STATEWIDE EVALUATION OF OVERLAYS WITH FABRICS AND GEOGRIDS

SPECIAL STUDY NO 1019

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ABSTRACT

Reflective cracking has long been an issue of concern. Pavement rehabilitation techniques often are established in an attempt to address this issue. During the 1970's several products were introduced to the highway market for the purpose of retarding reflective cracking in bituminous overlays. Since then, a wide variety of geosynthetics including full coverage fabrics, strip fabrics and geogrids have been placed throughout Minnesota to evaluate their performances.

This paper presents a brief history of geosynthetics, a literature search and review to obtain information on geotextile applications in asphalt overlays and their performances. This includes a list of known installations of fabrics and geogrids in Minnesota. In addition to MN/DOT test sections, numerous sections constructed by cities, counties, airports and other agencies were looked into.

This paper shows the historical performance results of known installations of various types of fabrics and geogrids used for mitigating crack reflectance. Results of a statewide crack counts and survey did not show noticeable improvements of test sections over controls.

DISCLAIMER

The contents of this report reflect the views of the authors and do not necessarily reflect the official views or policies of the Minnesota Department of Transportation. This report does not constitute a standard specification or regulation.
FORWARD

This study was undertaken to evaluate the performances of asphalt concrete overlays with fabrics and geogrids. These test materials were incorporated in the overlays to test their ability to reduce or retard reflective cracking. A data base, containing information on these sites will be constructed.

The study was rendered invaluable assistance by the district offices of Mn/DOT, city, and county departments of public works that have jurisdictions over the areas the test projects were located.
INTRODUCTION

One of the most basic forms of pavement rehabilitation involves asphalt overlays. One of the concerns with asphalt overlays is controlling reflective cracking. During the past twenty years many manufacturers have introduced various types of geosynthetics, marketed to reduce reflective cracking, including full coverage fabrics, strip fabrics and geogrids. Numerous test sections have been constructed throughout Minnesota by MN/DOT since the late 1970's. In addition to MN/DOT test sections, there have been numerous test sections constructed by cities, counties and airports. This study involved specific site identifications, evaluation and data base development of asphalt overlays with fabrics, geogrids and other materials in Minnesota. This study provides an easy access to data on test locations and performances of overlays with these materials.

An extensive search for the various test sections in Minnesota, visual condition survey and analysis has been conducted. Some test sections could not be evaluated at the time of this study due to insufficient data present in existing files. It is important to note that these evaluations and data base development are expected to be a continuous process.

This report presents the results of the visual crack survey data. Detailed descriptions of the various material properties, installations, construction methods, and previous results of crack survey data are not included in this report. Reports covering these areas are available at the Office of Materials, Engineering and Research, Physical Research Unit, Minnesota Department of Transportation.

AN OVERVIEW OF GEOSYNTHETICS

Geosynthetics are primarily made of polymers from the plastics industry. They can also be made from rubber, fiberglas, and other materials. The major functions of these materials are: separation, reinforcement, filtration, drainage, and moisture barrier.

The major groups of geosynthetics are:

1) Geotextiles

They are indeed textiles in the traditional sense, but consist of synthetic fibers rather than natural ones such as cotton, wool, or silk. They are made into porous fabric by weaving, knitting, or matted together in a random, or nonwoven manner. There are many types and uses of geotextiles. Examples are

This study will be restricted to the ability of geotextiles to retard or delay reflective cracking.
2) Geogrids

They are plastics formed into a very open, gridlike configuration. They have large apertures. They are often stretched in one or two directions for improved physical properties. They function primarily as reinforcement and separation materials.

The other major groups of Geonets, Geomembranes, Geocomposites, and Geo-others have many engineering applications. However, much attention has not been paid to them as reflective crack control materials.

MECHANISMS OF REFLECTIVE CRACKING

Reflective cracks are cracks in a new overlay that occur over cracks in old pavement or overlay surfaces. Reflective cracking is due to strain concentration in the overlay resulting from movement in the vicinity of cracks in the existing surface. The movement may be horizontal due to expansion and contraction induced by temperature and moisture changes. Movements resulting from temperature changes are influenced by daily and seasonal variations in temperature, the coefficient of thermal expansion of pavement materials, and spacing of cracks. Bending or shear movement, induced by loads, may also contribute to the occurrence of reflective cracks. Load-induced movements are affected by the thickness of the overlay and the thickness and stiffness of the existing pavement.

Reflection cracking can have a profound effect on the life of an overlay in a number of ways. Poor riding quality and frequent maintenance could result. Reflection cracks allow water to enter the pavement structure. This may result in loss of bond between the new asphalt overlay and the existing asphalt or pavement surface, stripping in either layer, and softening of the subgrade materials.

LITERATURE REVIEW

Virtually all federal, states, counties, cities, and airport agencies responsible for pavement rehabilitation have tried a wide variety of materials, processes, and construction methods to retard or delay reflective cracking of asphalt overlay placed on existing overlays or pavement. Some of the materials that have been tried include welded-wire mesh, petromat, paveprep, polyguard, tenasr, geogrids, fiberglas, and mirafi. The list is a long one.
The performances of these materials with respect to reflective crack prevention or retardation varied widely from state to state, test sections to test sections and within test sections. While some agencies have reported satisfactory performance of some materials, others reported nonperformance of the same materials. Some agencies reported some test materials actually causing additional problems.

Countries, such as Sweden, Australia, Norway, Finland, Canada, and the United Kingdom have performed similar tests as the United States. Their findings were also similar to those of the U.S.

MINNESOTA EXPERIMENTAL PROJECTS

Several experimental projects have been undertaken in Minnesota to verify the effectiveness of various materials in retarding reflective cracking. A brief summary of some test sections surveyed and evaluated are given below.

1. C.S. 6004

The original location of this project is on the four lane divided highway T.H. 2 (E.B.L.) from Marcoux to Mentor in Polk County. The project was constructed during the summer of 1981. In 1982 the study was expanded to include another portion of the highway, from Mentor to Erskine.

The existing 9-7-9 Portland Cement Concrete was constructed in 1932. Visual inspection of this old pavement indicated that the 20 foot width of roadway was constructed in two 10 foot sections. With time, the longitudinal centerline joint had separated, resulting in an opening between the two slabs of up to several inches. The longitudinal joint had been sealed with joint sealer material and in 1968 the Portland Cement Concrete pavement was overlaid with 3 inches of plant mixed bituminous mixture.

The resurfacing plan of this section of roadway required the roadway to be widened to a width of 24 feet with the new centerline being relocated 2 feet of the old centerline. This places the old centerline joint in the left wheel path of the eastbound driving lane. As the longitudinal centerline joint had reflected through the previously placed bituminous overlay and maintenance of this joint was necessary, it was felt that an attempt to prevent this joint from reflecting through the planed overlay should be made.

Four experimental fabrics were placed on the 1981 project. These fabrics were the Roadglas Repair System, manufactured by
Owens-Corning Fiberglas Corp; Paveprep, manufactured by McAdams Manufacturing Co; "Y 78" Pavement Repair Material (Petromat), manufactured by Philips Fibers Corp; and Polyguard No. 665 membrane, manufactured by Polyguard Products, Inc. The 19982 Construction included only one fabric which was the Roadglas Repair system.

Crack evaluation was made in May of 1994. The results are tabulated in the appendix.

2. Route 39, Monticello

This test section is located in Wright County on CSAH 75, just outside Monticello. The trial sections featured the installation of Tensar, Owens-Corning continuous fiberglass mat, Petromat and unnamed experimental strip material. The construction of the test sections took place in 1984.

Due to severe failure, a portion of the test section (Fire hydrant to CSAH 39) has been overlaid with a new asphalt overlay. The remaining portion developed so many cracks that it was considered unnecessary to do a crack count.

3. C.S. 3007, T.H.95, Cambridge to Interstate 35

An asphalt concrete overlay was placed in this section of the roadway in 1989. Glasgrid material was incorporated into the overlay in east bound only to study its effectiveness in reducing crack reflectance. The existing pavement was a 25 year old bituminous surface at the time of the new overlay. A visual crack survey, conducted in 1994, revealed no substantial difference in performance between the test and control sections.

4. C.S.1903 Goodhue Dakota Co. Line to T.H. 50

The location of this project is on T.H.20, approximately 5 miles north of Cannon Falls. The existing structure is bituminous over concrete (9-7-9). On Friday, August 18, 1989, Glasgrid Pavement Reinforcement Mesh was installed on a 1" levelling course over a longitudinal interface between the inplace 9-7-9 concrete pavement and the 3' bituminous widening.

A visual crack survey was conducted in April of 1994. Both control and test sections were still in good conditions with few cracks. The Glasgrid section did not show improved performance over the control.
5. CITY OF ROSEVILLE
CITY PROJ. NO. 86-43

This project is located on Oakcrest ave, Prior ave, and West Perimeter drive. These roadways were surfaced in 1987. Test sections were placed using paveprep on the transverse joints of the old surface. Heavy tack coat applications to the surface of the old pavement resulted in difficulties in making the fabrics stay in place during construction. This led to the abandonment of the test in a section of Oakcrest ave. Crack survey was done in May of 1994. The results are in the appendix.

5. C.S. 0305 AND 4403

This roadway was surfaced in 1980. At that time various test sections were placed using petromat and Owens Corning on the longitudinal joints of the old centerline and the 4' widening. The length of cracking on each section was measured in May of 1994. The results are tabulated in the appendix.

6. C.S. 0301

The location of this project is on T.H. 10, from the city of Hawley to the city of Detroit Lakes in northwestern Minnesota. The test sections were constructed in 1980. T.H. 10 is a four-lane divided roadway. The existing pavement structure was constructed in 1957 and 1958. Traffic flow volume was 5700 to 6500 AADT in 1980. Rehabilitation of the highway was needed because the existing pcc pavement was severely "D" cracked and required continual maintenance.

Full width Petromat, Strip fabric Owens-Corning Roadglas, and SAMI were placed in the new bituminous overlay to reduce reflective cracking. Crack survey was made in May of 1994. The results are tabulated in the appendix.

7. HENNEPIN COUNTY

The following bituminous overlay paving projects using fabric to reduce reflective cracking were surveyed for cracks in March of 1994.

CSAH 32

The location of this project is S.Rad. 68th to center line 67th on Penn ave, Richfield. The construction took place in 1987. 20 and 12" wide strip fabric paveprep materials were placed at transverse and longitudinal cracks respectively. Crack survey was done in May of 1994. Several cracks were observed.
CSAH 53
The location of this project is Morgan ave to 200 ft. east on 66th street, Richfield. The overlay was placed in 1988. 20 and 12" wide strip fabric paveprep/pcf-100 materials were placed at transverse and longitudinal cracks respectively. Crack survey was done in May of 1994. Several cracks were observed.

CSAH 52
Two test sections and a control were placed on Nicollet, Minneapolis, in 1980. A Bidimc-22 fabric material, manufactured by Monsanto, was placed in the overlay from North Rad. 58th street to South Rad. 57th street. South Rad. 57th st. to North Rad. 56th st. was used as a control section. Tru Tex Mg-75, manufactured by True Temper, was placed in the overlay from North Rad. 56th street to 200 ft south of center line Diamond Lake road. All the sections have developed severe cracks at very close spacing.

CSAH 156
Overlaid in 1991, this test section is located in Winnetka, from school district bus garage entrance to a point 200 ft. north in New Hope. Geogrid, manufactured by Gundle, was placed in North bound outside lane only. The overlay was surveyed for cracks in May of 1994. See the appendix for the results.

BLOOMINGTON
Four test sections: Overlook drive, 111th st. to Queens drive, Queens drive to 112 st; and Morgan ave from 101st street to 99th street were surveyed for cracks in April of 1994. These sections had Petromat materials in their overlays. They were constructed in 1978. Several severe cracks had occurred in all sections.

8. C.S. 5601

The project is located on T.H. 210, between Fergus Falls and Breckenridge in district 4. A 20 inch wide paveprep, manufactured by McAdams Manufacturing Company and a 24 inch wide strip of Roadglas Spot Repair System, manufactured by Owens-Corning Fiberglass, were placed over the longitudinal joint, located approximately 2 feet and 8 feet left of the existing centerline joint. The construction took place in 1983. For the results of the crack survey conducted in May of 1994, refer to the appendix.


The project is located on T.H. 2, Proctor, between junction T.H. I94 and T.H. 35. A non-woven polypropylene Petromat fabric was placed in two sections in the overlay. Two other sections were also setup as controls. The overlay was placed in 1978. For the results of the crack survey conducted in May of 1994, refer to the appendix.
The project is located on T.H. 14, between W.Jct T.H. 56 and Havanna. A 4" asphalt concrete overlay was placed in August of 1993 on a 1" milled existing road surface. Two types of 20 inch wide Paveprep material were placed in the overlay. The two types were, self-adhesive and regular. They were used to retard transverse cracks from reflecting. A crack count was conducted in May of 1994. For the results of the survey, see the appendix.

**DISCUSSION**

Prior to the placement of the new asphalt overlays, longitudinal and transverse joints were cleaned and sealed, and all depressions were filled with bituminous patching mixture to provide a good surface for the new overlay. Installation difficulties were experienced in some cases in not being able to place the experimental materials flat. The asphalt overlay failed to bond to the existing surfaces or materials in some test sections. Some asphalt overlays did not have adequate thickness. As with any new product, it will take some time for the contractors and engineers to gain sufficient knowledge of placement to ensure that a uniform pavement can be produced and the performance can be compared to that of pavements placed using other familiar products and processes. Variations in roadbed and climate can also affect the performance of any test material.

**SUMMARY OF FINDINGS AND CONCLUSIONS**