Inspection of Salt-Treated Granular Bases, Multiple Seals, District 8

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MEMORANDUM

TO: W. B. Drake
   Assistant State Highway Engineer

FROM: J. H. Havens
      Director of Research

SUBJECT: Base Stabilization; Initial Bituminous Treatment;

REF: Your memorandum dated January 31, 1964;
     memorandum dated January 22, 1964, from
     D. L. Hacker, District Engineer, District 8
     Somerset, Kentucky

On February 20 and 21, Robert L. Florence, Research
Engineer, and D. J. Garland, Assistant District Engineer for Planning
and Research in the 8th District, inspected each of the initial treatment
projects mentioned in Mr. Hacker's memorandum of January 22 and
also visited some other similar projects in that area. Mr. Florence
has prepared a memorandum report on the several projects, and copies
thereof are attached hereto for your review and transmittal to Mr. Hacker
along with whatever additional comments you might have in mind.

As you know, there are several optional approaches to the
initial bituminous surfacing of existing traffic-bound roads; and it has
always been a problem, from the standpoint of costs, to obtain sufficient
structural thicknesses to assure satisfactory performances. However,
regardless of how deficient these initial surface treatments may be
structurally, the failures that occur tend to disclose the weaker sections
of the road where additional thicknesses and other corrective measures
are needed. Moreover, if such failures are confined to a relatively small
percentage of the roadway surface, it may be logically concluded that the
pavement is not otherwise structurally deficient or extravagant. I have
held the belief for a long time that rural roads which are not likely to
serve high volumes of traffic in the future can be maintained more eco-
nomically after initial bituminous surfacing than they can be maintained
in the traffic-bound condition. If we pursue this line of thought far enough, we would be compelled to dismiss the traffic-bound type of road from practical consideration. It has been our experience on previous occasions that when a traffic-bound road is properly maintained in good appearance, there is a strong compulsion to proceed to the surfacing stage.

The optional approaches which I alluded to earlier include the following:

1. Bases
   a. Granular stabilization of soils
   b. Soil-cement stabilization
   c. Crushed stone

2. Bituminous surfacing
   a. Hot-mixed bituminous concrete
   b. Multiple seal coats
   c. Road mix

The selection of any of these approaches should, of course, be based on economics and on individual or local preferences. A planned program of initial treatments would undoubtedly contribute experience records which, in time, would prove the value of a particular method. From this point of view, I believe that we should endorse and encourage this type of work throughout the state and provide helpful guidance whenever an opportunity arises.

Mr. Florence has referred to three earlier reports which involve some aspects of initial treatment work. In addition to those, your attention is invited to our recent memorandum reports pertaining to an experimental, initial-treatment project in Butler County. Copies of those reports are attached hereto for convenient review, and attention is invited more specifically to the introductory discussions in the memoranda dated February 16, 1962, and February 20, 1962.

In summary, and based on the good appearance of the roads inspected, I recommend that we encourage the continuation of the initial treatment program which Mr. Hacker has outlined and that performance records be maintained and reviewed from time to time. In regard to the use of salt, I suggest that it be reserved for dry weather construction of the bases and that it be withheld from early spring and late fall construction.
This recommendation is offered on the basis that the salt serves largely as a construction aid during dry weather. I suggest, too, that the existing base should not be disturbed any more then is necessary and that the quantity of crushed stone to be added be determined according to the adjudged structural needs. In some cases, the stone might be preferentially apportioned to the weaker sections within a particular roadway.

It would be helpful to us if the district engineer would advise us of progress from time to time and furnish project identifications and locations.

JHH: afj

Attachments
March 24, 1964

MEMORANDUM

TO: J. H. Havens
    Director of Research

FROM: R. L. Florence
       Research Engineer

RE: Inspection of Salt-Treated Granular Bases, multiple seals, District 8.
Reference: Memorandum to W. B. Drake, Assistant State Highway Engineer, from D. L. Hacker, District Engineer, January 22, 1964; Memorandum to J. H. Havens, Director of Research, from W. B. Drake, Assistant State Highway Engineer, January 31, 1964.

In compliance with requests from Mr. Drake and Mr. Hacker, the subject salt-treated and sealed bases were inspected February 20 and 21 by Mr. D. J. Garland, Assistant District Engineer for Planning and Research, and myself. All of the construction was done on rural roads in 1962 and 1963 and involved intermixing of salt and additional stone with the existing traffic-bound material on the roadway, compacting the base, and then sealing with a double A-2 seal.

Five projects were constructed in 1962 and totaled 13.971 miles in length. Three of these bases were stabilized, primed, and then sealed with a double A-2 seal. A third seal was placed on these roads in 1963. The remaining two projects, located in McCreary County, on Ky. 700 and totaling 2.72 miles in length, were not sealed but were paved (by contract) with hot-mix binder and surface courses. Three of the bases constructed in 1962 were treated with CaCl₂, and two were treated with NaCl.

Seven additional projects were constructed in 1963 and totaled 15.262 miles in length. All of these bases were treated with NaCl, primed, and sealed with a double A-2 seal.
In constructing these bases, the ditches were first cleaned, and the salt and a sufficient amount of No. 610 limestone and agricultural limestone was intermixed with the existing traffic-bound material on the roadway to bring the compacted thickness of granular material to approximately 3 inches. Salt was applied at a rate of 17 to 20 tons per mile. District 8 Maintenance estimates this to be an application rate of approximately 3 lb. per sq. yd. The compacted base was primed and allowed to cure approximately 10 days. The first seal coat was compacted first with a 7-ton pneumatic roller and then with a 10-ton steel-wheeled roller. The second seal coat was then laid in the same manner. On some projects RS-2 was used in the seal coat, and on others RC-3 was used. On those projects, which were constructed in 1962 and which received a third seal coat in 1963, RC-3 was used in the third seal. The type of priming material varied from project to project.

When the inspection was made, the projects as a group were in good condition, considering the time of year. There were no open pot-holes, and there was only a few scattered, small, patched areas on any project. Cracking was noted in the seal coat on several projects; but, in many instances, this was located in cut-sections and the instability could be attributed to subgrade drainage problems that are so often encountered in cut-sections. The cover stone was firmly imbedded in the bituminous material. A very definite improvement in the texture and tightness of the seal was apparent on those projects constructed in 1962 and which had received a third seal in 1963. Assuming that all of the material applied as seal coats has been retained on the roadway, a surfacing approaching 95 lb. per sq. yd. has been applied. In all cases, the seal coat appeared to be bonded tightly to the underlying base.

In 1962 and 1963, the Research Division studied 14 rural road bases, 10 of which were salt treated. Three of the untreated bases are located in Pulaski County. These were constructed in 1962 by adding 3-inches of D.G.A. to the existing traffic-bound base material and then sealing them with a double A-2 seal. Two of the treated bases in that group are located in Rockcastle County and were constructed in the same manner except that calcium chloride was intermixed with the D.G.A. at a rate of 3 lb. per sq. yd. A third seal was added to all of these bases in 1963, and this has made a great improvement in the condition of the surfaces. These bases were also inspected in February, and all of them were found to be in good condition.

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One of the salt-treated bases mentioned in Mr. Hacker's memorandum, Lincoln County MP 69-510-C (Ky. 618), had been included previously in a study conducted by the Research Division (1958 and 1959) in connection with the use of calcium chloride to maintain traffic-bound roads.\(^2\) Also, in 1957, the Research Division reported on a study which included four projects on which the bases were treated with CaCl\(_2\) and sealed.\(^3\)

Although all of the roads inspected were in very good condition, there was no apparent evidence of any superiority in performance which could be attributed directly to the use of salt in this type of work. Any apparent advantage from addition of controlled amounts of salt (calcium chloride or sodium chloride) to an unsealed granular base (exposed FBM) seems to emanate from the retention of moisture which aids in compaction and reduces the loss of aggregate by dusting and ravelling.

Descriptive information pertaining to various projects relating to the foregoing inspections is appended hereto.


ADAI R COUNTY, MP 1-430-C

Road: Ky. 531, from intersection with Ky. 80 northward 3.311 miles.

Length: 3.311 miles

Width: 16 feet

Date Stabilized: September, 1962

Treatment:
Stabilization - No. 610 limestone, agricultural limestone, and 3 lb./sq. yd. of CaCl were intermixed with the existing traffic-bound stone (total compacted thickness - 3 inches).

Prime - 0.4 gal./sq. yd., RT-2 (cured approximately 10 days).

First Seal - 0.4 gal./sq. yd., RC-3; covered with 30 lb./sq. yd., No. 9 limestone.

Second Seal - Same as first seal.

Third Seal - Applied in 1963. Same as first seal.

Condition
February 21, 1964: The base was in good condition (Fig. 1). Some cracking was noted in the wheel-tracks in widely scattered spots (Fig. 2).
Fig. 1. MP 1-430-C. General Condition of Roadway, February 21, 1964.

Fig. 2. MP 1-430-C. An Area Showing Cracking of the Seal in the Wheel-Tracks.
ADAIR COUNTY, MP 1-550-C

Road: Ky. 76, from the Adair County line to an intersection with Ky. 206 in Adair County.
Length: 3.44 miles
Width: 18 feet
Date Stabilized: August, 1962
Treatment: Stabilization - No. 610 limestone, agricultural limestone, and 3 lb./sq. yd. NaCl were intermixed with the existing traffic-bound stone (total compacted thickness - 3 inches).

Prime - 0.4 gal./sq. yd., Primer L.
First Seal - 0.4 gal./sq. yd., RS-2; covered with 30 lb./sq. yd., No. 9 limestone.
Second Seal - Same as first seal.
Third Seal - 0.4 gal./sq. yd., RC-3; covered with 30 lb./sq. yd. No. 9 limestone, applied in 1963.

Condition February 21, 1964: The base was in good condition (Fig. 3). Alligator cracking, in the seal coat, was apparent in some cut-sections (Fig. 4).
Fig. 3. MP 1-550-C. General Condition of Roadway, February 21, 1964.

Fig. 4. MP 1-550-C. An Area of Distress in the Outside Wheel-Track.
McCREARY COUNTY
(MP 74-393-H and MP 74-393-G)

Road: Ky. 700,
MP 74-393-H, starts approximately 2.5 miles east of the intersection with U.S. 27 and extends 2.20 miles in an easterly direction.

MP 74-393-G, begins at the intersection with U.S. 27 and extends 0.52 miles in a westerly direction.

Length: MP 74-393-H, 2.20 miles
MP 74-393-G, 0.52 miles

Width: 16 feet

Date Stabilized: July, 1962

Treatment: Stabilization - No. 610 limestone, agricultural limestone, and 3 lb./sq. yd. of CaCl were intermixed with the existing traffic-bound stone (total compacted thickness - 3 inches).

Surfacing - 1 1/2 inches of Class I Binder, 1 1/4 inches of Class I-Type B Surface. The surfacing was done by contract with the Kelly Contracting Co.

Condition February 20, 1964: MP 74-393-H, This section is trafficked by heavily loaded coal trucks. There was some rutting in the wheel-tracks; although, the overall condition of the roadway was good. In a few areas the surface had been patched (Fig. 5).

MP 74-393-G, This section was in very good condition. No rutting or other failures were apparent.
Fig. 5. MP 74-393-H. General Condition of Roadway, February 20, 1964.
Heavy Coal Trucks Travel the Road.
ROCKCASTLE COUNTY, RH 1002 A-M1

Road: Extends from the northern city limit of Brodhead to an intersection with Ky. 1505.

Length: 4.5 miles

Width: 16 feet

Date Stabilized: August, 1962

Treatment: Stabilization - No. 610 limestone, agricultural limestone, and 3 lb./sq. yd. NaCl were inter-mixed with the existing traffic-bound stone (total compacted thickness -3 inches).

Prime - 0.4 gal./sq. yd., Primer L.

First Seal - 0.4 gal./sq. yd., RC-3; covered with 30 lb./sq. yd., No. 9 limestone.

Second Seal - Same as first seal

Third Seal - Same as first seal, applied in 1963.

Condition: February 20, 1964: The base was in good condition (Fig. 6). A few soft spots were noted in the base.
Fig. 6. RH 1002 A-M1. General Condition of Roadway, February 20, 1964.
The Montpelier - Joppa Road, Ky. 92, from the Adair Co. line to an intersection with Ky. 55.

3.311 miles

16 feet

September - October, 1963

Stabilization - No. 610 limestone, agricultural limestone, and 3 lb./sq. yd. of NaCl were intermixed with the existing traffic-bound stone (total compacted thickness - 3 inches).

Prime - 0.4 gal./sq. yd., Primer L.

First Seal - 0.4 gal./sq. yd., RS-2; covered with 30 lb./sq. yd., No. 9 limestone.

Second Seal - Same as first seal.

Overall the condition of the sealed base was good (Fig. 7). There were some areas showing evidence of repaired pot-holes (Fig. 8), and a few failed areas due to poor subgrade drainage in cut-sections (Fig 9).
Fig. 7. MP 1-830-C. General Condition of Roadway, February 21, 1964.

Fig. 8. MP 1-830-C. Area Showing Repaired Pot-holes.
Fig. 9. MP 1-830-C. An Area of Distress, in Side-Hill Cut.
ROAD:

Columbia - Abshear Rd., Ky. 551, from the intersection with Ky. 1323.

LENGTH:

MP 1-490-E, 2.739 miles
MP 1-410-E, 2.226 miles

WIDTH:

16 feet

DATE STABILIZED:

August, 1963

TREATMENT:

Stabilization - No. 610 limestone, agricultural limestone, and 3 lb./sq.yd. of NaCl were intermixed with the existing traffic-bound stone (total compacted thickness ~ 3 inches).

Prime - 0.4 gal./sq. yd., Primer L.

First Seal - 0.4 gal./sq.yd., RC-3; covered with 30 lb./sq. yd., No. 9 limestone.

Second Seal - Same as first seal.

CONDITION:

February 21, 1964: The over-all condition of the base was good (Fig. 10). There was a small amount of ravelling in the top seal-coat (Fig. 11).
Fig. 10. MP 1-490-E. General Condition of Roadway, February 21, 1964.

Fig. 11. MP 1-410-E. Section Showing Ravelling in Top Seal.
ADAIR COUNTY, MP 1-90-N

Road: Ky. 1313, from an intersection with Ky. 55 to the Crocus Post Office.

Length: 0.662 miles

Width: 16 feet

Date Stabilized: July, 1963

Treatment:
Stabilization - No. 610 limestone, agricultural limestone, and 3 lb./sq.yd., of NaCl were intermixed with the existing traffic-bound stone (total compacted thickness - 3 inches).

Prime - 0.4 gal./sq.yd., application rate. Part of the base was primed with Primer L and the remainder with RC-3 diluted with diesel fuel.

First Seal - 0.4 gal./sq.yd., RC-3; covered with 30 lb./sq.yd., No. 9 limestone.

Second Seal - Same as first seal.

Condition
February 21, 1964: The base was in good condition (Fig 12). In some areas the cover stone appeared to be ravelling out of the top seal. (Fig. 13).
Fig. 12. MP 1-90-N. General Condition of Roadway, February 21, 1964.

Fig. 13. MP 1-90-N. Close-up View of Seal Coat.
ROCKCASTLE COUNTY, MP 102-557-B, and
LINCOLN COUNTY, MP 69-510-C

Road: Ky. 618 and Ky. 1650, from Dog Walk in Lincoln County to Ottawa in Rockcastle County

Length: Rockcastle County, MP 102-557-B, Ky. 1650, 1.874 miles. Lincoln County, MP 69-510-C, Ky. 618, 1.028 miles

Width: 16 feet

Date Stabilized: October, 1963

Treatment:
- Stabilization - No. 610 limestone, agricultural limestone, and 3 lb./sq. yd., of NaCl were intermixed with the existing traffic-bound stone (total compacted thickness - 3 inches).
- Prime - 0.4 gal./sq. yd., Primer L.
- First Seal - 0.4 gal./sq. yd., RS-2; covered with 30 lb./sq. yd., No. 9 limestone.
- Second Seal - Same as first seal.

Condition
February 20, 1964: The base was in good condition (Fig. 14).
Fig. 14. MP 102-557-B. General Condition of Roadway, February 20, 1964.
### Road: Pueblo - Gregory Road, Ky. 790, from Pueblo to an intersection with Ky. 776.

### Length: 1.319 miles

### Width: 16 feet

### Date Stabilized: July, 1963

### Treatment:

- **Stabilization**: No. 610 limestone, agricultural limestone, and 3 lb./sq. yd. of NaCl were intermixed with the existing traffic-bound stone (total compacted thickness - 3 inches).

- **Prime**: 0.4 gal./sq. yd. application rate. Part of the base was primed with Primer L and the reminder with RC-3 diluted with diesel fuel.

- **First Seal**: 0.4 gal./sq. yd., RC-3; covered with 30 lb./sq. yd., No. 9 limestone.

- **Second Seal**: Same as first seal.

### Condition

#### February 20, 1964: The base was in good condition.
PULASKI COUNTY

Note: These projects were constructed in 1962 by contract and are presented here for comparison with the subject projects. The bases were constructed by adding an estimated compacted thickness of 3-inches of D.G.A. (no salt added) to the reshaped traffic-bound base and then sealing with a double A-2 seal. A third seal was added in 1963.

Roads: the Liberty-Penobscott Road (Ky. 1012), from Ky. 39 near the Rockcastle County Line, extending westerly.

The Woodstock-Clifty Creek-Rockcastle County Line Road (Ky. 934), from Ky. 39 at Woodstock to Ky. 935.

The Bush Creek Road (Ky. 935), from Ky. 39 approximately 0.79 mile south of Bandy to the Woodstock-Clifty Creek-Rockcastle County Line Road.

Projects: RS 100-615 (Ky. 1012); RS 100-635 (Ky. 934); RS 100-655 (Ky. 935);

Length: 11.401 miles total; 5.700 miles - RS 100-615; 2.856 miles - RS 100-635, 2.845 miles - RS 100-655.

Width: 18 feet

Treatment: 345 pounds per square yard of dense-graded aggregate base (limestone). Double A-2 seal - 35 pounds per square yard of No. 8 limestone, 20 pounds per square yard No. 9 limestone; emulsified asphalt RS-2. Additional compacted base thickness approximately three inches.

Contractor: Kelly Contracting Company

Construction Date July 31 - November 8, 1962
Construction Procedure:

1. Shaping existing roadway with patrol grader.
2. Watering and rolling re-shaped roadway with a 10-ton, 3-wheel roller.
3. Spreading of dense-graded aggregate base with two spreaders.
4. Compaction of base with a 10-ton, 3-wheel roller.
5. Shaping surface of DGA with a patrol grader.
6. Compaction with a vibratory compactor attached to a 3-wheel roller.
7. Re-rolling one day later to tie down loose material.

Condition:
February 20, 1964: All three bases were in good condition (Figs. 15, 16, and 17).
Fig. 15. RS 100-615. General Condition of Roadway, February 20, 1964.

Fig. 16. RS 100-635. General Condition of Roadway, February 20, 1964.
Fig. 17. RS 100-655. General Condition of Roadway, February 20, 1964.
ROCKCASTLE COUNTY

Note: These roads were constructed in 1962 by contract and are presented here for comparison with the subject projects. The bases were constructed by adding an estimated compacted thickness of 3-inches of salt treated D.G.A. to the reshaped traffic-bound base and then sealing with a double A-2 seal. A third seal was added in 1963.

Roads: The Negro Creek Road from U.S. 150 south of Brodhead to 1.5 miles east of the Lincoln County Line:

Ky. 1505, the Brodhead-Conway Road, from 0.5 mile west of Conway, extending southwesterly.

Projects: RS 102-107 (Negro Creek Road), and RS 102-277 (Ky. 1505).

Length: 6,300 miles (2,100) miles, RS 102-107; 4,200 miles, RS 102-277.

Width: 16 feet, RS 102-107; and 18 feet, RS 102-277.

Treatment: 345 pounds per square yard of dense-graded aggregate base (limestone). Sodium chloride-2.9 pounds per square yard (17 pounds per ton). Additional compacted thickness approximately three inches.

Contractor: Cardinal Construction Company.

Construction Date: October 16 - October 31, 1962.

Construction Procedure: 1. Shaping existing roadway with a patrol grader.
2. Spreading the aggregate.
3. Compaction of base with a 3-wheel roller.
5. Compaction of base with a pneumatic-tired roller.
6. Rolling the compacted base with a 3-wheel roller.
7. Re-rolling one day later to tie down loose metal.

Condition February 21, 1964: Both roadways were in good condition (Fig. 18, 19) Failures were more numerous on Ky. 1505 than on any of the other roadways constructed with D.G.A. This may be attributed to the narrowness of the roadway, and to rugged terrain in which it is located.
Fig. 18. RS 102-107. General Condition of Roadway, February 21, 1964.

Fig. 19. RS 102-277. General Condition of Roadway, February 21, 1964.