PROJECT NUMBER RF-ALF-062-4(25)

STEESE HIGHWAY

OPEN-GRADED ASPHALT FRICTION COURSE

EVALUATION REPORT

September  1979

Conducted by

Alaska Department of Transportation

and Public Facilities

Interior Region

Fairbanks, Alaska
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BACKGROUND

An open-graded fraction course has been placed on a section of the roadway constructed as a part of the Gaffney to Farmer's Loop project, under contract RF-ALF-062-4(25).

Placement of the open-graded friction course was done on an experimental basis by the Alaska Department of Transportation and Public Facilities in cooperation with the Federal Highway Administration. This was the Department's first application of open-graded mix in interior Alaska, although it has been previously used in other areas of the state.

The project is located at Fairbanks in the Interior Region of the Department of Transportation and Public Facilities. The test section was placed over a newly constructed embankment and pavement structure. Included as a part of the test section was placement of 964 tons of open-graded mix over a distance of 3035 linear feet of 4-lane divided highway. The two roadway prisms each have a paved width of 38 feet.

Typically, the improvement consists of the following section:

1. 30 inches of selected material.
2. 6 inches of subbase.
3. 42 inches of base course.
4. 14 inches of hot asphalt paving.
5. Tack coat of CRS-1.
6. 3/4 inch of open-graded friction course.

SPECIFICATIONS AND FIELD CONTROL RESULTS

The specifications pertaining to open-graded asphalt friction course are found in the project special provisions. A copy of these specifications is included in this report as Appendix I. The project mix
design and the field control test results are tabulated below.

Material Source:

Associated Asphalt Paving (single stockpile).

Aggregate Gradation:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Job Mix Blend</th>
<th>Project Tolerance</th>
<th>Project Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>40</td>
<td>35-45</td>
<td>41</td>
</tr>
<tr>
<td>No. 8</td>
<td>11</td>
<td>7-15</td>
<td>14.5</td>
</tr>
<tr>
<td>NO. 200</td>
<td>3</td>
<td>2-5</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Asphalt:

(AR-40) 5.6% to 6.6% (Aggregate Basis)

Project Average = 5.6% (by extraction)

Mixing Temperature:

Range 238°F to 247°F

Additive:

Silicone 2 parts per million (1.28 oz. per 5000 gal)

Tack Coat:

CSS-1 0.05 gal per sq.yd.

Laydown Temperature

225°F Minimum

Project Average 239.8°F

Two areas of the open graded friction course were sampled and tested approximately one year after being placed. The film thickness for each sample was computed using the procedure recommended by FHWA Region 10. Film thickness values computed were 15.7 microns and 17.1 microns, A film thickness of 20 microns is the attempted standard in mix designs, The desirable thickness could probably have been achieved with a decrease in the mixing temperature.
CONSTRUCTION OPERATIONS

Paving with the open-graded asphalt friction course was done on August 12 and 13, 1977. A Cedarapids track mounted paving machine was used for laydown and a 10-Ton steel wheel roller was used for consolidation of the mix.

An initial problem during laydown operations was over-rolling of the mat. Apparently, contractor personnel were not informed of the procedures required in the placement of the friction course.

As compared to conventional paving operations, the open-graded mix requires only the rolling necessary to consolidate the mix and bind the particles together.

During the handling and laydown operation the aggregate and asphalt tended to segregate. Extraction tests on samples taken during the laydown operation gave erratic results. The asphalt contents calculated using the plant meter readings were generally a higher percentage than extraction test results. Using the extraction tests as a basis for the control, asphalt quantities were increased at the plant to keep the mix within specifications.

Mixing temperatures were near the maximum of the design range of 238°F to 248°F, with the project average being 246.6°F. Construction personnel observed separation of asphalt from the aggregate, but did not attempt lowering the mixing temperature.

MAINTENANCE

Initially, the open-graded asphalt friction course was very tender, and extra precautions were exercised by maintenance personnel to keep blade damage to a minimum. No serrated blades or chemicals have been used in the maintenance of this test section. See Appendix III.
Substantial subgrade deformation has taken place in the test section. In some areas it has been necessary to re-level the surface in order to maintain an acceptable riding surface. Re-leveling was accomplished with conventional dense-grade asphalt concrete. No attempt has been made to seal the cracks resulting from subgrade deformation.

OBSERVATIONS
This section of open-graded asphalt friction course was placed over a newly constructed embankment, and most of the section was across virgin terrain. Severe differential settlement has taken place in some areas and has required a leveling course. Cracks in the surface structure throughout the test area indicate there has been some differential settlement in all sections of the embankment.

Raveled areas developed soon after traffic was routed onto the project in the fall of 1977. Since the first season's use, additional raveling has not been noticeable. Raveled areas marked prior to the second winter's use have shown no noticeable advancement of the raveling. It appears that there is blade damage, though it is difficult to distinguish from the raveled areas.

There is some indication that raveling initiates where a crack has projected through the friction course. In areas where raveling has not progressed, the cracks are much wider at the surface of the friction course than at the surface of adjacent dense graded mix.
Attempts to relevel the badly deformed areas have resulted in discontinuities of the riding surface of the open-graded asphalt friction course. Patching material which will duplicate the original mix is not readily available to maintenance forces.
The friction course appears to function well during all types of weather. It remains free of standing water during heavy rains. During wet weather, vehicles on conventional asphalt pavements produced a mist effect. On the open-graded mix the effect was a light spray. During cold weather when frost forms on the pavement surface, the open-graded friction course is not as slick as other types of surfacing. There has been no noticeable difference in the extent of roadway icing between the test section and adjacent areas of roadway.

A noise test was conducted by the Region Environmental Section, comparing noise levels on the open-graded friction course with those obtained on an adjacent section of dense-graded pavement. An average of 1.4 dba reduction in noise level was observed on the open-graded course as compared with the dense-graded mix. While the difference appears not to be a significant amount, it could be used where noise levels are an important factor in right of way acquisition or relocation. A copy of the memorandum reporting test procedures and the results is attached as Appendix 11.

COSTS COMPARISON

On the Gaffney-Farmer's Loop project three types of surfacing were specified in the contract. The following is a cost breakdown of the in-place costs for each of the three items:

- Open-graded friction course $2.25/sq.yd., 3/4" depth
- Hot Asphalt Pavement 1.98/sq.yd., 3/4" depth
- Asphalt Surface treatment 5.11/sq.yd.,

On another project in this area also constructed during the 1977 season the unit cost for asphalt surface treatment was $1.76/sq.yd.,
and may be considered a more reasonable comparison. A Slurry seal
used at the Fairbanks International Airport during 1978 was placed
at a unit cost of $1.53 per sq.yd.,

RECOMMENDATIONS:
Future uses of open-graded friction course should be restricted to
areas where an embankment exists or can be provided which will be
relatively free of settlement and deformation and/or over a
structurally sound pavement. Unstable embankment appears to be a
prime cause of raveling. Surfaces which have a proven in place
stability are recommended.
Mixing temperatures should be carefully considered during the mix
design phase, with a view to lowering the mixing temperature range with
a resultant increase in film thickness. Problems in obtaining uniform
extraction test results and a less than desirable film thickness indi-
cate the specified temperature was too high.
Rolling of open-graded mix should be kept to a minimum since consolidation
of the mix is not a problem for such a thin lift.
SECTION 408.

OPEN GRADED ASPHALT
FRICITION COURSE

408-1.01 Description. This work consists of the furnishing and mixing of aggregate and asphalt at a central mixing plant, and the hauling, spreading, and compaction of the mixture as specified in the contract and in close conformity with the lines, grades, and thicknesses shown on the plans or established by the Engineer.

408-2.01 Composition of Mixtures. Materials and the composition of mixtures shall conform to the requirements of subsections 401-2.01 through 401-2.04, and special provisions set forth except the following:

408-2.02 Gradation. The job-mix formula with the allowable tolerances shall be within the master range gradation limits set forth in the following table:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>30-50</td>
</tr>
<tr>
<td>No. 8</td>
<td>5-15</td>
</tr>
<tr>
<td>No. 200</td>
<td>2-5</td>
</tr>
</tbody>
</table>

408-2.03 Tolerances. After the job-mix formula is established, all mixtures furnished shall conform thereto within the following ranges of tolerances:

<table>
<thead>
<tr>
<th>Sieve Sizes or Item</th>
<th>Tolerances, % Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>±5</td>
</tr>
<tr>
<td>No. 8</td>
<td>±4</td>
</tr>
<tr>
<td>No. 200</td>
<td>1.5</td>
</tr>
<tr>
<td>Asphalt %</td>
<td>0.5</td>
</tr>
</tbody>
</table>

408-2.05 Aggregate. Aggregate for Open-Graded Asphalt Friction Course shall conform to the subsection 703-2.04 except the following:

Course aggregate shall be that retained on the No. 8 sieve. Aggregate retained on the No. 8 sieve shall have at least 90 percent by weight with one or more fractured faces as determined by Alaska T-4. The abrasion loss shall not exceed 40 percent (AASHTO T-96).

408-2.06 Asphalt. The type and grade of asphalt material will be AR-40 Asphalt Cement, AASHTO M 226-73. From test information of the aggregate sample the grade and type of asphalt may be changed by the Engineer with no change in unit price.

CONSTRUCTION REQUIREMENTS

408-3.01 Construction Requirements. Open graded asphalt plant mix friction course shall be constructed in accordance with the requirements of subsections 401.3.01 through 401.3.16 and special provisions set forth except the following:

408-3.02 Weather Limitations. Open graded asphalt friction course shall not be placed unless the road surface to be treated is at a temperature of 60°F or higher.

SPECIAL PROVISIONS

RF-ALF-062-4 (25)
Gaffney Road to Farmer’s Loop Road
4083.03 Mixing. The mixture shall not be delivered on the road at a temperature less than 225°F.

4083.04 Rolling. Rolling shall be accomplished with a flat-wheel steel roller weighing not more than 10 tons. Rolling operations shall be conducted in such a manner that shoving, distortion, or stripping will not develop beneath the roller. The amount of rolling shall be only that necessary for consolidating the open grade friction course and bonding it to the underlying surface course, and will be confined to one or two passes only. Excessive rolling shall be avoided.

4083.05 Additives. A silicone additive with a dosage of 2 parts per million (1.28 oz. per 5,000 gallons) added to the mix to provide adequate retained strength. Grade of silicone used shall have a viscosity of 1,000 centistokes at 77°F. The cost of silicone additive will not be paid for separately but shall be included in the work.

4084.01 Method of Measurement. Open graded friction course, and Asphalt Cement AR-40 shall be measured as prescribed in subsection 401-4.01.

408-5.01 Basis of Payment The accepted quantity determined as provided above, shall be paid for at the contract price per unit of measurement of the pay item listed below, complete in place.

Payment will be made under:

<table>
<thead>
<tr>
<th>Pay Item No.</th>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>408(1)</td>
<td>Open Graded Asphalt Friction Course</td>
<td>Ton</td>
</tr>
<tr>
<td>408(2)</td>
<td>Asphalt Cement AR-40, for Open Graded Asphalt Friction Course</td>
<td>Ton</td>
</tr>
</tbody>
</table>

SPECIAL PROVISIONS
RF-ALF-062-4(25)
Gaffney Road to Farmer’s Loop Road
APPENDIX II

Memo from Mike Tinker to
Paul Misterek, dated 08-02-79
TO:

Paul Misterek
Regional Materials Engineer
Interior Region

FROM:

Mike Tinker
Environmental Coordinator
Interior Region

DATE: August 2, 1979
FILE NO: 3213
TELEPHONE NO: MT/ck

SUBJECT: Open Graded Asphalt, Noise Test

The noise test you requested comparing the open graded asphalt test strip on the Steese Highway (between Trainer Gate Road and Birch Hill) and the more standard hot mix asphalt, was completed on August 2, 1979.

The test was made between 6:30 and 7:00 AM to avoid heavy traffic. Weather was overcast, 63°F., and the asphalt surface was dry.

The test was made by driving the test vehicle past both sampling stations five times at 45 miles per hour. The sampling stations were at Station L 148+00 for the open graded section and at Station L 189+00 for the normal hot mix. The sampling points were located on the highway fill slope, 20 feet from the near lane. The sound level meter was hand held at two feet above the level of the pavement.

Test Vehicle: 75 Chevrolet Malibu with radial tires
Speed: 45 MPH
Sound Level Meter: Quest Model 215
ANSI S 1.4 Type 2 - 1EC R 123

Test Results:

<table>
<thead>
<tr>
<th>Pass</th>
<th>Noise Level</th>
<th>Pass</th>
<th>Noise Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>72.5 dba</td>
<td>1</td>
<td>75.2 dba</td>
</tr>
<tr>
<td>2</td>
<td>74.3</td>
<td>2</td>
<td>75.0</td>
</tr>
<tr>
<td>3</td>
<td>73.3</td>
<td>3</td>
<td>74.5</td>
</tr>
<tr>
<td>4</td>
<td>73.3’</td>
<td>4</td>
<td>74.6</td>
</tr>
<tr>
<td>5</td>
<td>73.6</td>
<td>5</td>
<td>74.5</td>
</tr>
<tr>
<td>Avg.</td>
<td>73.4</td>
<td>Avg.</td>
<td>74.8</td>
</tr>
</tbody>
</table>

As expected, the open graded mix produced less noise than the normal hot mix. The difference was not a significant amount, but could be used where noise levels are an important factor in right of way acquisition or relocation. In some instances, saving 1 or 2 dba could eliminate expensive noise abatement measures.

The tests were conducted by staff from the Interior Region Environmental Section.

MT/ck
APPENDIX III

Memo from Ron Doner to Paul Misterek, dated 12-27-78
TO: Paul Misterek  
FROM: Ron Doher  

DATE: December 27, 1978  
FILE NO:  
TELEPHONE NO:  

SUBJECT: Open-Graded Friction Course  

The following are our observations of the open-graded friction course placed on the Gaffney to Farmers Loop project.

The friction course appeared to function well in both summer and winter. It remained free of visible standing water during heavy rains and also does not get as slick in the winter when frost forms on the pavement. The only problem observed was that several sections ravelled out. This ravelling began as soon as traffic was on the road and prior to any winter blading. Maintenance has not used serrated blades nor chemicals on this section. It appears that the problem was an inadequate tack coat to anchor the friction course to the underlying pavement.

I would like to see some additional experimental sections placed at some of our slippery intersections.

RJD/dc