Special Report 1998-06

PB98-138571

Review of Local Road Research Board Research Implementation 1980-1996

Local Road Research Board

FUNDING ACKNOWLEDGEMENT

This project was conducted with funding provided by the Minnesota Local Road Research Board (LRRB). The LRRB's purpose is to develop and manage a program of research for county and municipal state aid road improvements. Funding for LRRB research projects comes from a designated fund equivalent to 1/2 of one percent of the annual state aid for county and city roads.

Technical Report Documentation Page

1. Report No.	2.	3. Recipient's Accession No.
MN/RC - 1998/06		

4. Title and Subtitle	5. Report Date
REVIEW OF LOCAL ROAD RESEARCH BOARD (LRRB) RESEARCH IMPLEMENTATION 1980-1996	January 1998
	6.

7. Author(s)	8. Performing Organization Report No.
Michael M. Marti, P. E.	

9. Performing Organization Name and Address	10. Project/Task/Work Unit No.
Braun Intertec Corporation 6875 Washington Avenue South P.O. Box 39108 Minneapolis, MN 55439	11. Contract (C) or Grant (G) No. (C) 75194

12. Sponsoring Organization Name and Address	13. Type of Report and Period Covered
Minnesota Department of Transportation 395 John Ireland Boulevard Mail Stop 330 St. Paul, Minnesota 55155	Final, 1980 - 1996
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This report summarizes 16 years of projects and products of the Minnesota Local Road Research Board's (LRRB) Research Implementation Committee. The report includes a general overview of the LRRB's Research Implementation Committee (RIC) and also provides a summary of implementation products and projects that the RIC sponsored from the years 1980 to 1996.

The report divides implementation products into three areas: research syntheses, Research Implementation Series (RIS), and videotapes. It also presents the following information on implementation projects: title, author, date summary, project number, and a description of implementation or current status.

17. Document Analysis/Descriptors		18. Availability Statement
Research Implementation Series RIS LRRB	RIC Research Videotapes	No restrictions. Document available from: National Technical Information Services, Springfield, Virginia 22161

19. Security Class (this report)	20. Security Class (this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	62	

REVIEW OF LOCAL ROAD RESEARCH BOARD (LRRB) RESEARCH IMPLEMENTATION 1980 - 1996

Review Report

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January 1998

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Minnesota Local Road Research Board
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200 Ford Building Mail Stop 330
117 University Avenue
St. Paul MN 55155

ACKNOWLEDGEMENTS

The financial and logistical support provided by the Local Road Research Board, the Minnesota Department of Transportation, and the Center for Transportation Studies at the University of Minnesota for this work is gratefully appreciated.

EXECUTIVE SUMMARY

This report is a summary of all tasks performed by the Minnesota Local Road Research Board's Research Implementation Committee (LRRB-RIC) from 1980 through 1996. The report gives a general overview of the LRRB-RIC (including its history and structure), and provides a summary and status of the implementation products developed during the past 16 years. The implementation products are divided into three areas: research syntheses, Research Implementation Series (RIS), and videotapes. The majority of this report focuses on summarizing each of the implementation projects conducted by the LRRB-RIC. For each project, the following information has been compiled: title, author, date, summary, project number, and a description of implementation or current status. The implementation status was determined through a series of interviews involving personal and telephone surveys with the original researcher, county, city and Mn/DOT experts, and other technical experts within the respective topic.

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CHAPTER 1
RESEARCH IMPLEMENTATION

Introduction

In Minnesota, the Department of Transportation (Mn/DOT) and the Legislature have created an organization specifically devoted to overseeing and funding research for low-volume roads. This group is known as the Minnesota Local Road Research Board (LRRB). Although technology and innovation are important factors in research, good communication of research results are equally important in putting them into practical use.

Fortunately, Mn/DOT and the LRRB had the vision to fund an ongoing project to concentrate on implementing research. The project, known as *Investigation 645 Research Implementation*, has been active since 1974. The focus of this project is not to conduct physical research, but to put research into practice. The objectives of this project are two-fold:

1) To communicate a research topic's findings, current practices, and state-of-the-art technology. Rather than allowing research findings and information to be isolated at the sponsoring agency's office, one goal of this project is to communicate relevant information to the Minnesota local government engineers. One benefit of Investigation 645 is the prevention of duplicate research by similar agencies.

2) A reference source for local engineers. In an era of diminishing budgets and staff reductions, Investigation 645 is an extension of a local community's engineering staff. Most of the implementation products developed under this project provide a synthesis of current practices and technologies. Information is presented in a format that introduces and summarizes a topic, then provides additional resources for local engineering staff to consult for more specific information.

Research Implementation Committee

Because of the importance and variety of topics that research implementation encompasses, the LRRB commissioned an advisory committee to direct and oversee the project. The advisory committee,

known as the Research Implementation Committee (RIC), includes representation from local governments, Mn/DOT and the University of Minnesota.

Voting Members

- Four County Engineers
- Two City Engineers
- The Mn/DOT Assistant State Aid Engineer
- A Mn/DOT District State Aid Engineer
- The Mn/DOT Technology Development Engineer
- The Mn/DOT Research Operations Engineer

Ex-officio Members

- The Mn/DOT Technology Transfer Manager
- The Mn/DOT Research Services Engineer
- The University of Minnesota for Transportation Studies T^2 Center Director
- Others as appointed by the State Aid Engineer

Members are appointed by the Mn/DOT State Aid Engineer with the concurrence of the LRRB Chairperson. Local government membership is reviewed on a two-year cycle to make sure new member input and ideas are included.

Implementation Process

Many of the implementation tasks are performed by a consulting firm under a two-year contract. The consultant is selected based on their knowledge of the research topics, qualifications, expertise and most importantly, their ability to develop products that effectively communicate research findings.

Communication is defined by the RIC as a two-way exchange. The topics implemented under this project are a direct result of the communication process. The RIC surveys the Minnesota city and county engineers to determine their specific problem areas. Research requests are forwarded to the LRRB as topics for possible projects. To further delineate the implementation tasks, volunteer technical subcommittees are created for each task. These subcommittees typically are made up of engineers and technical experts from counties, cities, Mn/DOT, academia, and the private sector.

The premise for the subcommittees is to *use firsthand resources that have applied knowledge.* The level of implementation is a direct result of the communication product's effectiveness — products that go beyond the standard research report.

The consultant is charged with synthesizing these research topics. The synthesis includes: determining what is done locally, nationally and internationally with respect to the research topic; defining any special processes or concepts; providing any applicable case studies; and, providing a list of available references to further educate the audience.

The typical implementation task process includes: a literature search and review; interviews with technical experts, practitioners and researchers; research case studies; an information outline; preliminary document production; review process (by technical staff, subcommittee, RIC and the LRRB, respectively); and final product development. Involvement and interaction with the topic's subcommittee occurs during this process. Typically, a task is completed in five to six months.

One of the most important steps in this process is defining the medium in which the results will be presented. Generally, this is done during the topic selection process. During this process, the task force may determine that the delivery medium should be changed for more effective communication. Later in this document, the various mediums are reviewed and discussed.

Upon task completion, the information is communicated to the end users — the Minnesota city and county engineers — in either reports, documents, handbooks, workshops or videotapes. The communication strategy for each topic depends on the nature of the information and the audience. The printing, duplicating and distribution is handled by the Mn/DOT Office of Research Administration. Typical distribution includes, as a minimum, all Minnesota counties and each city with a population of 5,000 or greater, the Mn/DOT District Offices and Library, the Minnesota T^2 Center, and all LTAP centers through the APWA clearinghouse, although some topics call for special distribution.

RIC Products

The key to successful communication is to identify and address the audience. For each task a primary and secondary audience is identified. The products are developed in a context appropriate for the identified audience. In general, the primary audience has been the county and city engineers, or their

staff, or maintenance crews. The secondary audience has generally been the public (either in the form of the general public or the governing city and county boards).

Since the research implementation project started, there have been a number of definable products developed. The major areas of effort have been in pavement management, pavement maintenance and rehabilitation, pavement recycling, geotextiles, roadway stabilization, guardrails, speed control, and dust control.

As stated earlier, the presentation medium is specifically selected for each topic based on the material, audience and required delivery style. Although numerous media have been used, the three most common delivery media to date have been reports, videos and workshops.

Research Implementation Reports

The focus of the research syntheses is to provide the end user with a resource that will provide easy-to-use and applicable information. Generally, the topics for the research syntheses are either a current technology, maintenance or design application, or topic of relevant concern for local engineers. A good example of a research synthesis produced by the LRRB-RIC was on the topic of pavement rehabilitation. To assist the local engineer in determining the appropriate rehabilitation procedures for common causes of pavement distresses, a three-volume set of guide books was developed: an office manual and two field guides. The manual describes the evaluation and design procedures for pavement rehabilitation. The field guides, printed on heavy mylar stock for use in the field, are color coded and include detailed photographs that aid the user in identifying the types of distresses for both flexible and concrete pavements. Please see the description of *Pavement Rehabilitation — A Guide for Minnesota Cities and Counties* on Page 2-8.

The following Research Implementation Reports are reviewed.

- *Crack Sealing Bituminous Pavements in Minnesota*
- *Dust Control on Unpaved Roads*
- *Infrastructure Management Software Use in Minnesota*
- *Lightweight Fill Materials for Road Construction*
- *Load Effects on Highway Pavements*
- *Pavement Rehabilitation — A Guide for Minnesota Cities and Counties*
- *Proper Treatment and Disposal of Maintenance Wastes*

- *Recycling of Pavement Materials in the 1990s*
- *Repairing Utility Trenches*
- *Synthesis on Subsurface Drainage of Water Infiltrating a Pavement Structure*
- *Waste Products in Highway Construction*
- *Width Standards for Minnesota State Aid Streets and Roads*

Research Implementation Series (RIS)

The LRRB-RIC developed a unique document referred to as a *Research Implementation Series* to review and evaluate selected techniques or technology on a given topic and to briefly and succinctly summarize the information for local government agencies. The RIS are approximately eight pages in length and provide the following information: topic summary, overview of the knowledge to be communicated to the end user, any applicable case study reviews with respect to local experiences, and provide a resource of additional technical papers, reports and publications.

The following RIS are reviewed.

RIS 1 *Bituminous Pavements Using Sand Aggregates*
RIS 2 *Geotextiles in Highway and Road Construction*
RIS 3 *Geotextiles in Highway and Road Construction to Stabilize Shallow Fills*
RIS 4 *Geotextiles as Separation Layers in Highway and Road Construction*
RIS 5 *Geotextiles in Highway and Road Construction for Filtration, Drainage, and Erosion Control*
RIS 6 *Geosynthetics in Reinforcement and Subgrade Separation in a Structural Section*
RIS 7 *Geosynthetics for Control of Crack Reflectance*
RIS 8 *Geosynthetics for Erosion Control of Slopes*
RIS 9 *Subsurface Drains for Minnesota Low Volume Roadways*
RIS 10 *Synthesis of Speed Control Devices*
RIS 11 *Insulation of Utility Trenches*
RIS 12 *Seal Coat Procedures and Problems*
RIS 13 *Subgrade Stabilization Procedures*
RIS 14 *Guardrails, End Treatments and Transitions*
RIS 15 *Waste Products in Highway Construction*
RIS 16 *A Synthesis of Measuring and Modeling Frost Depths*
RIS 17 *Herbicides for Roadside Vegetation Management*
RIS 18 *Use of Herbicides*

RIS 19 *Soil Stabilization of Low Volume Roads*

RIS 20 *Use of Aggregate Materials as Roadway Base, Shoulder and Surface Courses in Minnesota*

RIS 21 *Soybean Oil Soapstock as a Dust Control Agent*

Videotapes

With respect to the videotapes, the LRRB determined that since these products were to deliver a broad, important series of messages, they should professionally address concerns and engage the audience without sounding either too technical or condescending. This goal requires hiring professional talent (writers, production companies, etc.). The LRRB has made a significant financial commitment to funding videos. Their investment has been worthwhile; they have been well received by their audiences. Additionally, there have been numerous requests for the videos nationwide and they have been shown on local cable television. Because of numerous requests, the RIC has recently made the decision to distribute their videos to all LTAP Centers through the APWA Clearinghouse.

- *Weather and Loads: The Effect They Have on Roads*
- *Road Repair: Do the Right Thing at the Right Time*
- *Asphalt Crack Treatment: Helpful Information for the Road*
- *Sealcoating: A Matter of Science and Skill*
- *Asphalt Overlays: The Four Ps*
- *Roadway Design: Balancing Safety, Environment and Cost*
- *The Minnesota Local Road Research Board*
- *Utility Cut Repair: Doing It Right*
- *Traffic Control: What Works?*

Developing a System for Evaluating the Impact of Research Implementation Tasks

The Minnesota Local Road Research Board (LRRB) is interested in using an evaluation system to determine measurable, results-oriented goals and objectives for their research and implementation projects. Results-oriented goals and objectives are statements about the end results that a service, program, or project is expected to accomplish in a given period of time. As part of this project an evaluation system has been developed that allows review of current projects and provides a template for the evaluation of future projects of the LRRB. Recommendations developed by the project team are currently being implemented.

CHAPTER 2
SUMMARY OF LRRB RESEARCH IMPLEMENTATION REPORTS

Crack Sealing Bituminous Pavements in Minnesota **Report 92-03**

David W. Janisch, P.E.
Jean M. Sexton
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1992

Summary

One of the most common maintenance activities performed on bituminous pavements by local governmental agencies relates to crack treatment. Crack treatments include crack sealing, crack filling, and crack repair. Crack sealing is the method of placing material in a crack to create a water tight barrier, while crack filling involves coating the sides or edges of a crack in an attempt to reduce the rate of deterioration. Crack repair is more extensive than both sealing or filling and can involve fine mix patching, tight blading, mill and repair, and overlays. Generally, rubberized materials, due to their ductile properties are considered to be crack sealants while asphalt-based materials are considered fillers.

This report discusses the most commonly used materials and practices used by local engineers in Minnesota to seal and fill cracks on bituminous pavements. The report is based on the results of a survey conducted by the authors in 1991. The primary goal of this report was to assist local engineers and street/highway superintendents in determining what their peers were doing in the area of crack sealing/filling. A secondary goal was to present guidelines used by other agencies outside of Minnesota that may be applicable.

Status/Implementation

Mn/DOT distributed a Tech-Memorandum in 1997 outlining their new specification criteria (for Specifications 3719, 3720 and 3723). The reasons for updating the specifications were:

- Movement away from using AC-3 for filling cracks on older bituminous pavements;
- Cohesion failures of a sealant that met the 3723 laboratory requirements;

- Poor field performance of the 3720 sealant; and
- Applied experience from the South Dakota DOT and Ontario Ministry of Transportation.

The Ontario Ministry's research (TRB Paper 950763, 1995) has shown that crack sealing yields, on average, five extra years of serviceable life.

In 1992, the LRRB produced a video entitled *Asphalt Crack Treatment: Helpful Information for the Road*. This video specifically describes crack maintenance. Since the techniques and philosophies of crack maintenance are diverse, the video is a dialogue between two maintenance workers. One worker, older with little advanced education, has been a maintenance foreman for years — from experience he knows what works. The other, having recently finished technical school, has plenty of "book smarts." He has read every research project available on crack maintenance but has no experience. The dialogue is a friendly debate between the two workers sharing their respective knowledge, field experience, and research technology. The video specifically discusses the differences between cracking filling and crack sealing and between routing versus sealing. Computer animation is used throughout to illustrate the various points. The video concludes with the maintenance foreman taking the younger worker to a site where he sees an actual demonstration of equipment and each specific phase of a typical crack maintenance operation.

Dust Control on Unpaved Roads

Report 92-07

Chunhua Han, Ph.D., P.E.

Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1992

Summary

This report summarizes dust control procedures used by various states and local agencies for unpaved roads. The research results related to dust control are also outlined. The report starts with a brief introduction on dust problems associated with unpaved roads and three main dust control methods: chemical, mechanical, and administrative. Preliminary concepts and background of a temporary surface treatment for dust control are presented. The relative effectiveness of a dust control program is estimated based on traffic levels, road conditions, and the climate. The report discusses various materials used in dust control, selection of a proper dust palliative, dust control procedures, and evaluation of a dust control program. Results from a survey sent to Minnesota city and county agencies are presented summarizing current dust control practices used on unpaved roads. The report concludes with evaluation and recommendations based on the survey results and an extensive literature review.

Status/Implementation

In 1996 the LRRB published RIS 21 — *Soybean Oil Soapstock as a Dust Control Agent*. The purpose of this RIS was to gather information with respect to the properties, application, and effectiveness of this material. The RIS outlines the properties of soapstock, conditions for application, application procedures, results of environmental testing of the material, economics, and experiences from local Minnesota agencies using soapstock as a dust control agent.

Infrastructure Management Software Use in Minnesota **Report 92-04**

David W. Janisch, P.E.
Richard W. Chamberlin
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1992

Summary

The purpose of this report is to give an overview of the number of Minnesota agencies that use Infrastructure or Pavement Management software and provide information as to their common components and requirements. Software of this type is used to store and analyze the various components of an agency's infrastructure including streets, highways, bridges, signs, utilities, etc. Most systems of this type are capable of data storage, retrieval, analysis, and forecasting or projecting future conditions and maintenance needs.

A Federal Highway Administration policy, issued January 13, 1989, requires all states to have a fully operational Pavement Management System (PMS) within four years of the issuance of the policy; however, this mandate has been postponed until the year 2000. As more states implement a PMS, the number of county and city agencies will also likely increase. This report reviews the current status of Minnesota cities and counties in terms of their implementation and use this type of software.

Status/Implementation

In 1995 the University of Minnesota's Center for Transportation Technology Transfer Center sponsored four workshops throughout the state (Duluth, Rochester, Brainerd and Minneapolis) on the subject of pavement management. These workshops were targeted at city and county engineers to explain what pavement management was, why it should be used, and how to implement a pavement management system.

Currently, the Mn/DOT State Aid Division's Pavement Management Committee is determining how pavement management information on the state aid system will be combined, handled and reported. To assist them, the Pavement Management Committee is conducting a survey of all city and county engineers. This basic survey is collecting data on what pavement management systems are being used (vendor), if the system is PC based, and if the agency is willing to share their pavement management experience.

Lightweight Fill Materials for Road Construction — Report 92-06

Guy W. Kohlnhofer, P.E.
Michael M. Marti, P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1992

Summary

The use of lightweight fill is increasing in Minnesota. This material is used to replace heavier insitu soil to reduce the subgrade load burden.

There may be several alternative materials to consider for any construction project; however, design engineers might not consider them because of a limited knowledge or unfamiliarity with them. Various materials have been used, but specific design guidelines are not available because this type of construction is still considered experimental.

The current selection is generally based on local knowledge. Additional research is required to determine more specific design guidelines for each lightweight fill material. This synthesis reviews what technology and materials are available for use as lightweight fill material in road construction.

Status/Implementation

Mn/DOT feels this report has been very useful because all options available are synthesized in one document. There have been no significant changes in Mn/DOT practices since document publication.

The use of rubber tires is being re-evaluated. This re-evaluation is due to two specific concerns.

- Current specifications are very stringent about the use of rubber tires below the water table. Neighboring states permit the use of rubber tires as a fill material below the water table; however, Minnesota is in the process of re-evaluating its specifications.

- Recently, a buried fill (a mixture of compost and rubber tires) caught fire in Washington. A report will be published soon and Minnesota will review its current practice.

The LRRB is currently funding Investigation 701 — *Deformability Parameters of Lightweight Fills.*

Load Effects on Highway Pavements **No Report Number**

Eugene L. Skok, Jr., Ph.D. 1980
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

One of the primary problems that Minnesota city and county engineers have with their pavements is determining what the allowable load capacity should be for a given route. In Minnesota this has been studied for almost 40 years using the flexible pavement design procedure, the plate load test, the Benkelman beam test, the Road Rater, and the falling weight deflectometer.

In 1980 proposals were being made to increase the allowable load limit on single axles of trucks to 10 tons (20,000 pounds). The effect of this increase would not necessarily show up as a dramatic decrease in serviceability or increase in cracking and rutting of pavements especially on low-volume roads, but there would be a fatigue effect over a period of time. A slide-tape show was developed to bring out what some of the consequences would be of increasing allowable axle loads. This slide-tape show presented the equivalent load concept as a fatigue effect on pavement sections. The slide tape was developed so that city and county engineers could present it to truckers, city councils, legislators, and so forth, to point out the decrease in pavement life that would occur if the axle loads were increased. This slide-tape show was presented at many town councils and the state legislature. It has been distributed to all nine districts of Mn/DOT and to many state DOTs. It has also been translated into Spanish and used by the World Bank.

No formal report was printed. A publication was put together based on the slide-tape show on load effects on pavements. This report was also distributed to all Minnesota city and county engineers and to other selected engineers throughout the country.

Status/Implementation

In 1991 the LRRB produced a video, *Weather and Loads: The Effect They Have on Roads*, that was an update of the information presented in this report. This video explains how pavement materials are affected by the forces of weather and loading. In the process, the viewer learns the basic concepts of pavement engineering including fatigue, bearing capacity and thermal expansion. With a technical topic and a general audience, it was decided that the narrator should be a scientist, a locally well-known personality. Accordingly, a popular television meteorologist was selected. This video

also includes a set of cross-sectional pavement models. The narrator uses these tabletop models to show how pavement responds to weather and loading. A description is given regarding the additional damage caused by overweight vehicle loads. Based on research, the models were built to duplicate the responses of actual pavement materials.

Pavement Rehabilitation — A Guide for Minnesota Cities and Counties **Report 89-01**

Michael M. Marti, P.E.
Erland O. Lukanen, P.E.
David W. Janisch, P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1989

Summary

This document is a three-set manual; a manual and two field guides.

The manual describes the evaluation and design procedures for pavement rehabilitation. The evaluation emphasizes a number of variables or conditions that should be considered. This manual does not introduce any new technology. Thickness designs of new pavements require two primary variables: traffic and soil strength. Rehabilitation design requires several additional variables such as: pavement structure, condition and strength. Rehabilitation design can involve more alternatives than new designs that deal with materials, equipment, disruption of traffic, and work zone safety. This manual has been written as a working reference to help identify and classify the surface distress, explore the various rehabilitation alternatives, select an appropriate alternative, and briefly describe the rehabilitation procedure. The manual provides standardized identification of distress types for both flexible and rigid pavements, calculation procedures for Equivalent Axle Loads, and a brief synopsis of the AASHTO thickness design procedure. This manual should be used by cities and counties as a reference in developing rehabilitation strategies.

The two field guides are printed on a heavy mylar stock intended for rugged field use. These two field guides are distress identification handbooks for both flexible and concrete pavements. The field guides include photographs of each pavement distress in three severity levels (low, medium, and high). Along with the photographs, the guides provide the name of the distress, a description of the distress including what it looks like and how it can be identified, a description of the severity levels, a description of how to measure the distress, and a discussion of rehabilitation alternatives suggesting how the various severity and densities should be treated.

Status/Implementation

These manuals have served as training guides for numerous workshops held throughout the state over the past seven years. On average, five workshops were held annually at various locations throughout the state. The workshops were targeted at maintenance professionals and local government engineers. In addition to these workshops, the University of Minnesota's Center for Transportation Technology Transfer Center sponsored four workshops throughout the state (Duluth, Rochester, Brainerd and Minneapolis) entitled *Asphalt Pavement Rehabilitation Techniques*. These workshops were targeted at engineers, managers, supervisors and technicians responsible for asphalt pavement design, construction, and maintenance.

In 1991, the LRRB produced a video entitled *Road Repair: Do the Right Thing at the Right Time*. The primary purpose of this video is to describe the efforts, by governmental bodies, to manage and maintain county and city streets. There is an effort to indicate to the typical public the actions behind pavement management and the reasoning behind selecting a proper rehabilitation for road maintenance. In the video, the on-screen moderator shares what he has learned about pavements from talking with his local engineer. He explains what he knows in nontechnical terms. Using actual pavement material samples, video clips, and many other aids, he shows the viewer how engineers gather data on pavement and underlying soils. He then walks the viewer through a discussion of the factors considered in making rehabilitation decisions.

The LRRB is currently funding Investigation 704 — *Preventive Maintenance for Streets and Highways.*

Proper Treatment and Disposal of Maintenance Wastes **Report 95-15**

Ann M. Johnson, P.E.
Julie Vandenbossche
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1995

Summary

This report presents an outline of the requirements for treatment of maintenance wastes, including solvents, waste paint, waste oil, fuel and oil filters, batteries, antifreeze, shop rags, road maintenance wastes, and pesticides. The criteria for what makes a waste hazardous, and suggested methods for reducing waste are also given. Lead paint removal and disposal are outlined, including regulations for lead content in air, soil, and water. Current removal and containment techniques are given by case study. Note that this report contains material that is subject to frequent changes according to laws and regulations, and the user is encouraged to check current rules for changes.

Status/Implementation

After publication of this report, the LRRB requested that wall charts be developed and distributed to all maintenance garages throughout the state. These charts were created, printed and distributed.

Because of continuous regulatory changes and an ever-growing list of waste materials, this document is slightly out-of-date, although it was published in 1995.

Recycling of Pavement Materials in the 1990s **Report 92-05**

Ann M. Johnson, P.E.
Chunhua Han, Ph.D., P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1992

Summary

Pavement recycling is a necessity due to the diminishing supply of available construction materials and increasing regulations concerning the disposal of removed concrete and asphalt pavements. Since the 1950s and 1960s recycling has grown to include hot and cold mix asphalt recycling, the use of crushed asphalt pavement as an aggregate base, and the use of Portland cement concrete as an aggregate base, concrete aggregate, and bituminous aggregate. Crack and seating and rubblizing of concrete pavement are also common forms of recycling in Minnesota.

The report provides information regarding the common methods of recycling and determines the status of recycling in Minnesota. This report outlines the recycling methods listed above, and gives specifications and mix designs for their use in Minnesota.

Status/Implementation

Recycling asphalt material in pavement construction is an acceptable practice and has been incorporated into Mn/DOT Standard Specifications for Construction. Currently, Mn/DOT is reviewing the national standards and publishing a report on cold in-place recycling (CIR). This report will also be synthesized into an RIS and distributed to the Minnesota county and city engineers.

On a national basis, there is widespread use of reclaimed asphalt pavement (RAP). Research performed under the Strategic Highway Research Program (SHRP) did not address the issues associated with use of RAP in hot-mix asphalt mixtures and did not provide guidelines to characterize asphalt binders extracted from RAP and recycled hot-mix asphalts. Because SUPERPAVE is gradually becoming the sole means for design and analysis of asphalt mixtures, research is needed to develop guidelines and procedures that will incorporate RAP in the SUPERPAVE system. Currently, NCHRP is sponsoring Project 9-12, *Incorporation of Reclaimed Asphalt Pavement in the Superpave System,* which specifically addresses using recycled material in SUPERPAVE mixes. The objectives of this research are to (1) develop guidelines for incorporating RAP in the Superpave system, and (2) prepare a manual that can be used by laboratory and field technicians.

Repairing Utility Trenches **Report 92-08**

Ann M. Johnson, P.E. 1992
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

Each year miles of utility trenches are cut, backfilled, and surfaced by utility companies, government agencies, and contractors. Improper repair of these trenches leads to bumps, settlements and pavement failure. Unfortunately, city and county governments are not always responsible for the repair and have little control over the construction methods used.

This report was written to provide information regarding the methods commonly used in Minnesota for repairing utility trenches. The report outlines the results of a survey of Minnesota cities that were asked to detail their specifications and construction methods for backfill and surface repair.

Status/Implementation

This report was used as the basis for a video produced by the LRRB in 1996 entitled *Utility Cut Repair: Doing It Right!* The objective of this video was to increase the quality of workmanship associated with making and repairing utility cuts throughout Minnesota. The video shows supervisors, workers, and public officials how everyone benefits from quality workmanship and use of research-tested materials and methods. The video shows how doing things right saves time and headaches for workers; saves money for companies, agencies, and the general public; and gives the driving public a smooth comfortable ride. Conversely, it also shows how doing things the wrong way costs money, headaches, and time. Finally, the video presents the idea that doing the job right gives workers a reason to take pride in their work.

Mn/DOT has also recently published Report 95-19, *Low Vibration Methods of Soil Compaction for Urban Utility Projects, Phase II*, that discusses in detail compaction methods for utility projects.

Synthesis on Subsurface Drainage of Water Infiltrating a Pavement Structure **Report 89-20**

Robert J. Van Sambeek 1989

Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

This paper summarizes current subsurface pavement drainage used by state and local agencies. An introduction is given on moisture in pavement and the damage it can cause. The relative effectiveness of subsurface drainage is estimated based on environmental conditions, traffic levels, and the pavement structure physical characteristics. Then the paper discusses various components used in subsurface drainage, combinations of drainage components to perform specific drainage tasks, and drainage component maintenance required. Survey results from Minnesota city and county agencies are given summarizing current drainage practices used on lower volume roads. Finally, cost and performance data are given on drainage systems used by various states.

Status/Implementation

Typically, Mn/DOT currently uses either edge drains or select granular base with subdrains when constructing flexible pavements in wet areas. For concrete pavements, Mn/DOT uses an open-graded base with subdrains. Mn/DOT stated that there have been design changes since report publication.

As a report follow up, a LRRB RIS has been published entitled RIS 9 — *Subsurface Drains for Minnesota Low Volume Roadways*. The RIS describes, in detail, various types of subsurface drains and gives general information on permeable edge drains, subcut drains, and special purpose transverse-type subsurface drains. References to Mn/DOT specifications and special provisions are noted in the text and are included at the end of the report.

There are several research projects currently being conducted in the area of drainage.

- The NCHRP's project, *1-34 Performance of Subsurface Pavement Drainage*, research objective is to develop guidelines enabling designers to consider the effect of subsurface drainage on pavement performance. Specifically, the project will investigate the effectiveness of (1) subsurface drainage of surface-infiltration water on the performance of Portland Cement Concrete (PCC), Hot Mix Asphalt (HMA), and composite pavements; (2) permeable bases

and associated edge drains, and traditional dense-graded bases with and without edge drains; and (3) retrofit subsurface drainage. This project was scheduled for completion in November of 1997.

- The LRRB is currently funding Investigation 677, *Improving Drainage for Local Roads*.

- The Mn/ROAD test facility is also studying the impact of pavement edge drains and subsurface drains as part of its overall program.

Waste Products in Highway Construction **Report 93-16**

Chunhua Han, Ph.D., P.E. 1993
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

This report has also been summarized in RIS 15 — *Waste Products in Highway Construction.*

This report presents waste materials and products for highway construction. The general legislation, local liability, and research projects related to waste materials are outlined. The waste materials and products presented include waste paving materials, industrial ash materials, taconite tailing materials, waste tire rubber materials and products, building rubble materials, incinerator ash products and materials, waste glass materials, waste shingle materials and products, waste plastics products, and slag materials. For each waste category, the legislation and restrictions, material properties, construction and application, field performance, and recycling at the end of service life, if available, are discussed. In addition, procedures for the evaluation and selection of waste alternatives are presented. Results from a survey sent to Minnesota city and county agencies are presented summarizing current practices in waste reuse for highway construction.

Status/Implementation

According to Mn/DOT the material presented in this RIS and subsequent reports is still current. This report is informational and worked well in informing local engineers.

In 1996, Mn/DOT published Report 96-34, *Minnesota's Experience Using Shingle Scrap in Bituminous Pavements.* This report documented two case studies using shingle scraps in hot mix asphalt. Based on the performance of these test sections, shingle manufacturing scrap is now an allowable salvage material in hot mix asphalt under Mn/DOT Specification 2331.E2e, *Recycled Mixture Requirements.*

Currently, the LRRB is funding one study.

- Investigation 713 entitled *Mechanical Properties of Shredded Tires/Soil Mixtures.*

Additionally, the NCHRP has a study under investigation. Project 4-21, *Appropriate Use of Waste and Recycled Materials in the Transportation Industry*, is scheduled to be completed during August of 1998. The objectives of this research are to first develop a methodology for (1) assessing the suitability and practicability of specific Waste Recycled Materials (WRMs) in transportation applications; (2) determining appropriate uses; (3) developing design and construction guidelines; and (4) evaluating long-term, in-service performance; and, second to apply the methodology to a spectrum of WRMs.

Width Standards for Minnesota State Aid Streets and Roads — No Report Number

Benson and Associates, Inc.
Park Rapids, Minnesota

1984

Summary

This publication is intended for use as an introduction to Minnesota State Aid standards. It answers several questions regarding standards: e.g., how are standards developed, how are they applied, why are they necessary. These questions are explained in basic non-engineering terms for the layperson or public presentation. The booklet can be used alone or along with the companion synchronized slide-tape presentations (Urban Standards, Rural Standards). A tri-fold pamphlet was also produced for use as a handout with the slide-tape presentations.

Status/Implementation

Currently under study by a *Geometric Design Standards Task Force* is an evaluation and potential change to the geometric standards of rural roadways. The current design standard calls for 12-foot driving lanes and shoulders ranging from 4 to 8 feet. The nationwide trend is to relax the standard and reduce the lane and shoulder width. This reduction in width has caused some concern from local engineers — specifically safety concerns. The Task Force's draft report is calling for the following.

Minnesota Proposed Minimum Construction and Reconstruction Standards Low Volume Rural Trunk Highways and Rural State Aid Highways Lane and Shoulder Widths for Two-Lane Highways			
Projected Daily Traffic	**Driving Lane Surface Type**	**Lane Width**	**Shoulder Width**
0 - 49	Aggregate	11 feet (3.3 meters)	1 foot (0.3 meters)
50 - 149	Aggregate	11 feet (3.3 meters)	3 feet (0.9 meters)
150 - 1500	Paved	12 feet (3.6 meters)	4 feet (1.2 meters)
1500 and above (Collector & Local Hwys)	Paved	12 feet (3.6 meters)	6 feet (1.8 meters)

This report was to be completed in early 1997.

CHAPTER 3

SUMMARY OF THE LRRB RESEARCH IMPLEMENTATION SERIES (RIS)

Bituminous Pavements Using Sand Aggregates **RIS 1**

Erland O. Lukanen, P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1984

Summary

Bituminous mixes represent a major cost item on low-volume city streets and county roads. In certain areas these costs are driven up due to lack of local aggregates that meet the Mn/DOT Specification 3139, *Graded Aggregate for Bituminous Mixtures*, as described in the 1983 edition of *Standard Specifications for Construction*. Often, the reason locally available aggregates are not acceptable under this specification, is that they do not meet the gradation requirements for BA-1 or BA-2.

The Local Road Research Board has sponsored several studies that have evaluated the use of locally-available sand aggregates and have found that they could be used successfully in bituminous mixes, particularly on low-volume roads. The success of these studies, coupled with the shortage of aggregates in certain areas, has led to the development of several specifications that allow the use of locally-available aggregates and bituminous mixes. This RIS briefly describes the research conducted and contains a summary of the specifications currently available that allows the use of a broader range of aggregate gradations.

Implementation/Current Status

The use of sand aggregates in bituminous mixes is allowable as long as the mix design meets the required specifications. However, with the SUPERPAVE mix implementation, research has shown that our natural sands do not meet the necessary criteria. To alleviate this problem, manufactured sands are being produced. This will be one of the focuses of a recently-funded LRRB study conducted by the University of Minnesota. This study will specifically evaluate the SUPERPAVE mix design for low-volume road applications.

Sand mixes have also been widely used as a patching material. These mixes work well for surface patching and correcting rutted areas.

Geotextiles in Highway and Road Construction **RIS 2**

Michael M. Marti, P.E.
Eugene L. Skok, Jr. Ph.D.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1985

Summary

Geotextiles have come into more extensive use during the past ten years. *Geotextiles* is a term given to "a variety of permeable, artificial fiber textile products used in engineering construction of civil works." These materials have also been called geotechnical fabric, filter fabric, geofabric, plastic filter-cloth, or engineering fabric. Geotextiles have been used as fill reinforcement, as separation layers, or as part of drainage and erosion control systems. The Implementation Series on geotextiles is intended to provide an introduction to engineering fabrics and their uses. They are not intended as detailed design guides, but rather to provide an understanding of possible applications and suggestions for fabric specifications of some typical uses.

In this Implementation Series No. 2, general geotextile applications are discussed. Procedure details presented in this Implementation Series are listed in a manual entitled *Use of Engineering Fabrics and Transportation Related Applications* by T. Allan Halliburton and John B. Berran, that was distributed by the Research Section of Mn/DOT in 1982 and 1983 for geotextile seminars given around the state. Information has also been drawn from the *Geotextile Engineering Manual* prepared for the Federal Highway Administration National Highway Institute by Barry R. Christopher and Robert D. Holtz. This manual is not widely available but efforts are underway for a general printing. A condensed version of the same is in preparation. A short reference list is appended and many articles and manufacturers literature exists.

Implementation/Current Status

During the past 12 years the LRRB has sponsored several research summaries of geotextiles and geosynthetics uses.

RIS 2	*Geotextiles in Highway and Road Construction*
RIS 3	*Geotextiles in Highway and Road Construction to Stabilize Shallow Fills*
RIS 4	*Geotextiles as Separation Layers in Highway and Road Construction*
RIS 5	*Geotextiles in Highway and Road Construction for Filtration, Drainage, and Erosion Control*
RIS 6	*Geosynthetics in Reinforcement and Subgrade Separation in a Structural Section*
RIS 7	*Geosynthetics for Control of Crack Reflectance*
RIS 8	*Geosynthetics for Erosion Control of Slopes*

In addition to these locally-sponsored publications, a literature search provided titles and abstracts of more than 250 documents published since 1984. One specific document identified was NCHRP 10-33, *Potential Benefits of Geosynthetics in Flexible Pavement Systems*. This study was primarily concerned with the reinforcement of the aggregate base of a surfaced, flexible pavement system using geosynthetics (i.e., geotextiles and geogrids). Separation, filtration, and durability were also considered. Specific methods of reinforcement that were evaluated included: (1) placing the reinforcement within the base; (2) pre-tensioning a geosynthetic within the base; and (3) pre-rutting the aggregate base with and without reinforcement. Both large-scale laboratory tests and an analytical sensitivity study were conducted. Recommendations were also made for full-scale field studies. The research has been completed and the principle findings have been published in NCHRP Report 315, *Potential Benefits of Geosynthetics in Flexible Pavements*.

Although the use of engineering fabrics is widespread, consensus on its effectiveness seems to be dependent on the intended application, selection of material, and the construction technique. In general, geosynthetics are used on an "as needed" basis during roadway construction. Mn/DOT does not specifically require the use of geosynthetics.

There is interest is seeing additional research on the use of geogrids in base course construction. The Transportation Research Board (TRB) is addressing this topic.

A LRRB-RIC project entitled *Use of Fabric for Roadway Stabilization* is scheduled to be conducted in 1998. This project will focus on developing a guideline for designers that will outline "when" and "how" fabrics should be used for the purpose of roadway stabilization. The proposed deliverables for this task are a self-running program on computer diskette and a videotape. This computer program would be developed to run on a basic office computer (DOS or Windows-based) and in video format.

Geotextiles in Highway and Road Construction to Stabilize Shallow Fills RIS 3

Michael M. Marti, P.E.
Eugene L. Skok, Jr. Ph.D.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1985

Summary

Geotextiles have come into more extensive use during the past ten years. *Geotextiles* is a term given to, "a variety of permeable, artificial fiber textile products used in engineering construction of civil works." These materials have also been called geotechnical fabric, filter fabric, geofabric, plastic filter-cloth, or engineering fabric. Geotextiles have been used as reinforcement of fills, as separation layers, or as part of drainage and erosion control systems. The Implementation Series on geotextiles is intended to provide an introduction to engineering fabrics and their uses. They are not intended as detailed design guides, but rather to provide an understanding of possible applications and suggestions for fabric specifications of some typical uses.

In this RIS the concept of using fabrics to stabilize shallow fills is presented and discussed. This RIS provides information with respect to construction methods (equipment, site preparation and fabric placement). It also provides a summary of the Mn/DOT specifications for geotextiles when used to stabilize fills. A more detailed presentation is given in the manual entitled *Use of Engineering Fabrics and Transportation Related Applications* by T. Allen Halliburton and John B. Berran that was distributed by the Mn/DOT Office of Research and Development in 1982 and 1983.

Status/Implementation

During the past 12 years the LRRB has sponsored several research summaries pertaining to geotextile and geosynthetic uses.

RIS 2	*Geotextiles in Highway and Road Construction*
RIS 3	*Geotextiles in Highway and Road Construction to Stabilize Shallow Fills*
RIS 4	*Geotextiles as Separation Layers in Highway and Road Construction*
RIS 5	*Geotextiles in Highway and Road Construction for Filtration, Drainage, and Erosion Control*
RIS 6	*Geosynthetics in Reinforcement and Subgrade Separation in a Structural Section*
RIS 7	*Geosynthetics for Control of Crack Reflectance*
RIS 8	*Geosynthetics for Erosion Control of Slopes*

In addition to these locally-sponsored publications, a literature search provided titles and abstracts of more than 250 documents published since 1984. One specific document was NCHRP 10-33, *Potential Benefits of Geosynthetics in Flexible Pavement Systems*. This study was primarily concerned with the reinforcement of the aggregate base of a surfaced, flexible pavement system using geosynthetics (i.e., geotextiles and geogrids). Separation, filtration, and durability were also considered. Specific methods of reinforcement that were evaluated included: (1) placing the reinforcement within the base; (2) pretensioning a geosynthetic within the base; and (3) pre-rutting the aggregate base with and without reinforcement. Both large-scale laboratory tests and an analytical sensitivity study were conducted. Recommendations were also made for full-scale field studies. The research has been completed, and the principle findings have been published in NCHRP Report 315, *Potential Benefits of Geosynthetics in Flexible Pavements*.

Although the use of engineering fabrics is widespread, consensus on its effectiveness seems to be dependent on the intended application, selection of material, and the construction technique. In general, geosynthetics are used on an "as needed" basis during roadway construction. Mn/DOT does not specifically require the use of geosynthetics.

There is interest is seeing additional research on the use of geogrids in base course construction. The Transportation Research Board (TRB) is addressing this topic.

Two LRRB projects on the subject of fabrics follow.

- LRRB Investigation 724 — *Fabric Strength*. This project is currently under investigation.

- A LRRB-RIC project entitled *Use of Fabric for Roadway Stabilization* is scheduled to be conducted in 1998. This project will focus on developing a guideline for designers that will outline "when" and "how" fabrics should be used for the purpose of roadway stabilization. The proposed deliverables for this task are a self-running program on computer diskette and a videotape. This computer program would be developed to run on a basic office computer (DOS or Windows-based) and in video format.

Geotextiles as Separation Layers in Highway and Road Construction RIS 4

Michael M. Marti, P.E.
Eugene L. Skok, Jr. Ph.D.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1985

Summary

Geotextiles have come into more extensive use during the past ten years. *Geotextiles* is a term given to "a variety of permeable, artificial fiber textile products used in engineering construction of civil works." These materials have also been called geotechnical fabric, filter fabric, geofabric, plastic filter-cloth, or engineering fabric. Geotextiles have been used as reinforcement of fills, as separation layers, or as part of drainage and erosion control systems. The Implementation Series on geotextiles is intended to provide an introduction to engineering fabrics and their uses. They are not intended as detailed design guides, but rather to provide an understanding of possible applications and suggestions for fabric specifications of some typical uses.

In this RIS the concept of using fabrics as separation layers is presented and discussed. Nearly all theories of "layered" roadway design assume that the respective layers will remain "as placed" over the existing subgrade. However, when the subgrade is cohesive and reaches a moisture content at or above its plastic limit, localized bearing failures may occur at the aggregate-subgrade interface resulting in subgrade intrusion. This subgrade intrusion initiates a progressive failure mechanism, resulting in a need for continuous roadway maintenance. Placement of a geotextile as a separation layer between the base and subgrade has been an effective use of geotextiles. This RIS details specific design considerations, construction guidelines, some case studies using geotextiles as separation layers here in Minnesota, and a summary of the Mn/DOT Specifications as they relate to using geotextiles as separation layers. A more detailed presentation is given in the manual entitled *Use of Engineering Fabrics and Transportation Related Applications* by T. Allen Halliburton and John B. Berran that was distributed by the Mn/DOT Office of Research and Development in 1982 and 1983.

Status/Implementation

During the past 12 years the LRRB has sponsored several research summaries of geotextile and geosynthetic uses.

RIS 2 *Geotextiles in Highway and Road Construction*
RIS 3 *Geotextiles in Highway and Road Construction to Stabilize Shallow Fills*
RIS 4 *Geotextiles as Separation Layers in Highway and Road Construction*

RIS 5 *Geotextiles in Highway and Road Construction for Filtration, Drainage, and Erosion Control*

RIS 6 *Geosynthetics in Reinforcement and Subgrade Separation in a Structural Section*

RIS 7 *Geosynthetics for Control of Crack Reflectance*

RIS 8 *Geosynthetics for Erosion Control of Slopes*

In addition to these locally-sponsored publications, a literature search provided titles and abstracts of more than 250 documents published since 1984. One specific document was NCHRP 10-33, *Potential Benefits of Geosynthetics in Flexible Pavement Systems*. This study was primarily concerned with the reinforcement of the aggregate base of a surfaced, flexible pavement system using geosynthetics (i.e., geotextiles and geogrids). Separation, filtration, and durability were also considered. Specific methods of reinforcement that were evaluated included: (1) placing the reinforcement within the base; (2) pre-tensioning a geosynthetic within the base; and (3) pre-rutting the aggregate base with and without reinforcement. Both large-scale laboratory tests and an analytical sensitivity study were conducted. Recommendations were also made for full-scale field studies. The research has been completed, and the principle findings have been published in NCHRP Report 315, *Potential Benefits of Geosynthetics in Flexible Pavements*.

Although the use of engineering fabrics is widespread, consensus on its effectiveness seems to be dependent on the intended application, selection of material, and the construction technique. In general, geosynthetics are used on an "as needed" basis during roadway construction. Mn/DOT does not specifically require the use of geosynthetics.

There is interest is seeing additional research on the use of geogrids in base course construction. The Transportation Research Board (TRB) is addressing this topic.

A second RIS was published in 1992, RIS 6 — *Geosynthetics in Reinforcement and Subgrade Separation on a Structural Section*, that updated and expanded on the information presented in RIS 4. In RIS 6, definitions of geosynthetics, geotextiles, and geogrids are explained and their specification application with respect to separation and reinforcement are discussed. The RIS also provides a discussion of local success and failures in Minnesota, describes some construction techniques, and provides a listing of references for more detailed information.

Two LRRB projects on the subject of fabrics are as follows.

- LRRB Investigation 724 — *Fabric Strength*. This is a LRRB project currently under investigation.

- A LRRB-RIC project entitled *Use of Fabric for Roadway Stabilization* is scheduled to be conducted in 1998. This project will focus on developing a guideline for designers that will outline "when" and "how" fabrics should be used for the purpose of roadway stabilization. The proposed deliverables for this task are a self-running program on computer diskette and a videotape. This computer program would be developed to run on a basic office computer (DOS or Windows-based) and in video format.

Geotextiles in Highway and Road Construction for Filtration, Drainage, and Erosion Control

RIS 5

Michael M. Marti, P.E.
Eugene L. Skok, Jr. Ph.D.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1985

Summary

Geotextiles have come into more extensive use during the past ten years. *Geotextiles* is a term given to, "a variety of permeable, artificial fiber textile products used in engineering construction of civil works." These materials have also been called geotechnical fabric, filter fabric, geofabric, plastic filter-cloth, or engineering fabric. Geotextiles have been used as reinforcement of fills, as separation layers, or as part of drainage and erosion control systems. The Implementation Series on geotextiles is intended to provide an introduction to engineering fabrics and their uses. They are not intended as detailed design guides, but rather to provide an understanding of possible applications and suggestions for fabric specifications of some typical uses.

In this RIS the concept of using fabrics for drainage and erosion control as silt fences is presented and discussed. In roadway construction, numerous filtration/drainage applications occur, with the majority of these related to protecting the roadway and appurtenant structures from both groundwater and surface water infiltration. Use of fabrics in silt fences construction, to remove sediment in precipitation and runoff, can also be viewed as a filtration mechanism. Use of standard designs without a full evaluation of the natural soils to be protected, the amount of water to be removed, and the length of drainage path required could result in drains and filters that will either pipe or clog. While both conventional and geotextile drainage systems are simple in both concept and implementation, rational design procedures must be followed in order to obtain desired performance. This RIS provides design and construction considerations along with a summary of the Mn/DOT specifications for use of geotextiles in filtration/drainage systems. A more detailed presentation is given in the manual entitled *Use of Engineering Fabrics and Transportation Related Applications* by T. Allen Halliburton and John B. Berran that was distributed by the Mn/DOT Office of Research and Development in 1982 and 1983.

Status/Implementation

During the past 12 years the LRRB has sponsored several research summaries of geotextile and geosynthetic uses.

RIS 2	*Geotextiles in Highway and Road Construction*
RIS 3	*Geotextiles in Highway and Road Construction to Stabilize Shallow Fills*
RIS 4	*Geotextiles as Separation Layers in Highway and Road Construction*
RIS 5	*Geotextiles in Highway and Road Construction for Filtration, Drainage, and Erosion Control*
RIS 6	*Geosynthetics in Reinforcement and Subgrade Separation in a Structural Section*
RIS 7	*Geosynthetics for Control of Crack Reflectance*
RIS 8	*Geosynthetics for Erosion Control of Slopes*

In addition to these locally-sponsored publications, a literature search provided titles and abstracts of more than 250 documents published since 1984. One specific document was NCHRP 10-33, *Potential Benefits of Geosynthetics in Flexible Pavement Systems*. This study was primarily concerned with the reinforcement of the aggregate base of a surfaced, flexible pavement system using geosynthetics (i.e., geotextiles and geogrids). Separation, filtration, and durability were also considered. Specific methods of reinforcement that were evaluated included: (1) placing the reinforcement within the base; (2) pre-tensioning a geosynthetic within the base; and (3) pre-rutting the aggregate base with and without reinforcement. Both large-scale laboratory tests and an analytical sensitivity study were conducted. Recommendations were also made for full-scale field studies. The research has been completed, and the principle findings have been published in NCHRP Report 315, *Potential Benefits of Geosynthetics in Flexible Pavements.*

A second RIS published in 1992, *RIS 8 — Geosynthetics for Erosion Control of Slopes*, updated and expanded on the information presented in RIS 5. RIS 8 focuses on erosion control — both permanent and temporary systems. Permanent systems can include soil stabilization, riprap and hard armor systems, and scour protection. Temporary systems include soil stabilization with geotextiles, chemical treatment, hay bales, and silt fences. In this RIS both permanent and temporary systems are reviewed, but only as they relate to slope soil stabilization.

Geosynthetics in Reinforcement and Subgrade Separation in a Structural Section RIS 6

Richard W. Chamberlin 1992
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

This is the second RIS developed for the use of geotextiles as a separation layer. The first RIS, RIS 4 — *Geotextiles as Separation Layers in Highway and Road Construction*, was published circa 1985.

Geotextiles have been widely accepted as a separation layer in pavement structures. Strength of a pavement requires that the coarser layers not be infiltrated by the finer subgrade materials. However, in practice, this is not always achievable. For silty-type soils, when saturated conditions occur with repeated loads, high pore pressures develop in the subgrade causing the material to become unstable. Over time, fines are then forced into the voids of the aggregate base lowering the shear strength of the base course and decreasing the drainage capacity. With pumping, the result is a reduction in the effective thickness of the road system. This can occur rapidly over very soft soils, or over time creating the need for early maintenance. The geosynthetic is designed to act as a separation inner layer to prevent aggregates from penetrating the subgrade under action of applied loads. It can also prevent the intrusion of the subgrade soils into the base layer.

This RIS provides definitions of geosynthetics, geotextiles, and geogrids along with their specific application with respect to separation and reinforcement. Also provided is a discussion of local Minnesota successes and failures, descriptions of some construction techniques, and a reference listing.

Status/Implementation

During the past 12 years the LRRB has sponsored several research summaries of geotextile and geosynthetic uses.

RIS 2	*Geotextiles in Highway and Road Construction*
RIS 3	*Geotextiles in Highway and Road Construction to Stabilize Shallow Fills*
RIS 4	*Geotextiles as Separation Layers in Highway and Road Construction*
RIS 5	*Geotextiles in Highway and Road Construction for Filtration, Drainage, and Erosion Control*
RIS 6	*Geosynthetics in Reinforcement and Subgrade Separation in a Structural Section*
RIS 7	*Geosynthetics for Control of Crack Reflectance*
RIS 8	*Geosynthetics for Erosion Control of Slopes*

In addition to these locally-sponsored publications, a literature search provided titles and abstracts of more than 250 documents published since 1984. One specific document was NCHRP 10-33, *Potential Benefits of Geosynthetics in Flexible Pavement Systems*. This study was primarily concerned with the reinforcement of the aggregate base of a surfaced, flexible pavement system using geosynthetics (i.e., geotextiles and geogrids). Separation, filtration, and durability were also considered. Specific methods of reinforcement that were evaluated included: (1) placing the reinforcement within the base; (2) pre-tensioning a geosynthetic within the base; and (3) pre-rutting the aggregate base with and without reinforcement. Both large-scale laboratory tests and an analytical sensitivity study were conducted. Recommendations were also made for full-scale field studies. The research has been completed, and the principle findings have been published in NCHRP Report 315, *Potential Benefits of Geosynthetics in Flexible Pavements*.

Although the use of engineering fabrics is widespread, consensus on its effectiveness seems to be dependent on the intended application, selection of material, and the construction technique. In general, geosynthetics are used on an "as needed" basis during roadway construction. Mn/DOT does not specifically require the use of geosynthetics.

There is interest is seeing additional research on the use of geogrids in base course construction. The Transportation Research Board (TRB) is starting to address this topic.

Two LRRB projects on the subject of fabrics follow.

- LRRB Investigation 724 — *Fabric Strength*. This project is currently under investigation.

- A LRRB-RIC project entitled *Use of Fabric for Roadway Stabilization* is scheduled to be conducted in 1998. This project will focus on developing a guideline for designers that will outline "when" and "how" fabrics should be used for the purpose of roadway stabilization. The proposed deliverables for this task are a self-running program on computer diskette and a videotape. This computer program would be developed to run on a basic office computer (DOS or Windows-based) and in video format.

Geosynthetics for Control of Crack Reflectance

RIS 7

Richard W. Chamberlin

1992

Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

Reflective cracking is the cracking or fracturing of a bituminous or PCC concrete overlay that results from movement of the older, underlying pavement layers. The underlying cracks reflect through, usually within one to two years, creating the same patterns of cracking in the overlay. Eventually, reflective cracks deteriorate into raveling and spalls over old asphalt pavements, and become close parallel cracks creating bumps over the joints in rigid pavements. Reflective cracks allow moisture to migrate into the base or subbase. This can cause loss of bond between the old surface and the overlay, result in pumping, and also cause loss of subgrade support. The early deterioration of the overlay causes an increase in maintenance costs for crack sealing and patching.

In RIS 7, the concept of crack filling and repair are addressed. The synthesis considers the effectiveness of geosynthetics and geogrids to reduce reflective cracking in flexible and rigid pavements. The RIS also provides a listing of references and publications.

Status/Implementation

During the past 12 years the LRRB has sponsored several research summaries of geotextile and geosynthetic uses.

RIS 2	*Geotextiles in Highway and Road Construction*
RIS 3	*Geotextiles in Highway and Road Construction to Stabilize Shallow Fills*
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RIS 7	*Geosynthetics for Control of Crack Reflectance*
RIS 8	*Geosynthetics for Erosion Control of Slopes*

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geosynthetics (i.e., geotextiles and geogrids). Separation, filtration, and durability were also considered. Specific methods of reinforcement that were evaluated included: (1) placing the reinforcement within the base; (2) pre-tensioning a geosynthetic within the base; and (3) pre-rutting the aggregate base with and without reinforcement. Both large-scale laboratory tests and an analytical sensitivity study were conducted. Recommendations were also made for full-scale field studies. The research has been completed and the principle findings have been published in NCHRP Report 315, *Potential Benefits of Geosynthetics in Flexible Pavements*.

Mn/DOT considers the use of geosynthetics as experimental and does recommend its use for reducing crack reflectance. Mn/DOT conducted and completed a study regarding geosynthetics to control cracks; however, the results have yet to be published.

Geosynthetics for Erosion Control of Slopes

RIS 8

Richard W. Chamberlin

1992

Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

This is the second RIS developed for the use of geotextiles as a separation layer. The first RIS, RIS 5 — *Geotextiles in Highway and Road Construction for Filtration, Drainage, and Erosion Control,* was published circa 1985.

Erosion control encompasses a large area that includes permanent and temporary systems. Permanent systems can include soil stabilization, riprap and hard armor systems, and scour protection. Temporary systems include soil stabilization with geotextiles, chemical treatment, hay bales, and silt fences. In this RIS both permanent and temporary systems are reviewed, but only as they relate to slope soil stabilization.

Status/Implementation

During the past 12 years the LRRB has sponsored several research summaries of geotextile and geosynthetic uses.

RIS 2	*Geotextiles in Highway and Road Construction*
RIS 3	*Geotextiles in Highway and Road Construction to Stabilize Shallow Fills*
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RIS 7	*Geosynthetics for Control of Crack Reflectance*
RIS 8	*Geosynthetics for Erosion Control of Slopes*

In addition to these locally-sponsored publications, a literature search provided titles and abstracts of more than 250 documents published since 1984. One specific document was NCHRP 10-33, *Potential Benefits of Geosynthetics in Flexible Pavement Systems*. This study was primarily concerned with the reinforcement of the aggregate base of a surfaced, flexible pavement system using geosynthetics (i.e., geotextiles and geogrids). Separation, filtration, and durability were also considered. Specific methods of reinforcement that were evaluated included: (1) placing the reinforcement within the base; (2) pre-tensioning a geosynthetic within the base; and (3) pre-rutting the aggregate base with and without reinforcement. Both large-scale laboratory tests and an

analytical sensitivity study were conducted. Recommendations were also made for full-scale field studies. The research has been completed and the principle findings have been published in NCHRP Report 315, *Potential Benefits of Geosynthetics in Flexible Pavements.*

Although the use of engineering fabrics is widespread, consensus on its effectiveness seems to be dependent on the intended application, selection of material, and the construction technique. In general, geosynthetics are used on an "as needed" basis during roadway construction. Mn/DOT does not specifically require the use of geosynthetics.

Two LRRB projects on the subject of fabrics follow.

- LRRB Investigation 724 — *Fabric Strength.* This project is currently under investigation.

- A LRRB-RIC project entitled *Use of Fabric for Roadway Stabilization* is scheduled to be conducted in 1998. This project will focus on developing a guideline for designers that will outline "when" and "how" fabrics should be used for the purpose of roadway stabilization. The proposed deliverables for this task are a self-running program on computer diskette and a videotape. This computer program would be developed to run on a basic office computer (DOS or Windows-based) and in video format.

Subsurface Drains for Minnesota Low-Volume Roadways

RIS 9

Robert J. Van Sambeek
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1992

Summary

With typical road construction, relatively impermeable materials may surround the pavement structure and create *bathtub* sections that retain infiltration and spring-thaw seepage for extended periods of time. However, if this water is removed, the base and subgrade can provide better pavement support, pumping of fines can be minimized, and aggregate freeze-thaw performance can be enhanced.

This RIS is an updated summary of LRRB Report *89-20, Synthesis on Subsurface Drainage of Water Infiltrating a Pavement Structure*, published in 1989. This RIS describes, in detail, the various types of subsurface drains and gives general information on permeable edge drains, subcut drains, and special purpose transverse type subsurface drains. References to Mn/DOT specifications and special provisions are noted in the text and included at the end of the report.

Status/Implementation

Typically, Mn/DOT currently uses either edge drains or select granular base with subdrains when constructing flexible pavements in wet areas. For concrete pavements, Mn/DOT uses an open-graded base with subdrains. Since this report was published, Mn/DOT indicated designs have changed.

There are several research projects currently being conducted in the area of drainage.

- The NCHRP's project, *1-34 — Performance of Subsurface Pavement Drainage*, research objective is to develop guidelines enabling designers to consider the effect of subsurface drainage on pavement performance. Specifically, the project will investigate the effectiveness of: (1) subsurface drainage of surface-infiltration water on the performance of Portland Cement Concrete (PCC), Hot Mix Asphalt (HMA), and composite pavements; (2) permeable bases and associated edge drains, traditional dense-graded bases with and without edge drains; and (3) retrofit subsurface drainage. This project was scheduled to be completed in November of 1997.

- The LRRB is currently funding Investigation 677 — *Improving Drainage for Local Roads*.

- The Mn/ROAD test facility is also studying the impact of pavement edge drains and subsurface drains as part of its overall program.

Synthesis of Speed Control Devices **RIS 10**

Benjamin J. Worel 1992
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

Vehicle speed control is a concern for many neighborhood residents as well as city and county engineers. Residents are concerned with vehicle speed for many reasons including: safety of their children and pets, property values, noise, visibility, and dust control. Engineers have tried numerous devices and strategies to control vehicle speed. Many solutions appear to be effective; however, upon further evaluation they are not. This, coupled with success from one type of speed control used at one location and with failure found using the same type of speed control in a different location, makes it difficult for engineers to decide what types of speed control will work best in their communities. This RIS summarizes a questionnaire sent to all Minnesota county and larger city engineers regarding their experiences with speed control devices, examines some common types of speed control, and explores some new techniques for controlling speed.

Status/Implementation

According to Mn/DOT, studies on speed control are being conducted and published continually. Currently, Mn/DOT is evaluating radar-activated speed warning signs. Additionally, Mn/DOT's Office of Traffic Engineering, the Traffic Safety Unit, conducts an annual study to investigate new technologies available.

Mn/DOT and the LRRB have recently completed two videos on the subject of speed and traffic control. Mn/DOT's video, *Safety and Sensible Speed Limit*, describes the process of how speed limits are set. The LRRB video entitled *Traffic Control: What Works?* discusses two main points — intersection control and speed control. More specifically, the objective of the video was to offer information on how public officials develop reasonable, research-based traffic control strategies and apply engineering judgment to select traffic and speed control devices.

The LRRB is currently funding Investigation 721 — *Traffic Calming*.

Insulation of Utility Trenches

RIS 11

Ann M. Johnson, P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1992

Summary

Many utility trenches in northern climates have been insulated by agencies and utility companies to reduce or eliminate problems caused by frost penetrating the soils around buried pipes. Although Mn/DOT does not recommend insulating under roadways, many Minnesota cities insulate utilities below their streets. Guidelines and examples of methods for insulating are outlined in this RIS.

Status/Implementation

Mn/DOT reports that utility trenches are not commonly insulated. Although this option seems to work well, it is not often practiced in Minnesota.

Seal Coat Procedures and Problems

RIS 12

David W. Janisch, P.E.

1992

Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

Sealcoating bituminous pavements is one of the most common types of routine maintenance performed by city and county agencies. Basically, all seal coats are surface treatments, meaning their goal is to treat and protect the surface of the pavement. Surface treatments do not provide any additional strength but do improve the surface characteristics of the pavement. A seal coat is a good choice to repair raveling and weathering; improve surface friction and seal; and protect a dry, brittle asphalt pavement. This RIS concentrates on the possible problems or defects that can be encountered when sealcoating and discusses what can be done to minimize the chances of these problems occurring.

Status/Implementation

Mn/DOT and the LRRB have recently sponsored several significant research projects and completed a video on the subject. Janisch has been conducting LRRB Investigation 693 entitled *A Re-Evaluation of Sealcoating in Minnesota*. Several local agencies have been participating in this study to determine the best practice for conducting a seal coat. It is anticipated that this study will produce new specifications.

The message of the video entitled *Sealcoating: A Matter of Science and Skill* is that in order to achieve quality sealcoating, both science and skill must be involved. Science must be considered in the design of a seal coat, while skill is a factor in seal coat application techniques.

A LRRB-RIC project entitled *Seal Coat Training Handbook* is currently in progress. The proposed project is to develop a handbook that can be taken in the field and help the inspector or project engineer know what a good seal coat should look like, how to calibrate the equipment, how to recognize problems and how to correct them. Many times the seal coat inspector in the field comes from the construction office and has little seal coat experience. Proper training will help the inspector know what to look for, what a good seal coat looks like, how to calibrate the equipment, and what causes certain problems and how to correct them. By having a field guide that is easy to use, easy to carry, and full of useful information, the inspector can feel confident and make the correct decisions in the field.

Subgrade Stabilization Procedures

RIS 13

Brian K. Nieuwenhuis

1992

Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

For many years, road construction has been slowed by wet subgrade conditions. Local governmental agencies and contractors needed to either minimize or alleviate this situation. One method to minimize the effects of a poor subgrade is subgrade stabilization. Subgrade stabilization is the treatment of soil by chemical or mechanical methods to improve its engineering properties.

There are numerous subgrade stabilization alternatives but not all are applicable during wet subgrade conditions, or over a wide range of subgrade soil types. The focus of this RIS is on subgrade stabilization techniques that may be used during wet conditions, and some that help reduce the moisture content in the subgrade material to a tolerable level.

The chemical and mechanical stabilization alternatives are all examined for applicable conditions of use, feasibility, effectiveness, and which stabilization methods are currently being utilized in Minnesota by county agencies. The RIS lists several other publications for additional references.

Status/Implementation

Current practices are similar to those indicated in the RIS. Mn/DOT rarely uses subgrade stabilization. Counties typically use calcium chloride for drying during construction. Mn/DOT is not aware of any additional studies pertaining to subgrade stabilization techniques that may be used during wet conditions.

Guardrails, End Treatments and Transitions RIS 14

Benjamin J. Worel 1993
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

Improving roadside safety is a concern for every city, county, and state traffic agency. Motor vehicle accidents inflict a tremendous hardship on American society. Nationally, the number of fatalities each year in the United States has remained relatively constant at nearly 50,000 per year. From 1976 to 1986, about 60 percent of fatal accidents involved only one motor vehicle, and of these, 70 percent of the vehicles left the roadway and either overturned or collided with a fixed object.

This RIS summarizes the accepted guardrail types, end treatments, and transition systems used in Minnesota. It is intended to be used as a quick reference to show what is available and the suggested use of each type. The appendix references the standard plates that are used in Minnesota. *Note: This report contains information current as of April, 1993.* Agencies should contact Mn/DOT to insure that the standards and requirements have not changed.

Status/Implementation

The current Mn/DOT practices are listed in the RIS with the exception of Slotted Rail Terminals (SRT) that are now in place. These are similar to the old Eccentric Loader Terminal (ELT).

The NCHRP recently completed a project entitled *Project 22-07, Update of Recommended Procedures for Safety Performance Evaluation of Highway Appurtenances*. The study objective is to update the recommended procedures for the safety performance evaluation of both temporary and permanent highway appurtenances in such a manner as to reflect advances in technology and to accommodate current and anticipated roadway and vehicle characteristics. The final report has been approved, and it has been published as NCHRP Report 350, *Recommended Procedures for the Safety Performance Evaluation of Highway Features.*

A LRRB-RIC project entitled *Guardrail Installation/Repair Action Plan* is currently being conducted. This new task will follow through on the recommendations from RIS 14 that an agency have an action plan for each system that details procedures for installation and repair. The document will provide a framework for public agencies to develop their own action plan for guardrail installation and repair.

Waste Products in Highway Construction

RIS 15

Chunhua Han, Ph.D., P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1993

Summary

This RIS is an executive summary of LRRB Report 93-16, *Waste Products in Highway Construction.*

Highway construction projects are dependent on adequate supplies of aggregate and binder. The aggregate and binder demand for construction has increased dramatically especially where aggregate sources are depleted, the available aggregate quality is at a low level, or aggregate cannot be obtained because of mining restrictions, environmental protection regulations, or appreciating land values.

In contrast, enormous quantities of domestic, industrial, and mining wastes are generated annually in the United States. An extensive effort to reuse wastes in highway construction has been made by researchers and engineers for almost a century. This RIS establishes a waste source inventory with technical definitions and sources of waste products. Waste materials are evaluated, along with field performance of roads built with them. This synthesis also summarizes survey results regarding the use of waste materials in Minnesota highway construction, based on responses from city and county engineers.

Status/Implementation

According to Mn/DOT, the material presented in this RIS and the subsequent report is still current. This report is informational and has worked well in communicating this information to local engineers.

Currently, the LRRB is funding two studies.

- Investigation 713 entitled *Use of Waste Shingles Scraps in Aggregate Base*
- Investigation 713 entitled *Mechanical Properties of Shredded Tires/Soil Mixtures*

Additionally, the NCHRP has Project 4-21, *Appropriate Use of Waste and Recycled Materials in the Transportation Industry,* scheduled to be completed in August of 1998. The research objectives are first, to develop a methodology for: (1) assessing the suitability and practicability of specific Waste Recycled Materials (WRMs) in transportation applications; (2) determining appropriate uses; (3) developing design and construction guidelines; and (4) evaluating long-term, in-service performance; and second, to apply the methodology to a spectrum of WRMs.

A Synthesis of Measuring and Modeling Frost Depths **RIS 16**

Guy W. Kohlnhofer 1993
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

The change of seasons has a substantial effect on almost everything in Minnesota, especially pavement structures supported by fine-grained soils. These soils are susceptible to a loss of strength during spring thaw. As pavement temperatures increase in the spring, frozen layers under the pavement begin to thaw from the top. The water released from the thawing materials saturates and weakens the pavement structure since the water is not able to drain through the still-frozen lower layers.

Because of the loss of strength in saturated pavement structures, it is important to determine the extent of the thawed zone. Knowing the time and extent of thawing can help the appropriate personnel determine when it is best to establish spring load restrictions. Extensive research has been conducted by others in the hope of finding a simple, inexpensive, and accurate method of determining frost depth throughout the year. This synthesis addresses various reports regarding equipment and methods used to determine frost zones within the soil. Some of the equipment described is used to determine soil strength characteristics, thereby enabling us to determine frozen soil layers.

Status/Implementation

Since the publication of this document, Mn/DOT has developed specifications on the construction and use of a frost resistivity probe based on their experience, research, and usage. These specifications and other information are listed in a technical publication entitled *User Guide to the Frost Resistivity Probe* published in November of 1996. This guide describes how to fabricate the device, cost, installation procedures, data collection, and data analysis.

Additionally, Mn/DOT published a report in 1997 entitled *Calculating Maximum Frost Depths at Mn/ROAD Test Cells for the Winters of 1993, 1994, 1995, and 1996.* This report reviews a process in which Mn/DOT used to calculate frost depths based on climatic data and compared their results to actual increased frost depths at various Mn/ROAD test cells.

Herbicides for Roadside Vegetation Management

RIS 17

Chunhua Han, Ph.D., P.E.
Michael M. Marti, P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1994

Summary

Herbicides have been recognized as one of the most effective methods for roadside vegetation control. In a large-scale vegetation management program, herbicides or chemical controls are applied with other control options (*manual, mechanical, biological, ecological, and cultural*) to maintain a safe and attractive roadside at an affordable cost. With advancements in modern vegetation control, a well-planned program will maintain safety characteristics and legal requirements for the roadside, improve the road structure, and enhance the delineation and beauty of the roadside.

This RIS has been developed in conjunction with RIS 18 entitled *Use of Herbicides*. This two-part series is intended to provide an updated summary regarding the regulation and application of herbicides. This information will serve as integrated education/training modules for local governmental agencies. In this document, herbicides are discussed with respect to the current EPA and other governmental regulations and restrictions, applicator safety, and program planning and management.

Status/Implementation

Mn/DOT felt these reports, in general, have influenced the decisions of local engineers; however, they could not provide any specific details. Because herbicide policies change often, reports such as these have a short-term effectiveness. Additionally, due to industry dynamics, updates are continually needed. Currently, most information is obtained from symposiums and training seminars. The University of Minnesota previously had a contact (the late Oliver Strand) who provided summaries and publications for the public sector. Mn/DOT expressed an interest in having the position reopened, likely part time, to once again assist the public sector in updating their practices.

Use of Herbicides **RIS 18**

Chunhua Han, Ph.D., P.E. 1994
Michael M. Marti, P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

This synthesis was developed in conjunction with RIS 17 entitled *Herbicides for Roadside Vegetation Management* that describes the process and components of establishing a management plan for controlling roadside vegetation. These two documents will serve as integrated education/training modules for local governmental agencies.

This document discusses the use of herbicides with respect to weed biology, soil science, chemical characteristics of herbicides and growth regulators, application, and usage. A user guide/table for the recommended use of various herbicides and growth regulators for specific situations is provided. Before using any of the herbicide products, the user should read and follow the instructions on the product label — that is the best source of information.

Status/Implementation

Mn/DOT felt these reports, in general, have influenced the decisions of local engineers; however, they could not provide any specific details. Because herbicide policies change often, reports such as these have a short-term effectiveness. Additionally, due to industry dynamics, updates are continually needed. Currently, most information is obtained from symposiums and training seminars. The University of Minnesota previously had a contact (the late Oliver Strand) who provided summaries and publications for the public sector. Mn/DOT expressed an interest in having the position reopened, likely part time, to once again assist the public sector in updating their practices.

Soil Stabilization of Low-Volume Roads

RIS 19

Julie Vandenbossche
Ann M. Johnson, P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1994

Summary

The use of admixtures for stabilizing soils involves adding granular materials or chemical compounds to improve the engineering properties of a soil. The synthesis presented in this RIS is limited to the discussion of surface soil stabilization, which consists of excavating and breaking up the soil, adding the admixture, mixing the soil and the additive(s), compacting the soil, and then allowing the mixture to cure.

Portland cement, fly ash, lime, and asphalt cement are the most commonly used stabilizers because they are readily available at relatively low costs, many agencies have experience in using them, and they are environmentally safe. The use of each is outlined in this synthesis.

Status/Implementation

This document was published in 1994 and the information is still valid. Currently, the LRRB is funding two specific studies on soil stabilization of low-volume roads.

- Investigation 711 — *Surface Stabilization on Low Volume Roads*
- Investigation 725 — *Efficacy of Erosion Control Blankets and Soil Stabilizers*

Use of Aggregate Materials as Roadway Base, Shoulder and Surface Courses in Minnesota **RIS 20**

Ann M. Johnson, P.E.
Chunhua Han, Ph.D., P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1995

The Mn/DOT Standard Specification for aggregates contains several different classes of surfacing and base course aggregates. To effectively use and specify these aggregates, it is important that their performance be characterized and guidelines for their use be established. This RIS outlines the properties of each aggregate class and details the effect that the specifications have on performance, stability, durability, and weathering of an aggregate surface course, base, and shoulder material.

Status/Implementation

This RIS was published in 1995. The information is current and Mn/DOT is following the specification as outlined in the RIS.

Soybean Oil Soapstock as a Dust Control Agent

RIS 21

Chunhua Han, Ph.D., P.E.
Michael M. Marti, P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1996

Summary

In 1992, a report published by the LRRB, *92-07 — Dust Control on Unpaved Roads*, discussed using a vegetable by-product for dust control on gravel-surfaced roads. This material, soybean oil soapstock, was then tested and marketed as a dust control agent. The purpose of this RIS was to gather information with respect to the properties, application, and effectiveness of this material. The RIS outlines the properties of soapstock, conditions for application, application procedures, environmental testing results of the material, economics, and experiences from local Minnesota agencies using soapstock as a dust control agent.

Status/Implementation

This RIS was published in 1996. No significant changes or developments were noted since the publication.

CHAPTER 4

LRRB RESEARCH IMPLEMENTATION VIDEO SUMMARY

Weather and Loads: The Effect They Have on Roads **VT 24**

Michael M. Marti, P.E. 1991
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

This video explains how pavement materials are affected by the forces of weather and loading. In the process, the viewer learns the basic concepts of pavement engineering including fatigue, bearing capacity, and thermal expansion. With a technical topic and a general audience, it was decided that the narrator should be a scientist with a locally well-known personality. Accordingly, a popular television meteorologist was selected. This video also includes a set of cross-sectional pavement models. The narrator uses these tabletop models to show how pavement responds to weather and loading. A description is given regarding the additional damage caused by overweight vehicle loads. Based on research, the models were built to duplicate the responses of actual pavement materials.

Status/Implementation

This video has been distributed to all Minnesota city and county engineers. It has served as an educational tool for both staff and the general public. Most of the information and concepts presented in the video are still valid and current. However, current design practices are moving towards 10-ton design which is not addressed in the video.

Road Repair: Do the Right Thing at the Right Time VT 65

Michael M. Marti, P.E. 1991
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

The primary purpose of this video is to describe the efforts, by governmental bodies, to manage and maintain county and city streets. There is an effort to indicate to the typical public the actions behind pavement management and the reasoning behind selecting proper rehabilitation for road maintenance. In the video, the on-screen moderator shares what he has learned about pavements from talking with his local engineer. He explains what he knows in nontechnical terms. Using actual pavement material samples, video clips and other aids, he shows the viewer how engineers gather data on pavement and underlying soils. He then walks the viewer through a discussion of the factors considered in making rehabilitation decisions.

Status/Implementation

This video has been distributed to all Minnesota city and county engineers. It has served as an educational tool for both staff and the general public. Most of the information and concepts presented in the video are still valid and current.

The LRRB is currently funding Investigation 704 — *Preventative Maintenance for Streets and Highways.*

Asphalt Crack Treatment: Helpful Information for the Road VT 74

Michael M. Marti, P.E. 1993
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

This is a video which specifically describes one rehabilitation technique — crack maintenance. Since the techniques and philosophies of crack maintenance are diverse, the video is a dialogue between two maintenance workers. One worker, older with little advanced education, has been a maintenance foreman for years — from experience he knows what works. The other, having recently finished technical school, has plenty of "book smarts." He has read every research project available on crack maintenance but has no experience. The dialogue is a friendly debate between the two workers sharing their respective knowledge, field experience, and research technology. The video specifically discusses the differences between cracking filling and crack sealing and between routing versus sealing. Computer animation is used throughout to illustrate the various points. The video concludes with the maintenance foreman taking the younger worker to a site where he sees an actual demonstration of equipment and each specific phase of a typical crack maintenance operation.

Status/Implementation

This video has been distributed to all Minnesota city and county engineers. It has served as an educational tool for both staff and the general public.

Mn/DOT distributed a Tech-Memorandum in 1997 outlining their new specification criteria (for Specifications 3719, 3720 and 3723). The reasons for updating the specifications were:

- Movement away from using AC-3 for filling cracks on older bituminous pavements;
- Cohesion failures of a sealant that met the 3723 laboratory requirements;
- Poor field performance of the 3720 sealant; and
- Applied experience from the South Dakota DOT and Ontario Ministry of Transportation.

The Ontario Ministry's research (TRB Paper 950763, 1995) has shown that crack sealing yields, on average, five extra years of serviceable life.

Sealcoating: A Matter of Science and Skill **VT 259**

Michael M. Marti, P.E. 1993
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

This video was developed in response to some of the findings in RIS 12 — *Seal Coat Procedures and Problems*. This video continues the message of earlier videos regarding the importance of regular maintenance in relation to a pavement's life expectancy. This time, the specific rehabilitation technique is sealcoating. The video's message indicates that in order to achieve quality sealcoating, both science and skill must be involved. Science must be considered in the design of a seal coat while skill is a factor in seal coat application techniques.

The video contains footage of emulsion and aggregate spreaders in action. Included is footage showing the project management necessary to maintain an efficient sealcoating operation.

Status/Implementation

This video has been distributed to all Minnesota city and county engineers. It has served as an educational tool for both staff and the general public.

Mn/DOT and the LRRB have recently sponsored several significant research projects on the subject of sealcoating. David Janisch has been conducting LRRB Investigation 693 entitled *A Re-Evaluation of Sealcoating in Minnesota*. Several local agencies have been participating in this study to determine the best practice for conducting a seal coat. It is anticipated that this study will produce new specifications.

A LRRB-RIC project entitled *Seal Coat Training Handbook* is currently in progress. The proposed project is to develop a handbook that could be taken in the field and help the inspector or project engineer know what a good seal coat should look like, how to calibrate the equipment, how to recognize problems, and how to correct them. Many times the seal coat inspector in the field comes from the construction office and has little seal coat experience. By having a field guide that is easy to use, easy to carry, and full of useful information, the inspector can feel confident and make the correct decisions in the field.

Asphalt Overlays: The Four Ps

VT 333

Michael M. Marti, P.E.
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

1994

Summary

The intention of this video is to provide information regarding asphalt overlays. It focuses on explaining the philosophy, purpose, and benefits of placing an asphalt overlay and is not intended to be a training video. However, the video does briefly present the components and "how to's" of placing an asphalt overlay. Because people are more likely to accept an idea if they understand the logic behind that it, this video emphasizes the "why" of bituminous overlays. The video shows that there are rational, scientific reasons for doing things the right way and that doing things the right way is cost-effective. To keep viewers interested and to make the ideas real, all topics are visualized via in-studio samples or with field footage of actual overlay operations.

Status/Implementation

This video has been distributed to all Minnesota city and county engineers. It has served as an educational tool for both staff and the general public.

The LRRB is currently sponsoring several studies in the area of asphalt overlay.

- Investigation 703 — *Surface Preparation Prior to Overlay*
- Investigation 708 — *Local Government Evaluation of SHRP-SUPERPAVE*
- Investigation 723 — *Local Government Evaluation of Saw and Seal of Bituminous Pavements*

Roadway Design: Balancing Safety, Environment and Cost VT 387

Michael M. Marti, P.E. 1995
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

This video has two main objectives: one is to motivate citizens and public officials to approve reasonable roadway design and construction projects. "Reasonable" is defined by a design that results from a balanced view of three goals: safety, environmental protection, and cost. The second objective of the video is to show engineers and other pavement maintenance professionals some engineering practices they may not be aware of — practices that can be useful in achieving the balance referred to above. The video acknowledges that there is not a universal solution. Each situation must be looked at independently. All factors must be taken into account and through open discussion and cooperation a creative solution can be found that balances safety, environment, and cost. To illustrate a variety of roadway design choices, a three-dimensional model was constructed. The model, about 4'x4'x1', represents a typical rolling Minnesota countryside with a two-lane roadway, and has removable and insertable pieces that change the roadway shape. The model is available for loan from the LRRB.

Status/Implementation

This video has been distributed to all Minnesota city and county engineers. It has served as an educational tool for both staff and the general public.

However, there is a study currently underway that could impact some of the specifics expressed in the video. This study by a *Geometric Design Standards Task Force* is an evaluation and potential change to the geometric standards of rural roadways. The current design standard calls for 12-foot driving lanes and shoulders ranging from 4 to 8 feet. The nationwide trend is to relax the standard and reduce the lane and shoulder width. This reduction in width has caused some concern from local engineers — specifically safety concerns.

The Task Force draft report is calling for the following.

Minnesota Proposed Minimum Construction and Reconstruction Standards Low Volume Rural Trunk Highways and Rural State Aid Highways Lane and Shoulder Widths for Two-Lane Highways			
Projected Daily Traffic	**Driving Lane Surface Type**	**Lane Width**	**Shoulder Width**
0 - 49	Aggregate	11 feet (3.3 meters)	1 foot (0.3 meters)
50 - 149	Aggregate	11 feet (3.3 meters)	3 feet (0.9 meters)
150 - 1500	Paved	12 feet (3.6 meters)	4 feet (1.2 meters)
1500 and above (Collector & Local Hwys)	Paved	12 feet (3.6 meters)	6 feet (1.8 meters)

This report was to be completed in early 1997.

The Minnesota Local Road Research Board

VT 386

Michael M. Marti, P.E.

1995

Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

This video provides an overview of the history and function of the LRRB to stimulate interest and convince city and county engineers to actively participate in the LRRB. It concentrates on showing the ways that engineers, officials, and citizens all have benefitted directly from LRRB research. It briefly presents the LRRB's legal status and history to establish its position in the matrix of Minnesota public service. It focuses on several of the 150 research projects funded by the LRRB. In addition to funding research, the LRRB makes sure that its research results get to the right people. The LRRB publishes research reports and field guides, conducts seminars, produces videos, and provides other technical assistance. Local governments receive this help through the technology transfer efforts of Mn/DOT and the University of Minnesota's Center for Transportation Studies.

Status/Implementation

This video has recently been distributed to all of the city and county engineers throughout Minnesota. It has served as an educational and promotional tool to explain the function of the LRRB and stimulate involvement from local government agencies.

Utility Cut Repair: Doing it Right! VT 388

Michael M. Marti, P.E. 1996
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

The objective of this video was to increase the quality of workmanship associated with making and repairing utility cuts throughout Minnesota. The video shows supervisors, workers, and public officials how everyone benefits from quality workmanship and use of research-tested materials and methods. The video shows how doing things right saves time and headaches for workers; saves money for companies, agencies, and the general public; and gives the driving public a smooth, comfortable ride. Conversely, it also shows how doing things the wrong way costs everyone money, headaches, and time. Finally, the video presents the idea that doing the job right gives workers a reason to take pride in their work.

Status/Implementation

This video has recently been distributed to all of the city and county engineers throughout Minnesota. It has served as an educational and promotional tool to explain the function of the LRRB and stimulate involvement from local government agencies.

Traffic Control: What Works? **VT 389**

Michael M. Marti, P.E. 1996
Braun Intertec Corporation, 6875 Washington Avenue South, Minneapolis, MN 55439

Summary

A common response to a serious accident is a request for a STOP, YIELD, or a lower speed limit sign at the site. However, FHWA Report FHWA/RD 81/084 entitled *Stop, Yield and No Control at Intersections* states that trying to increase the amount of control at an intersection with signs usually does not bring the desired results. In fact, the report shows that intersections with no control and those controlled by YIELD signs actually had lower accident frequencies than those controlled by STOP signs.

Determining the best type of traffic control for a given situation is one of the most complex tasks faced by our public engineers. Through many decades of research and experience, engineers have developed reliable methods for controlling traffic on our streets and roads.

This video discusses two main points — intersection control and speed control. More specifically, the objective of the video was to offer information on how public officials develop reasonable, research-based traffic control strategies and apply engineering judgment to select traffic and speed control devices.

Status/Implementation

This video has recently been distributed to all of the city and county engineers throughout Minnesota. It has served as an educational and promotional tool to explain the function of the LRRB and stimulate involvement from local government agencies.

The LRRB is currently funding Investigation 721 — *Traffic Calming*.