additive within a tolerance of  $\pm 10\%$  of the specified rate.

### 6.3 Mixing/Reclaiming Equipment

Only self-propelled, high powered, minimum \_\_\_\_\_ HP, rotary mixers/reclaimers capable of mixing in-place to a minimum depth of \_\_\_\_\_ inches (mm) shall be used. The cutting drum shall be a minimum \_\_\_\_\_ feet (meters) in width and fitted with cutting teeth capable of trimming earth, aggregate and asphalt materials and be so designed that they may be accurately adjusted vertically and held in-place. The machine shall not weigh less than 25,000 lbs. (11,300 kg) and shall have the strength and rigidity so that it shall not develop a center deflection of more than 1/8 in (3 mm). Disc harrows, bucket teeth and other equipment that does not meet the above requirements shall not be used for FDR.

The mixer/reclaimer shall be fitted with an integrated water injection system capable of introducing water into the cutting drum during the mixing process. The metering device shall be capable of automatically adjusting the flow of water to compensate for any variation in the amount of reclaimed material introduced into the mixing chamber. Water shall be calculated on a volumetric basis tied to a foot per minute gauge using a calibrated meter that is capable of accurately measuring the amount of water to within a tolerance of  $\pm 10\%$  of the rate required. Automatic digital readings shall be displayed for both the flow rate and total amount of reclaimed material and water in appropriate units of weight and time.

User Note: If 5.0% water is required, based upon the allowable tolerance the water must be introduced between 4.5% and 5.5%.

### 6.4 Motor Grader

A motor grader for pre-shaping, aerating, spreading and final shaping of the material shall be provided. The motor grader shall have a cross slope indicator.

### 6.5 Rollers

Compacting of the reclaimed mixture shall be completed using self-propelled rollers, complete with properly operating scrapers and water spray systems. The number, weight and types of rollers shall be as necessary to obtain the required compaction throughout the entire FDR thickness. A pneumatic roller of adequate size, a vibratory padfoot roller with an 84-inch (2.13-m) wide drum equipped with knockdown blade, and a single or double drum vibratory steel roller may be used in any combination to achieve density.

User Note: For some applications the vibratory padfoot roller may not be necessary. Any combination of rollers should be allowed provided the compaction requirements are met.

## 6.6 Water Truck

Water truck(s) for supplying water to the reclaimer or roadway for addition of moisture and for curing during the FDR operation shall be provided. Water truck(s) shall be capable of providing a controlled and consistent spray without eroding or otherwise damaging the compacted FDR stabilized base surface.

## 7. Construction

Prior to the start of construction, employees representing both the Contractor and Owner Agency shall submit certification of PPT to ensure the FDR is constructed properly.

Throughout the pulverization, mixing, placement and compaction of the reclaimed materials, adjustments may be made to the cementitious stabilizing agent, water, and additives so as to produce a reclaimed mixture with optimal performance that meets specification requirements. All adjustments shall be recorded and submitted to the Owner Agency.

### 7.1 Roadway Preparation

Before the stabilization process begins, the area to be stabilized shall be pre-pulverized, graded, and/or shaped to the lines and grades as shown on the plans and specifications. During this process any unsuitable soil or material shall be removed and replaced with materials meeting project plan and specification requirements. The subgrade shall be firm and able to support, without yielding or subsequent settlement, the construction equipment and compaction of the FDR stabilized base. Soft or yielding subgrade shall be made stable before construction proceeds. Any manholes, valve covers, or other buried structures/utilities shall be protected from damage prior to processing. FDR shall be constructed in a series of parallel lanes such that longitudinal and transverse joints are minimized.

### 7.2 Weather Limitations

FDR processing shall not be conducted when the soil, aggregate or subgrade is frozen, or when the ambient temperature is below 35 °F (2 °C) or when freezing temperatures are anticipated within 7 days of the end of FDR placement.

### 7.3 Control Strip

During the first day of production the first load of cementitious stabilizing agent shall be used by the Contractor to construct a control strip to verify that the construction process meets specification requirements. The control strip shall be of adequate size for the Contractor to:

- A. Demonstrate that the equipment, materials, and processes proposed can produce a reclaimed material layer that conforms to specification requirements.
- B. Determine the optimal rates for cementitious stabilizing agent, water, and any additives recommended for the reclaimed material.
- C. Determine the sequence and manner of rolling necessary to obtain specified density requirements.

FDR operations may continue through the first day unless the Contractor's equipment and process fails to meet the requirements for successful completion of FDR operations. FDR operations shall not continue beyond the first day unless a control strip has been approved by the Owner Agency. Cease production after the first load of cementitious stabilizing agent if any of the requirements of the specifications are outside specification tolerances. Change procedures to contingency plans approved in the QC plan to continue work. The first load of cementitious stabilizing agent applied with the contingency plans will be used as a control strip to evaluate the corrective action plan. If the requirements of the specifications are still not being met cease production and submit a revised corrective action plan to the Engineer for acceptance prior to continuing work. Continue with

this process until all specification requirements are met. Upon acceptance of the control strip by the Owner Agency, the Contractor shall use the same equipment, materials, and construction methods for the remainder of FDR operations, unless adjustments made by the Contractor are approved by the Owner Agency. If adjustments are made, the Contractor shall produce a new control strip.

In lieu of a control strip, the Owner Agency may allow the Contractor to provide proof, based on previous experience with the same equipment, personnel, and materials that the work will conform to specification requirements.

#### **7.4 Pulverization**

The pre-determined full depth of asphalt material and underlying materials (base and/or subgrade) shall be pulverized to a homogenous mixture and specified gradation using a mixer/reclaimer meeting the requirements of Section 6.3. The mixture shall be brought to the desired moisture content during this process by means of surface application or through the mixer/reclaimer's integrated fluid injection system.

*User Note: Desired moisture content of a pulverized mixture will vary on every project, based on the material to be stabilized as well as the type of stabilizing agent used. Desired moisture content should be determined prior to construction.*

Longitudinal joints between successive cuts shall overlap a minimum of 6 inches (150 mm) and transverse joints shall overlap a minimum of 2 feet (0.60 m).

When a paving fabric is encountered during the pulverizing operation, the Contractor shall make the necessary changes in equipment or operations so that incorporation of shredded fabric into the reclaimed material does not affect the performance parameters or inhibit placing or compaction of the FDR stabilized base. The Contractor shall be required to remove and properly dispose of oversized pieces of paving fabric as indicated by the plans and specifications.

Rubberized crack filler, pavement markers, loop wires, thermoplastic markers and other similar materials shall be removed from the roadway as observed during the reclaiming process. Residual materials that cannot be completely removed from the processed materials may be incorporated into the reclaimed materials if the Contractor can demonstrate that those added materials will not adversely affect the performance of the FDR stabilized base. Any such materials retained in the mixture shall be appropriately sized and blended so as not to adversely affect the appearance or strength of the FDR stabilized base.

#### **7.5 Corrective Aggregate**

Corrective aggregate, if stipulated in the design, shall be spread uniformly on the roadbed using equipment as specified in Section 6.1. Aggregate may be placed either prior to pulverization or following pulverization, but prior to the addition of the stabilizing agent. If applied following pulverization, the corrective aggregate shall be blended with the reclaimed material by means of additional full depth mixing to form a homogeneous mixture prior to application of the stabilizing agent. No traffic, other than the reclaiming equipment, shall be allowed to pass over corrective aggregate until the reclaiming operation is complete.

#### **7.6 Cementitious Application and Mixing**

Removal and disposal of excess material, if required, shall be performed on the pulverized asphalt, base and subgrade material prior to cementitious treatment. Following pulverization and any trimming, if necessary, the cementitious material shall be spread on or applied to the pulverized material in accordance with the mix design using an approved spreader/distributor or slurry equipment at the applied rate [of \_\_\_\_\_ lbs/yd<sup>2</sup> (kg/m<sup>2</sup>) for dry stabilizing agent and \_\_\_\_\_ gal/yd<sup>2</sup> (L/m<sup>2</sup>) for slurry; of not less than \_\_\_\_\_ percent based

upon dry unit weight of the pulverized material; or in accordance with the mix design] based on a dry unit weight [of \_\_\_\_\_ pcf ( $\text{kg/m}^3$ ) assumed for bidding purposes; or the in-place dry unit weight determined in the mix design] of pulverized material and for the depth of treatment specified or as shown on the plans. The actual final dry unit weight of pulverized material shall be determined during construction. The cementitious stabilizing agent shall be applied to within a tolerance of  $\pm 5\%$  of the rate required. The compressive strength at 7 days for the FDR stabilized base shall be a minimum of \_\_\_\_\_ psi (kPa) (ASTM D1633, Method A), but shall not exceed \_\_\_\_\_ psi (kPa) (ASTM D1633 Method A).

**User Note:** If 6.0% cementitious stabilizing agent is required, based upon the allowable tolerance the stabilizing agent must be applied between 5.7% and 6.3%.

Dust control measures shall be employed to minimize fugitive dust. With a dry stabilizing agent the distance between the spreader and the reclaiming operation shall be reduced appropriately during windy days. Slurry may be spread on the pulverized reclaimed material in front of the reclaiming operation or may be added directly to the reclaimer's mixing chamber through the reclaimer's integrated fluid injection system. If the stabilizing agent is supplied in slurry form in front of the reclaiming operation, the reclaimed material shall be scarified prior to spreading of slurry to prevent excessive runoff or ponding. Slurry shall be produced at the jobsite. The Contractor shall provide the Owner Agency with batch or inline production logs daily. In no case shall dry stabilizing agent or slurry be allowed to remain exposed at the end of the workday. No traffic, other than the reclaiming equipment, shall be allowed to pass over the spread stabilizing agent until the reclaiming operation is complete.

The first contact of cementitious stabilizing agent with water prior to application on the reclaimed material shall not exceed 60 minutes. The time from cementitious stabilizing agent placement to start of mixing shall not exceed 30 minutes. If using dry stabilizing agent, water application shall only be added through the mixer/reclaimer's integrated fluid injection system during mixing. Mixing shall be performed while introducing water into the pulverized material through the metering device on the mixer. After completion of the first pass, the road shall be shaped with a motor grader and compacted with a steel wheel roller to provide improved depth control. A second pass of the reclaimer shall be completed with the required amount of stabilizing agent added. If necessary, water shall be added to the pulverized material during mixing to bring the moisture content to within minus 1 to plus 2 percent of the optimum moisture content determined in accordance with ASTM D558 to ensure chemical reaction of the cementitious stabilizing agent and processed materials. Mixing shall continue until the entire mixture, RAP, base and/or subgrade material is pulverized and gradation requirements are met. The final check for gradation shall not be made until the conclusion of mixing operations. The entire operation of cementitious stabilizing agent spreading, water application and mixing shall result in a uniform pulverized base, stabilizing agent, and water mixture for the full design depth and width.

Longitudinal joints between successive passes shall overlap a minimum of 6 inches (150 mm) and transverse joints shall overlap a minimum of 2 feet (0.60 meters).

To ensure a uniformly treated section, any material/soil around manholes, utility risers, valves and adjacent to curbs/gutters or in corners, shall have that material/soil pulled out to the depth of treatment and placed where it is accessible for mixing. After mixing, that material shall be replaced and compacted.

## 7.7 Compaction

The Contractor shall sequence operations such that compaction shall begin no more than 20 minutes after mixing or immediately upon achieving gradation and moisture requirements. All compaction operations shall be completed within 2 hours from start of mixing operations. No section shall be left undisturbed for more



than 30 minutes during compaction operations. At the start of compaction, the moisture content shall be within -1% to +2% of the specified optimum moisture content determined in accordance with ASTM D558. The mixed material shall be uniformly compacted in one layer to a minimum of 98% of the maximum dry density determined in accordance with ASTM D558, based on a moving average of five consecutive tests, with no test below 96%. Field density of compacted material may be determined by nuclear method in the direct transmission mode (AASHTO T 310, ASTM D6938) or sand cone method (AASHTO T 191, ASTM D1556).

## 7.8 Finishing and Surface Tolerance

As compaction nears completion, the surface of the FDR stabilized base shall be shaped to the specified lines, grades and cross sections. Compaction shall then be continued until uniform and adequate density is achieved. During the finishing process the surface shall be kept moist by means of water spray devices that shall not erode the surface. Compaction and finishing shall be performed in such a manner so as to produce a surface free of compaction planes, cracks, ridges or loose material. The surface tolerance shall not vary more than 1/2 inch (12 mm) from a 10-foot (3.0-m) straight edge placed on the surface. The Contractor shall correct humps exceeding this tolerance by trimming, milling or abrasive grinding. Feathering shall not be permitted for repair of low areas. Depressions exceeding the specified depth tolerance shall have a tack coat applied and filled with an asphalt mixture just prior to placement of the final surfacing. All finishing operations shall be completed within 4 hours from start of mixing. However, trimming (cuts only) can be completed within 24 hours of mixing.

## 7.9 Curing

After completion of final finishing, the cementitious stabilized surface shall be cured by application of a bituminous or other approved sealing membrane, or by being kept continuously moist for a period of 3 to 5 days with a water spray that shall not erode the surface of the FDR stabilized base. If curing material is used, it shall be applied as soon as possible, but no later than 24 hours after completing finishing operations. The surface shall be kept continuously moist prior to application of the curing membrane.

For bituminous curing membranes the FDR stabilized base shall be free of all loose, extraneous materials and shall be applied in the form of a fog seal composed of either CSS-1h or SS-1h emulsified asphalt, or another emulsion approved by the Owner Agency, diluted up to 60 percent by volume with water. The fog seal shall be applied at a rate of 0.10 to 0.20 gal/yd<sup>2</sup>, (0.4 to 0.8 L/m<sup>2</sup>). When a sand blotter is required, it shall be applied to the surface at 2 to 3 lbs/yd<sup>2</sup>, (1 to 5 kg/m<sup>2</sup>). Sand shall be free from clay or organic material. Application rates of fog seal and sand blotter shall be determined by the Contractor and shall be such that a stable and safe roadway surface can be maintained until the surface course is placed.

## 7.10 Microcracking (Optional)

User Note: Microcracking is not commonly conducted in some areas. However, if a cement stabilizing agent is utilized, the surface sealing is thin, and the compressive strength of the FDR stabilized base is not limited, microcracking is a technique that can help prevent shrinkage cracking and therefore reduce reflective cracking in the final surface course. If microcracking is specified include the following:

After the initial 24 hour curing period, the FDR stabilized base shall be tested to determine the stiffness using an approved device, such as a Humboldt Stiffness Gauge (HSG), or equivalent. Stiffness testing shall be at the rate of one test per 100 lineal feet (30 m) of section. Test locations shall be marked with paint for later retesting. If the initial HSG readings are in the range of 50 to 60 (MN/m), then microcracking of the FDR section shall begin. If the readings are below the stated range, the FDR section shall be allowed to cure for an additional 24 hours and stiffness readings obtained at the end of the 24 hour period and prior to the commencement of microcracking operations.

Microcracking of the FDR stabilized base shall be accomplished by a 12 ton (11 metric ton) steel-wheel vibratory roller, traveling at a speed of approximately 2 mph (3 kph) and vibrating at maximum amplitude and lowest frequency, or as directed by the Owner Agency. The section shall have 100% coverage, exclusive of the outside 1-foot (0.3 m), so as to induce minute cracks in the FDR section. After one pass of the vibratory roller the stiffness of the FDR section shall be determined. Microcracking operations may be terminated when a minimum 40% reduction in stiffness of the FDR section is achieved as compared to the initial (pre-cracked) readings or, in the absence of measurement by a stiffness gauge, until the desired crack pattern is achieved. Additional passes of the steel-wheel roller may be required to achieve the desired crack pattern or section modulus as determined by the Owner Agency. The FDR stabilized base shall be tested for stiffness after each additional rolling pass. It is anticipated that the roller will have to make 1 to 4 passes to achieve the required reduction in stiffness.

After cessation of microcracking the section the stabilized surface, if previously moist cured, shall be moist cured for an additional 2 to 4 days with a water spray that shall not erode the surface of the FDR stabilized base. As an alternative, the stabilized surface shall be moist cured for an additional 4 hours and then a bituminous or other approved sealing membrane applied in accordance with Section 7.9.

If the stabilized surface was previously cured prior to microcracking with a bituminous or other approved sealing membrane, then the stabilized surface shall be moist cured by being kept continuously moist for a period of 2 hours and then a bituminous or other approved sealing membrane reapplied in accordance with Section 7.9.

## **8. Traffic**

Completed portions of FDR stabilized base can be opened immediately to low speed local car traffic and to construction equipment, provided the curing material is not impaired. Finished portions of the FDR stabilized base traveled on by construction equipment used in constructing an adjoining section shall be protected in such a manner so as to prevent equipment from marring or damaging the completed work. If damage occurs, it may be necessary to keep heavy truck traffic off the stabilized base until the final surfacing is placed, and/or the stabilized base has passed proof roll testing. Proof rolling shall represent the type of traffic expected on the pavement. If deformation does not occur, moving truck traffic can be allowed at speeds less than \_\_\_\_\_ mph (kph) until the final surfacing is placed. If deformation does occur, truck traffic shall be kept off the stabilized base until it is firm enough to support the loads.

## **9. Maintenance**

After opening to traffic and prior to placing the surface course, the surface of the FDR stabilized base shall be maintained in a condition suitable for the safe movement of traffic. The Contractor shall protect and maintain the surface from nuisance water, other deleterious substances, and/or any other damage. Any damage to the completed FDR stabilized base shall be repaired by the Contractor prior to placement of the final surfacing. If it is necessary to replace any processed material, the replacement shall be for full depth, with vertical cuts, using an approved material. Skin patches shall not be permitted. No direct payment shall be made and costs shall be included elsewhere for protection and maintenance of the stabilized base.

## **10. Surfacing**

Final surfacing (hot or warm mix asphalt, seal coat, or concrete) can be placed any time after curing, as long as the FDR stabilized base is sufficiently stable (proof roll) to support the required construction equipment without marring or permanent distortion of the surface.

## **11. Quality Assurance Testing**

The Contractor shall perform process and quality control (QC) sampling and testing, and exercise management control to ensure that FDR base conforms to the project plans and specifications. Sampling and testing shall be performed as outlined in *ARRA FDR302-Recommended Quality Assurance Guidelines for Full Depth Reclamation using Cementitious Stabilizing Agents*. The Contractor or Owner Agency shall provide a qualified technician, testing laboratory and personnel to perform process and quality control sampling and testing during the FDR. The proficiency of testing laboratories and sampling and testing personnel shall be reviewed and approved by the Owner Agency prior to providing services to the project. The Owner Agency shall have unrestricted access to the laboratory, sampling, testing sites, and all information resulting from mix design and quality control activities. All quality control testing results shall be submitted to the Owner Agency.

## **12. Measurement and Payment**

Quantities of the FDR stabilized base shall be measured by the square yard (square meter) completed and accepted by the Owner Agency to the depths specified or shown on the plans. Cementitious stabilizing agent and additive weight shall be based upon certified delivery weight tickets, less any unused portion. Water used in this operation shall not be paid for directly and shall be considered subsidiary to the bid item.

Payment for FDR shall be made at the contract unit price per square yard (square meter). The price shall be full compensation for all labor, materials, tools, equipment, and incidentals; for doing all the work involved in full depth reclaiming, complete in-place; for pulverizing, mixing, blending, placing, compacting and curing of the FDR stabilized base; for protection and maintenance of the FDR stabilized base; for performing all QA testing including mix design, if required to be provided by the Contractor, PPT training and instructor, if provided by Contractor, and for obtaining measurements and recording results of all tests as shown on the plans and specifications.

Cementitious stabilizing agents shall be paid for at the contract price per ton (metric ton).

Additives shall be paid for at the contract price per ton (metric ton).