

DIVISION 300 – AGGREGATE PAVEMENT AND BASES

SECTION 301 – AGGREGATE BASE

301.01 Description

This work shall consist of placing coarse aggregate on a prepared subgrade in accordance with 105.03.

MATERIALS

301.02 Materials

10 Materials shall be in accordance with the following:

Coarse Aggregate, Class D or Higher.....	904
Geotextile	918.02

CONSTRUCTION REQUIREMENTS

301.03 Preparation of Subgrade

20 Subgrade shall be compacted in accordance with 207.04. In areas of 500 ft or less in length, or for temporary runarounds, proofrolling will not be required. Proofrolling will not be required in trench sections where proofrolling equipment cannot be used.

301.04 Temperature Limitations

Aggregate shall not be placed when the air temperature is less than 35°F. Aggregate shall not be placed on a frozen subgrade. Frozen aggregate shall not be placed.

301.05 Spreading

30 The moisture content of dense graded aggregate shall be between 4% and the optimum moisture content prior to placement when the aggregate is delivered to the project. Unless otherwise directed, water shall not be added to the aggregate on the grade. The aggregate shall be spread in uniform lifts with a spreading and leveling device approved by the Engineer. The spreading and leveling device shall be capable of placing aggregate to the depth, width, and slope specified. The compacted depth of each lift shall be a minimum of 3 in. and a maximum of 6 in. The aggregate shall be handled and transported to minimize segregation and the loss of moisture. In areas inaccessible to mechanical equipment, approved hand spreading methods may be used.

301.06 Compacting

40 Dense graded aggregate shall be compacted to achieve the maximum allowable deflection as determined with the Light Weight Deflectometer, LWD, testing in accordance with ITM 508. Compaction shall not occur if the moisture content of the aggregate is greater than 6.0%. The maximum allowable deflection will be determined from a test section or will be specified. Test sections shall be constructed in accordance

with ITM 514 for other materials not included in Table 1 to determine the maximum allowable deflection. The optimum moisture content will be determined in accordance with 203.24(a).

50 Samples for moisture content testing shall be taken on the grade from the first truck of the day. The frequency of the moisture content test for aggregates will be one test for each day of aggregate placement. The maximum allowable deflection for aggregate over chemically modified soils shall be in accordance with the following:

Material Type	Maximum Allowable Deflection (mm)
Aggregate over Lime Modified Soil	0.30
Aggregate over Cement Modified Soil	0.27

Table 1

60 Acceptance of the compaction of aggregates will be determined by averaging three LWD tests obtained at a random station determined in accordance with ITM 802. The location of the three tests will be at 2 ft from each edge of the construction area and at 1/2 of the width of the construction area. The average deflection shall be equal to or less than the maximum allowable deflection allowed in Table 1 or determined by the test section. The frequency of the LWD testing will be three tests for each 800 t for compacted aggregate.

As an alternate, aggregates shall be compacted to a minimum of 100% of the maximum dry densities in accordance with AASHTO T 99. In situ density will be determined in accordance with 203.24(b). The aggregate shall meet the compaction requirements at the time subsequent courses are placed. In areas inaccessible to compaction equipment such as private drives, mailbox approaches, and temporary runarounds, the compaction requirements may be accepted by visual inspection.

70 All displacement or rutting of the aggregate shall be repaired prior to placing subsequent material.

Coarse graded aggregates shall be compacted in accordance with 203.25. When specified, geotextiles shall be installed in accordance with 616.11.

301.07 Checking and Correcting Base

80 The top of each aggregate course shall be checked transversely to the cross section and all deviations in excess of 1/2 in. shall be corrected. If additional aggregate is required, the course shall be remixed and re-compacted.

301.08 Priming

A prime coat, when required, shall be in accordance with 405.

301.09 Method of Measurement

Compacted aggregate base will be measured by the cubic yard based on the

theoretical volume to the neat line as shown on the plans. Geotextiles will be measured in accordance with 616.12.

301.10 Basis of Payment

90 The accepted quantities of compacted aggregate base will be paid for at the contract unit price per cubic yard, complete in place. Geotextiles will be paid for in accordance with 616.13.

Payment will be made under:

	Pay Item	Pay Unit Symbol
	Compacted Aggregate, No. 2	CYS
	Compacted Aggregate, No. 5	CYS
100	Compacted Aggregate, No. 8	CYS
	Compacted Aggregate, No. 53	CYS

The cost of placing, compacting, water, aggregate placed outside neat lines as shown on the plans, and necessary incidentals shall be included in the cost of the pay item.

Payment will not be made for material placed outside of a 1:1 slope from the planned typical section.

110 Replacement of pavement damaged by the Contractor’s operations shall be at no additional payment.

SECTION 302 – SUBBASE

302.01 Description

This work shall consist of a foundation course of selected materials, placed and compacted on a prepared subgrade in accordance with 105.03.

Subbase for PCCP shall consist of 3 in. of coarse aggregate No. 8 as the aggregate drainage layer placed over a 6 in. coarse aggregate No. 53 as the separation layer. Dense graded subbase shall consist of a 6 in. coarse aggregate No. 53.

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MATERIALS

302.02 Materials

Materials shall be in accordance with the following:

Coarse Aggregate, Class B or Higher, Size No. 8	904
Coarse Aggregate, Class D or Higher, Size No. 53	904

302.03

20 Coarse aggregate No. 8 used as an aggregate drainage layer shall consist of 100%
crushed stone or ACBF.

CONSTRUCTION REQUIREMENTS

302.03 Preparation of Subgrade

Subgrade shall be prepared in accordance with 207.

302.04 Temperature Limitations

30 Aggregate shall not be placed when the air temperature is less than 35°F.
Aggregate shall not be placed on a frozen subgrade. Frozen aggregate shall not be
placed.

302.05 Spreading

40 The moisture content of the aggregate shall be between 4% and the optimum
moisture content prior to placement when the aggregate is delivered to the project.
Unless otherwise directed, water shall not be added to the aggregate on the grade. The
aggregate shall be spread in uniform lifts with a spreading and leveling device
approved by the Engineer. The spreading and leveling device shall be capable of
placing aggregate to the depth, width, and slope specified. The compacted depth of
each lift shall be a minimum of 3 in. and a maximum of 6 in. The aggregate shall be
handled and transported to minimize segregation and the loss of moisture. In areas
inaccessible to mechanical equipment, approved hand spreading methods may be used.

302.06 Compacting

Subbases shall be compacted as follows:

(a) Aggregate Separation Layers and Dense Graded Subbase

Compaction shall be in accordance with 301.06.

50 All displacement or rutting of the aggregate separation layers shall be repaired
prior to placing subsequent material.

(b) Aggregate Drainage Layers

Compaction shall consist of two passes with a vibratory roller before trimming,
and one pass with the same roller in static mode after trimming. A vibratory roller shall
be equipped with a variable amplitude system, a speed control device, and have a
minimum vibration frequency of 1,000 vibrations per minute. A roller in accordance
with 409.03(d)4 may be used.

60 Construction traffic shall not be allowed on the aggregate drainage layer, except
where placement of the PCCP is restricted. Exceptions shall be submitted for approval.
All displacement or rutting of the aggregate drainage layers shall be repaired prior to
placing subsequent material.

In areas inaccessible to standard size compacting equipment a specialty roller/compactor in accordance with 409.03(d)7 shall be used.

302.07 Checking and Correcting Subbase

70 The top of each aggregate course shall be checked transversely and all deviations in excess of 1/2 in. shall be corrected. If additional aggregate is required, the course shall be remixed and recompactd.

302.08 Method of Measurement

Subbase for PCCP or dense graded subbase will be measured by the cubic yard based on the theoretical volume to the neat lines as shown on the plans. The quantity shown in the Schedule of Pay Items will be adjusted if it is shown to be different by more than 2% of the measured quantity.

302.09 Basis of Payment

80 The accepted quantities of subbase for PCCP or dense graded subbase will be paid for at the contract unit price per cubic yard, complete in place.

Payment will be made under:

Pay Item	Pay Unit Symbol
Dense Graded Subbase	CYS
Subbase for PCCP	CYS

90 The cost of compacting, water, aggregate placed outside neat lines as shown on the plans, and necessary incidentals shall be included in the cost of the subbase.

SECTION 303 – AGGREGATE PAVEMENTS OR SHOULDERS

303.01 Description

This work shall consist of placing a dense-graded compacted aggregate on prepared subgrade in accordance with 105.03.

MATERIALS

303.02 Materials

10 Materials shall be in accordance with the following:

Coarse Aggregate, Class D or Higher, Size No. 53	904
Coarse Aggregate, Class D or Higher, Size No. 73*	904
* Surface courses only, when specified.	

CONSTRUCTION REQUIREMENTS

303.03 Preparation of Subgrade

20 Subgrade shall be compacted in accordance with 207.04. In areas of 500 ft or less in length, or for temporary runarounds, proofrolling will not be required. Proofrolling will not be required in trench sections where proofrolling equipment cannot be used.

303.04 Temperature Limitations

Aggregate shall not be placed when the air temperature is less than 35°F. Aggregate shall not be placed on a frozen subgrade. Frozen aggregate shall not be placed.

303.05 Spreading

30 The moisture content of the aggregate shall be between 4% and the optimum moisture content prior to placement when the aggregate is delivered to the project. Unless otherwise directed, water shall not be added to the aggregate on the grade. The aggregate shall be spread in uniform lifts with a spreading and leveling device approved by the Engineer. The spreading and leveling device shall be capable of placing aggregate to the depth, width, and slope specified. The compacted depth of each lift shall be a minimum of 3 in. and a maximum of 6 in., except where utilized as a shoulder. The compacted depth of a lift for a shoulder shall be a minimum of 3 in. and a maximum of 9 in. The aggregate shall be handled and transported to minimize segregation and the loss of moisture. In areas inaccessible to mechanical equipment, approved hand spreading methods may be used.

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303.06 Compacting

Compaction shall be in accordance with 301.06.

All displacement or rutting of the compacted aggregate shall be repaired prior to placing subsequent material.

303.07 Checking and Correcting Base and Surface

50 The top of each aggregate course shall be checked transversely and all deviations in excess of 1/2 in. shall be corrected. If additional aggregate is required, the course shall be remixed and re-compacted.

303.08 Dust Palliative

A dust palliative, if required, shall be in accordance with 407.

303.09 Method of Measurement

Compacted aggregate will be measured by the ton in accordance with 109.01(b) for the type specified.

303.10 Basis of Payment

60 The accepted quantities of compacted aggregate will be paid for at the contract unit price per ton, for the type specified, complete in place.

Payment will be made under:

Pay Item	Pay Unit Symbol
Compacted Aggregate, No. 53	TON
Compacted Aggregate, No. 73	TON

70 The cost of placing, compacting, water, and necessary incidentals shall be included in the costs of the compacted aggregate.

Payment will not be made for material placed outside of a 1:1 slope from the planned typical section.

Replacement or repair of pavement or shoulders damaged by the Contractor’s operations shall be at no additional payment.

SECTION 304 – ASPHALT BASES

304.01 Description

This work shall consist of constructing an HMA base on a prepared surface or preparing an existing asphalt pavement for use as an asphalt base in accordance with 105.03.

MATERIALS

10 **304.02 Materials**

Materials shall be in accordance with the appropriate sections.

304.03 Sealing Cracks and Joints

Cracks and joints shall be sealed in accordance with 408.

304.04 Patching

20 Areas to be patched will be marked on the surface by the Engineer. The marked pavement shall be removed to the depth shown on the typical section or as directed. A minimum 2 in. vertical joint shall be constructed with the pavement that remains in place. If it is determined that the marked pavement is to be removed full depth, the patch depth shall be to the bottom of the existing asphalt material or as directed.

Subgrade of aggregate base under patches shall be compacted in accordance with 203.25. If the excavation for patches reveals unsuitable subgrade material, such material shall be removed to a depth of 6 in. and backfilled to the top of subgrade with compacted aggregate in accordance with 301. Unauthorized excavation beyond neat lines shall be replaced with compacted aggregate in accordance with 301.

304.05

30 The excavated patch areas shall be filled with HMA for patching of the type specified in the pay item. Partial depth patches shall use HMA intermediate mixture and full depth patches shall use HMA base mixture in accordance with 402. A MAF in accordance with 402.05 will not apply. Mixtures will be accepted in accordance with 402.09.

Each course shall be compacted by approved mechanical equipment in accordance with 409.03(d).

40 A smooth riding surface shall be maintained on HMA patches at all times. Deformation due to traffic or other conditions shall be corrected immediately. HMA base, intermediate, or surface mixtures may be used to maintain patches. Unless otherwise specified, patches shall be completed during daylight hours and opened to traffic at the close of the workday. Patches that cannot be completed prior to the end of daily operations shall be backfilled, compacted, and a temporary surface placed to carry traffic, unless otherwise specified.

304.05 Widening

50 The outside face of the excavated area shall be left as nearly vertical as the nature of the material will allow and not wider than the outside limits of the widening section. The subgrade in the widened area shall be compacted in accordance with 207.

Widening mixtures shall be HMA mixtures in accordance with 402 and as shown on the typical section or as directed.

For widening 3 ft or less and 330 lb/sq yd or less, six passes of trench rollers in accordance with 409.03(d)6 shall be used. For widening 3 ft or less and greater than 330 lb/sq yd, 12 passes of trench rollers in accordance with 409.03(d)6 shall be used.

60 For widening greater than 3 ft and 330 lb/sq yd or less, six passes of rollers with a compaction wheel bearing of no less than 300 lb/in. shall be used. For widening greater than 3 ft and greater than 330 lb/sq yd, 12 passes of rollers with a compaction wheel bearing of no less than 300 lb/in. shall be used.

Except for surface mixtures, the course flush with the top of the existing surface shall be compacted with equipment entirely on the widening.

A MAF in accordance with 401.05 or 402.05 will not apply. HMA mixtures will be accepted in accordance with 402.09.

304.06 Method of Measurement

70 Widening and patching will be measured by the ton of the type of HMA specified, in accordance with 109.01(b). Compacted aggregate for base will be measured by the ton in accordance with 109.01(b).

CONSTRUCTION REQUIREMENTS

305.03 New PCC Base

20 Construction of new PCC bases shall be in accordance with 502, except for 502.14, and 502.20. The CMDS shall be in accordance with 502.03 except utilization of the Department provided spreadsheet is not required. The surface shall be finished with wet burlap or by wood floats. Smoothness of the base will be controlled with a 16 ft long straightedge longitudinally and a 10 ft long straightedge transversely.

Joints shall be in accordance with 503, except for the following:

- 30 (a) the second saw cut and sealing shall not be performed for transverse joints;
- (b) sealing shall not be performed for longitudinal joints; and
- (c) sawing and sealing shall not be performed for construction joints.

305.04 Existing PCCP

Preparation of PCCP for use as a base shall be in accordance with 507, except for:

40 (a) **Patching**
Patching PCC base shall be in accordance with 506 except the coarse aggregate shall be Class A or higher.

(b) **Surface Milling**
Surface milling shall be in accordance with 306.

(c) **Retrofit Load Transfer**
Retrofit load transfer shall be in accordance with 507.08.

50 (d) **Rubblizing Existing PCCP**
The existing pavement shall be rubblized with a self-contained, self-propelled, resonant frequency pavement breaking unit capable of producing low amplitude, 2,000 lbf blows at a rate of not less than 44 per second or with a self-contained, self-propelled, multiple headed, impact hammer with the heads directly adjacent to each other and the lift height of each head independently adjustable. The sequence of impacts shall be on a random basis. The unit shall be equipped with a water system to suppress dust generated by the operation.

60 The operating speed of the unit shall be such that the existing pavement is reduced to particles ranging from sand sized to pieces not exceeding 6 in. in the largest dimension, the majority being a nominal 1 to 2 in. in size. The concrete from the surface to the top of the reinforcement shall be reduced to the 1 to 2 in. size to the

fullest extent possible. Continuous coverage, overlapped if necessary, with the breaking shoe or impact hammers shall be used. Additional passes of the resonator or multiple headed impact hammer may be required if larger sizes remain above the reinforcement.

Subsurface drains shall be installed along the edges of the pavement prior to the rubblization.

70 Rubblizing shall begin at the edge of pavement and proceed to the center of the pavement. The rubblization of the first lane shall extend 6 in. into the adjoining lane.

80 Prior to placing HMA mixtures, the complete width of the rubblized pavement shall be compacted by means of vibratory steel wheel and pneumatic-tired rollers in accordance with 409.03(d) in the following sequence: two initial passes with a vibratory roller, two passes with a pneumatic-tired roller, and then four final passes with a vibratory roller. The last two roller passes shall be immediately prior to priming operations. When the multiple headed impact hammer is used, a Z-pattern grid cladding bolted to the surface of the drum of the vibratory roller shall be used at least for the final two passes.

The vibratory roller shall be operated in the vibration mode at a speed not to exceed 6 ft per s. All depressions 1 in. or greater in depth from that of the immediate surrounding area that result from the rubblizing or compaction effort shall be filled with coarse aggregate No. 53 or 73 and struck off level with the surrounding area. Filled depressions shall be compacted with the same roller and compactive effort previously described.

90 Reinforcement in the rubblized pavement shall be left in place. Any reinforcement protruding above the surface as a result of rubblizing or compaction operations shall be cut off below the surface and removed from the site. All loose joint fillers, expansion material, or other similar materials shall also be removed from the rubblized surface.

100 Traffic will not be allowed on the rubblized pavement before the HMA base or immediate courses are in place unless otherwise directed. Rubblized material dislodged by traffic shall be removed from the pavement. The initial HMA course shall be placed within 48 h of rubblizing. However, in the event of rain, this time limitation may be waived to allow sufficient time for the rubblized pavement to dry to the satisfaction of the Engineer. Crossover and ramp crossings shall be maintained in the same compacted state as other areas until the initial HMA course is placed.

The preceding rubblizing operations shall be scheduled after widening or shoulder work has progressed up to the elevation of the existing pavement grade. These areas may then be utilized to support the breaking unit while the existing pavement is being rubblized. Shoulders may then be completed in conjunction with the placement of HMA pavement courses over the compacted rubblized pavement.

305.05

110 A joint shall be saw cut full depth or load transfer devices shall be severed at an existing joint on ramps or mainline where the rubblizing abuts concrete pavement which is to remain in place.

305.05 Widening With PCC Base

The subgrade shall be prepared in accordance with 207. Subbase shall be in accordance with 302.

120 The concrete shall be placed directly against the existing pavement edges, which shall be free from all foreign materials. The surface of the concrete widening shall be at the same elevation as the top of the existing concrete base.

Materials and construction requirements shall be in accordance with the applicable requirements of 502, except the following:

- (a) coarse aggregate shall be Class A or higher;
- (b) joints shall be sawed in one pass and not sealed. Transverse joints constructed in the widening shall be aligned with existing transverse joints or cracks;
- 130 (c) tining is not required;
- (d) shoulder corrugations are not required;
- (e) pavement smoothness shall be controlled by a 16 ft straightedge; and
- (f) utilization of the Department provided spreadsheet is not required.

140 When the widening is not open to traffic prior to placing an overlay, liquid membrane compounds shall not be used and an alternative curing option shall be used. Tack coat in accordance with 406 may be used as a curing option.

305.06 Method of Measurement

150 Compacted aggregate will be measured by the ton in accordance with 109.01(b) for the type specified. Retrofit load transfer will be measured in accordance with 507.09. Surface milling will be measured in accordance with 306.10. PCC base, PCC base patching, and widening with PCC base will be measured by the square yard of the thickness specified. The area of PCC will be the planned width of the base, patching or widening multiplied by the measured length or as directed in writing. The planned width of the base, patching and widening will be as shown on the typical cross section of the plans.

Rubblized PCCP will be measured by the square yard of rubblized pavement.

SECTION 306 – MILLING

306.01 Description

This work shall consist of the milling of asphalt and concrete pavements and the disposal of milled materials in accordance with 105.03.

CONSTRUCTION REQUIREMENTS

306.02 General

- 10 Milling operations shall be described in the QCP in accordance with ITM 803. Where the milling operation in a partial-day closure results in a longitudinal vertical or near vertical face exceeding 2 in. in height, the adjacent lane shall be milled during the same day, the milled lane resurfaced during the same day, or the vertical face tapered at a 45° angle or flatter. Where located within 3 in. of a curb, surface material that cannot be removed by the cold-milling machine shall be removed by other approved methods.

20 Transverse milled vertical faces greater than 1 in. that are exposed to traffic shall be transitioned in an approved manner.

Castings located in milling areas that are not to be adjusted may remain in place during the milling, or may be removed and replaced at the Contractor's option.

Localized weak areas uncovered by the milling process shall be patched in accordance with 304 or 305.

The milled material shall become the property of the Contractor, unless otherwise specified.

- 30 The roadway shall be cleaned before opening to traffic.

306.03 Equipment

Equipment for milling shall be in accordance with the following.

(a) Roadway Milling Machine

- 40 A milling machine shall be a power operated cold-milling machine, equipped with automatic control devices to establish profile grades by referencing from either the existing pavement or from independent grade control. The equipment shall have a positive means of controlling cross slope elevations, have an effective means for removing excess material from the surface, preventing airborne dust escaping from the operation, and producing a finished surface that provides a good bond to the new overlay.

Sufficient cutting teeth shall be on the coarse milling or fine milling cutting drum to produce cuttings such that 90% of the conglomerate particles pass a 2 in. sieve. A coarse milling cutting drum shall have 5/8 in. spacing between the cutting teeth and

50 be capable of producing a surface macrotexture ratio in accordance with ITM 812 equal to or greater than 1.8. A fine milling cutting drum shall have 5/16 in. or 3/8 in. spacing between the cutting teeth and be capable of producing a surface macrotexture ratio in accordance with ITM 812 equal to or greater than 5.0.

(b) Power Saw

Sawing equipment shall be capable of maintaining the specified alignment and depth of cut without damaging the pavement.

(c) Rotary Power Broom

A motorized, pneumatic tired unit with rotary bristle broom head.

(d) Straightedge

60

1. Straightedge – 16 ft

A 16 ft straightedge shall be a rigid beam mounted on two solid wheels on axles 16 ft apart. The straightedge has a mounted push bar to facilitate propelling the device along or across the pavement. Tolerance points are located at the 1/4, 1/2, and 3/4 points and may be composed of threaded bolts capable of being adjusted to the tolerance required.

2. Straightedge – 10 ft

70 A 10 ft straightedge is the same as a 16 ft straightedge except that the wheels are mounted 10 ft apart. A handheld rigid beam may be substituted.

306.04 Asphalt or PCCP Scarification Milling

Scarification milling shall consist of preparing a base for resurfacing by roughening the entire existing asphalt or PCCP surface. The milled pavement profile shall have a surface finish that does not vary longitudinally more than 1/4 in. from a 16 ft straightedge or as described in the QCP in accordance with 401.02.

80 A fine milling cutting drum in accordance with 306.03(a) shall be used when a single course overlay is specified with a lay rate as shown on the plans less than 165 lb/sq yd and the maximum scarification mill cut depth is expected to be less than 3/4 in. for asphalt or PCCP, otherwise, a coarse milling cutting drum in accordance with 306.03(a) shall be used.

The scarified milled surface shall have a macrotexture ratio in accordance with ITM 812 as follows:

- (a) equal to or greater than 5.0 when using a fine milling cutting drum for a single course overlay, or
- 90 (b) equal to or greater than 2.2 for a single course overlay, or
- (c) equal to or greater than 1.8 for multiple course overlays.

Frequency of macrotexture testing shall be a minimum of once per day and shall be described in the QCP. The cross-slope shall not vary more than 1/8 in. when measured with a 10 ft straightedge.

100 Milled traveled way areas left open to traffic for longer than five work days will be assessed \$1,600.00 per day per lane mile, or portion thereof, as liquidated damages, not as a penalty, but as damages sustained for each work day that the milled area remains open to traffic.

Milled non-traveled way areas such as auxiliary lanes and shoulders left open to traffic for longer than 10 work days will be assessed \$800.00 per day per lane mile, or portion thereof, as liquidated damages, not as a penalty, but as damages sustained for each work day that the milled area remains open to traffic.

306.05 Asphalt or PCCP Profile Milling to Correct Cross-Slope

110 Profile milling shall consist of preparing a base for resurfacing by removing the existing asphalt or PCCP material to the specified cross-slope as shown on the plans. The milled pavement profile shall have a surface finish that does not vary longitudinally more than 1/4 in. from a 16 ft straightedge or as described in the QCP in accordance with 401.02.

120 A fine milling cutting drum in accordance with 306.03(a) shall be used when a single course overlay is specified with a lay rate as shown on the plans less than 165 lb/sq yd and the maximum profile mill cut depth is expected to be less than or equal to 1 1/2 in. for asphalt or 3/4 in. for PCCP, otherwise, a coarse milling cutting drum in accordance with 306.03(a) shall be used.

The profile milled surface shall have a macrotexture ratio in accordance with ITM 812 as follows:

- (a) equal to or greater than 5.0 when using a fine milling cutting drum for a single course overlay, or
- (b) equal to or greater than 2.2 for a single course overlay, or
- (c) equal to or greater than 1.8 for multiple course overlays.

130

Frequency of macrotexture testing shall be a minimum of once per day and shall be described in the QCP. The cross-slope shall not vary more than 1/8 in. when measured with a 10 ft straightedge.

Milled traveled way areas left open to traffic for longer than five work days will be assessed \$1,600.00 per day per lane mile, or portion thereof, as liquidated damages, not as a penalty, but as damages sustained for each work day that the milled area remains open to traffic.

140 Milled non-traveled way areas such as auxiliary lanes and shoulders left open to traffic for longer than 10 work days will be assessed \$800.00 per day per lane mile, or portion thereof, as liquidated damages, not as a penalty, but as damages sustained for each work day that the milled area remains open to traffic.

306.06 Approach Milling

150 Approach milling shall consist of milling the surface and cutting a wedge at the driveways, commercial or public road approaches. The existing approach shall be milled a minimum depth of no less than 1/4 in. to accommodate the approach pavement. The approach milling shall be completed to provide a smooth transition from the traveled way pavement to the termini of the approach. The existing approach pavement shall be cut to provide a vertical face of 1 1/2 in. for the termini of surface.

Mailbox approaches to be resurfaced shall be milled to maintain the traveled way profile and cross-slope.

Automatic control devices will not be required on surface milling equipment used for approach milling. Milling shall not damage any pavement that is to remain in place.

160 Approach milling shall not be performed at driveways unless it is required to meet a paved surface that continues beyond the construction limit. If the driveway is other than HMA or PCC beyond the construction limits, the approach milling is not required.

The transverse vertical cut face for commercial or public road approaches shall be transitioned at a rate of 24:1 or as approved.

306.07 Asphalt or PCCP Milling to a Specified Average Depth

170 Milling shall consist of preparing a base for resurfacing by removing the existing asphalt material or PCCP to the specified average depth as shown on the plans. The milled pavement shall have a surface finish that does not vary longitudinally more than 1/4 in. from a 16 ft straightedge or as described in the QCP in accordance with 401.02.

A fine milling cutting drum in accordance with 306.03(a) shall be used when a single course overlay is specified with a lay rate as shown on the plans less than 165 lb/sq yd and the average mill cut depth is less than or equal to 1 1/2 in. for asphalt or 3/4 in. for PCCP, otherwise, a coarse milling cutting drum in accordance with 306.03(a) shall be used.

The milled surface shall have a macrotexture ratio in accordance with ITM 812 as follows:

- 180
- (a) equal to or greater than 5.0 when using a fine milling cutting drum for a single course overlay, or
 - (b) equal to or greater than 2.2 for a single course overlay, or

(c) equal to or greater than 1.8 for multiple course overlays.

190 Frequency of macrotexture testing shall be a minimum of once per day and shall be described in the QCP. The cross-slope shall not vary more than 1/8 in. when measured with a 10 ft straightedge.

If shoulders or turn lanes are not milled and the overlay material is not placed in the milled areas within the same day, drainage slots shall be provided to eliminate ponding of water.

200 Milled traveled way areas left open to traffic for longer than five work days will be assessed \$1,600.00 per day per lane mile, or portion thereof, as liquidated damages, not as a penalty, but as damages sustained for each work day that the milled area remains open to traffic.

Milled non-traveled way areas such as auxiliary lanes and shoulders left open to traffic for longer than 10 work days will be assessed \$800.00 per day per lane mile, or portion thereof, as liquidated damages, not as a penalty, but as damages sustained for each work day that the milled area remains open to traffic.

The transverse vertical cut face shall be transitioned by HMA, CMA or prefabricated materials at a rate of 24:1 or as approved.

306.08 Asphalt Overlay Removal

210 Asphalt removal shall consist of complete removal of an asphalt overlay by milling from a portland cement concrete or brick base and the satisfactory disposal of the milled materials. Minor amounts of asphalt pavement material bonded to a concrete base at joints or cracks may remain in place. If this material becomes displaced during subsequent operations, it shall be removed. Minor amounts of asphalt pavement material bonded to a brick base may remain in place. Removal of minor areas of portland cement concrete or brick base during the milling operations is acceptable.

220 Milled areas shall be cleaned prior to reopening to traffic or before continuing construction operations.

The transverse vertical cut face shall be transitioned by HMA, CMA or prefabricated materials at a rate of 24:1 or as approved.

306.09 Transition Milling

230 Transition milling shall consist of cutting a wedge at the beginning and ending of projects, and paving exceptions. The existing pavement shall be cut to provide a nearly vertical face of 1 1/2 in. for the termini of each overlay lift of base, intermediate, and surface. The existing pavement shall be milled at a rate of 720:1 or as directed to achieve the specified cut where the pavement transition overlay lifts differ from cut

SECTION 307 – CEMENT STABILIZED FULL DEPTH RECLAMATION, FDR

307.01 Description

This work shall consist of pulverizing and stabilizing an existing asphalt pavement along with existing base and subgrade materials to construct a reclaimed base course, RBC, to the approved design properties in accordance with 105.03.

307.02 Just-in-Time Training, JITT

10 The Engineer and Contractor are required to attend a JITT course regarding FDR and both shall mutually agree on the course instructor, course content and training site. The training class shall be conducted at a project field location convenient for all project construction personnel responsible for FDR operations and inspection to attend.

The JITT course shall be held during normal working hours and be completed not more than 14 days prior to the start of FDR operations.

20 The Contractor shall provide a JITT instructor experienced in the construction methods, materials and test methods associated with cement stabilized FDR. A copy of the course syllabus, handouts and presentation materials shall be submitted to the Engineer at least five business days before the course is to be taught.

307.03 Quality Control

30 A quality control plan, QCP, shall be submitted to the Engineer a minimum of five calendar days prior to the JITT. The QCP shall include the proposed FDR mix design; a start to finish process description including discussion on corrective action measures; a list of proposed equipment; a list of proposed QC tests and testing frequencies; the curing methods applied to the cement stabilized RBC and the stabilization process applied to the RBC and subgrade after a failed proofroll. All QC test results shall be maintained during the duration of the contract and made available to the Engineer upon request.

QC Testing	
Test	Frequency ^{1,2}
Depth of Pulverization	1 per 500 ft
Pulverized Material Gradation	1 per 0.5 day of production
In-place Moisture of Pulverized Material	1 per 0.5 day of production
Cement Application Rate	1 per 500 ft
Maximum Density and Moisture Content of Stabilized Material	1 per 0.5 day of production
Compacted In-Place Field Density	1 per 1,000 ft
1. The Contractor shall perform all QC tests within the first 500 ft after startup and after any change in the mix design. 2. Testing frequency is based upon linear feet of FDR laydown. 3. The density probe shall be no more than 2.0 in. above the bottom of the FDR treatment.	

MATERIALS

307.04 Materials

40 RBC shall consist of a homogenous blend of reclaimed asphalt pavement, RAP, base and subgrade materials that are combined with cement, water, and when required, recycling additives such as corrective aggregate. The cement may be dry powder or slurry with a minimum dry solids content of 60%. The actual materials used are dependent on the FDR mix design and project requirements.

Materials for use in RBC shall be in accordance with the following:

Corrective aggregate to adjust gradation or supplement material volume:

- 1. Coarse or Dense Graded Aggregate, Class C or Higher 904.03
 - 2. Fine Aggregate 904.02
 - 50 3. RAP shall be the product resulting from the cold milling or crushing of an existing asphalt pavement. The RAP coarse aggregate shall be processed so that 100% passes the 1 1/2 in. (37.5 mm) sieve.
- Portland Cement, Type I..... 901.01(b)
Water 913.01

Acceptance of the RBC will be in accordance with the Frequency Manual on the basis of a type D certification in accordance with ITM 804.

60 **307.05 Mix Design**

The FDR mix design shall be in accordance with ITM 595 and comprised of existing RAP, existing base and subgrade materials, cement and if necessary, recycling additives. The 7-day unconfined strength shall be based on the overlay lay rate specified on the plans.

Test	Procedure	Requirement
7-Day Unconfined Strength	ASTM D 1633, Method A	see notes 1, 2, 3
Notes:		
1. 300 psi minimum when an HMA overlay with a total lay rate \geq 330 lb/sq yd.		
2. 400 psi minimum when an HMA overlay with a total 165 lb/sq yd \leq lay rate < 330 lb/sq yd.		
3. 500 psi minimum when an HMA overlay with a total lay rate < 165 lb/sq yd or an applied seal coat surface.		

70 The mix design and all associated testing shall be performed using samples of the existing pavement, base and subgrade material from the project site representing the reclaiming depth, by a design laboratory that is AASHTO Material Reference Laboratory, AMRL, accredited for soil, aggregates, and concrete.

307.06

The sulfate content for the subgrade material shall be less than or equal to 1,000 ppm as determined in accordance with ITM 510.

Additional mix designs shall be performed when the in-place material changes significantly in order to establish representative mixes for the entire job. The Contractor shall obtain all samples required to develop the mix design. One sample per lane mile of planned RBC shall be the minimum sampling frequency for mix design preparation.

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The Contractor shall provide a mix design or designs for approval at least five calendar days prior to the JITT. The mix design shall include all test results performed. If new materials are added, a new mix design, including the revised test results, shall be submitted at least one day prior to implementation.

CONSTRUCTION REQUIREMENTS

307.06 Roadway Preparation

90

Snowplowable raised pavement markers shall be removed in accordance with 808.11(e) prior to FDR operations.

Grass and other vegetation shall be removed from the edge of the existing pavement to prevent contamination of the RBC during milling operation.

Grade adjustments of existing structures shall be made in accordance with 720.04 except existing structures shall be lowered prior to FDR operations, properly covered and filled with material compatible with the FDR mix design to maintain traffic.

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All areas of soft or yielding subgrade, as shown on the plans, shall be corrected prior to pulverization operations.

307.07 Equipment

The equipment shall be capable of pulverizing the existing asphalt pavement, base and subgrade materials. The equipment used for mixing the pulverized materials with cement, water, additives and corrective aggregate, when required, shall be capable of producing a homogenous and uniformly blended RBC. The equipment used for placement of the RBC shall be capable of placement in accordance to 105.03.

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The equipment shall consist of the following major components:

(a) Spreaders and Distributors

Spreaders or distributors used to apply dry powder 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. Corrective aggregate, when required, 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.

(b) Additive Slurry Storage and Supply Equipment

120 Slurry shall be produced using a batch or continuous-flow type stationary mixer equipped with calibrated metering and feeding devices that introduce the cement, water and additives into the mixer in the specified quantities. 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.

(c) Mixing and Reclaiming Equipment

130 Only self-propelled, high powered, minimum 500 hp rotary mixers or reclaimers capable of mixing in-place to the depth specified shall be used. The minimum cutting drum width shall be 7 ft and fitted with cutting teeth capable of trimming earth, aggregate and HMA 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 and shall have the strength and rigidity so that it shall not develop a center deflection of more than 1/8 in.

140 The mixer or reclaimer shall be fitted with an integrated water injection system capable of introducing the water into the cutting drum during the mixing process. The metering device shall be capable of automatically adjusting the flow of material to compensate for any variation in the amount of reclaimed material introduced into the mixing chamber. The water shall be calculated on a volumetric basis tied to a speed gauge, ft/min, using a calibrated meter that is capable of accurately measuring the amount of material to within 0.5% of the rate required. Automatic digital readings shall be displayed for both the flow rate and total amount of reclaimed material in appropriate units of weight and time.

(d) Motor Grader

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

(e) Compaction Equipment

150 The RBC shall be compacted using self-propelled rollers. The number, weight and types of rollers shall be as necessary to obtain the required compaction throughout the entire RBC thickness. The rollers may be used in any combination and may include a pneumatic tire roller, an 84 in. wide drum vibratory pad-foot roller equipped with a knockdown blade or a 10 t minimum single or double drum vibratory steel roller.

(f) Water Trucks

160 A water truck shall be used for supplying water to the reclaimer or roadway for the addition of moisture during the reclaiming operation. The water truck shall be capable of providing a controlled and consistent spray without eroding or otherwise damaging the compacted RBC.

307.08 Weather Limitations

FDR operations shall be performed when the ambient temperature is 40°F or above. The FDR shall not be performed when the soil, aggregate, or subgrade is frozen or when freezing temperatures are anticipated within seven days of the end of RBC placement. The Engineer may restrict work when the heat index is greater than 100°F. The FDR shall not be performed before May 1 or after October 1.

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307.09 Pulverization

The existing pavement shall be pulverized and stabilized in separate operations. Corrective aggregate, when required, shall be spread onto the existing surface in accordance with 307.07(a). The pre-determined full depth of asphalt pavement, base and subgrade materials shall be pulverized, along with the corrective aggregate, to a homogenous mixture. The mixture may be brought to the desired moisture content during this process by means of surface application or through the mixing or reclaiming equipment's integrated fluid injection system for dust control. The base course shall not contain roots, sod, topsoil, weeds, wood or any material deleterious to its reaction with the cement stabilizer.

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For cement stabilized RBC, the pulverization shall produce a gradation that has 100% passing the 2 in. (50 mm) sieve and $\geq 55\%$ passing the No. 4 (4.75 mm) sieve.

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When a paving fabric is encountered during the pulverization operation, the Contractor shall make the necessary changes in equipment or operations so that incorporation of shredded fabric into the RBC does not affect the performance parameters or inhibit placement or compaction of the RBC. The Contractor shall be required to remove and properly dispose of oversized pieces of paving fabric. The Contractor shall make the necessary adjustments in equipment or operations so that the shredded fabric in the recycled material is no more than 5 sq in. No fabric piece shall have a dimension exceeding a length of 4 in.

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Rubberized crack filler, durable pavement markings, loop wires, and other non-pavement materials shall be removed as observed from the roadway during the pulverization process. Residual materials that cannot be completely removed may be incorporated into the 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 strength of the RBC.

307.10 Stabilization

The cement used to stabilize the RBC may be dry powder or slurry and the Contractor shall address the application methods and fugitive dust control procedures in the QCP when dry powder materials are used. The pulverized surface shall be scarified or knifed prior to applying materials in slurry form to prevent runoff or ponding. Any dry additives used shall be spread onto the pulverized surface using a

210 mechanical spreader. The pulverized material shall be mixed with the stabilizer and additives as required by the mix design to create a homogeneous RBC.

The in-place moisture content of the material shall be within -1% to +2% of the design moisture content as determined by the mix design.

Cement stabilizing materials shall have an application tolerance determined by adding $\pm 0.5\%$ to the percent total cement content.

220 The cement shall be incorporated into the pulverized material at the initial rate determined by the mix design and approved by the Engineer. Sampling and mix design may determine different levels of cement at various portions of the project.

The Contractor can request the cement percentage to exceed the upper tolerance provided the mix design requirements are satisfied at the requested percentage. The request will be subject to approval by the Engineer.

307.11 Control Strip and Compaction

A minimum 500 ft long control strip shall be conducted on the first day of production to verify the construction process meets the requirements as specified. The control strip shall allow the Contractor to:

- 230
- (a) demonstrate the equipment, materials and processes proposed can produce a RBC layer in accordance with specification requirements;
 - (b) determine the optimal rates for the cement, water and any additives recommended for the reclaimed material;
 - (c) determine the sequence and manner of rolling necessary to obtain strength requirements in one uniformly compacted layer.

240 The RBC density shall be achieved with the same equipment, materials, construction methods and density requirements used on the accepted control strip. A new control strip shall be constructed if changes are made outside the tolerances of the original mix design, equipment or construction methods.

250 The processed material shall be uniformly compacted in one layer to a minimum of 95% of the maximum density. Maximum density shall be determined in accordance with AASHTO T 180 at the required QC frequency from a representative sample collected after the cement has been added and mixed into the pulverized material but prior to compaction.

Compaction shall be monitored in accordance with AASHTO T 310 in the direct transmission mode and continue to reach a minimum of 95% of the established maximum density during the control strip and for the remainder of the compaction operation.

260 Compaction equipment shall be in accordance with 307.07(e). Initial compaction shall be within 500 ft of the reclaiming unit using either a vibratory pad-foot roller, a pneumatic tire roller or a combination of the two. The pass counts shall continue to increase until the cleat indentations from the pad-foot roller are no more than 3/16 in. in depth and light can be seen between the pad-foot and RBC interface or there are no wheel impressions from the pneumatic tire roller remaining in the RBC.

 The cement stabilized material shall be bladed and shaped by a motor grader in accordance with 307.07(d) to remove any remaining roller marks or indentations then leveled in accordance with 301.07. The profile grade and cross section of the RBC shall be finished within a tolerance of $\pm 1/2$ in. from the plan RBC elevation prior to profile milling.

270 Intermediate and final compaction shall be applied to the bladed and shaped RBC using either a pneumatic tire roller, a single or double drum vibratory steel roller or a combination of the two. Finish rolling shall not be performed in vibratory mode. The compaction operation shall be performed while the RBC remains in a workable condition and continued until roller marks no longer appear.

 Any type of rolling effort that causes cracking, displacement or other type of pavement distress shall be discontinued until such time as the problem can be resolved and approved by the Engineer.

280 The QC technician shall be on site, observing all compaction efforts and approving areas as they reach minimum relative compaction. Care shall be taken to not over compact the mat.

 All tests shall be conducted at the stated QC testing frequencies throughout FDR operations.

307.12 Opening to Traffic

290 Opening to traffic shall occur after sufficient cure time has been applied to the RBC so traffic will not initiate raveling or permanent deformation. All loose particles that may develop on the pavement surface shall be removed by a rotary power broom in accordance with 409.

 After opening to traffic, the surface of the RBC shall be maintained in a condition suitable for the safe movement of traffic.

307.13 Maintenance

 The Contractor shall maintain the RBC until the surface course has been constructed.

300 Any damage to the completed recycled material shall be repaired by the Contractor prior to the placement of new HMA or final surface sealing. Patching shall

be in accordance with 304. The excavated patch areas shall be filled and compacted with HMA or RBC material as directed by the Engineer. No direct payment will be made for damage or repair unless approved by the Engineer.

307.14 Curing

The planned method and duration of curing for cement stabilized RBC shall be in accordance with the QCP. The specified surface course shall be placed within two weeks of the RBC final cure, but no later than November 1.

310 Before placing the final surfacing, the cement stabilized RBC shall remain in-place for a minimum of three days.

Cement stabilized RBC shall be cured to minimize moisture loss from the surface for a time period that achieves the minimum required 7-day unconfined strength.

307.15 Proofrolling

320 The cement stabilized RBC shall be proofrolled in accordance with 203.26 using a tandem or tri-axle dump truck loaded to the legal limit and operated between 2 to 4 mph over the RBC. The Engineer will determine the limits for any area that has deflection or rutting greater than 1/2 in.

The Contractor shall rework the areas failed in proofrolling by re-pulverizing and re-stabilizing the RBC in-place at no additional cost or by removing the RBC and stabilizing the subgrade with subgrade treatment Type IC in accordance with 207.

In locations of failing subgrade the RBC shall be removed and subgrade treatment Type IC shall be placed in accordance with 207. HMA patching, type B shall be placed in accordance with 304.

330 **307.16 Milling**

The entire surface of the cement stabilized RBC shall be scarified in accordance with 306 to the specified cross-slope in preparation for the overlay. Construction engineering in accordance with 105.08(b) shall be provided.

307.17 Underdrain Installation

Underdrain installation in accordance with 718, when required, shall begin after having completed the proofrolling.

307.18 RBC Overlay

340 The overlay atop the RBC shall be as shown on the plans. The overlay shall be placed after having completed the proofrolling.

The RBC shall be swept of all loose material and standing water with a rotary power broom in accordance with 409 immediately prior to placing the surface. The RBC shall be swept lightly to avoid damage to the RBC.

307.19

A tack coat shall be required only for the HMA overlay and shall be applied to the RBC in accordance with 406 immediately following sweeping operations.

350 Monuments shall be reestablished in accordance with 615.10.

307.19 Method of Measurement

The RBC will be measured by the square yard complete in place. Cement, used as stabilizing material, will be measured by the ton. Subgrade treatment will be measured in accordance with 207.05. Corrective aggregate to adjust the RBC gradation will be measured by the ton of material used. HMA patching, type B will be measured in accordance with 304.06. Milling will be measured in accordance with 306.10. Re-established monuments will be measured in accordance with 615.13. Removal of snowplowable raised pavement markers will be measured in accordance with 808.12.

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307.20 Basis of Payment

The RBC will be paid for as full depth reclamation at the contract unit price per square yard, complete in place. Cement, used as stabilizing material, will be paid for at the contract unit price per ton, complete in place. Subgrade treatment will be paid for in accordance with 207.06. Corrective aggregate used to adjust the RBC gradation will be paid for at the contract unit price per ton, complete in place. HMA patching, type B will be paid for in accordance with 304.07, of the thickness specified on the plans. Milling will be paid for in accordance with 306.11. Re-established monuments will be paid for in accordance with 615.14. Removal of snowplowable raised pavement markers will be paid for in accordance with 808.13.

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Payment will be made under:

Pay Item	Pay Unit Symbol
Corrective Aggregate, FDR.....	TON
Full Depth Reclamation.....	SYS
Stabilizing Material, Portland Cement	TON

380

The costs of the FDR mix design and QC testing shall be included in the cost of the full depth reclamation.

The costs associated with removal of grass and vegetation, rubberized crack filler, durable pavement markings, loop wires and other non-pavement materials shall be included in the cost of the full depth reclamation.

The costs associated with pulverizing, stabilizing, compacting curing and maintenance of the RBC shall be included in the cost of the full depth reclamation.

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The cost associated with mixing water shall be included in the cost of the full depth reclamation.

The cost associated with aggregate when used to supplement material volume shall be included in the cost of the corrective aggregate pay item.

The cost associated with aggregate when used to adjust the RBC gradation shall be included in the cost of the corrective aggregate pay item.

400 In the locations of failing subgrade, removal of the RBC shall be included in the cost of subgrade treatment.

SECTION 308 – ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR

308.01 Description

This work shall consist of pulverizing and stabilizing an existing asphalt pavement and base material, excluding subgrade, to construct a reclaimed base course, RBC, to the approved design properties in accordance with 105.03.

308.02 Just in Time Training, JITT

10 The Engineer and Contractor are required to attend a JITT course regarding FDR and both shall mutually agree on the course instructor, course content and training site. The training class shall be conducted at a project field location convenient for all project construction personnel responsible for FDR operations and inspection to attend.

The JITT course shall be held during normal working hours and be completed not more than 14 days prior to the start of FDR operations.

20 The Contractor shall provide a JITT instructor experienced in the construction methods, materials and test methods associated with asphalt emulsion stabilized FDR. A copy of the course syllabus, handouts and presentation materials shall be submitted to the Engineer at least five business days before the course is to be taught.

308.03 Quality Control

30 A quality control plan, QCP, shall be submitted to the Engineer a minimum of five calendar days prior to the JITT. The QCP shall include the proposed FDR mix design; a start to finish process description including discussion on corrective action measures; a list of proposed equipment; a list of proposed QC tests and testing frequencies; the curing methods applied to the asphalt emulsion stabilized RBC and the stabilization process applied to the RBC and subgrade after a failed proofroll. All QC test results shall be maintained during the duration of the contract and made available to the Engineer upon request.

QC Testing	
Test	Frequency ^{1,2}
Depth of Pulverization	1 per 500 ft
Pulverized Material Gradation	1 per 0.5 day of production
In-place Moisture of Pulverized Material	1 per 0.5 day of production
Asphalt Emulsion Content	1 per 500 ft
Maximum Density and Moisture Content of Injected Material	1 per 0.5 day of production
Compacted In-Place Field Density	1 per 1,000 ft
Field Moisture Content for Curing	1 per each day of production
Notes:	
1. The Contractor shall perform all QC tests within the first 500 ft after startup and after any change in the mix design.	
2. Testing frequency is based upon linear feet of FDR laydown.	
3. The density probe shall be no more than 2.0 in. above the bottom of the FDR treatment.	

MATERIALS

308.04 Materials

40 RBC shall consist of a homogenous blend of reclaimed asphalt pavement, RAP, and base materials that are combined with asphalt emulsion, water, and when required, recycling additives such as corrective aggregate or cement. Cement recycling additives used in asphalt emulsion stabilized RBC may be dry powder or slurry with a minimum dry solids content of 60%. The actual materials used are dependent on the FDR mix design and project requirements.

Materials for use in RBC shall be in accordance with the following:

- Asphalt Emulsion 902.1(b)3
- Corrective aggregate to adjust gradation or supplement material volume:
 - 50 1. Coarse or Dense Graded Aggregate, Class C or Higher 904.03
 - 2. Fine Aggregate 904.02
 - 3. RAP, shall be the product resulting from the cold milling or crushing of an existing asphalt pavement. The RAP coarse aggregate shall be processed so that 100% passes the 1 1/2 in. (37.5 mm) sieve.
- Portland Cement, Type I..... 901.01(b)
- Water 913.01

60 Acceptance of the RBC will be in accordance with the Frequency manual on the basis of a type D certification in accordance with ITM 804.

308.05 Mix Design

The FDR mix design shall be in accordance with ITM 594 and comprised of existing RAP, existing base material, asphalt emulsion and if necessary, recycling

additives. The mix design and all associated testing shall be performed using samples of the existing pavement and base material from the project site representing the reclaiming depth, by a design laboratory that is AASHTO Material Reference Laboratory, AMRL, accredited for soil, aggregates, HMA and asphalt emulsion.

70 Additional mix designs shall be performed when the in-place material changes significantly in order to establish representative mixes for the entire job. The Contractor shall obtain all samples required to develop the mix design. One sample per lane mile of planned RBC shall be the minimum sampling frequency for mix design preparation.

The Contractor shall provide a mix design or designs for approval at least five calendar days prior to the JITT. The mix design shall include all test results performed. If new materials are added, a new mix design, including the revised test results, shall be submitted at least one day prior to implementation.

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CONSTRUCTION REQUIREMENTS

308.06 Roadway Preparation

Snowplowable raised pavement markers shall be removed in accordance with 808.11(e) prior to FDR operations.

Grass and other vegetation shall be removed from the edge of the existing pavement to prevent contamination of the RBC during milling operation.

90 Grade adjustments of existing structures shall be made in accordance with 720.04 except existing structures shall be lowered prior to FDR operations, properly covered and filled with material compatible with the FDR mix design to maintain traffic.

All areas of soft or yielding subgrade, as shown on the plans, shall be corrected prior to pulverization operations.

308.07 Equipment

100 The equipment shall be capable of pulverizing the existing asphalt pavement and base materials. The equipment used for mixing the pulverized materials with asphalt emulsion, water, additives and corrective aggregate, when required, shall be capable of producing a homogenous and uniformly blended RBC. The equipment used for placement of the RBC shall be capable of placement in accordance to 105.03.

The equipment shall consist of the following major components:

(a) Spreaders and Distributors

110 Spreaders or distributors used to apply dry powder 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. Corrective aggregate, when required, 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.

(b) Additive Slurry Storage and Supply Equipment

120 Slurry shall be produced using a batch or continuous-flow type stationary mixer equipped with calibrated metering and feeding devices that introduce the cement, water and additives into the mixer in the specified quantities. 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.

(c) Mixing and Reclaiming Equipment

130 Only self-propelled, high powered, minimum 500 hp rotary mixers or reclaimers capable of mixing in-place to the depth specified shall be used. The minimum cutting drum width shall be 7 ft and fitted with cutting teeth capable of trimming earth, aggregate and HMA 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 and shall have the strength and rigidity so that it shall not develop a center deflection of more than 1/8 in.

140 The mixer or reclaimer shall be fitted with an integrated water and asphalt emulsion injection system capable of introducing both materials into the cutting drum during the mixing process. The metering device shall be capable of automatically adjusting the flow of material to compensate for any variation in the amount of reclaimed material introduced into the mixing chamber. The water or asphalt emulsion shall be calculated on a volumetric basis tied to a speed gauge, ft/min, using a calibrated meter that is capable of accurately measuring the amount of material to within 0.5% of the rate required. Automatic digital readings shall be displayed for both the flow rate and total amount of reclaimed material in appropriate units of weight and time.

(d) Motor Grader

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

(e) Compaction Equipment

150 The RBC shall be compacted using self-propelled rollers. The number, weight and types of rollers shall be as necessary to obtain the required compaction throughout the entire RBC thickness. The rollers may be used in any combination and may include a pneumatic tire roller, an 84 in. wide drum vibratory pad-foot roller equipped with a knockdown blade or a 10 t minimum single or double drum vibratory steel roller.

(f) Water Trucks

A water truck shall be used for supplying water to the reclaimer or roadway for the addition of moisture during the reclaiming operation. The water truck shall be

capable of providing a controlled and consistent spray without eroding or otherwise damaging the compacted RBC.

308.08 Weather Limitations

160 FDR operations shall be performed when the ambient temperature is 50°F or above. The FDR shall not be performed when the soil, aggregate, or subgrade is frozen or when freezing temperatures are anticipated within seven days of the end of RBC placement. The Engineer may restrict work when the heat index is greater than 100°F. The FDR shall not be performed before May 1 or after October 1.

308.09 Pulverization

170 The existing pavement shall be pulverized and stabilized in separate operations. Corrective aggregate, when required, shall be spread onto the existing surface in accordance with 308.07(a). The pre-determined full depth of asphalt pavement and base materials shall be pulverized, along with the corrective aggregate, to a homogenous mixture. The mixture may be brought to the desired moisture content during this process by means of surface application or through the mixing or reclaiming equipment's integrated fluid injection system for dust control. The base course shall not contain subgrade, roots, sod, topsoil, weeds, wood or any material deleterious to its reaction with the asphalt emulsion.

180 For asphalt emulsion stabilized RBC, the pulverization shall produce a gradation that has 100% passing the 2 in. (50 mm) sieve and $\geq 35\%$ passing the No.4 (4.75 mm) sieve.

180 When a paving fabric is encountered during the pulverization operation, the Contractor shall make the necessary changes in equipment or operations so that incorporation of shredded fabric into the RBC does not affect the performance parameters or inhibit placement or compaction of the RBC. The Contractor shall be required to remove and properly dispose of oversized pieces of paving fabric. The Contractor shall make the necessary adjustments in equipment or operations so that the shredded fabric in the recycled material is no more than 5 sq in. No fabric piece shall have a dimension exceeding a length of 4 in.

190 Rubberized crack filler, durable pavement markings, loop wires, and other non-pavement materials shall be removed as observed from the roadway during the pulverization process. Residual materials that cannot be completely removed may be incorporated into the 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 strength of the RBC.

308.10 Injection

200 An additive used in asphalt emulsion stabilized RBC may be dry powder or slurry and the Contractor shall address the application methods and fugitive dust control

procedures in the QCP when dry powder materials are used. The pulverized surface shall be scarified or knifed prior to applying materials in slurry form to prevent runoff or ponding. Any dry additives used shall be spread onto the pulverized surface using a mechanical spreader. The pulverized material shall be mixed with the stabilizer and additives as required by the mix design to create a homogeneous RBC.

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The in-place moisture content of the material shall be within -1% to +2% of the design moisture content as determined by the mix design.

Asphalt stabilizing materials shall have an application tolerance determined by adding $\pm 0.25\%$ to the percent total asphalt emulsion content.

The asphalt emulsion shall be incorporated into the pulverized material at the initial rate determined by the mix design and approved by the Engineer. Sampling and mix design may determine different levels of asphalt emulsion at various portions of the project.

220

The Contractor can request the asphalt emulsion percentage to exceed the upper tolerance provided the mix design requirements are satisfied at the requested percentage. The request will be subject to approval by the Engineer.

308.11 Control Strip and Compaction

A minimum 500 ft long control strip shall be conducted on the first day of production to verify the construction process meets the requirements as specified. The control strip shall allow the Contractor to:

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- (a) demonstrate the equipment, materials and processes proposed can produce a RBC layer in accordance with specification requirements;
- (b) determine the optimal rates for the asphalt emulsion, water and any additives recommended for the reclaimed material;
- (c) determine the sequence and manner of rolling necessary to obtain specified density requirements in one uniformly compacted layer.

240

The RBC density shall be achieved with the same equipment, materials, construction methods and density requirements used on the accepted control strip. A new control strip shall be constructed if changes are made outside the tolerances of the original mix design, equipment or construction methods.

The processed material shall be uniformly compacted in one layer to a minimum of 95% of the maximum density. Maximum density shall be determined in accordance with AASHTO T 180 at the required QC frequency from a representative sample collected after injection but prior to compaction.

250 Compaction shall be monitored in accordance with AASHTO T 310 in the direct transmission mode and continue to reach a minimum of 95% of the established maximum density during the control strip and for the remainder of the compaction operation.

260 Compaction equipment shall be in accordance with 308.07(e). Initial compaction shall be within 500 ft of the reclaiming unit using either a vibratory pad-foot roller, a pneumatic tire roller or a combination of the two. The pass counts shall continue to increase until the cleat indentations from the pad-foot roller are no more than 3/16 in. in depth and light can be seen between the pad-foot and RBC interface or there are no wheel impressions from the pneumatic tire roller remaining in the RBC.

260 The asphalt emulsion stabilized material shall be bladed and shaped by a motor grader in accordance with 308.07(d) to remove any remaining roller marks or indentations then leveled in accordance with 301.07. The profile grade and cross section of the RBC shall be finished within a tolerance of $\pm 1/2$ in. from the plan RBC elevation prior to profile milling.

270 Intermediate and final compaction shall be applied to the bladed and shaped RBC using either a pneumatic tire roller, a single or double drum vibratory steel roller or a combination of the two. Finish rolling shall not be performed in vibratory mode. The compaction operation shall be performed while the RBC remains in a workable condition and continued until roller marks no longer appear.

Any type of rolling effort that causes cracking, displacement or other type of pavement distress shall be discontinued until such time as the problem can be resolved and approved by the Engineer.

280 The QC technician shall be on site, observing all compaction efforts and approving areas as they reach minimum relative compaction. Care shall be taken to not over compact the mat.

All tests shall be conducted at the stated QC testing frequencies throughout FDR operations.

308.12 Opening to Traffic

Opening to traffic shall occur after sufficient cure time has been applied to the RBC so traffic will not initiate raveling or permanent deformation. All loose particles that may develop on the pavement surface shall be removed by a rotary power broom in accordance with 409.

290 After opening to traffic, the surface of the RBC shall be maintained in a condition suitable for the safe movement of traffic.

308.13 Maintenance

The Contractor shall maintain the RBC in a satisfactory manner until the surface course has been constructed.

300 Any damage to the completed recycled material shall be repaired by the Contractor prior to the placement of new asphalt concrete or final surface sealing. Patching shall be in accordance with 304. The excavated patch areas shall be filled and compacted with HMA or RBC material as directed by the Engineer. No direct payment will be made for damage or repair unless approved by the Engineer.

308.14 Curing

Before placing the final surfacing, the asphalt emulsion stabilized RBC shall remain in-place for a minimum of three days and meet one of the following conditions:

- 310 (a) there is less than 3.0% moisture remaining in the mixture, or
- (b) the in-place moisture contents have remained constant at 50% or less of the design optimum moisture content for a continuous time period of five days.

The planned method and duration of curing for asphalt emulsion stabilized RBC shall be in accordance with the QCP. The specified surface course shall be placed within two weeks of the RBC final cure, but no later than November 1.

308.15 Proofrolling

320 The asphalt emulsion stabilized RBC shall be proofrolled in accordance with 203.26 using a tandem or tri-axle dump truck loaded to the legal limit and operated between 2 to 4 mph over the RBC. The Engineer will determine the limits for any area that has deflection or rutting greater than 1/2 in.

The Contractor shall rework the areas failed in proofrolling by re-pulverizing and re-stabilizing the RBC in-place at no additional cost or by removing the RBC and stabilizing the subgrade with subgrade treatment Type IC in accordance with 207.

The reworked areas shall be proofrolled for final acceptance.

330 In locations of failing subgrade the RBC shall be removed and subgrade treatment Type IC shall be placed in accordance with 207. HMA patching, type B shall be placed in accordance with 304.

308.16 Milling

The entire surface of the asphalt emulsion stabilized RBC shall be scarified in accordance with 306 to the specified cross-slope in preparation for the overlay. Construction engineering in accordance with 105.08(b) shall be provided.

308.17 Underdrain Installation

340 Underdrain installation in accordance with 718, when required, shall begin after having completed the proofrolling.

308.18 RBC Overlay

The overlay atop the RBC shall be as shown on the plans. The overlay shall be placed after having completed the proofrolling.

The RBC shall be swept of all loose material and standing water with a rotary power broom in accordance with 409 immediately prior to placing the surface. The RBC shall be swept lightly to avoid damage to the RBC.

350 A tack coat shall be required only for the HMA overlay and shall be applied to the RBC in accordance with 406 immediately following sweeping operations.

Monuments shall be reestablished in accordance with 615.10.

308.19 Method of Measurement

360 The RBC will be measured by the square yard complete in place. Asphalt emulsion will be measured by the ton. Subgrade treatment will be measured in accordance with 207.05. Corrective aggregate to adjust the RBC gradation will be measured by the ton of material used. HMA patching, type B will be measured in accordance with 304.06. Milling will be measured in accordance with 306.10. Re-established monuments will be measured in accordance with 615.13. Removal of snowplowable raised pavement markers will be measured in accordance with 808.12. Portland cement will be measured by the ton.

308.20 Basis of Payment

370 The RBC will be paid for as full depth reclamation at the contract unit price per square yard, complete in place. Asphalt emulsion will be paid for at the contract unit price per ton, complete in place. Subgrade treatment will be paid for in accordance with 207.06. Corrective aggregate used to adjust the RBC gradation will be paid for at the contract unit price per ton, complete in place. HMA patching, type B will be paid for in accordance with 304.07, of the thickness specified on the plans. Milling will be paid for in accordance with 306.11. Re-established monuments will be paid for in accordance with 615.14. Removal of snowplowable raised pavement markers will be paid for in accordance with 808.13.

Portland cement will be paid for in accordance with 104.03. The change order will include direct material costs, delivery costs, and shall not include any other markups.

Payment will be made under:

380

Pay Item	Pay Unit Symbol
Corrective Aggregate, FDR.....	TON
Full Depth Reclamation.....	SYS

Stabilizing Material, Asphalt Emulsion.....	TON
Stabilizing Material, Portland Cement	TON

390 The costs of the RBC mix design and QC testing shall be included in the cost of the full depth reclamation.

The costs associated with removal of grass and vegetation, rubberized crack filler, durable pavement markings, loop wires and other non-pavement materials shall be included in the cost of the full depth reclamation.

The costs associated with pulverizing, stabilizing, compacting, curing and maintenance of the RBC shall be included in the cost of the full depth reclamation.

400 The cost associated with mixing water shall be included in the cost of the full depth reclamation.

The cost associated with aggregate when used to supplement material volume shall be included in the cost of the corrective aggregate pay item.

When portland cement is a required stabilizing material, costs associated with mixing, installation, compaction, curing, and maintenance shall be included in the cost of the full depth reclamation.

410 The cost associated with aggregate when used to adjust the RBC gradation shall be included in the cost of the corrective aggregate pay item.

In the locations of failing subgrade, removal of the RBC shall be included in the cost of subgrade treatment.