

Full Depth Reclamation (FDR) Chemical Stabilization

I. DESCRIPTION — This work consists of pulverizing and mixing a combination of virgin aggregate (if/where specified), Reclaimed Asphalt Pavement, Reclaimed Aggregate Material, and Subgrade Material to the specified length, width, and depth. Once pulverized, add the Chemical Stabilizing additives as per Project Mix Design, and mix the materials together to create a chemically stabilized base course. This work also consists of shaping, finishing, fine grading, and compaction of the reclaimed base material.

II. MATERIAL —

A. Reclaimed Material. 95% of the pulverized surface material is required to pass through a 2-inch sieve. Incorporate all reclaimed material into the stabilized base course.

1. **Reclaimed Aggregate Material (RAM).** In-situ aggregate material which is incorporated in the stabilization.
2. **Reclaimed Asphalt Pavement (RAP).** Processed paving material containing asphalt cement and aggregates.

B. Stabilizing Agent.

1. 1. Cement. Publication 408, Section 701. (3 to 8% by weight).
1.a Cement Slurry. Pub 408, Section 701 & Pub 242 Appendix J (applied cement 3 to 8% by weight). Portland Cement Slurry must be produced at a concrete plant listed in Bulletin 42 and supplied in Ready Mix Concrete Trucks currently approved by the DME/DMM. Other slurries must be provided in distributor and tanker trucks equipped with a recirculating pump and/or agitation system to prevent settling of the materials before application.
1.a.1 Admixtures, Publication 408 Section 711.3
2. *Hydrated Lime. Publication 408, Section 723. (2 to 6% by weight).
3. *Fly Ash. Publication 408, Section 724.2(a). (6 to 14% by weight).
4. Lime Pozzolan. Publication 408, Section 725. (6 to 8% by weight).

* Hydrated Lime or Fly Ash will not be used as a singular additive but will be used as a combination of the two. This combination shall be referred to as Lime/Fly Ash (L/FA).

C. Aggregate. Publication 408, Section 703.2 (Type A), No. 8, 10, 57, and 67. Add the gradation and quantity to the mix as required.

D. Mix Design. Remove samples of RAP and RAM to the specified depth and perform appropriate **laboratory** testing to establish mix design. Submit mix design to the District Materials Engineer/District Materials Manager (DME/DMM) for approval three weeks before the planned start of work. Provide an approved mix design and work plan to the Municipality five (5) working days before the planned start of work.

Approval of the mix design by the DME/DMM is solely for monitoring quality control and in no way releases the Contractor from their responsibilities.

Mix Design Development. Samples must be obtained inclusive of the depth to be recycled. Sampled materials must be properly processed and prepared to closely simulate field conditions. A Qualified Laboratory Technician will analyze the samples and provide the following information as part of the mix design to the DME/DMM.

1. Location of core samples.
2. Thickness and description of existing pavement and aggregate layers to be reclaimed.

3. A selected matrix of soils testing standards.

Moisture Content AASHTO T265

Sieve Analysis PTM 616

*Mechanical and Hydrometer

Particle Size Analysis of Soils AASHTO T88-90

*Liquid Limit, Plastic Limit AASHTO T89

Moisture Density Relationship PTM 106

Unconfined Compression AASHTO T208

Material Finer than No. 200 Sieve PTM 100

* To be performed only if more than 20% of the underlying subgrade is to be included in the chemically stabilized layer.

1. **Strength Requirements** —

A. Cement. Make, cure, and test three unconfined compressive strength specimens of FDR material and Cement in accordance with ASTM 1633, method A. Wrap the specimens in plastic wrap, seal in an airtight, moisture proof bag and cure the test specimens for a period of 7 days. For the final mix design, the required amount of cement will be that which provides an average unconfined compressive strength of the three specimens of:

A minimum unconfined compression value of 200 psi in 7 days and a maximum unconfined compression value of 500 psi in 7 days for roads that are designed with a minimum of a 3-inch pavement overlay.

A minimum unconfined compression value of 300 psi in 7 days and a maximum unconfined compression value of 500 psi in 7 days is required for roads that are to be Surface Treated or overlaid with less than 3 inches of pavement.

B. Lime/Fly Ash (L/FA), Lime Pozzolan and combinations thereof. Make, cure, and test three unconfined compressive strength specimens of FDR material and L/FA or Lime Pozzolan in accordance with ASTM 1633, method A. Wrap the specimens in plastic wrap, seal in an airtight, moisture proof bag and cure the test specimens for a period of 7 days at 104°F before testing. For the final mix design, the required amount of L/FA or Lime Pozzolan will be that which provides an average unconfined compressive strength of the three specimens of at least 200 psi.

C. Mixture. Combine the reclaimed material, aggregates (if necessary), stabilizing additive(s), and water according to the mix design and at the mix design recommended moisture content. If conditions change, make field adjustments as recommended in the design under the guidance of the Inspector and Qualified **Laboratory** Technician to obtain a satisfactory Stabilized Base Course.

III. **CONSTRUCTION** —

A. Equipment. Use equipment that will produce the completed chemical stabilized base course as follows:

1. Use equipment capable of automatically metering liquids with a variation of not more than ±2% by mass (weight) of liquids. Calibrate before use.
2. Ready Mix concrete trucks from an approved Bulletin 42 producer must be used to apply cement slurry.
3. Maintain all equipment in a satisfactory operating condition as specified in Publication 408, Section 108.05(c).

4. **Reclaimer.** Use a self-propelled, traveling rotary reclaimer or equivalent machine capable of cutting through existing roadway material to depths of up to 16 inches with one pass. The equipment will be capable of pulverizing "In-place" the existing pavement, base and subgrade at a minimum width of 8 feet and mixing any added materials to the specified depth. The cutting drum must have the ability to operate at various speeds (rpm), independent of the machines forward speed, in order to control oversized material and gradation.

Use a machine equipped with a computerized integral liquid proportioning system capable of regulating and monitoring the water application rate relative to depth of cut, width of cut, and speed. Have the water pump on the machine connected by a hose to the supply tanker/distributor, and mechanically or electronically interlocked with the forward movement/ground speed of the machine. Mount the spray bar to allow the water to be injected directly into the cutting drum/mixing chamber. Provide equipment capable of mixing water, dry additives, and the pulverized pavement materials into a homogenous mixture. Keep the cutting drum fully maintained and in good condition at all time throughout the project.

5. Equipment such as road planers or cold-milling machines designed to mill or shred the existing roadway materials rather than crush or fracture it is not allowed.
6. Placement Equipment. Motor Grader or by another method approved by the Inspector.
7. **Compaction Equipment.** Vibratory pad-foot roller 52,000-pounds centrifugal force or Pneumatic Tire Roller 25 ton for breakdown compaction. Single or tandem steel drum (static) roller 12-14 ton for finish rolling.

- B. **Weather Limitations.** Do not place paving mixtures from November 1 to March 31 unless allowed in writing by the District Executive. Do not place mixtures when surfaces are wet or when the air or surface temperature is 40°F and falling. Cement Slurry with accelerating admixtures can be used in periods of cooler temperatures with the written approval of the DME/DMM. Do not place cement slurry mixtures with accelerating admixtures when the air temperature is anticipated to fall below 35o F within the first 24 hours following placement.

- C. **General.** FDR consists of a series of steps that include pulverization and mixing of the existing roadway surface between 5-16 inch in depth with the aggregate base. The motor grader is used to move and place the reclaimed material to the desired longitudinal grade and cross-slope.

- D. **Pulverization/Shaping.** Before the application of any stabilizing additives pulverize the roadway materials to the depth specified by the project mix design. Shape to within 3/4 inch of irregularity to the lines, grades and/or cross-slope of the proposed roadway and compacted until no further densification is achieved. Water will be added to the pulverized material to adjust the moisture content to at least Optimum Moisture Content (OMC), but no more than ±3% over OMC. Addition of this water can be done through the machines liquid additive system and/or through top watering. After acceptance by the DME/DMM the additive spreading and mixing will be done as described below.

1. Additive Application.

- a. **Cement, Lime/Fly Ash (L/FA), Lime Pozzolan and combinations there-of.** Upon completion of the pulverization pass the stabilizing additives previously outlined will be applied at the rate established by the DME/DMM approved project mix design. The additive will be accurately and uniformly spread on the pulverized pavement by using an adjustable rate auger/vane type dry additive distributor. The contractor will provide a 1-square yard of canvas and scale to check the application rate of the spreader. Dry additives will be spread in a manner to minimize dusting. The dry additive will not be applied when the wind conditions in the opinion of the DME/DMM, are such that blowing additives become objectionable to traffic or adjacent property owners. Manual and/or gravity (tail gate) spreading of the additives is unacceptable.
- b. **Lime or Cement Slurry.** If slurries are to be used, the distributor and tanker trucks will be equipped with a recirculating pump and/or agitation system to prevent settling of the materials before application. If the cement slurry is obtained from a Ready Mix Concrete plant the cement slurry must be produced at a concrete plant listed in Bulletin 42 and supplied in Ready Mix Concrete Trucks

currently approved by the DME/DMM. Verify "cement" application rate by calculating the weight of cement contained in the mixer truck and the area covered by the slurry after discharge by the Ready Mix Truck. The cement slurry producer shall supply a written record of the amount of cement, water, and admixture with each load of cement slurry. Evenly and uniformly distribute the cement slurry, over the area of the prepared subgrade, calculated to provide the required application rate.

E. Stabilization/Mixing. Once the additives are applied thoroughly mix the additives and pulverized pavement together at the design specified treatment depth while simultaneously injecting any additional water needed (if any) through the machines computerized integral liquid proportioning system to create a homogenous mixture. The moisture content before compaction must be at or no more than 3% over OMC.

F. Compaction. Shape, grade and compact to the lines, grades, and depth shown on the plans and cross sections after the material has been processed. The moisture content before compaction must be at or no more than 3% over OMC. Allow the mixture to cure as necessary before rolling. Commence rolling at the low side of the course. Leave 3 to 6 inches from any unsupported edge(s) unrolled initially to prevent distortion.

Determine the in-place density requirements by the construction of at least one control strip under the guidance of a nuclear gauge operator. After each pass of the compaction equipment take a nuclear density reading in accordance with PTM No. 402. Continue compaction with each piece of equipment until no appreciable increase in density is obtained by additional passes. Upon completion of compaction, make a minimum of ten tests at random locations to determine the average in-place density of the control strip. Record and provide results to the Municipality.

Compact the chemically stabilized base course to a target density of at least 98% of the average in-place density of the control strip. Determine the in-place density in accordance with PTM No. 402 for each 3000 square yard area. If the density of an area is less than the minimum density, but the base course is uniform in texture, stable and otherwise acceptable, try additional compaction.

If additional compaction does not achieve the minimum density, complete an additional control strip in order to verify that proper density is being obtained. Take a minimum of five tests at random locations to determine the average in-place density of the control strip. The new minimum density is 98% of the average in-place density.

If it is determined that the contractor is achieving the target density with minimum compactive effort, the Inspector may require a new control strip to verify or establish a new target density.

If the completed chemically stabilized base course is unacceptable for any reason do not continue construction until the cause of the deficiency (ies) is determined and corrected.

G. Finishing. Complete all portions of the chemical stabilized base course during daylight hours, unless otherwise allowed.

H. Protection. Protect any finished portion of the chemical stabilized base course upon which any construction equipment is required to travel to prevent marring, distortion or damage of any kind. Immediately and satisfactorily correct any such damage.

I. Surface Tolerance. When directed by the Inspector, test the completed chemical stabilized base course for smoothness and accuracy of grade, both transversely and longitudinally using suitable templates and straightedges. Satisfactorily correct any 3000 square yard area where the average surface irregularity exceeds 1/2 inch under a template or straightedge, based on a minimum of at least three measurements.

J. Curing. Do not allow traffic on the newly constructed chemical stabilized base course until it cures unless otherwise directed in writing by the Municipality. Allow the chemical stabilized base course to cure for at least five days after final compaction has been completed. Protect the surface from drying and apply a bituminous prime coat, or DME/DMM approved equivalent over the entire surface within 24 hours of final compaction of the stabilized base course. Apply at a rate of 0.21 gallons per square yard. Use emulsified asphalt meeting the requirements of Publication 408, Section 461.2(a). Where the surface is utilized for maintaining traffic the application of the bituminous material shall be immediately followed by the application of an approved cover aggregate.

IV. MEASUREMENT AND PAYMENT —

A. Chemical Stabilized Base. Square Yard.

B. Aggregate. Ton.

C. Stabilizing Additives.

1. **Cement.** Ton.

2. **Hydrated Lime.** Ton.

3. **Fly Ash.** Ton.

4. **Lime-Pozzolan.** Ton.

D. Bituminous Prime Coat. Square Yard or Gallon.