MIDWEST SMART WORK ZONE DEPLOYMENT INITIATIVE

MwSWZDI

FHWA POOLED FUND STUDY

IA.KS.MO.NE.WI

Evaluation Plan

February 2004

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INTRODUCTION

The Midwest Smart Work Zone Deployment Initiative (MwSWZDI) was initiated in 1999 as a Federal Highway Administration (FHWA) Pooled Fund Study intended to coordinate and promote research among the participating states related to safety and mobility in highway work zones. Led by Pat McCoy at the University of Nebraska, the original four states of Iowa, Kansas, Missouri, and Nebraska were joined by Wisconsin in 2001. In 2003, the Nebraska Department of Roads stepped down from its role as lead state, and the Kansas Department of Transportation stepped forward to lead the study. To best facilitate the transition, a new study was initiated with the same title and participants. The study is an ongoing cooperative effort between state Departments of Transportation, universities, and industry. Commercial products are provided by private vendors. State DOTs provide funds, prioritize products with respect to their anticipated benefits to their construction and maintenance activities, and cooperate with university researchers to identify test sites and conduct the evaluations. To date, 47 evaluations of various work zone related products have been conducted or are ongoing. Completed reports and descriptions of ongoing projects can be obtained at Mid-America Transportation Center (MATC) website (www.matc.unl.edu).

PROGRAM PROCESS

For Project Year 2004 (PY 2004, corresponding roughly to Fiscal Year 2004), the programming process has been significantly changed compared to previous years. In the past, the typical process comprised the following steps.

1. The Technical Advisory Committee (TAC) develops problem statements describing the highest priority issues related to work zone safety and mobility.
2. The TAC issues a Request for Proposals (RFP) aimed at vendors of commercial products that address one or more of the problem statements.
3. Vendors submit descriptions of their products and their espoused benefits.
4. The TAC determines which state(s) are most appropriate for evaluating each product based on interest and site availability.
5. University evaluators prepare work plans for each evaluation assigned to their state.
6. The TAC decides by consensus which evaluations will be included in the overall work plan based on discussions of the anticipated usefulness of the results and the availability of funds.

The funding of the overall program was distributed evenly among the participating states.

In 2003, several states expressed the need to reduce their funding level for the study. Additionally, discussions within the TAC resulted in several of the highest priority problem statements describing issues that are more appropriately addressed with synthesis studies than with product evaluations. To accommodate these two issues, a new programming process was developed comprising the following steps.

1. The Technical Advisory Committee (TAC) develops problem statements describing the highest priority issues related to work zone safety and mobility.
2. The TAC issues a Request for Proposals (RFP) aimed at vendors of commercial products that address one or more of the problem statements.
3. Vendors submit descriptions of their products and their espoused benefits.
4. State DOT representatives rank these products by their relative importance to maintenance and construction activities in their respective states.
5. Evaluators prepare proposed work plans addressing the problems statements. The work plans may describe a product evaluation, a synthesis study, or a research study.
6. State representatives rank the proposals based on their respective needs.
7. An aggregate score for each proposal is calculated based on a weighted average of the state rankings. Rankings are weighted based on the funding level from each state.
8. The ranked list of proposals based on aggregate scores is compared against the available funds to determine the disposition of each proposal.[1]

For PY 2004, nine problem statements were developed, one of which was sent out to vendors in an RFP. 19 products were proposed for evaluation, three of which pertained to the problem statement.[2] Nine proposals were submitted by evaluators. Based on state rankings and funding levels, seven of the nine proposals will be funded. Additional funds will be designated for study

[1] I.e., funded or not funded.

[2] Vendors are encouraged to submit any products for consideration with the understanding that the problem statements are an indication of state priorities.

administrative duties and for a conference to be held in the Fall of 2004 to disseminate information about completed evaluations.

PROJECT YEAR 2004 (PY 2004) PROGRAM

The nine proposals submitted plus the conference and administrative budgets totaled $296,354. Available funding, including $20,000 contributed by the FHWA, totaled $245,000. Two projects were dropped and the conference budget was adjusted to accommodate the overall funding. The participating states and their respective funding levels are shown in Table 1. The resulting program is shown in Table 2.

Table 1. Funding Levels of Participating Agencies.

Agency	Funding level
Iowa	$ 10,000
Kansas (FY 03)	$ 25,000
Kansas (FY 04)	$ 80,000
Missouri	$ 15,000
Nebraska	$ 25,000
Wisconsin	$ 70,000
FHWA	$ 20,000
Total	$ 245,000

Table 2. Proposal funding status and level

Proposal	PI	Institution	Amount	Status
Web site and listserve administration	Aemal Khattak	University of Nebraska	$2,910	Funded
Project Administration	Eric Meyer	Meyer ITS	$49,222	Funded
Spring 2004 Conference	???	???	$10,565	Funded
Portable Rumble Strips: Advanced Traffic Markings (ATM) And Recycled Technology, Inc. (RTI)	Alan Horowitz	University of Wisconsin	$15,177	Funded
Criteria For Portable ATIS In Work Zones: Lane Merge, Travel Time And Speed Advisory Systems	Alan Horowitz	University of Wisconsin	$27,186	Funded
Synthesis Of Procedures To Forecast And Monitor Work Zone Mobility And Safety Impacts	Tom Maze	Iowa State University	$34,357	Funded
The Use Of Raised Pavement Markings In Work Zone Applications – A Synthesis Of Practice	Aemal Khattak	University of Nebraska	$23,666	Funded
Design Of Portable Rumble Strips	Rick Hale	University of Kansas	$18,640	Funded
	Eric Meyer	Meyer ITS	$16,530	
Evaluation Of Portable Rumble Strips	Eric Meyer	Meyer ITS	$24,939	Funded
Work Zone Incident Management Practices: Synthesis Study	Alan Horowitz	University of Wisconsin	$21,808	Funded
Total Budget for PY 2004			$245,000	

Projects Not Funded

Temporary Traffic Control Measures And Enforcement Of Traffic Laws In Closed Road (Street) Sections	Stephen Andrle	Iowa State University	$19,565	Not Funded
Synthesis Of Work Zone Mobility And Safety Impact Procedures	Mark Virkler	University of Missouri	$29,997	Not Funded

This program and associated work has been approved by the Technical Advisory Committee (TAC). Details of the Work Plan and budget details per project are provided in Appendix A.

APPENDIX A: WORK PLAN

The Midwest Smart Work Zone Deployment Initiative 2004 Work Plan comprises the individual work plan proposals submitted for individual projects that were subsequently included in the approved Study Program. Funds for each project will be transferred to the local State DOT, and contracts will be executed between the research institutions and their respective State DOT. Contract performance will be monitored by the contracting DOT and reported regularly to the TAC. Overhead rates shown are those applicable to contracts between the research institutions and their respective State DOT. Changes in project budget or work plan require approval of the TAC. For minor changes, the Project Monitor in the contracting DOT shall represent the TAC, deferring to the TAC when deemed appropriate.

Project Budget

Item	PY04_Administration-Travel	PY04_Web Administration	PY04_Conference	PY04_PS 1_Prop 5--Portable Rumble Strips: Advanced Traffic Markings (ATM) and Recycled Technology, Inc. (RTI)	PY04_PS 9_Prop 1--Criteria for Portable ATIS in Work Zones: Lane Merge, Travel Time and Speed Advisory Systems	PY04_PS 2_Prop 1--Synthesis of Procedures to Forecast and Monitor Work Zone Mobility and Safety Impacts	PY04_PS 6_Prop 1--The Use of Raised Pavement Markings in Work Zone Applications – A Synthesis of Practice	PY04_PS 1_Prop 4--Design of Portable Rumble Strips	PY04_PS 1_Prop 6--Evaluation of Portable Rumble Strips	PY04_PS 3_Prop 1--Work Zone Incident Management Practices: Synthesis Study	Total
State	KS	NE	???	WI	WI	IA	NE	KS	KS	WI	
Personnel											
Salaries & Wages	$39,416	$ 2,000		$ 7,171	$14,085	$16,962	$12,570	$25,822	$20,320	$11,268	$ 149,614
Fringe Benefits	$ -	$ -		$ 2,053	$ 3,709	$ 3,870	$ 1,770	$ 1,799		$ 2,967	$ 16,168
Subtotal	$39,416	$ 2,000		$ 9,224	$17,794	$20,832	$14,340	$27,621	$20,320	$14,235	$ 165,782
Other Direct Costs						$ -	$ -				
Materials & Supplies	$ 1,500	$ -		$ 800	$ 500	$ 200	$ 300	$ 1,020	$ 3,600	$ 400	$ 8,320
Printing & Copying	$ 1,500	$ -		$ 100	$ 100	$ -	$ -	$ -	$ 25	$ 100	$ 1,825
Postage	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ 100		$ 100
Telephone & FAX	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ 50		$ 50
Research Equipment	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -		$ -
Travel	$ 6,806	$ -		$ 200	$ 100	$ 2,000	$ -	$ 700	$ 847	$ 100	$ 10,753
Other	$ -	$ -		$ -	$ -	$ 500	$ 1,625	$ -	$ -		$ 2,125
Subtotal	$ 9,806	$ -		$ 1,100	$ 700	$ 2,700	$ 1,925	$ 1,720	$ 4,622	$ 600	$ 23,173
Total Direct Cost	$49,222	$ 2,000		$10,324	$18,494	$23,532	$16,265	$29,341	$24,942	$14,835	$ 188,955
Indirect Cost	$ -	$ 910		$ 4,853	$ 8,692	$10,825	$ 7,401	$ 5,829	$ -	$ 6,973	$ 45,483
Total Cost	**$49,222**	**$ 2,910**	**$10,562**	**$15,177**	**$27,186**	**$34,357**	**$23,666**	**$35,170**	**$24,942**	**$21,808**	**$ 245,000**

PY2004 Study Administration

PI: Eric Meyer

Administration of the Midwest Smart Work Zone Deployment Initiative comprises the organization of all meetings of the Technical Advisory Committee, assisting KDOT in the contract administration, facilitating the vendor solicitation and project programming processes, assembling group reports for distribution, maintaining the web site, providing for certain TAC travel to meetings, and serving as a contact point for inquiries about the study or component research. The web site and listserve maintenance function will be provided by the University of Nebraska (Aemal Khattak, PI), and is broken out as a separate budget.

2004 Administrative Budget

Personnel	
E. Meyer	$ 39,416
Subtotal	**$ 39,416**
Other Direct Costs	
Supplies and Materials	$ 1,500
Printing & Duplicating	$ 1,500
Travel	$ 6,806
Subtotal	**$ 9,806**
Total Direct Costs	$ 49,222
Indirect Costs	$ -
Total Cost	**$ 49,222**

PI: Eric Meyer

2004 Web Maintenance Budget

Personnel	
Student	$ 2,000
Subtotal	**$ 2,000**
Total Direct Costs	$ 2,000
Indirect Costs	$ 910
Total Cost	**$ 2,910**

PI: Aemal Khattak

Portable Rumble Strips: Advanced Traffic Markings (ATM) and Recycled Technology, Inc. (RTI)

Submitted by the University of Wisconsin--Milwaukee

Technology

Previously, the MwSWZDI has evaluated the Rumbler (Swarco) and Removable Orange Rumble Strips (ATM), which were temporary rumble strips that could be affixed to a pavement for several weeks, then removed and discarded. The two products of this evaluation (from ATM and RTI) can be quickly placed for shorter periods of time, and can then be easily relocated. These products have the potential advantage of being able to be moved with the changing extents of a work zone. Like any rumble strip, the ATM and RTI products give an audible and tactile message to drivers when approaching a location where a change in speed may be required. They may also provide a visual warning to a potential hazard. They could be used ahead of a temporary sign, a flag operation, lane closure or any hazard.

Objective

These products will be evaluated for their ability to provide necessary warnings (sound and tactile), and for durability,-portability and ability to remain affixed to pavement.

Study Site

The ATM and RTI products will be installed, removed and reinstalled on multiple days ahead of a state- or county-trunk highway temporary work zone. The temporary work zone selected will include a flagging operation or other temporary lane closure where all lanes are re-opened at the end of each work day or where work zone boundaries change from day to day. The strips will be installed by a contractor or cooperating county highway department.

Performance Measures

Objectives of the product deployment and the performance measures for each objective are shown in the next table.

Objectives	Performance Measures	Measurement Methods
Product provides sufficient warning for drivers	1. Noise level and quality within vehicle 2. Vibration level and quality of steering column 3. Crash history 4. Appearance as a traffic control device 5. Subjective evaluations of safety	Sound level meter Accelerometer Law enforcement records Motorist focus group
Product is economical	1. Durability of the products through repeated applications 2. Cost	Work zone crew focus group Vendor information
Product is easy to deploy	1. Ability to remain affixed to pavement 2. Ease of installation 3. Ease of removal	Work zone crew focus group
Product does not have negative impacts on traffic	1. Unusual behaviors 2. Subjective evaluations of safety	Motorist focus group Work zone crew focus group

Evaluation Methodology

It is anticipated that both products will be used at the same work zone, with each product assigned to a different direction of traffic. The products will be used for approximately two weeks or until the products are no longer functional or no longer needed. For at least some of the days, the products will be installed at a location that permits vehicular speeds of at least 55 miles per hour, while still allowing for adequate safety of work zone personnel and motorists.

The evaluation will compare the two products head-to-head and compare both products to a relatively-new, permanent rumble strip that is cut into pavement. The evaluation will consist of four phases: sound analysis; vibration analysis; a work zone crew focus group; and a motorist focus group.

- *Sound Analysis:* The strength of the audible message will be measured with a sound level meter within a test vehicle. The sound time-history will be recorded on a laptop computer, so that it can be visually compared between the three types of rumble strips. The sound time-history will also be analyzed for dominant frequencies using FFT.
- *Vibration Analysis:* The strength of the tactile message will be measured with a single accelerometer that has a wide frequency response. The accelerometer will be attached to the steering column of a test vehicle in a manner that will allow recording the strongest vibrations in the vertical direction. The vibration time-history will be recorded on a laptop computer, so that it can be visually compared between the three types of rumble

strips. The vibration time-history will also be analyzed for dominant frequencies using FFT.

- *Work Zone Crew Focus Group:* The work zone crew will be interviewed as a group to give their impressions as to durability, ease of application and removal, enhanced feelings of safety, their own experiences while driving over the rumble strips, and anecdotal information.
- *Motorist Focus Group:* A focus group of 8-10 motorists will be assembled to provide a subjective evaluation of the rumble strips. Each motorist will drive their own vehicle across both products and, if possible, a relatively-new, permanent rumble strip. The motorists will later meet as a group to describe their opinions of the products, including their impressions of sound, vibration, appearance, level of integration with other warnings and perceptions of safety. Motorists will be drawn from a cross-section of drivers, including truck owners, and they will be paid for participating.

According the manufacturer, the RTI product is heavy enough to remain in place without adhesive. This claim will be verified by driving test vehicles over the device when it is placed on a closed road.

Evaluation Tasks

The following seven tasks need to be performed to accomplish the objectives of the study.

Task	Responsibility
1. Select Site, Plan Installation and Test	(UWM/WisDOT)
2. Train Work Zone Crew and Deploy Devices	(WisDOT/Vendors/Contractor)
3. Sound and Vibration Data Collection and Analysis	(UWM)
4. Stability Test without Adhesive	(UWM)
5. Motorist Focus Group	(UWM)
6. Work Zone Crew Focus Group	(UWM/WisDOT)
7. Write Report	(UWM)

Evaluation Schedule

The anticipated milestones for the seven tasks are shown below. The milestones assume a project start date of February 1, 2004 and a 7-month project duration. The schedule allows sufficient time in Task 1 for the required human subjects review.

Task	Feb	Mar	Apr	May	Jun	Jul	Aug
1. Select Site, Plan Installation and Test	■	■	■	■			
2. Train Work Zone Crew and Deploy Devices					■		
3. Sound and Vibration Data Collection and Analysis					■		
4. Stability Test without Adhesive					■		
5. Motorist Focus Group					■	■	
6. Work Zone Crew Focus Group						■	
7. Write Report							■

Budget

The following budget is based on costs at the University of Wisconsin—Milwaukee. The project involves 90 hours each of faculty time and 50 hours each of graduate project assistant and student hourly help for a total of 190 person-hours. The materials and supplies budget item includes $500 for payments to motorists, at $50 per motorist.

The budget further assumes that the vendors will provide their products and required training for free.

Project Budget

Item	**Budget**
Faculty Salaries (Horowitz)	$5,571
Student PA Salaries	$1,000
Student Hourly Salaries	$600
Faculty Fringe	$1,838
Student PA Fringe	$200
Student Hourly Fringe	15
Subtotal	*9,224*
Other Direct Costs	
Materials and Supplies	$800
Printing and Copying	$100
Travel	$200
Subtotal	*$1100*
Total Direct Cost	$10,324
Indirect Cost	$4,853
Total Cost	$15,177

Criteria for Portable ATIS in Work Zones: Lane Merge, Travel Time and Speed Advisory Systems

Submitted by University of Wisconsin Milwaukee

Description of the Technology and Background

The Midwest Smart Work Zone Deployment Initiative has been conducting multiple evaluations of portable ATIS (Advanced Traveler Information Systems) that are intended to provide good real-time information to drivers about delays and geometric issues in advance of work zones. Systems have included TIPS, Intellizone, ADAPTIR, Brown RTCMSC, and D-25. In addition, similar tests of such equipment have been performed elsewhere, sporadically. Some of the evaluations have been expensive, and a cohesive body of knowledge does not yet exist for providing guidance as to the most effective methods of deploying such systems and determining when such systems are warranted. If these technologies are to become part of standard practice for departments of transportation, given their complexity and expense, such guidance needs to be developed.

Characteristics of these systems that distinguish them from other ATIS devices are (1) they can be readily moved between work zones or redeployed within the same work zone in a similar or different configuration; (2) they provide a message directly to the driver within the driving environment; and (3) the message can change in response to traffic, lane geometry, construction equipment location or personnel needs. Many of these systems obtain and process traffic information automatically, but systems that require human intervention have also been tested. Message formats vary, but can include variable message signs, highway advisory radio or CB broadcasts. A recent review of the ATIS literature, covering 158 reports and articles, performed for the Wisconsin Department of Transportation by the University of Wisconsin—Milwaukee concluded that there is still a deficiency in knowledge of how such technologies should be deployed.

Objectives of the Evaluation

The objective of the evaluation is to assemble all readily available knowledge of portable ATIS devices in work zones; to understand existing practices; to reach conclusions as to what constitutes best practice; and to define future testing needs. Issues of particular interest include:

- Means of delivering message
- Intent of message (e.g., speeds advisory, delay advisory, travel times and merge warnings)
- Content of message
- Legal or policy restrictions or other requirements on the content of message
- Number, variety and placement of method of delivery means
- Type, number and locations of detectors
- Methods of internal operation of the system, including communications, data logging and algorithms
- Types and sizes of impacts on safety, driver behavior, driver satisfaction and worker satisfaction

- Effectiveness of system components, including detectors, signs and transmitters
- Nonautomatic methods of changing message and criteria for manual override
- Use of traffic demand estimates as an aid to determining detector or sign placement
- Typical costs and cost effectiveness of deployments as a whole.

This review will not compare products directly to each other. Rather the review will focus on applications of the most promising technologies, regardless of the vendor, in actual work zone situations.

Evaluation Methodology

The method of evaluation is a literature review and best practices scan. It is anticipated that very little useful information will be found in the academic or professional literature. It will be necessary to work through persons involved in the technology (either as vendors or as DOT personnel) to obtain reports or anecdotal information related to the topics cited in the previous section.

Synthesis studies, like this one, work best if they are guided by a small advisory committee. The role of the advisory committee is to further define the objectives of the project, to provide an initial list of agency contacts, and to help formulate conclusions and recommendations. If the project is funded at UWM, it is anticipated that the chair of the advisory committee will be the SWZDI representative from WisDOT.

The list of information sources should include:

- Literature collected as part the WisDOT ATIS review
- Abstracts from TRIS
- Full text of documents located by TRIS, when deemed appropriate
- National Transportation Library documents
- Abstracts from Engineering Village 2
- Major university transportation libraries (e.g., Northwestern, UC-Berkeley)
- Information from MwSMDI participating state DOTs
- Information from other state or local DOTs
- Information from FHWA and other USDOT entities
- Documents posted on the Internet
- Review of trade publications.

In addition to a traditional literature search, information will be obtained by:

- Direct contact (phone or e-mail) with key individuals at FHWA
- Direct contact with key individuals at state DOTs
- Direct contact with vendors
- Direct contact with any referrals.

The methods of analysis will include:

- Determining the relevant literature and information

- Organizing relevant literature and information by topic
- Summarizing the literature and information
- Determining best practice
- Recommending future directions of research and evaluation.

This review will recognize that lessons learned in the deployment of other types of ATIS might be applicable to the deployment of portable ATIS in work zones. For deployments where written reports have not yet been issued, it will likely be necessary to conduct extensive interviews with key individuals who were intimately involved in deployments.

Evaluation Tasks

The following six tasks needs to be performed to accomplish the objectives of the study.

Task	Responsibility
1. Assemble an advisory committee of experts associated with the MwSWZDI to guide the study and to participate in making recommendations. Meet with advisory committee.	UWM/WisDOT
2. Develop interview protocol. Develop contact list.	UWM
3. Make contacts, conduct interviews and compile literature and experiences with portable ATISs in work zones.	UWM
4. Review, organize and critique information obtained in Task 3.	UWM
5. Make recommendations with the assistance of the advisory committee	UWM/WisDOT
6. Prepare final report.	UWM

Evaluation Schedule

The anticipated milestones for the six tasks are shown below. The milestones assume a project start date of October 1, 2003 and a 10 month project duration.

Task	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1. Advisory Committee	■	■								
2. Interview Protocol		■	■							
3. Contacts, Literature			■	■	■	■				
4. Review, Organize						■	■	■		
5. Recommendations								■	■	
6. Final Report									■	■

Itemized Budget

The following budget is based on costs at the University of Wisconsin—Milwaukee. The project involves 150 hours each of faculty, graduate project assistant and student hourly help for a total of 450 person-hours.

Project Budget

Item	**Budget**
Faculty Salaries (Horowitz)	9,285
Student PA Salaries	3,000
Student Hourly Salaries	1,800
Faculty Fringe	3,064
Student PA Fringe	600
Student Hourly Fringe	45
Subtotal	*17,794*
Other Direct Costs	
Materials and Supplies	$500
Printing and Copying	$100
Travel	$100
Subtotal	*$700*
Total Direct Cost	$18,494
Indirect Cost	$8,692
Total Cost	$27,186

Proposal
Synthesis of Procedures to Forecast and Monitor Work Zone Mobility and Safety Impacts

Background

Federal Highway Administration (FHWA) has published a notice of proposed rule making, CFR part 630 Subpart J, "Work Zone Safety and Mobility." In general the proposed rule requires that state transportation agencies (STA) develop policies to investigate the safety and mobility impacts as early as possible in the project development process; quantify the impacts; look for alternative actions which will reduce the impacts; select a work zone approach and communicate the impacts of the approach to the public; measure the safety and mobility performance of the actual work zone once it is put in place; and use the performance data of past programs to manage the impacts of future work zone activity. The proposed rule provides some flexibility by allowing each state to set its own procedures and policies to comply with the rule and allowing states to seek solutions which are commensurate with the severity of the potential impacts.

The above paragraph greatly simplifies the specific processes outlined in the proposed rule and the state-of-the-art for developing procedures to implement the proposed rules may take years to mature. However, we believe that some STAs currently must have best practices for determining the mobility and safety impacts of work zone activities; processes for considering the potential impacts of work zones early in the project development process; strategies for minimizing the impacts of work zone activities; and practices for systematically measuring the safety and mobility impacts of work zones. These practices can be documented and then adopted by other STAs when complying with the proposed FHWA rules.

This project is limited in scope and resources and, therefore, will research only a couple of the issues addressed by proposed rules. The purpose of this project is to investigate two issues and determine best practices currently employed by STAs. The initial issues to be investigated are:

1. **Work zone related traffic safety monitoring and crash reporting**. It is believed that agencies are under-reporting crashes at high volume work zones and, therefore, making it difficult to monitor safety performance. For example, at high volume work zones with lane restrictions, queues may stretch one or more miles upstream from a work zone. It is doubtful that a rear-end collision miles upstream will be recorded as being a work zone related crash. The issue is, how do agencies capture good comprehensive traffic safety performance data to monitor the performance of work zones and what practices could be adopted to more comprehensively measure work zone traffic safety.
2. **Forecasting and monitoring work zone congestion.** When planning work zones on high volume facilities, agencies should investigate and plan for the congestion impacts of work zones and, once a work zone is established in a high volume facility, measure and monitor the resulting congestion. The issue is, how

do agencies forecast congestion in work zone planning and once the work zone is in place, how do agencies monitor work zone congestion (queuing and delays).

The scope of this research is to complete the tasks below:

1. Conduct a literature review documenting practices for the two issues above.
2. Survey STAs to determine their practices in the areas above. The survey may be either a written questionnaire or a structured telephone interview.
3. Identify roughly three STAs with particularly good practices and conduct case studies of these STAs. Unless the states are nearby, these case studies should not involve traveling to the STA but involve research of in-house documents, telephone interviews, and email exchanges.

Management and Staffing Plan

This project will be managed through the Center for Transportation Research and Education (CTRE) at Iowa State University. We have assumed that services will be provided to the pool fund study through a contract between the Iowa Department of Transportation and CTRE. Although the Iowa Department of Transportation will be responsible for administering the contract and for financial management, staff from any pool fund member may serve on the project steering committee. For example, the contracting administrator will be a staff member at the Iowa DOT, but the chair of the project steering committee may be a staff member at the Wisconsin DOT. Immediately following the initiation of the project, a project steering committee will be formed to provide oversight and direction to the investigators.

Neal Hawkins, P.E. and CTRE's Associate Director for Traffic Engineering and Traffic Operations will be the project's project manager. Neal will manage the project's financial and technical progress. Neal recently joined CTRE after 14 years of experience first as a traffic engineer for the City of Des Moines and then as a team leader and senior project engineer for Howard R. Green Company. At Howard R. Green, Neal managed traffic engineering projects for local governments in Iowa, Minnesota, and Kansas, and for the Iowa Department of Transportation. He lead a team of 8 to 10 traffic engineers and transportation planners and he successfully managed large and small projects

Neal will be supported by Tom Maze, P.E. and professor of civil engineering. Tom will also serve as the university's principal investigator although Neal will manage the day-to-day project activities. Tom's role in the project will be to assist in the development of the project design, provide quality control over data collection, help interpret the findings, and assist in the final report. Tom's time commitment to this project will be minimal to conserve on financial resources and his main involvement will be to provide project quality control/quality assurance.

A student working on a masters degree in civil engineering with an emphasis in transportation engineering or a student working on an interdisciplinary degree in transportation will be assigned to this project and will assist in conducting and compiling the survey and in conducting the literature review.

All accounting, financial management, and office services will be provide by CTRE support staff.

Schedule and Tasks

Given the limited resources available to this project, we have scheduled the project to last only four months starting at the beginning of the calendar year, 2004. The scope of the project calls for three work tasks. We have added two project management tasks. The tasks include:

1. **Task I. Form Project Steering Committee**. At the beginning of the project we will identify individuals wishing to serve on the steering committee and meet with them as soon as possible. It is envisioned that we will only hold two steering committee meetings. The first one will be at the very beginning of the project to review the proposed scope of services and the second one will be within two weeks of the end of the project to review the findings and the project deliverables. All meetings will be videoconferences. We anticipate no meeting requiring steering committee members to meet in-person.
2. **Task II. Literature Review.** Computerized literature databases will be searched to identify the relevant literature related to work zones impact analysis. Since the investigators have already conducted significant research in this area, they are already familiar with the topic and can quickly progress through the literature. Also, the Iowa DOT's librarian is a member of CTRE's staff and is available to help researchers search for relevant literature. This relationship has been a tremendous assistance when CTRE is called upon to conduct a literature search.
3. **Task III. Conduct a Survey of Practices of Other STAs.** Because of the short time frame available for the project, the questionnaire will be conducted through telephone interviews. The graduate student assistant assigned to this project will call the STA and determine the appropriate individual to interview and establish an appointment. Neal Hawkins or Tom Maze will actually conduct the telephone interview. During the interview, questions will be asked to lead the interviewer to a better understanding of the agency's practices. Although we would like to interview all 50 states, our past experience with surveys of STAs has shown that we can very quickly isolate states that have the best practices. Once the few states with leading practices have been identified, contacting additional states does not generally uncover additional useful information. Therefore, depending on how much time is required to run-down STA staff to complete interviews, we may interview some number of STAs less than the entire population.
4. **Task VI. Conduct Case Studies.** In consultation with the steering committee, we will identify the STAs where we should conduct detailed case studies. We have included in our budget funding visits to three states to document their practices.

5. **Task V. Draft Final Report.** Two weeks in advance of the end of the project, we will schedule a videoconference call with the project steering committee. The purpose of this meeting will be to review the finding of the project and discuss the format and content of the final report. Based on the discussion at this meeting, the researchers will prepare a final report.

Project Schedule																
Task I																
Task II																
Task III																
Task IV																
Task V																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Weeks following the beginning of the contract																

Budget

The budget assumes that the project contract with CTRE will be managed through the Iowa DOT and applies the negotiated overhead rate between the Iowa DOT and CTRE. If the contract is not managed through the Iowa DOT, then the overhead rate will be increased to 46 percent.

Synthesis of Procedures to Forecast and monitor Work Zone Mobility and Safety Impacts						
Budget Estimates						
January 1 - April 30, 2004						
Staff Detail						
Faculty				Level of effort	# of mos	Total Project Amount
	Tom Maze			5.00%	4	$3,000
	Fringe benefits @24.7%					$741
Professional & Scientific Staff						
	Neal Hawkins			25.00%	4	$7,167
	Fringe benefits @29.5%					$2,114
Merit (Support) Staff						
	Secretary/Acct Clerk @			10.00%	4	$1,196
	Fringe benefits @38.9%					$465
Student Research Assistants		#				
	R.A. Student (MS candidate)	1	@	50.00%	4	$5,600
Total Personnel						$20,832
Budget Summary by Category						
Salaries/Hourly						$16,962
Payroll Benefits						$3,869
Equipment >$5,000						$0
Travel-Domestic		Case study visits				$2,000
	Air Fare To Case Study STAs		3 trips	$1,500		
	Lodging		3 Nights	$300		
	Ground Transportation			$200		
Supplies/Materials						$200
	Project supplies			$200		
Other Direct Costs						$500
Telecommunication Charges (basic, toll, data)				$200		
Printing/Copying				$200		
Postage				$100		
TOTAL DIRECT COSTS						$23,532
Indirect Costs		@	46.0%			$10,825
TOTAL ALL COSTS						$34,357

1.ISU employees are salaried. Hourly rate is estimated by dividing annual salary by 2080. Fringe rates are estimated as follows: Faculty - 24.7%; P&S - 29.5%; Merit - 38.9%; Research Asnts - 9.8%. Actual fringe will be charged.

2.Estimate is based on the FY2003 base rate. Annual increases and/or midyear promotions or rate changes may affect the level of effort available.

3.This project is administered by CTRE (Center for Transportation Research and Education), an ISU non-academic research center that has no ISU department funding for administering this research. Charges must be made to the project to cover basic staff support services, phone calls, copies, etc for the project. Internal accounting systems ensure that such charges are made directly to the appropriate project.

The Use of Raised Pavement Markings in Work Zone Applications – A Synthesis of Practice

Project Cost: $23,666
Completion Time: 6 months

Proposal submitted to:
Midwest Smart Workzone Deployment Initiative (MwSWZDI)

Aemal Khattak
Assistant Professor

Kathy Glenn
Assistant Director

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INTRODUCTION

Delineation of proper driving path is a major concern in work zones and it is enhanced at nighttime and/or in times of inclement weather when visibility is reduced and pavement markings are covered with water, snow, or ice. Long-term work zones with overnight lane closures are becoming common in most states with adverse impacts on the driving public. Also, a major concern is providing adequate guidance to older drivers, who invariably suffer from vision-related defects. Raised pavement markings offer increased visibility during nighttime and inclement weather and some states (mostly in the South) have been using them in work zones for improved roadway delineation and for positive guidance of drivers.

PROBLEM STATEMENT

The benefits of positive guidance to drivers are well documented. In the recent past, manufacturers have developed raised pavement markings with new retroreflective materials improving nighttime visibility. The use of these raised pavement markings appears to vary among state transportation agencies, especially in work zones. A review and synthesis of practice for the application of raised pavement markings in work zones is needed to provide guidance on uniform provision of nighttime and inclement weather guidance to drivers in work zones using raised pavement markings.

RESEARCH OBJECTIVE

The objective of this proposed research is to document different state transportation agencies' practices with respect to the use of raised pavement markings in work zones. Subsequently, a summary listing of the different practices will be compiled for consideration by other states.

PROJECT TASKS

1. Literature review

A review of the published literature from various sources (Transportation Research Information System, TRANSPORT database, Internet, etc.) will be made to identify research efforts and their results in use of raised pavement markings in work zones. Findings from the review will be synthesized and included in the final report.

2. E-mail and Telephone Survey

An email survey will be designed that will be sent to state transportation agencies nationwide. This survey will solicit information on respondent's policies and practices in the use of raised pavement markings in work zones. Follow up telephone calls will be made to: 1) improve response to the survey, and 2) gain more information into promising practices. Not all state transportation agencies will necessarily be called. However, particular attention will be paid to state transportation agencies in the south and the Midwest.

3. Summary of Practice

The results from the survey will be compiled, discussed with respect to adaptability by other state transportation agencies, and presented in a tabular format.

4. Final Report with Recommendation

A final report documenting the research effort and its results will be provided as part of this project. The final report will include the research team's recommendations on the use of raised pavement markings in work zones for driver guidance. The report will also document future research needs, if any.

STUDY PERIOD

The study will require 6 months to complete. Table 1 presents the time needed for each task.

Table 1. Study schedule

Task	Time in Months					
	1	2	3	4	5	6
1. Literature review						
2. E-mail & telephone survey						
3. Summary of practice						
4. Final report with recommendations						

BUDGET

The study will require $17,862 to complete. Details of the budget are presented in Table 2. Dr. Aemal Khattak will the PI while Kathy Glenn will be Co-PI on this project. Lynn DeShon will provide administrative assistance for this project and a gradate student will be employed for one semester.

Table 2. Itemized budget

Item	Hours	Rate	Amount $
Personnel			
Aemal Khattak	90	41	3,690.00
Kathy Glenn	90	23	2,070.00
Lynn Deshon	70	15	1,050.00
Fringe		26%	1,770.60
Gr. Res. Assistants	360	16	5,760.00
Tuition remission @ 23 %		23%	1,324.80
Student Health Insurance (1 sems)		300	300.00
Personnel Subtotal :			***15,965.40***
Operating Expenses			
Printing & supplies (lumpsum)			300.00
Operating Expenses Subtotal :			***300.00***
Overhead			
UN-L F & A Costs (10% of salaries & benefits)	45.5%		7,401
Overhead Subtotal :			7,401
Project Total :			23,666.40

PROJECT IMPLEMENTATION

The results from this project will be made available to transportation agencies nationwide via the Mid-America Transportation Center website (www. matc.unl.edu). The results will be publicized via local, regional, and national forums such as the local chapter of the Institute of Transportation Engineers, the Transportation Research Board, the American Society of Civil Engineers, and the American Association of State Highway and Transportation Officials (AASHTO).

Midwest Smart Work Zone Deployment Initiative

2004 Program Year

Research Proposal

DESIGN OF PORTABLE RUMBLE STRIPS

July 2003

Submitted by:

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Rick Hale, PhD
Dept of Aerospace Engineering
The University of Kansas

Ray Taghavi, PhD
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The University of Kansas

Introduction

Based on discussions among the members of the Technical Advisory Committee (TAC), the Midwest Smart Work Zone Deployment Initiative (MwSWZDI) has issued a solicitation for products to be evaluated as portable rumble strips, as per the problem statement below (Figure 1, excerpted from the solicitation letter). While the intent of the solicitation is to identify commercial products and evaluate them empirically for their effectiveness, no such products were identified during committee discussions. The rumble mat developed through the SHRP program is well known, and well known to be applicable to low speed applications only, due to its tendency to lift off the pavement in the wake of large trucks traveling at highway speeds (or even somewhat less than highway speeds).

PROBLEM STATEMENT:

The Midwest Smart Work Zone Deployment Initiative seeks proposals for products to be evaluated as portable rumble strips for use in work zones with durations of less than a day. These products must be reusable, and it is anticipated that they will install without adhesives. Products to be evaluated will be selected on the following criteria.

1. Ease of installation and removal
2. Ability to remain in place under traffic, including heavy trucks at highway speeds
3. Ability to generate perceptible noise and vibration (though not egregiously severe so as to alarm drivers)

Figure 1. Problem Statement.

As a complement to any empirical evaluations that might be selected, a scientific approach to the design of a device to fill this need can identify and quantify critical issues related to its effectiveness.

Approach

The approach proposed for this study comprises four components. First, an aerodynamic study would be conducted to determine the air pressure (i.e., lifting force) distribution in the truck wake. Second, a finite element model (FEM) will be developed to examine the dynamics of the strips themselves, particularly the reaction of the ends of the strips under the combined loading of the vehicle tires and truck wake. Third, based on the results of the FEM analyses, a device will be designed and prototypes created. Fourth, the prototypes will be field tested to confirm that they will not lift from the pavement under design conditions.

Aerodynamic Study

The aerodynamic study is the core of this work. Understanding the pressures occurring in the wake of a truck is essential to identifying a combination of shape and material that will safely and effectively produce sound and vibration to alert drivers of the upcoming work zone. Aerodynamic modeling of tractor-trailers has been done. For example, Figure 2 shows a visualization of a truck wake based on data generated by a computer model developed at Old Dominion University. (Bayraktar, 2001)

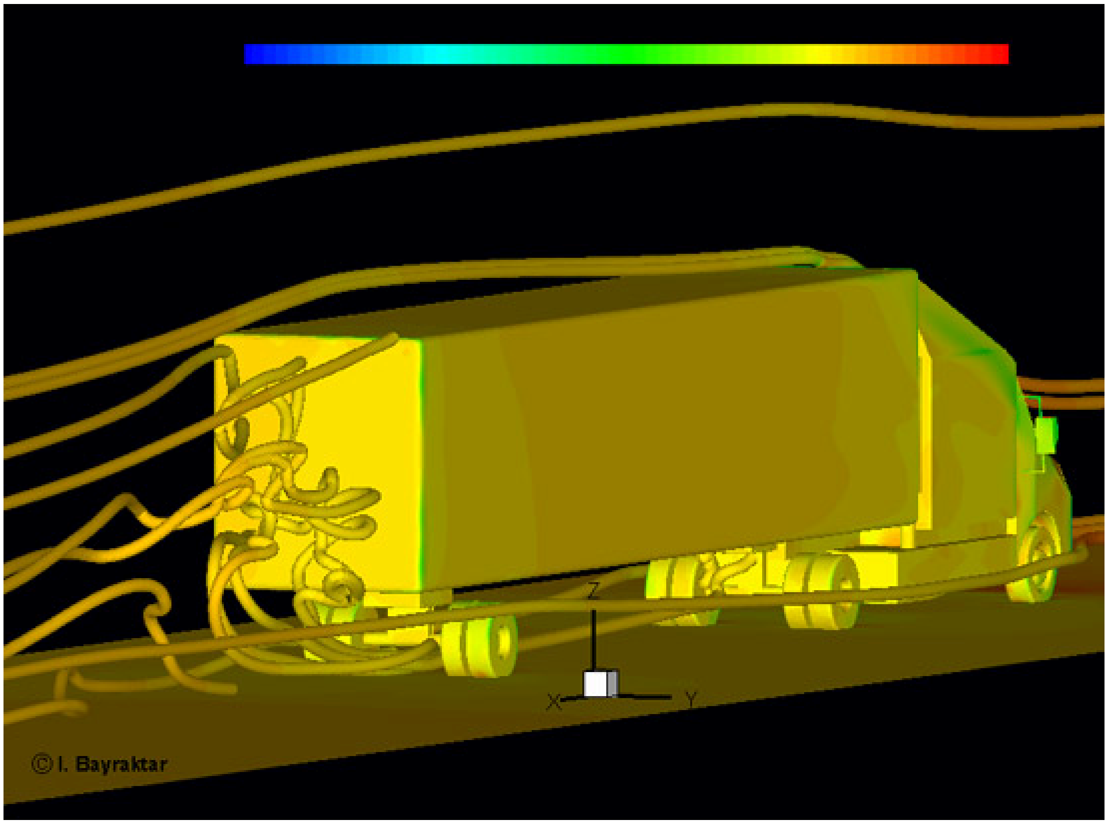

Figure 2. Visualization of Modeled Truck Wake. (Bayraktar, 2001)

If the data from this particular study can be obtained, the aerodynamic study performed as part of this study will be redesigned to complement that data, rather than repeat it. An aerodynamic analysis will be conducted using the wind tunnel at The University of Kansas maintained by the Department of Aerospace Engineering, shown in Figure 3.

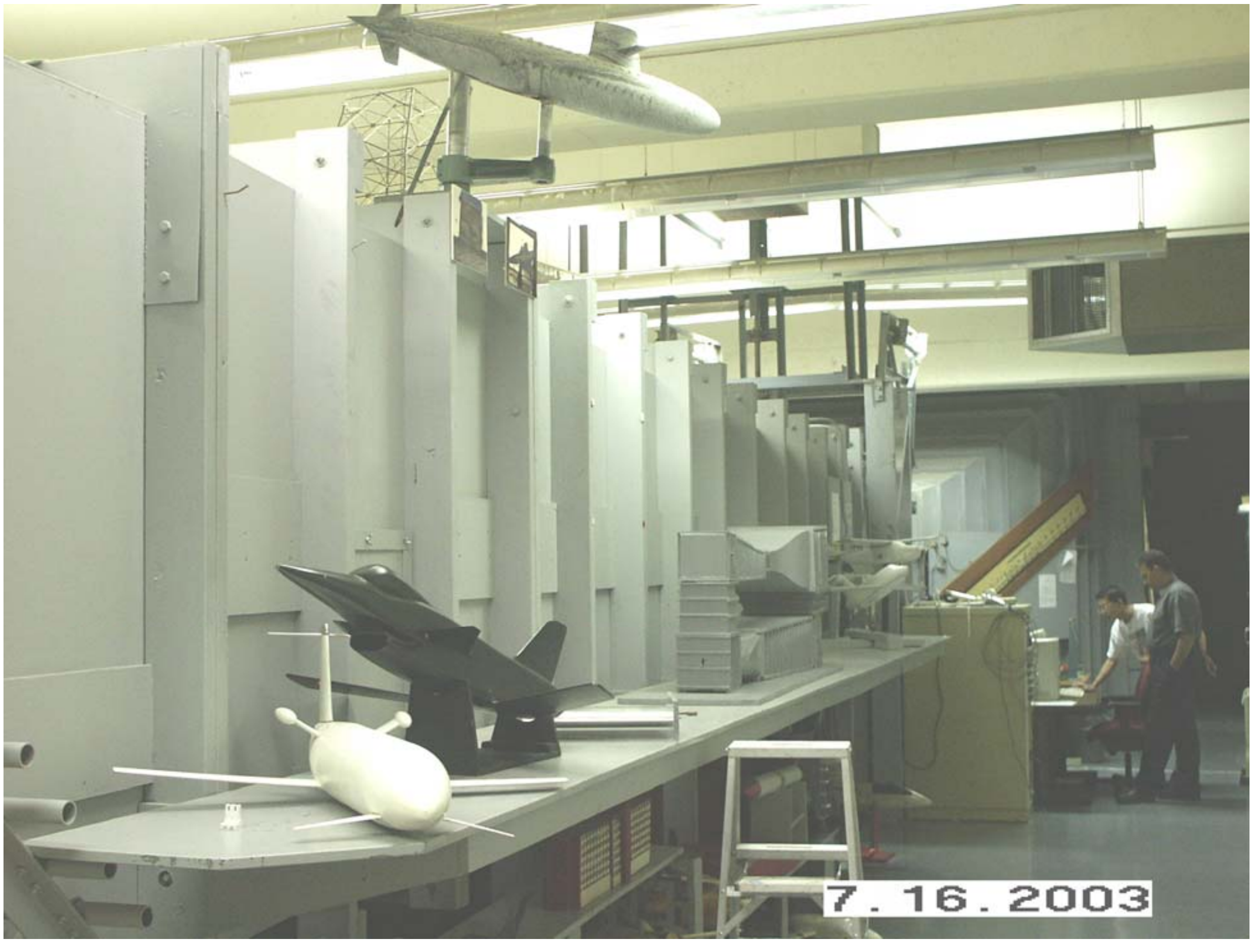

Figure 3. KU Aerospace Engineering's Wind Tunnel.

Figure 4 shows a model of a truck (either single unit or tractor-trailer) for use in generating related aerodynamic data. A second (larger) model is also available. Once the pressure sensors and model are positioned, pressure distributions on the pavement in the truck's wake can be measured for various wind speeds. The distributions will help identify the critical force magnitudes acting to lift the rumble strips off the pavement. The weight of the strips needed to counteract these pressures can be calculated.

An additional concern is the potential for the strips to flex under the load of the truck, lifting the ends slightly off the pavement. The characteristic vortices behind the truck may act on the bottom of the lifted ends of the strip to increase the upward forces. Other wind tunnel tests can help examine the significance of these forces and suggest potential design characteristics that might obviate them.

Figure 4. Model of Tractor-Trailer for Aerodynamic Data Collection.

FEM Analysis

A finite element model analysis would be used to examine the behavior of the strips under the loads imposed by the truck tires and the aerodynamic pressures induced by the truck wake vortices. Specifically, various designs and materials will be investigated to determine if the loading is likely to cause the strip to bow, lifting the ends off the pavement and exposing a surface on which the aerodynamic forces can act.

Design and Prototyping

Based on the results of the wind tunnel tests and the FEM analyses, one or more designs will be developed and 1:1 scale prototypes will be generated. The technique used for prototyping will depend on the characteristics of the design and the material used.

Field Test

Once the prototype(s) is created, a field test will be conducted to verify that the product will not lift off the pavement in the field. A site will be identified in cooperation with KDOT, and the prototypes set out and observed as a tractor-trailer runs over them at highway speeds.

Draft Design

A side view and a top view of a draft design are shown in Figure 5 and Figure 6, respectively. This will serve only as a starting point for applying the results of the various analyses.

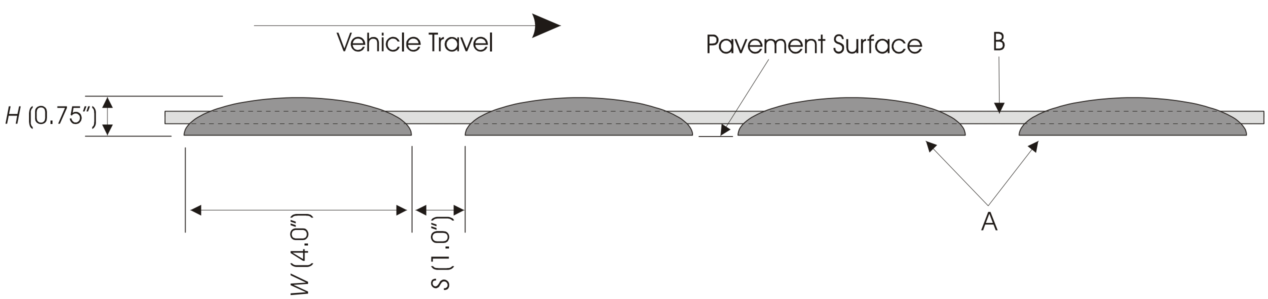

Figure 5. Side View

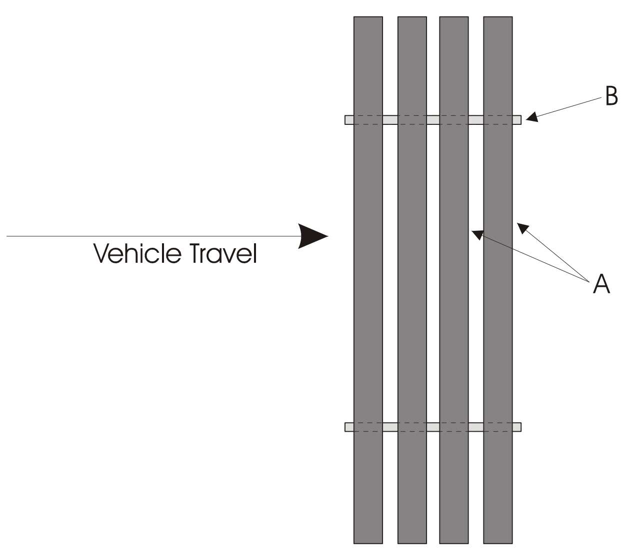

Figure 6. Top View

Dimensions:

- Height: 0.25” < H < 0.75”
- Width: 1.0” < W < 4.0 “
- Spacing: 1.0” < S < 20.0”

Part A (strips) comprises strips with a semi-ellipse cross section. Each strip must be either 4-ft long (one unit for each wheel path, or 10-ft long (one unit for both wheel paths). Strips may be made of rubber.

Part B (joiners) comprises a joining rod or cable, approximately ¼” in diameter.

Heavier material increases stability (i.e., reduces tendency to lift from pavement). Total weight, however, cannot become excessive. Assume each unit must be deployable by two workers. Thus a maximum total weight of 100 to 120 lbs would be appropriate.

The range given for height is taken from previous work pertaining to removable rumble strips. (Meyer, 2003) The maximum spacing is taken from the same study, while the minimum is an anticipated minimum based on the ability to roll the unit up for storage, assuming flexible joiners. The width range given is arbitrary, merely a starting point. Other considerations for the dimensions are the ability to transport the units in a typical pickup truck.

Work Plan

The project tasks comprise the following:

Task 1. A literature review will be conducted to identify related work and applicable data.

Task 2. A suite of aerodynamic tests will be conducted to generate pressure profiles of the truck wake under various conditions (e.g., speeds).

Task 3. Based on the results of Task 2, a draft design (including material) will be developed. A finite element model of the design will be developed and analyzed under typical loadings.

Task 4. Appropriate revisions to the design will be made and further FEM analysis conducted, as appropriate.

Task 5. If necessary, a scale model of the designed strips will be used in the wind tunnel to examine the interaction of the truck wake and the strips under deformation from a typical loading.

Task 6. One or more designs will be selected for prototyping. Prototypes will be generated by methods appropriate for the design and material.

Task 7. Prototypes will be field tested to verify the results of the laboratory analyses under field conditions. Site selection and appropriate traffic control will be performed in cooperation with the Kansas Department of Transportation.

Task 8. A final report will be generated detailing the analysis and design processes employed, their results, the recommended design, and its performance in field testing.

Personnel

The research will be jointly conducted by Dr. Eric Meyer, Meyer ITS, Dr. Rick Hale, KU Dept of Aerospace Engineering, and Dr. Ray Taghavi, KU Dept of Aerospace Engineering. Student research assistants will be identified to participate as needed.

Schedule

The project will span 12 months, beginning January 1, 2004. Estimated time by task is shown in Table 1.

Table 1. Anticipated Project Schedule.

Task	**Time**
1	1 mo.
2	2 mo.
3	1 mo.
4	1 mo.
5	1 mo.
6	2 mo.
7	2 mo.
8	2 mo.
Total	12 mo.

Budget

The total budget for this study is $30,000. Details are given in Table 2.

Table 2. Project Budget, KU.

Item	KU	MeyerITS	Total
Personnel			
Salaries & Wages	$ 10,992	$ 14,830	$ 25,822
Fringe Benefits	$ 1,799	$ -	$ 1,799
Total	**$ 12,791**	**$ 14,830**	**$ 27,621**
Other Direct Costs		$ -	$ -
Materials & Supplies	$ 20	$ 1,000	$ 1,020
Printing & Copying	$ -	$ -	$ -
Postage	$ -	$ -	$ -
Telephone & FAX	$ -	$ -	$ -
Research Equipment	$ -	$ -	$ -
Travel	$ -	$ 700	$ 700
Tech Acquisition	$ -	$ -	$ -
Tech Installation	$ -	$ -	$ -
Tech Maintenance	$ -	$ -	$ -
Total	**$ 20**	**$ 1,700**	**$ 1,720**
Total Direct Costs	$ 12,811	$ 16,530	$ 29,341
Indirect Costs	$ 5,829	$ -	$ 5,829
Total	**$ 18,640**	**$ 16,530**	**$ 35,170**

References

Bayraktar, I., (2001) “Simulation of External Truck Aerodynamics Pressure Contours and Velocity Streamlines,” http://www.amtec.com/Product_pages/bayraktar.html, pub. AMTEC.

Meyer, E., (2003) *Guidelines For The Application Of Removable Rumble Strips*, KDOT Project RE-0286-01 Final Report, Kansas Department of Transportation, Topeka, Kansas.

Midwest Smart Work Zone Deployment Initiative

2004 Program Year

Research Proposal

EVALUATION OF PORTABLE RUMBLE STRIPS

August 2003

Submitted by:

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Introduction

The Midwest Smart Work Zone Deployment Initiative (MwSWZDI) Problem Statement 1 for Project Year 2004 calls for evaluations of portable rumble strips. The following three products were recommended.

1. ATM
2. AstroOptics
3. RTI

Based on past experience, the thickness of the AstroOptics product (2 in) is too high to be safely used in high-speed applications. No evaluation of this product is recommended.

The products submitted by ATM and RTI both have merit for application as temporary rumble strips. This study proposes to evaluate both products independently for suitability to task. Since similar products have been evaluated previous studies (ATM Orange Rumble Strips—1999, ATM Orange Rumble Strips—2002, Davidson Plastics Rumble Strips—2002), measures of effectiveness can be limited to those which have not been previously examined or those which pertain to aspects of the strips that vary from previous tests.

Approach

The rumble mat developed through the SHRP program is well known, and well known to be applicable only to low-speed scenarios, due to its tendency to lift off the pavement in the wake of large trucks traveling at highway speeds (or even somewhat less than highway speeds). The two products proposed have diverse characteristics and require tailored approaches.

ATM Product

Previous evaluations of ATM products have shown that 250 mil is sufficient to produce sound and vibration perceptible to the driver, and that the adhesive used is reliably durable. The use of multiple layers of adhesive to facilitate reuse of the strips has not been previously considered. Three aspects of installation need to be examined. First, will the reuse as prescribe adversely affect the adhesion of the strips to the pavement. Second, how does temperature affect the installation process (i.e., do the adhesive pads become difficult to work with when warmed to 90° or more, as is the case with butyl-based adhesives). Third, what is the typical effort required for installation, removal, and re-installation. These factors will be studied using field tests performed at appropriate test facilities and will not require deployment at an active work site.

RTI Product

The cross-sectional profile of the RTI product is sufficiently similar to that of the Davidson-Plastics rumble strip evaluated in 2002 (under KDOT funding) that the effect on vehicles will be similar. Both are ¾ in high and differences in cross-sectional profile alone were shown to have little, if any, effect on the sound and vibration produced for strips of this height and approximate width. Thus the primary measure of effectiveness of these strips will be their potential to remain in place under traffic.

A high-speed video camera will be used to examine the motion of the strips—if any—when traversed by a large truck. The video will reveal any tendency for the strips to lift from the pavement or to slide across the pavement (i.e., creep). The camera will also be used to study the relative motion of the wheel and body of a passenger car while traversing the strips at various speeds. This video will provide information about vehicle response to the strips and the effects of speeds on rumble strip effectiveness.

Work Plan

The project tasks comprise the following:

Task 1. A literature review will be conducted to identify related work and applicable data.

Task 2. The ATM product will be deployed for one day at each of 10 locations. Installation and removal times, strip condition, and ease of installation will be observed and recorded. Strips adhesive pads will be stored under a variety of conditions ranging from 70° and covered to 90° and direct sunlight. Effects of storage environment on ease of installation will be noted.

Task 3. The RTI product will be field tested to record its performance under load. The strips will be traversed by a truck at various speeds and high-speed video recorded. The video will be examined to determine the movement of the strips (if any) vertically or horizontally.[1]

Task 4. A final report will be generated detailing the processes employed, their results, and recommendations regarding the applicability of the two products to highway work zones.

Personnel

The research will be conducted by Dr. Eric Meyer, Meyer ITS.

Schedule

The project will span 12 months, beginning January 1, 2004.

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[1] If proposal *PY04_PS 1_Prop 4--Portable RS Design* is also funded, wind tunnel and finite element analysis results will be applied to the RTI product, and field test results of the RTI product will be compared with the results of the laboratory analyses.

Budget

The total budget for this study is $24,939. Details are given in Table 1.

Table 1. Project Budget.

Item	Amt
Personnel	
Salaries & Wages	$ 20,320
Fringe Benefits	$ -
Total	**$ 20,320**
Other Direct Costs	
Materials & Supplies	$ 3,600
Printing & Copying	$ 25
Postage	$ 100
Telephone & FAX	$ 50
Research Equipment	$ -
Travel	$ 847
Tech Acquisition	$ -
Tech Installation	$ -
Tech Maintenance	$ -
Total	**$ 4,622**
Total Direct Costs	$ 24,942
Indirect Costs	$ -
Total	**$ 24,942**

Work Zone Incident Management Practices: Synthesis Study

Submitted by University of Wisconsin Milwaukee

Description of the Technology and Background

As the number of highway construction and maintenance work zones increases at the same time traffic volumes are increasing, it becomes more challenging to maintain traffic safely and efficiently past work sites. When incidents such as traffic crashes or disabled vehicles block lanes or shoulders near work zones where capacity is already reduced, severe traffic congestion can occur in a very short period of time. Effective incident management practices greatly reduce the severity and effects of congestion, and highway agencies are placing greater emphasis on planning for incidents near work zones.

Objectives of the Evaluation

The objective of the study is to assemble best practices of highway agencies in managing incidents near highway work zones. Frequency and benefits of such practices will be assessed.

Techniques and devices to be surveyed include:

- Pre-planning for incident response
- Means of incident detection and reporting
- Road/lane closure procedures
- Ramp closures or ramp gates
- Alternate routing and signing
- Traveler information
- Use of dynamic message signs
- Highway advisory radio
- Video surveillance
- Communications and notification
- Coordination of road maintenance and emergency response agencies
- Coordination with traffic management centers
- Access for emergency responders
- Provision of highway helpers/towing agencies during construction projects
- Crash investigation sites

Results of the study will assist highway agencies in developing criteria and guidelines for incident planning at work zones.

Evaluation Methodology

The study will include a literature review and survey of states and other selected large transportation agencies nationwide. It is anticipated that very little useful information will be found in the academic or professional literature. Therefore, the emphasis will be on direct agency contacts. A list of agency contacts and a questionnaire will be developed. The questionnaire will try for a comprehensive coverage of work zone incident management, but it will be particularly focused on unusual or innovative practices, evaluations of their successes, sources of additional information about those practices, and the names of key individuals with knowledge of those practices. The questionnaire will be distributed and results analyzed to provide a summary of best practices. In addition, in-depth interviews will be conducted with key personnel, identified through the questionnaire or by other means, at state and local transportation departments with considerable experience in handling incidents in work zones.

Key individuals to be contacted will include DOT representatives, but will also include other stakeholders such as law enforcement officers and vendors.

Synthesis studies, like this one, work best if they are guided by a small advisory committee. The role of the advisory committee is to further define the objectives of the project, to provide an initial list of agency contacts, and to help formulate conclusions and recommendations. If the project is funded at UWM, it is anticipated that the chair of the advisory committee will be the SWZDI representative from WisDOT.

Beyond the questionnaire and interviews, the list of information sources should include:

- Abstracts from TRIS
- Full text of documents located by TRIS, when deemed appropriate
- National Transportation Library documents
- Abstracts from Engineering Village 2
- Major university transportation libraries (e.g., Northwestern, UC-Berkeley)
- Information from MwSMDI participating state DOTs
- Information from other state or local DOTs
- Information from FHWA and other USDOT entities
- Documents posted on the Internet
- Review of trade publications.

The methods of analysis will include:

- Determining the relevant literature and information
- Organizing relevant literature and information by topic
- Summarizing the literature and information
- Determining best practice
- Recommending future directions of research and evaluation.

Interviews and other direct contacts with knowledgeable individual may result in referrals to other key individuals. These referrals will be added to the list of contacts.

Evaluation Tasks

The following seven tasks needs to be performed to accomplish the objectives of the study.

Task	Responsibility
1. Assemble an advisory committee of experts associated with the MwSWZDI to guide the study and to participate in making recommendations. Meet with advisory committee.	UWM/WisDOT
2. Develop and pretest questionnaire. Develop questionnaire contact list.	UWM
3. Administer questionnaire.	
4. Make follow-up contacts, conduct interviews and compile literature and experiences with incident management in work zones.	UWM
5. Review, organize and critique information obtained in Tasks 3 and 4.	UWM
6. Make recommendations with the assistance of the advisory committee	UWM/WisDOT
7. Prepare final report.	UWM

Evaluation Schedule

The anticipated milestones for the six tasks are shown below. The milestones assume a project start date of October 1, 2003 and a 10 month project duration.

Task	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1. Advisory Committee	■	■								
2. Develop Questionnaire		■	■							
3. Administer Questionnaire				■	■					
4. Follow-up Contacts, Literature			■	■	■	■				
5. Review, Organize						■	■	■		
6. Recommendations								■	■	
6. Final Report								■	■	■

Itemized Budget

The following budget is based on costs at the University of Wisconsin—Milwaukee. The project involves 120 hours each of faculty, graduate project assistant and student hourly help for a total of 360 person-hours.

The budget assumes that this project is conducted independently of the "Portable ATIS" project. If the two projects were to run in parallel at UWM, some cost savings of about $1800 could be attained by combining the advisory committees and by eliminating duplicative contacts to DOTs.

Project Budget

Item	**Budget**
Faculty Salaries (Horowitz)	$7,428
Student PA Salaries	$2,400
Student Hourly Salaries	$1,440
Faculty Fringe	$2,451
Student PA Fringe	$480
Student Hourly Fringe	36
Subtotal	*14,235*
Other Direct Costs	
Materials and Supplies	$400
Printing and Copying	$100
Travel	$100
Subtotal	*$600*
Total Direct Cost	$14,835
Indirect Cost	$6,973
Total Cost	$21,808