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203-3.4.4 Rubberized Polymer Modified Emulsion (RPME).

203-4.4.4.1 General. RPME shall consist of a mixture of emulsified asphalt, crumb rubber, and latex. RPME shall contain between 0.55 pounds per gallon (66 grams/liter) and 0.65 pounds per gallon (78 grams/liter) of crumb rubber. Latex shall constitute a minimum of 2 percent by weight of RPME.

Crumb rubber shall:

- a) be granulated scrap tire rubber free from fabric, wires, and other contaminants
- b) be dry and free flowing;
- c) have a specified gravity between 1.15 and 1.20; and
- d) have a gradation of 100 percent passing the No. 16 (1.18mm) sieve, 95 percent passing the No. 20 (900µm) sieve, and a maximum of 1 percent passing the No. 200 (75µm) sieve.

Calcium carbonate or talc may be added to a maximum of 4 percent by dry weight of crumb rubber to prevent the rubber particles from sticking together.

203-3.4.4.2 Composition. RPME shall conform to the requirements to shown in Tale 203-3.4.4.2.

TABLE 203-3.4.4.2

Tests	ASTM Test Method	Requirements	
		Min.	Max.
Viscosity, 77°F (25°C), Brookfield, Model RVT #6 Spindle @ 10 RPM (Centipoise) @ 60 sec.	D 2196	4,000	12,000
Residue by Evaporation % (including fillers)	D 6934	50	55
Sieve Test (% retained on No. 20 (850µm) sieve)	D 6933	---	2.0 ¹
Penetration of Residue, 77°F (25°C), 0.1mm	D 5	15	30
Solubility of Residue	D 2042	75	---
Weight lbs/gallons (g/L) 77°F± 1°F (25°C ± 5°C)	D 1475	8.33 lbs/gal (1000g/L)	8.75 lbs/gal (1050g/L)
Asphalt Content ²	-----	40	-----

1. Sieve test of original emulsion is 0.10 max.

2. Asphalt Content shall be determined by multiplying Residue by Evaporation by Solubility of Residue.

203-3.5 Certificate of Compliance. If so specified in the Special Provisions or requested by the Engineer, a Certificate of Compliance conforming to 4-1.5 shall be sent with each load of emulsified asphalt.

203-3.6 Temperature. Emulsified asphalt may be reheated, but at no time after loading shall the temperature be raised above 160°F (70°C). During reheating, emulsified asphalt shall be agitated to prevent localized overheating. Emulsified asphalt shall not be permitted to cool to a temperature less than 40°F (5°C).

Unless otherwise specified in the Special Provisions, emulsified asphalt shall be mixed and applied within the temperature range shown in Table 203-3.6.

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TABLE 203-3.6

Grade of Emulsified Asphalt	Pug Mill Mixing Temperature °F (C°)		Application Temperature °F (C°)	
	Min.	Max.	Min.	Max.
CQS-1h	50 (10)	130 (55)	77 (25)	130 (55)
RS-1, CRS-1			77 (25)	130 (55)
RS-2, CRS-2			110 (45)	160 (70)
SS-1, CSS-1	50 (10)	130 (55)	77 (25)	130 (55)
SS-1h, CSS-1h	50 (10)	130 (55)	77 (25)	130 (55)
CMS-C, CMS-2S, CMS-2h	50 (10)	140 (60)	100 (40)	160 (70)
RPME	60 (15)	140 (60)	---	---

The Contractor shall furnish and keep on the Work site a thermometer capable of accurately determining the temperature.

203-3.7 Distribution Equipment. Distribution equipment shall conform to 203-2.5 except that hand spraying by means of a hose or bar through a gear pump or air tank is acceptable for uniform application rates up to 0.10 gallon per square yard (0.45 liter per square meter) for work on flat surfaces or tacking of vertical edges.

203-3.8 Volumetric Measurement. For volumetric quantities, the unit of measurement shall be the U.S. gallon (liter) at a temperature of 60°F (15°C).

In converting weight to volume, computation shall be based on the following, for all grades of emulsified asphalt, except RPME:

Gallons per ton = 240 (Liters per Tonne = 1002)

Pounds per gallon = 8.33 (Liters per Tonne = 998)

For RPME:

Gallons per ton = 235 (Liters per Tonne = 962)

Pounds per gallon = 8.5 (Liters per Tonne = 1018)

203-4 NOT USED.

203-5 SLURRY SEAL.

203-5.1 General. Slurry seal shall be either emulsion-aggregate slurry (EAS) conforming to 203-5.4 or rubberized emulsion-aggregate slurry (REAS) conforming to 203-5.5.

203-5.2 Mix Design. The Contractor shall submit a mix design in accordance with 2-5.3.4 for each combination of emulsified asphalt grade and aggregate gradation to be used in the Work. Each mix design shall conform to ASTM D3910. Laboratory reports supporting each mix design shall be included with the submittals. Laboratory reports shall identify the aggregate source and supplier, emulsified asphalt supplier and all of the test results required to ASTM D3910 except for the cohesion test. When addition, each mix design shall include the following:

- a) amount of emulsified asphalt or RPME in gallons (liters) per ton (Tonne) of aggregate,
- b) amount of added water in gallons (liter) per ton (Tonne) of aggregate,

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- c) quantity and type of set control agents,
- d) percent of latex, if so specified in the Special Provisions, and the
- e) loose unit weight of aggregate (ASTM C29 with 0.1 ft³ (3L) bucket).

When a mix design is more than 30 days old, it shall be supplemented with a Certificate of Compliance conforming to 4-1.5 that states the combined aggregate gradation is with ± 3 percent of the reference mix design based on a 30 days moving average or the average of a minimum of 10 of the most current laboratory results, whichever is greater. A mix design shall be reformulated if it is more than one year old or whenever the combined aggregate gradation changes from that in the previously submitted mix design by ± 3 percent points on any sieve size shown in Table 203-5.3.2 (A). If the source of any aggregate or emulsified asphalt is changed, or the mix design or supporting laboratory reports are over one year old, a new mix design shall be submitted to the Engineer in accordance with 2-5.3.4.

Mix designs shall be based on the following:

- a) for Type Fine, the content of RPME and water needed to produce a slurry seal with a maximum wet track abrasion test loss of 50 grams per square foot (540 grams per square meter) when tested in accordance with ASTM D3910;
- b) for Type I, the content of emulsified asphalt and water needed to produce a Type I slurry seal with a maximum wet track abrasion test loss of 50 grams per square foot (540 grams per square meter) when tested in accordance with ASTM D3910; or,
- c) for Type II or Type III, the content of emulsified asphalt and water needed to produce a slurry seal with a maximum wet track abrasion test loss of 60 grams per square foot (650 grams per square meter) when tested in accordance with ASTM D3910.

ASTM D3910 shall be modified to include the aggregate retained on the No. 4 (4.75mm) sieve for Type II and Type III slurry seals. Type III slurry seals shall use the 3/8 inch (9.5mm) template.

203-5.3 Aggregate.

203-5.3.1 General. Aggregate shall be 100 percent crushed rock conforming to 200-1.1, 200-1.2, and the requirements shown in Table 203-5.3.1.

TABLE 203-5.3.1

Tests	ASTM Test Method	Requirements
Percentage Wear at 500 Revolutions ¹	C131	40% Maximum
San Equivalent	D2419	55 Minimum
Soundness (5 cycles) ¹	C88	15% maximum

1. To be run on the material retained on the No. 4 (4.75mm) sieve graded from the source.

203-5.3.2 Grading. The combined aggregate gradation shall be determined in accordance with ASTM C136 and confirm to the requirements shown in Table 203-5.3.2.

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TABLE 203-5.3.2

Sieve Size	Percentage Passing Sieves							
	Type Fine		Type I		Type II		Type III	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
3/8 inch (9.5mm)	100	---	100	---	100	---	100	---
No. 4 (4.74mm)	100	---	100	---	90	100	70	90
No. 8 (2.36 mm)	95	100	90	100	65	90	45	70
No. 16 (1.18mm)	75	92	65	90	45	70	28	50
No. 30 (600µm)	50	75	40	60	30	50	19	34
No. 50 (300µm)	35	50	25	42	18	26	12	25
No. 100 (150µm)	15	30	15	30	10	24	7	18
No. 200 (75µm)	10	20	10	20	5	15	5	15

203-5.4 Emulsion-Aggregate Slurry (EAS)

203-5.4.1 General. EAS shall be a stable mixture of cationic emulsified asphalt, aggregate, water, a set control agent, and when so required, latex. EAS shall be specified by combined aggregate gradation and emulsified asphalt grade, i.e. Type II-CQS-1h-EAS. The combined aggregate gradation and emulsified asphalt grade shall be as specified in the Special Provisions or shown on the Plans.

203-5.4.2 Materials.

203-5.4.2.1 Aggregate. Aggregate shall be Type I, Type II, or Type III conforming to 203-5.3.

203-5.4.2.2 Emulsified Asphalt. Emulsified asphalt shall be slow-set or quick-set, and, if so specified in the Special Provisions or shown on the Plans, contain latex. Slow-set emulsified asphalt shall be CSS-1h conforming to 203-3 unless otherwise specified in the Special Provisions or shown on the Plans. Quick-set emulsified asphalt shall be CQS-1h conforming to 203-3 unless otherwise specified in the Special Provisions or shown on the Plans.

The percentage of emulsified asphalt and residual asphalt content shall conform to the requirements shown in Table 203-5.4.2.2.

TABLE 203-5.4.2.2

	Test Method	Type I	Type II	Type III
Emulsified Asphalt %, by weight of dry aggregate	---	17 - 20	14 - 18	11 - 15
Residual Asphalt Content, % by weight of dry aggregate	ASTM D6307 or CT 382 ¹	10 min.	7.5 min.	6.5 min.

1. Sample size shall be 500g minimum.

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203-5.4.2.3 Water. Water shall conform to 203-3.2

203-5.4.2.4 Latex. The addition and exact percentage of latex to be added shall be as specified in the Special Provisions or shown on the Plans. Latex for cationic emulsified asphalt shall conform to 203-3.3 except contain 65 ± 5 percent rubber solids.

203-5.4.2.5 Set Control Agents. Set control agents shall be either Type II or Type V portland cement conforming to 201-1.2.1, aluminum sulfate, or other material approved by the Engineer.

203-5.4.3 Mixing. Mixing shall conform to 302-4.

203-5.5 Rubberized Emulsion Aggregate Slurry (REAS).

203-5.5.1 General. REAS shall be a stable mixture of RPME, aggregate, water and portland cement. REAS shall be specified by combined aggregate gradation, i.e. Type II-REAS. The combined aggregate gradation shall be as specified in the Special Provisions or shown on the Plans.

203-5.5.2 Materials.

203-5.5.2.1 Aggregate. Aggregate shall be Type Fine, Type I, Type II or Type III conforming to 203-5.3 of RPME and residual RPME solids shall conform to the requirements shown in Table 203-5.5.2.2.

203-5.5.2.2 Rubberized Polymer Modified Emulsion. RPME shall conform to 203-3.4.5. The percentage of RPME and residual RPME solids shall conform to the requirements shown in table 203-5.5.2.2.

TABLE 203-5.5.2.2

Test	Test Method	Type Fine		Type I		Type II		Type III	
		Min	Max	Min	Min	Min	Max	Min	Max
RPME % by weight of dry aggregate ¹	ASTM D6307 ² or	61	85	50	57	33	40	28	35
Residual RPME Solids ³	CT 382 ²	31	47	26	31	17	22	15	19

1. Must meet Residual RPME Solids.

2. Sample size shall be 500g minimum.

3. Residual RPME Solids shall be determined by multiplying RPME % (ASTM D6307 or CT 382) by Residue by Evaporation of RPME % (ASTM D6934).

203-5.5.2.3 Water. Water shall conform to 203-3.2.

203-5.5.2.4 Portland Cement. Portland cement may be added to modify the viscosity and curing characteristics accordance with the approved mix design.

Portland cement shall be Type I/II or II/V conforming to 201-1.2.1 and shall not exceed 1.5 percent of the dry weight of the aggregate.

203-5.5.3 Central Plant Mixing.

203-5.5.3.1 General. Mixing at a central mixing plant shall conform to the following requirements:

- a) Component materials conforming to 203-5.5.2 shall be stored separately at the plant.

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- b) Aggregate shall neither be stored nor transported in such a way that may cause segregation, degradation, or intermingling of different size aggregates.
- c) Materials shall be proportioned by weight into the mixing tank. Volumetric proportioning will not be permitted.
- d) The mixing tank shall be equipped with scales. The zero tolerance for the tank scales shall be 0.5 percent based on the total batch weight. The scales shall be calibrated and certified on a yearly basis in accordance with 4-1.7 or after every modification or repair.
- e) The mixing tank shall be equipped with a full sweep mixer/agitator with blades or paddles of a sufficient size and number and operated at a speed sufficient to produce a homogeneous mix. Should the blades, paddles, or other parts of the mixer/agitator become worn to such an extent to adversely affect the quality of the mix they shall be promptly replaced. Insufficient mixing or agitation within the mixing tank shall be corrected by either a reduction in the volume of component materials or other adjustments.
- f) Each batch shall be continuously mixed for 3 minutes or until all of the component materials are thoroughly blended, whichever is longer. The mixing time shall begin upon the introduction of the last component material. If the Engineer determines that the mixture is not thoroughly blended, the mixing time shall be increased.
- g) Mixed REAS shall be stored at the central mixing plant site in storage tanks equipped with an agitator if a similar configuration to the agitator in the mixing tank. The agitator shall be capable of continuous operation.

203-5.5.3.2 Transporting. REAS shall be transported from the central mixing plant to the Work site in trucks specifically designed for this purpose equipped with an agitator. REAS shall be continuously agitated during transport.

203-5.5.4 Work Site Mixing. Mixing at the Work site in continuous-flow mixers shall conform to 302-4.

302-4.7 Rubberized Emulsion Aggregate Slurry (REAS).

302-4.7.1 General. REAS shall conform to 203-5.5

302-4.7.2 Mixing. REAS shall be mixed by one of the following methods as specified in the Special Provisions:

- a) in a continuous flow mixer conforming to 302-4.3 at the Work site or
- b) at a central mixing plant conforming to 203-5.5.3

302-4.7.3 Transporting. Transporting of REAS mixed at a central mixing plat shall conform to 203-5.5.3.2.

302-4.7.4 Work Site Storage. REAS mixes at a central mixing plat may be stored at the Work site in tanks specifically designed for this purpose and which are equipped with an agitator similar to that in a central mixing plant. The agitator shall be capable of continuous operation.

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302-4.7.5 Application Temperature. REAS shall not be applied if either the pavement or the ambient temperature is less than 55°F (13°C) and falling, but may be applied when the pavement and ambient temperatures are both above 50°F (10°C) and rising.

302-4.7.6 Application Rate.

302-4.7.6.1 Continuous-Flow Mixer. The aggregate application rate of REAS mixed on the Work site in a continuous-flow mixer shall conform to the requirements shown in Table 302-4.7.6.1 unless otherwise specified in the Special Provisions or shown on the Plans.

TABLE 302.4.7.6.1

Type	Application Rate (REAS)	
	Minimum	Maximum
Type Fine REAS	2.8 lbs/yd ² (1.5 kg/m ²)	3.4 lbs/yd ² (1.8 kg/m ²)
Type I REAS	4.4 lbs/yd ² (2.4 kg/m ²)	5.2 lbs/yd ² (2.8 kg/m ²)
Type II REAS	7.5 lbs/yd ² (4.1 kg/m ²)	10.0 lbs/yd ² (5.4 kg/m ²)
Type III REAS	15.7 lbs/yd ² (8.5 kg/m ²)	21.8 lbs/yd ² (14.7 kg/m ²)

302-4.7.6.2 Central Mixing Plant. The application rate of REAS mixed at a central mixing plant shall conform to the requirements shown in Table 302-4.7.6.2 unless otherwise specified in the Special Provisions or shown on the Plans.

TABLE 302-4.7.6.2

Type	Application Rate (REAS)	
	Minimum	Maximum
Type Fine REAS	5.0 lbs/yd ² (2.7 kg/m ²)	6.0 lbs/yd ² (3.2 kg/m ²)
Type I REAS	7.1 lbs/yd ² (3.8 kg/m ²)	8.4 lbs/yd ² (4.5 kg/m ²)
Type II REAS	11.3 lbs/yd ² (6.1 kg/m ²)	15.0 lbs/yd ² (8.1 kg/m ²)
Type III REAS	22.5 lbs/yd ² (12.2 kg/m ²)	28.1 lbs/yd ² (15.2 kg/m ²)

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302-4.7.6.3 Corrective Action. When the application rate is less than the minimum shown in the tables above, the Contractor shall apply additional REAS to the nonconforming areas as necessary to conform to the Specification.

When the application rate exceeds the maximum shown in the tables above, the nonconforming material shall be removed and replaced, or be left in a place at no additional cost to the Agency, as determined by the Engineer.

302-4.8 Spreading and Application. Prior to spreading, the Contractor shall clean the existing pavement unless otherwise specified in the Special Provisions. Immediately ahead of the spreader truck, the existing pavement shall be pre-wetted by a pressurized water distribution system equipped with a fog-type spray bar capable of completely covering the surface of the pavement.

Slurry seal mixed at the Work site shall be spread by a spreader box attached to a continuous-flow mixer truck conforming to 302-4.3. REAS produced at a central mixing plant shall be spread by a spreader box attached to an agitator truck conforming 203-5.5.3.2.

The spreader box shall be equipped with flexible material in continuous contact with the existing pavement and shall be capable of controlling the rate of application. The spreader box shall have adjustable width and strike-off height, and be capable of controlling and providing uniform spreading.

The maximum speed of the spreader truck shall not exceed 270 feet per minute (80 meters per minute).

REAS mixed at a central mixing plant shall be continuously agitated during spreading.

Hand squeegees and other equipment shall be provided for spreading and spillage removal in areas inaccessible to the spreader box.

Slurry seal shall be applied in such a manner that no ridges remain. Areas in which there is evidence of solidification of the emulsified asphalt, balling or lumping of the aggregates, or uncoated aggregates shall be removed and replaced to the satisfaction of the Engineer.

The Contractor shall prevent slurry seal from being deposited on other than asphalt concrete surfaces and shall remove it from surfaces not designated to be sealed. The method of removal shall be approved by the Engineer.

Where the completed slurry seal surfacing is not uniform in color, the street shall be treated by a method approved by the Engineer to eliminate the color variation.

302-4.9 Field Sampling and Testing.

302-4.9.1 Field Sampling. During the performance of the Work, the Contractor shall provide the Engineer with at least 2 field samples, from separate loads, of mixed slurry seal per mixer per day. WTAT specimens shall be cast and struck off within 60 seconds of obtaining the sample. WTAT specimens shall not be transported until the slurry seal has set as defined by ASTM D3910.

Field samples shall conform to the requirements shown in Table 302-4.9.1.

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TABLE 302-4.9.1

Test	ASTM Test Method	Requirements	
		Min.	Max.
Wet Track Abrasion Test, Weight loss, gm/ft ² (gm/m ²) Type Fine Aggregate	D3910 ¹	0	50 (540)
Wet Track Abrasion Test, Weight loss, gm/ft ² (gm/m ²) Type I Aggregate	D3910 ¹	0	50 (540)
Wet Track Abrasion Test, Weight loss, gm/ft ² (gm/m ²) Type II Aggregate	D3910 ¹	0	60 (650)
Wet Track Abrasion Test, Weight loss, gm/ft ² (gm/m ²) Type III Aggregate	D3910 ¹	0	60 (650)
Consistency Test (mm)	D3910 ¹	20	40
Extraction Test (Calculated Emulsion Content, %)	D6307 ² , CT 382 ²	± 1% of mix design for EAS ± 3% of mix design for REAS	
Water Content (% of Dry Slurry)	See Note 3	Type I, II and III EAS < 25 Type Fine and I REAS < 40 Type II and III REAS < 31	

1. Modified ASTM D3910 to include No. 4 (4.75mm) aggregate or greater and to be performed using field samples. Subsection 6.4.4.7, ASTM D3920 may be modified to use a microwave oven for drying the specimen after the abrasion cycle is complete and the debris washed off.
2. Modified ASTM D6307 and California Test Method 382 to allow a minimum of 500 ±50 gram sample.
3. Weight a minimum of 500 grams of homogenized mixed slurry into a previously tared quart can with a friction lid. The lid shall be placed on the can to prevent loss of material during transportation. Place the can with the lid off in an oven and dry to constant mass at 220°F± 10°F (110°C ±5°C).
4. The 3/8 inch (9.5mm) template shall be used.

If the test results fail to meet Specification, the Contractor shall cease spreading slurry seal produced by the nonconforming mixed until the Contractor demonstrates the mixer is producing slurry seal which conforms to the Specification.

302-4.10 Measurement.

302-4.10.1 General. The basis of measurement shall be the weight of materials, in tons (Tonnes), used in the Work, as determined by licensed weight master's certificates. Upon completion of the Work, the Contractor shall submit to the Engineer licensed weightmaster's certificates for materials delivered to the Work site and for excess materials not incorporated into the Work.

302-4.10.2 Slurry Seal Mix in Continuous-Flow Mixers. Slurry seal mixed in continuous-flow mixers shall be measured by each ton (Tonne) of emulsified asphalt and each ton (Tonne) of each type of aggregate used in the Work.

302-4.10.3 REAS Mixed at a Central Mixing Plant. REAS mixed in a central mixing plant shall be measure by each ton (Tonne) used in the Work, including aggregate, RPME, additives and water.

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302-4.11 Payment.

302-4.11.1 Payment Reduction for Noncompliance.

302-4.11.1.1 General. Payment to the Contractor will be reduced for failure of the field test samples to conform to the WTAT requirements specified in 302-4.9.1.

302-4.11.1.2 Reduction in Payment Based on WTAT. If the average of all WTATs performed per mixer, per day, fails to conform to the requirements specified in 302-4.10.1, the Contractor agrees that payment for the Work represented by the failed tests shall be reduced as shown in Table 302-4.11.1.2 (A) or (B).

TABLE 302-4.11.1.2 (A)

WTAT Loss gm/ft² (gm/m²)	Payment Reduction (Percent) Type Fine & Aggregate
0 – 50 (0 – 540)	0
50.1 – 60 (540.1 – 650)	5
60.1 – 70 (650.1 – 750)	15
70.1 – 80 (750.1 – 860)	30
80.1 – 99 (860.1 – 1070)	70
99.1 or greater (1070.0 or greater ¹)	100

1. Slurry seal surfacing with WTAT loss greater than 99.1 gm/m² (1070.0 gm/m²) shall be removed to the satisfaction of the Engineer.

TABLE 302-4.11.1.2 (B)

WTAT Loss gm/ft² (gm/m²)	Payment Reduction (Percent) Type II & III Aggregate
0 – 60 (0 – 540)	0
60.1 – 75 (650.1 – 810)	5
75.1 – 80 (810.1 – 860)	15
70.1 – 80 (750.1 – 860)	30
80.1 – 99 (860.1 – 1070)	70
99.1 or greater (1070.0 or greater ¹)	100

1. Slurry seal surfacing with WTAT loss greater than 99.1 gm/m² (1070.0 gm/m²) shall be removed to the satisfaction of the Engineer.

302-4.11.2 Slurry Seal Mixed in Continuous-Flow Mixer. Payment for slurry seal surfacing for slurry seal mixed in continuous-flow mixers shall be at the Contract Unit Price per ton (Tonne) for emulsified asphalt and the Contract Unit Price per ton (Tonne) for each type of

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aggregate. No separate payment will be made for calibration, scheduling, public convenience, or traffic control unless otherwise specified in the Special Provisions.

302-4.11.3 REAS Mixed at a Central Mixing Plant. Payment for slurry seal surfacing for REAS mixed in a central mixing plant shall be at the Contract Unit Price per ton (Tonne). No separate payment will be made for calibration, scheduling, public convenience, or traffic control unless otherwise specified in the Special Provisions.