When it is determined that the monthly selling price of asphalt binder on the first business day of the calendar month during which the last day of the partial payment period occurs varies either upward or downward from the base price index, the contract unit price for asphalt binder for plant mix will be adjusted. The adjusted contract unit price will be determined by adding the difference between the selling price and the base price index to the contract unit bid price for asphalt binder.

The adjusted contract unit price will then be applied to the theoretical quantity of asphalt binder authorized for use in the plant mix placed during the partial payment period involved, except that where recycled plant mix is used, the adjusted unit price will be applied only to the theoretical number of tons of additional asphalt binder materials required by the JMF.

Adjusted contract unit prices for all grades of asphalt binder, including additional asphalt binder materials in recycled mixtures, will be based on the average selling price and base price index for asphalt binder, Grade PG 64-22, regardless of the actual grade required by the JMF.

In determining the adjusted contract unit price for any material specified in this section the following formula will be used:

$$\mathbf{A} = \mathbf{B} + (\mathbf{D} - \mathbf{C})$$

Where:

**A** = Adjusted Contract Unit Price
**B** = Contract Unit Price
**C** = Base Price Index
**D** = Monthly Average Terminal F.O.B. Selling Price

In the event the Department is unable to secure an F.O.B. selling price from at least 4 terminals in a given month, payment will be at the contract unit price for each ton of asphalt binder used in the work during that month.

Payment will be made under:

| Pay Item | Pay Unit |
|---|---|
| Asphalt Binder for Plant Mix | Ton |
| Polymer Modified Asphalt Binder for Plant Mix | Ton |

# SECTION 650
# OPEN-GRADED ASPHALT FRICTION COURSE

## 650-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, construction of a plant mixed open-graded asphalt friction course (OGFC) properly laid upon a prepared surface in accordance with these Specifications and in conformity with the lines, grades, thickness and typical sections shown on the plans; producing, weighing, transporting, placing and rolling the plant mix as specified in Section 610; furnishing the asphalt binder, anti-strip additive, fiber stabilizing additive and all other materials for the plant mix; furnishing and applying tack coat as specified; providing QC as specified in Section 609 as modified for OGFC; surface testing of the completed pavement; furnishing scales; making any repairs or corrections to the friction course that may become necessary and maintaining the friction course until final acceptance of the project.

## 650-2 MATERIALS

Refer to Division 10.

| Item | Section |
|---|---|
| Anti-strip Additives | 1020-8 |
| Asphalt Binder, Performance Grade | 1020-2 |
| Coarse Aggregate | 1012-1(B) |
| Fiber Stabilizing Additives | 1020-10 |
| Fine Aggregate | 1012-1(C) |
| Mineral Filler | 1012-1(D) |
| Reclaimed Asphalt Shingles (RAS) | 1012-1(E) |

## 650-3 COMPOSITION OF MIXTURE (MIX DESIGN AND JOB MIX FORMULA)

### (A) General

Design the open-graded asphalt friction course using a mixture of coarse and fine aggregate, asphalt binder, mineral filler, fiber stabilizing additive and other additives as required to produce a mix meeting Table 650-1.

At least 20 days before start of asphalt mix production, submit the mix design and proposed JMF targets for each required mix type and combination of aggregates to the Engineer for review and approval. The mix design shall be prepared by a mix design technician approved by the Department in an approved mix design laboratory. Prepare the mix design in accordance with Article 610-3 and the Department's mix design procedures. Copies of these procedures can be obtained through the Materials and Tests Unit.

The mix design and JMF target values will be established within the mix design criteria specified in Table 650-1 for the particular type of mixture to be produced.

### (B) Mix Design Criteria

Design open-graded asphalt friction course (OGFC) mixtures conforming to the gradation requirements and other mix design criteria in Table 650-1 for the mix type specified.

Use the asphalt binder grade shown in Table 650-1 for the mix type specified. RAS may be used in accordance with Subarticle 610-3(A).

Use an anti-strip additive in all OGFC mixes. It may be hydrated lime or a chemical additive or both. Add chemical anti-strip additive at a rate of 0.5% by weight of asphalt binder. Add hydrated lime at a rate of 1.0% by weight of dry aggregate. Use an approved source and grade. Add the anti-strip additive to the asphalt binder in accordance with Article 620-3.

If needed to prevent asphalt draindown, incorporate a fiber stabilizing additive into all OGFC types. Add the fiber at a dosage rate by weight of the total mix as approved.

In addition to the required mix design submittal, the Contractor shall prepare and deliver gyratory compactor specimens to the Department's Central Asphalt Laboratory for Cantabro durability testing. The Contractor shall prepare these specimens using lab produced mix in accordance with NCDOT procedures. Provide the samples at least 20 days before the anticipated beginning placement of OGFC mixture.

| TABLE 650-1<br>OGFC DESIGN CRITERIA | |
|---|---|
| **Grading Requirements** | **Total Percent Passing** |
| *Sieve Size (mm)* | *Type FC-1 Modified* |
| 19.0 | - |
| 12.5 | 100 |
| 9.50 | 75 - 100 |
| 4.75 | 25 - 45 |
| 2.36 | 5 - 15 |
| 0.075 | 1.0 - 3.0 |
| | |
| Asphalt Binder Grade | PG 76-22 |
| Binder Content, % | 5.5 - 8.0 |
| Mixing Temperature at the Asphalt Plant[A] | 300 – 325°F |
| Air Voids, % minimum | 18.0 |
| Cantabro Loss, % maximum | 20.0 |
| Draindown, % maximum | 0.3 |

**A.** The JMF mix temperature shall be within the ranges shown unless otherwise approved.

## 650-4 PLANT EQUIPMENT

Use plant equipment in accordance with Article 610-5 and the requirements herein.

When fiber stabilizing additives are used as an ingredient of the mixture, use a separate feed system capable of accurately proportioning the required quantity into the mixture and in such a manner that uniform distribution will be obtained. Interlock the proportioning device with the aggregate feed or weigh system so as to maintain the correct proportions for all rates of production and batch sizes. Accurately control the proportion of fibers to within ± 10% of the amount required. Provide flow indicators or sensing devices for the fiber system that are interlocked with plant controls such that mixture production will be interrupted if introduction of the fiber fails.

When a batch type plant is used, add the fiber to the aggregate in the weigh hopper or as approved. Increase the batch dry mixing time by 8 to 12 seconds, or as directed, to assure the fibers are uniformly distributed before the injection of asphalt binder into the mixer.

When a continuous mix or dryer-drum type plant is used, add the fiber to the aggregate and uniformly disperse at the point of injection of asphalt binder. Add the fiber in such a manner that it will not become entrained in the exhaust system of the drier or plant.

## 650-5 CONSTRUCTION METHODS

Produce, transport to the site and place the OGFC in accordance with Section 610, except as otherwise provided below.

Do not place OGFC between October 31 and April 1 of the next year, unless otherwise approved. The minimum air and road surface temperature for placing Type FC-1 Modified mix will be 60°F.

Before starting production of the mix, stockpile all aggregates for a sufficient period of time to facilitate the drainage of free moisture.

Clean the existing surface in an acceptable manner before placement of any asphalt material.

Remove all existing raised pavement markers as directed and repair any damaged areas caused by the removal. Use an approved dense graded mixture of similar type material for the repair.

Apply tack coat in accordance with Section 605 and the following:

**(A)** Use Asphalt Binder, Grade PG 64-22 tack coat material or as approved.

**(B)** Uniformly apply the tack coat material at a rate of application 0.06 to 0.08 gal/sy, as directed.

Spread and finish the friction course as specified in Article 610-8. Roll the friction course as specified in Article 610-9.

Perform this work in accordance with and using equipment meeting Section 9.5 of the *Asphalt QMS Manual.*

Use a Material Transfer Vehicle (MTV) when placing all types of OGFC. Use a MTV meeting Section 9.5(E) of the *Asphalt QMS Manual.*

Remove and replace any part of the finished friction course that shows non-uniform distribution of asphalt binder, aggregate or fiber at no additional cost to the Department.

Coordinate plant production, transportation and paving operations such that uniform continuity of operation is maintained. If spreading operations are interrupted, the Engineer may require that a transverse joint be constructed any time the mixture immediately behind the paver screed cools to less than 250 ºF.

For end of project joints, provide a transition area consisting of one load of mixture per lane, or as directed. Taper the mixture in thickness from 3/8 inch at the end of the project to the typical thickness (approximately 3/4 inch) within the maximum distance of spread for one load of mixture. For ramps and gore areas, taper the mixture in thickness from that at the edge of the mainline, approximately 3/4 inch to 3/8 inch at the point of the ramp transverse joint. Construct the ramp transverse joint at a point specified by the plans or as directed.

## 650-6 QUALITY MANAGEMENT SYSTEM

Produce the OGFC in accordance with Section 609, with the following exceptions.

Sample and test the completed mixture from each mix design per plant per year at the following minimum frequency during mix production:

| Accumulative Production Increment | Number of Samples per Increment |
|---|---|
| 500 tons | 1 |

Record the following data on the standardized control charts and in accordance with the requirements of Section 7.4 of the *Asphalt QMS Manual*:

(a) Aggregate Gradation Test Results:
1. 2.36 mm
2. 0.075 mm Sieves

(b) Binder Content, %, $P_b$

## 650-7 MEASUREMENT AND PAYMENT

*Open-Graded Asphalt Friction Course, Type FC-1 Modified* will be measured and paid as the actual number of tons of friction course incorporated into the completed and accepted work. The friction course will be measured by being weighed in trucks on certified platform scales or other certified weighing devices.

Furnishing asphalt binder for the mix will be paid as provided in Article 620-4 for *Asphalt Binder for Plant Mix*. Adjustments in contract unit price due to asphalt binder price fluctuation will be made in accordance with Section 620.

No direct payment will be made for providing and using the materials transfer vehicle or any associated equipment, as the cost of providing same shall be included in the contract unit bid price per ton for the mix type to be placed.

Payment will be made under:

| Pay Item | Pay Unit |
|---|---|
| Open-Graded Asphalt Friction Course, Type FC-1 Modified | Ton |

# SECTION 652
# PERMEABLE ASPHALT DRAINAGE COURSE, TYPES P-78M AND P-57

## 652-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, the construction of a plant mixed permeable asphalt drainage course (PADC) properly laid upon a prepared surface in accordance with these Specifications and in conformity with the lines, grades, thickness and typical sections shown on the plans; producing, weighing, transporting, placing and rolling the plant mix as specified in Section 610; furnishing the asphalt binder, anti-strip additive and all other materials for the plant mix; furnishing and applying tack coat as specified in Section 605; furnishing scales; providing QC as specified in Section 609 as modified for PADC; making any repairs or corrections to the friction course that may become necessary; and maintaining the friction course until final acceptance of the project.

## 652-2 MATERIALS

Refer to Division 10.

| Item | Section |
|---|---|
| Anti-strip Additives | 1020-8 |
| Asphalt Binder | 1020-2 |
| Coarse Aggregate | 1012-1(B) |
| Fine Aggregate | 1012-1(C) |

The coarse aggregate shall meet Article 1012-1 except that that portion of the coarse aggregate retained on the No. 4 sieve shall contain at least 60% by weight of crushed pieces having two or more mechanically induced fractured faces.

## 652-3 COMPOSITION OF MIXTURE

### (A) General

Formulate the PADC from a mixture of crushed aggregate, asphalt binder, anti-strip additive and other additives as required to produce a mix meeting Table 652-1.

At least 10 days before start of asphalt mix production, submit the mix design and proposed JMF targets for each required mix type and combination of aggregates to the Engineer for review and approval. The JMF will be established in accordance with Article 610-3. Establish the asphalt binder content at the midpoint of the range specified in Table 652-1 or as approved.

### (B) Mix Design

Design PADC mixtures conforming to the gradation requirements and other mix design criteria in Table 652-1 for the mix type specified.

Use the asphalt binder grade shown in Table 652-1 for the mix type specified or as approved.

Use an anti-strip additive in all PADC mixes. It may be hydrated lime or a chemical additive or both. Add chemical anti-strip additive at a rate of 0.5% by weight of asphalt binder. Add hydrated lime at a rate of 1.0% by weight of dry aggregate. Use an approved source and grade.