Project No./Center No.: E-20-606 (R6273-0A0)

Project Director: John Moskaluk

Sponsor: Georgia Department of Transportation

Agreement No.: Task Order No. 8 under BOA #90

Award Period: From 1/1/87 to 12/31/87 (Performance) 12/31/87

Sponsor Amount:
- Contract Value: $125,000
- Funded: $125,000

Cost Sharing No./Center No.: E-20-332 (F6273-0A0)

Cost Sharing: $24,276

Title: Technology Transfer Program for Local Transportation Agencies (5th Year Program)

ADMINISTRATIVE DATA

1) Sponsor Technical Contact:
Sam Vollo
Georgia Department of Transportation
Office of Materials & Research
15 Kennedy Drive
Forest Park, GA 30050-2599
363-7583

Military Security Classification: N/A
(or) Company/Industrial Proprietary: N/A

2) Sponsor Issuing Office:
Tom Stapler, P. E.
Georgia Department of Transportation
Office of Materials & Research
15 Kennedy Drive
Forest Park, GA 30050-2599
363-7567

ONR Resident Rep. is ACO: Yes
Defense Priority Rating: N/A

RESTRICTIONS

See Attached N/A Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval — Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of $500 or 125% of approved proposal budget category.

Equipment: Title vests with Sponsor. However, none proposed or anticipated.

COMMITS:
Follow-on to project E-20-647.

OPIES TO:

SPONSOR'S I.D. NO. 02.300.000.87.002
Sponsored Project Termination/Closeout Sheet

Date: 7-29-88

Project No.: E-20-606 (R6273-0A0)
School: CE

Includes Subproject No.(s): N/A

Project Director(s): M. J. Moskaluk
GTRC/XXX

Sponsor: Georgia Department of Transportation

Title: Technology Transfer Program for Local Transportation Agencies (5th Yr. Program)

Effective Completion Date: 4-30-88 (Performance) 4-30-88 (Reports)

Grant/Contract Closeout Actions Remaining:

- [X] Final Invoice or Copy of Last Invoice Serving as Final
- [X] Release and Assignment
- [X] Final Report of Inventions and/or Subcontract:
  Patent and Subcontract Questionnaire sent to Project Director
- [X] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other

Continues Project No.: E-20-647
Continued by Project No.: E-20-831

COPIES TO:

- Project Director
- Research Administrative Network
- Research Property Management
- Accounting
- Procurement/GTRC Support
- Research Security
- Reports Coordinator (OCA)
- Program Administration Division
- Contract Support Division (2)
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<td>-HPR(1)</td>
<td>TECHNOLOGY TRANSFER PROGRAM FOR LOCAL TRANSPORTATION AGENCIES</td>
<td>16</td>
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<th>Project Director(s)</th>
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<tr>
<td>Georgia Institute of Technology, Atlanta, Georgia 30332</td>
<td>M. John Moskaluk</td>
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<th>% Time Expended</th>
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</tr>
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<td></td>
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<td>50% STATE MATCH</td>
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<td>Authorized $29,604 (24%)</td>
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<table>
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<th>Project Objectives, Status, Progress</th>
<th>Report Date 6/26/87</th>
</tr>
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<tbody>
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Project Objectives, Status, Progress attached.
PROJECT GOAL: To communicate to local transportation agencies the availability and application of new technology that bridges the gap between research and implementation in the area of roadways, bridges, and transit.

OBJECTIVES:

- To enhance the existing programs of technology services of GDOT and Georgia Tech.
- To improve and further promote communication on technical transportation issues between GDOT/Georgia Tech and the local agencies.
- To help insure that appropriate technology consistent with the needs of the local agencies in mind is made available.
- To encourage implementation of effective procedures, practices, and materials at local levels.

STATUS: The three major tasks of the project are: conduct training seminars, publish a quarterly newsletter, and respond to requests for information and assistance. Two training workshops were held during the quarter with a combined participation of 51. NACE manuals were distributed to each of the 34 participants in the NACE workshop, and the DOT distributed seven different publications to each of the 17 participants in the Surface Treatment presentation. The spring edition of Tech Trans was published, and 1800 copies of it were distributed. In addition to responding to requests for publications and technical assistance, the Center has loaned 23 video tapes from its library.

PROBLEMS: None

John Moskaluk, Director
Georgia Tech
Technology Transfer Center
PROJECT GOAL: To communicate to local transportation agencies the availability and application of new technology that bridges the gap between research and implementation in the area of roadways, bridges, and transit.

OBJECTIVES:

- To enhance the existing programs of technology services of GDOT and Georgia Tech.
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STATUS: The three major tasks of the project are: conduct training seminars, publish a quarterly newsletter, and respond to requests for information and assistance.
Two training workshops were held during the quarter with a combined participation of 51. NACE manuals were distributed to each of the 34 participants in the NACE workshop, and the DOT distributed seven different publications to each of the 17 participants in the Surface Treatment presentation. The spring edition of Tech Trans was published, and 1800 copies of it were distributed. In addition to responding to requests for publications and technical assistance, the Center has loaned 23 video tapes from its library.

PROBLEMS: None

M. John Moskaluk, Director
Georgia Tech
Technology Transfer Center
RESEARCH PROJECT PROGRESS REPORT
DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

Project No.
RTA-HPR(1)

Project Title
TECHNOLOGY TRANSFER PROGRAM FOR LOCAL TRANSPORTATION AGENCIES

Report No. 18
Report Period
from 1 JULY 1987 to 30 SEPTEMBER 1987

Research Agency(s)
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GA 30332

Project Director(s)
M. JOHN MOSKALUK

Starting Date
1 JANUARY 1987
Completion Date
31 DECEMBER 1987

% Time Expended
75%

Schedule Status
☐ On 
☐ Ahead 
☐ Behind 

Funding Sources(s)
50% FHWA 
50% STATE MATCH

Funds Authorized 
Total 
$125,000

Funds Expended 
Total, % 
$71,372, 68%

Report Period 
$30,306

Fiscal Year Funding 
Authorized 
$30,306

Expended, % 
24%

Project Objectives, Status, Progress
Report Date NOVEMBER 24, 1987

PROJECT GOAL: To communicate to local transportation agencies the availability and application of new technology that bridges the gap between research and implementation in the area of roadways, bridges, and transit.

OBJECTIVES:

- To enhance the existing programs of technology services of GDOT and Georgia Tech.
- To improve and further promote communication on technical transportation issues between GDOT/Georgia Tech and the local agencies.
- To help insure that appropriate technology consistent with the needs of the local agencies in mind is made available.
- To encourage implementation of effective procedures, practices, and materials at local levels.

STATUS: The three major tasks of the project are: conduct training seminars, publish a quarterly newsletter, and respond to requests for information and assistance.
A workshop entitled "Roadway Applications of Geotextiles" was held in three locations during August with a combined participation of 51. The summer edition of Tech Trans was published, and 1800 copies of it were distributed. Also 1500, brochures were distributed for the upcoming workshop on microcomputers. In addition to responding to requests for publications and technical assistance, the Center has loaned 68 video tapes from its library.

The Technology Transfer Center was represented at the American Public Works Association Annual Convention in Rome, Georgia on July 17, 1987, as well as the Technology Transfer Directors’ Meeting in Breckinridge, Colorado on July 20-22, 1987.

PROBLEMS: None

M. John Moskaluk, Director
Georgia Tech
Technology Transfer Center
RESEARCH PROJECT PROGRESS REPORT
DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

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<td>TECHNOLOGY TRANSFER PROGRAM FOR LOCAL TRANSPORTATION AGENCIES</td>
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Research Agency(s)
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GA 30332

Project Director(s)
M. JOHN MOSKALUK

Starting Date
1 JANUARY 1987

Completion Date
31 DECEMBER 1987** TIME EXTENDED**

% Time Expended
100%

Schedule Status
☑ On
☑ Ahead
 ☐ Behind

Funding Sources(s)
50% FHWA
50% STATE MATCH

Funds Authorized
Total
$125,000

Funds Expended
Total, %
$91,524, 77%
Report Period
$20,152

Fiscal Year Funding
Authorized
$50,458, 40%

Project Objectives, Status, Progress

**Project extended to April 30, 1988

REPORT DATE 2/26/88

PROJECT GOAL:

To communicate to local transportation agencies the availability and application of new technology that bridges the gap between research and implementation in the area of roadways, bridges, and transit.

OBJECTIVES:

- To enhance the existing programs of technology services of GDOT and Georgia Tech.
- To improve and further promote communication on technical transportation issues between GDOT, Georgia Tech, and the local agencies.
- To help insure that appropriate technology consistent with the needs of the local agencies is made available.
- To encourage implementation of effective procedures, practices, and materials at local levels.

STATUS:

The three major tasks of the project are: conduct training seminars, publish a quarterly newsletter, and respond to requests for information and assistance.
A workshop entitled "Traffic Engineering Applications of Microcomputers" was held in five locations (two presentations were given in Chamblee, Georgia) during October and November. The workshop offered hands-on training in microcomputer use and had a total participation of 80 persons. Also, "Roadway Liability in Georgia" was offered on October 28, 1987, with 111 persons participating. Approximately 1500 brochures were mailed out for each of these workshops.

The fall edition of TechTrans was published, and 1800 copies were distributed. In addition to responding to requests for publications and technical assistance, the Center has loaned 21 video tapes from its library during the quarter.

Seven presentations of each of three right-of-way workshops will be held in the spring, summer, and fall quarters of 1988. Planning for these presentations is underway.

M. John Moskaluk, Director
Technology Transfer Center
Georgia Tech
ABSTRACT

As the final report for the fifth year contract, this summary will document the activities of the Georgia Tech Technology Transfer Center during that year. Tallies and summaries will be provided concerning the workshops, newsletters, mailing list, and video tape library, as well as the distribution of technical publications and assistance. In addition, this report will evaluate these activities with a view to the progress of the Center.

In brief, the Center maintains a mailing list of over 1700 entries, a publication list of 230 entries, and a video tape library containing thirty-eight tapes. Documentation on each of these lists is contained in the appendix. Also, the Center has sponsored twenty-two workshop sessions, with a total attendance of 648 persons. As a result of instating a policy of charging a registration fee for workshops, the Center has received $10,730. Regarding the newsletter, the Center distributed approximately 2050 copies each quarter (Copies of each newsletter are found in the appendix). The evaluation of the Center’s fifth year activities are based primarily on the results of interviews conducted by Mr. Grover Bowman with officials throughout the state. Mr. Bowman was employed by the Center in December of 1987 to conduct these interviews in order to evaluate the services offered by the Center and the local agencies’ awareness of these services.

Evaluation indicates that the Center continues to increase its effectiveness in assisting local agencies with transportation needs. In addition, suggestions are made as to how the Center’s services could be even more applicable and specific for individual locales.
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<td>Newsletters</td>
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<tr>
<td>Technology Transfer Data Sheet</td>
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INTRODUCTION

The Georgia Tech Technology Transfer Center was established to bridge the gap between research and implementation in the area of roadways, bridges, and transit. The Center achieves this goal by encouraging awareness and implementation of effective procedures, practices, and materials at local levels. In doing so, the Center seeks to enhance communication with and programs provided by the Georgia Department of Transportation.

The GDOT has divided the 159 counties in the State into seven districts. Some of the district staff that the Center deals with includes the District Engineer, Maintenance Engineer, Construction Engineer, Traffic Engineer, and Training Officer. During the years, a strong working relationship has developed between the local agency staff and the GDOT. Most of the technical assistance received by the local agencies comes through GDOT, and it is this route of assistance that the Technology Transfer Center seeks to tap into and expand upon.

When the Center started its operation, it quickly realized the advantage of using the GDOT relationship with the local jurisdictions as a vehicle to get the program underway and to begin to establish credibility. The efforts of the Center are coordinated with those of the GDOT through the District Engineers, GDOT liaison (Mr. Sam Vollo), and with other GDOT Engineers. Further, work with the Federal Highway Administration is coordinated through the FHWA liaison (Mr. Andy Hughes) and other FHWA staff.

Center activities are monitored by two committees. These committees are the Technical Advisory Committee and the Policy Advisory Committee. The Technical Advisory Committee is composed of Mr. Andy Hughes (FHWA), Mr. Sam Vollo (GDOT), and Dr. John Moskaluk (Georgia Tech). The prime function of this committee is to oversee the daily activities of the Center and to provide guidance to the Center Director.

The Policy Advisory Committee is composed of Commissioner Hal Rives (GDOT), Mr. Peter Malphrus (GDOT), Mr. Louis Papet (FHWA), Mr. Erwin Kee (FHWA Advisory), Mr. Jerry Griffin (Association County Commissioners), Mr. James Burgess (Georgia Municipal Association), Dr. Edmund
Fitzgerald (Georgia Tech), and the Technical Advisory Committee. The function of this committee is to provide policy guidance to both the Technical Advisory Committee and to the Center Director. The committee deals with the broad issues concerning center strategy as well as specific issues such as workshop topics.

At the present time, the Center staff consists of John Moskaluk, Center Director, and his assistant, Marty Milliner, as well as a part-time student, Jeff Bump.
CENTER ACTIVITIES

Mailing List

The mailing list contains over 1700 entries and can be sorted by agency type, GDOT district, or employee type.

Included on the mailing list are Street Superintendents, City and County Engineers, City and County Maintenance Personnel, Law Enforcement Officials, County Commissioners, Area Planning and Development Commissions (APDC’s), State Legislators, City Mayors, County Road Advisors, Georgia DOT District Engineers and Training Officers, Federal Coordinators, Technology Transfer Centers, and others.

The mailing list is updated when changes in personnel are made available to the Center and also by request. Workshop participants are encouraged to have their name added to the mailing list, and many do so. A copy of the mailing list is included in the appendix.

Publication List

The software for the IBM-PC which was developed by the Center staff to maintain, revise, and print the mailing list has been improved to include the Center’s publication list. This list currently includes 230 publications and can be sorted by subject and author. A listing of the publications currently available from the Center is contained in the appendix.

Publications are distributed in two ways. During seminars and workshops, publications related to the subject area are provided for each participant. A total of 1598 publications were distributed in this manner. Also, publications are sent by request to local officials. As a result of such requests, 262 publications were mailed out.

Video Tape Library

The Center is currently in the process of building a video tape library. At the present time, the Center has thirty-eight VHS video tapes which may be borrowed for a two-week period (requests are usually limited to two tapes at a time). The tapes are loaned free of charge to
anyone who requests them. Updates on available tapes are made in the newsletter. Certain tapes are very popular, and a waiting list is maintained for the distribution of tapes which were unavailable at the time of the request. A current listing of the tapes available and their synopses is included in the appendix.

**Workshops**

Workshops are the most important of the Center’s activities, in terms of both the quality and the quantity of access to the local agencies. Therefore, before a workshop is implemented, discussions are held with local officials, GDOT, FHWA, and others to evaluate topics of potential benefit to local agencies. The Policy Advisory Committee uses this information as well as returned questionnaires from previous workshops to determine which workshops should be scheduled and the locations for their presentations.

Workshop instructors are chosen from GDOT, FHWA, local agencies, and consultants. Most frequently, instructors are GDOT personnel.

The criteria used in making each of the above decisions are shown below:

<table>
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<th>DECISION</th>
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</tr>
<tr>
<td></td>
<td>- Needs</td>
</tr>
<tr>
<td></td>
<td>- Maximum participation</td>
</tr>
<tr>
<td>Duration</td>
<td>- Maximum participation</td>
</tr>
<tr>
<td></td>
<td>- Efficient coverage</td>
</tr>
<tr>
<td>Schedule</td>
<td>- Maximum participation</td>
</tr>
<tr>
<td>Instructors</td>
<td>- Knowledge of subject</td>
</tr>
<tr>
<td></td>
<td>- Understanding of local agency needs</td>
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<tr>
<td></td>
<td>- Cost</td>
</tr>
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Fifteen workshop sessions were held during the last year with a total attendance of 363 persons. The following is a summary of workshop attendance:

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<tr>
<th>WORKSHOP TITLE</th>
<th>PARTICIPANTS</th>
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<tr>
<td>Atlanta</td>
<td>2/3</td>
</tr>
<tr>
<td>Macon</td>
<td>2/4</td>
</tr>
<tr>
<td></td>
<td>26</td>
</tr>
<tr>
<td></td>
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During 1987, the Technology Transfer Center instated the policy of charging a registration fee for participation in a workshop. The purpose of this fee is to assess the interest of the local agencies in the Center and to allow them to express their support through a token financial investment. The registration fee for "Roadway Applications of Geotextiles" and "Traffic Engineering Applications of Microcomputers" was $30 per person. The total dollars received for these workshops was $1350 and $1380, respectively. Since "Roadway Maintenance" was a two-day workshop, the registration fee was $50 per person, and $8000 was received. The total amount received from...
workshop registration fees is $10,730.

The Center sought a conclusion as to whether the new policy concerning registration fees had significantly affected workshop participation. Given the data available, it is not possible to make such a conclusion. For example, the attendance for the Roadway Maintenance Workshop in May-June, 1986 was 332. It is difficult to assess whether the 14% drop in attendance resulted from the policy change or because many officials concerned with Roadway Maintenance had attended the previous workshop. Summaries of both the 1986 workshop and the 1988 workshop are included in the appendix for further comparison.

"Roadway Liability in Georgia" was co-sponsored with the Georgia Division of the Institute of Transportation Engineers. The registration fee for that workshop was $10, but the monies were received by I.T.E..

**Newsletters (Tech Trans)**

The newsletter is a very valuable tool for the Technology Transfer Center. It provides the opportunity to make local agencies aware of the services which are available through the Center, as well as other programs throughout the Southeast. In addition, the newsletter is a channel for the actual transfer of technology to the local agencies, with pertinent information on new methods and trends.

Tech Trans was published each quarter of 1987, and approximately 2050 copies of the newsletter were distributed each quarter. Total distribution was increased 29% over 1986.

Contents of each newsletter may include the following:

- **Editor's Note:** This column is devoted to informing the readers about what is happening at the Center. Policy and personnel changes are noted here, as well as highlighting upcoming events.

- **Articles:** Each newsletter contains two or more articles. Articles come from various sources and are chosen for their applicability to the needs of the local agencies in the State.

- **Maintenance Tips:** Maintenance tips are selected from the "Field Maintenance Manual for Georgia Counties Local Roads and Streets."

- **Briefs, Trends, and Facts:** On the lighter side, several short, news-worthy topics are
published. Some of the items included under this heading are: historical facts, miscellaneous
trends, general transportation related news, financial data, and humorous items.

- Publications: Research reports and relevant articles are listed in the newsletter. These may
be publications which are available from the Center at no charge or which may be ordered
from other agencies. Video tapes are also included.

- Workshops and Conferences: A selective list of upcoming meetings, workshops, etc.,
concerning relevant topics, are listed so that the local agencies will be aware of such
opportunities.

Technical Assistance

The Center has during the past year responded to fifty-four requests for technical assistance.
Requests for assistance are made during workshops, by telephone, or by mail.

Typical areas of technical assistance provided were in microcomputer applications in transpor-
tation, roadway surface treatment, signalized intersection analysis, and traffic control and opera-
tions. Responses to these requests are provided by telephone, by mail, or by on-site visits.

To illustrate the types of technical assistance provided during the year, consider two examples.
The Center Director, accompanied by GDOT Bureau of Transportation personnel, met with staff
members of the Macon-Bibb County Transit Authority. Based on a detailed review of their
operation, the Director prepared a set of microcomputer specifications. As a result of this effort,
a microcomputer system will be installed at the Macon-Bibb County Transit Authority during 1988.

Upon request by the City of Waycross Traffic Engineer, the Center researched the availability
of accident record systems applicable for use in Waycross. It was found that the City of Athens
was using an appropriate non-proprietary software. The City of Waycross Traffic Engineer and the
Center Director went to Athens for a demonstration of the software. A copy of the software and
the documentation were obtained from the City of Athens. When the Waycross staff had difficulty
installing the software, the Center Director travelled to Waycross and resolved the problem; the
City of Waycross is currently using the accident record software.
EVALUATION

In December of 1987, the Technology Transfer Center hired Mr. Grover Bowman to conduct a series of interviews with officials throughout the state in order to evaluate the services offered by the Center and the local agencies' awareness of these services. The bulk of this portion of the Final Report will be based on Mr. Bowman's findings.

As of the compilation of this report, Mr. Bowman has conducted thirty-four interviews in twenty-eight counties in Georgia. Eleven interviews have been with County Commissioners or County Administrators; fourteen have been with County Engineers or Road Superintendents; six interviews have been with City Managers, City Engineers, or Public Works Directors; two have been with Traffic Engineers; and one interview was with a County Clerk. The results of each interview were recorded on the Technology Transfer Data Sheet, which is included in the appendix.

The agencies interviewed have responsibility for approximately 10,000 miles of paved roads and 5500 miles of unpaved roads with an employment force of approximately 1200 in transportation related activities. All of the local officials interviewed consider themselves at least minimally equipped to perform responsibilities as assigned, however, there is considerable variation in the level of sophistication applied in fulfillment of such assigned responsibilities.

All personnel interviewed were aware of the Technology Transfer program and knew that Georgia Tech, the Georgia DOT, and the Federal Government were involved in the program. However, a large number of the officials interviewed primarily related the program to the publication of the newsletter and to the workshops which many had attended. The availability of technical assistance and technical materials as a service of the Center were not as commonly known.

The following comments were compiled according to the four major responsibilities of the Technology Transfer Center--the newsletter, technical assistance, technical materials, and workshops.
Newsletters

A large majority of the officials interviewed currently receive the newsletter. They expressed appreciation for the beneficial information provided and indicated that no changes were necessary, as they generally considered the publication to be excellent.

No meaningful suggestions concerning the newsletter were forthcoming from those responding, but Mr. Bowman has offered a suggestion as a result of his interviews with the local officials. It is suggested that the newsletter include more articles on local procedures, practices, or processes. Such articles would probably be of more interest and relevance to local officials than similar articles about activities in other states.

Technical Assistance

A large number of the officials interviewed were not aware that the Center offered technical assistance upon request, but expressed considerable interest in such a service when informed of its availability. Several County Commissioners suggested that the Center advertise this service through the Area Planning and Development Commissions, possibly making an annual presentation at APDC meetings. It was noted that most of the engineers were aware that the Center offered technical assistance and have utilized this service. Those who had taken advantage of this aspect of the Technology Transfer program commended the excellent quality of service.

Technical Materials

Responses concerning technical materials were very similar to those concerning technical assistance, i.e., non-engineering officials were generally unaware of the availability of technical materials.

At the conclusion of the series of interviews with local officials, Mr. Bowman observed that the Center could increase its effectiveness in this area by serving as a repository for the standard plans of the State, as well as current tests and evaluations of products and materials, and could furnish them to cities and counties upon request.
Workshops

Workshops were the most recognized component of the Technology Transfer program. Without exception, those interviewed considered the workshops an excellent service. No adverse comments were offered, but it was suggested that the local agencies would like to see the development of the on-site presentation concept. The smaller rural counties, in particular, have difficulty allowing their single work supervisor to attend a one or two day workshop. The decreased productivity effected by his absence is a disincentive for the Commissioners to encourage participation. In contrast, these same Commissioners indicated a strong willingness to make available their entire road crew for a three hour subject specific course that would be immediately applicable.

Numerous suggestions were made as to workshop subjects that would be of value to those agencies interviewed. A summary listing of those subjects follows.

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<thead>
<tr>
<th>Subject</th>
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<tr>
<td>Asphalt Plant Inspection</td>
<td>Soil Erosion</td>
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Additional suggestions were made that the Center serve as a focal point to bring together selected small urban representation to serve as a "brainstorming" group in establishing standards for a good Public Works program.

Interview results indicated that few engineering consulting firms are utilized in Georgia for roadway activities. Those agencies which receive the additional 1% sales tax sometimes engage a consultant to coordinate that program. Also, local agencies occasionally encounter a unique
situation that warrants specialized expertise. For the most part, however, the local agencies rely on assistance from the State DOT.

The policy of charging for workshop participation, which was recently instated, has created limited problems. Several agencies indicated that the charge would not preclude their participation, but would reduce the number of representatives that could attend. It was noted that the University of Georgia charges $10 - $15 per day for their workshops.

Ranking of the four program components in terms of their importance to local agencies was 1) workshops, 2) newsletters, 3) technical assistance, and 4) technical materials, with the last two being almost equal in relative importance to local agencies. In rural counties in particular, it is recognized that the Technology Transfer Program provides the only training opportunities which are realistically available to them. Accordingly, they commend past performance and encourage continued efforts to bring practical technical knowledge and assistance to them.
CONCLUSION

As a result of the statistics included in this report regarding the activities of the Technology Transfer Center and the findings of Mr. Bowman, one must conclude that the Center is continuing to gain momentum and credibility in its service to the local agencies. The Center is recognized for and commended for its good work in making practical transportation information available to agencies that are otherwise limited in their resources for such assistance. The workshops and the newsletters have been lauded as an asset to agencies in Georgia.

Mr. Bowman’s findings indicate that the technical assistance and materials that the Center offers could be better utilized if the local agencies were better informed of these opportunities. The Center will endeavor to market these services more effectively.

The evaluation concerning workshops contains an extensive list of topics, which were suggested by the local officials interviewed by Mr. Bowman. It is evident that the needs of the local agencies are many and varied. Through initiating the program of on-site workshops which was suggested in the evaluation section of this report, the Center would be better able to address the specific needs of individuals agencies through workshop presentations. This benefit, in addition to the increased participation discussed earlier, is a great incentive for the Center to pursue a slight modification in emphasis.

In conclusion, the Georgia Tech Technology Transfer Center continues to grow as an effective and viable means of technology transfer for communities in Georgia. Through continual re-evaluation, the Center can continue to meet the spoken and unspoken needs of agencies in the state with applicable and effective information.
APPENDIX
MAILING LIST
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</table>
HON. MICHAEL DOBBS  
DISTRICT 74  
125 HARDWICK DR.  
COVINGTON, GA 30209

HON. JERRY FOWLER  
CITY SUPERVISOR  
2302 SCOTT CIR.  
DACULA, GA 30211

HON. LARRY FLEEMAN  
MAYOR  
P.O. BOX 14  
CITY HALL  
DACULA, GA 30211

HON. A. J. GREEN  
MAYOR  
P.O. BOX 145  
CITY HALL  
FAIRBURN, GA 30213

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STREET Supt.  
CITY OF FAYETTEVILLE  
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COUNTY ADMIN.  
FAYETTE CO.  
200 COURTHOUSE SQ.  
FAYETTEVILLE, GA 30214

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CHM.  
HEARD CO.  
COURTHOUSE  
FRANKLIN, GA 30217

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COUNTY ENGINEER  
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FRANKLIN, GA 30217

CITY ENGINEER  
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MAYOR JOHN CARTER  
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548 COURT SQUARE  
GREENVILLE, GA 30222

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GRIFFIN, GA 30223

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FAIRBURN, GA 30213

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MAYOR  
P.O. BOX 39  
FLOVILLA, GA 30216

MAYOR PAUL F. MUSICK  
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DISTRICT 29  
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GREENVILLE, GA 30222

CO. ROAD SUPERINTENDENT  
COURTHOUSE  
GRIFFIN, GA 30223

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GRIFFIN, GA 30223

HON. J. LOWERY  
MAINT. FOREMAN  
GWINNETT CO.  
2659 BOLD SPRINGS RD.  
DACULA, GA 30211

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POLICE CHIEF  
191 W. BROAD ST.  
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150 MEADOWISTA DR  
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<td>209 MCINTOSH TRAIL, PEACHTREE CITY, GA 30269</td>
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<td>DISTRICT 72 POST 5</td>
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<td>2460 MAIN ST, CITY HALL, SNELLVILLE, GA 30278</td>
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<td>DISTRICT ENGINEER</td>
<td>GDOT DISTRICT 3, P.O. BOX 711, THOMASTON, GA 30286</td>
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<td>1251 WILLINGHAM SPRS RD, THOMASTON, GA 30286</td>
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<td>CITY OF UNION CITY, P.O. BOX 262, UNION CITY, GA 30290</td>
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<td>FIELD INSPECTOR</td>
<td>CITY OF PEACHTREE CITY, 209 MCINTOSH TRAIL, PEACHTREE CITY, GA 30269</td>
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<td>HON. LAMAR HUTCHESON</td>
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<td>6690 CHURCH ST, CITY HALL, RIVERDALE, GA 30274</td>
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<td>JERRY KING</td>
<td>POLICE CHIEF</td>
<td>81 S. ATLANTA ST, BOWIE, RIVERDALE, GA 30274</td>
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<tr>
<td>RONALD S. BAIR</td>
<td>PRESIDENT</td>
<td>CUB RAILROAD SV. INC., P. O. BOX 721, SNELLVILLE, GA 30278</td>
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HON. SAM SMITH CHM.
EMANUEL CO. COMM.
COUNTY COURTHOUSE
SWAINSBORO, GA 30401

HON. JAMES BUCKLEY
MAYOR
101 MAIN ST.
CITY HALL
SWAINSBORO, GA 30401

HON. BILL ENGLISH
DISTRICT 21
214 GOLD DR.
SWAINSBORO, GA 30401

HON. NATHAN DEAN
DISTRICT 31
340 WINGFOOD ST.
ROCKMART, GA 30401

HON. RANDOLPH CARR
DISTRICT 109
P.O. DRAWER N
SWAINSBORO, GA 30401

SAM P. SMITH
COUNTY COMMISSIONER
EMANUEL COUNTY COURTHOUSE
SWAINSBORO, GA 30401

GRADY YANCEY
COUNTY COMMISSIONER
EMANUEL COUNTY
P.O. BOX 931
SWAINSBORO, GA 30401

CO. ROAD SUPERINTENDENT
COURTHOUSE
ALAMO, GA 30411

W. H. THOMAS JR.
COMM. OF WHEELER CO.
P.O. BOX 131
ALAMO, GA 30411

HON. WILLIAM DELOACH CHM.
EVANS CO. COMM.
COUNTY COURTHOUSE
CLAXTON, GA 30417

HON. PREBY DELOACH
MAYOR
P.O. BOX 829
CITY HALL
CLAXTON, GA 30417

HON. JOSEPH KENNEDY
DISTRICT 4
P.O. BOX 246
CLAXTON, GA 30417

HON. CHARLIE BOWLAND
MAYOR
134 SOUTH MAIN ST.
CITY HALL
GLENNVILLE, GA 30427

DATNE DELOACH
WATER & SEWER SUP’T
CITY OF GLENNVILLE
134 S. MAIN ST.
GLENNVILLE, GA 30427

HON. CLINTON OLIVER
DISTRICT 121
P.O. BOX 237
GLENNVILLE, GA 30427

CO. ROAD SUPERINTENDENT
COURTHOUSE
LOUISVILLE, GA 30434

HON. T. E. BUCHANAN CHM.
JEFFERSON CO. COMM.
P.O. BOX 658
LOUISVILLE, GA 30434

HON. JULIAN VEAUTH
MAYOR
P.O. BOX 527
CITY HALL
LOUISVILLE, GA 30434

HON. WM. GAREEBON
DISTRICT 108
P.O. BOX 447
LOUISVILLE, GA 30434

HON. CLINTON OLIVER
DISTRICT 121
P.O. BOX 237
GLENNVILLE, GA 30427

HON. MELL TAYLOR CHM.
TOOMBS CO. COMM.
COUNTY COURTHOUSE
ROUTE 1
LYONS, GA 30436

HON. W. T. AIKEN
MAYOR
417 NORTH STATE ST.
CITY HALL
LYONS, GA 30436

HON. GEORGE BIRD CHM.
CANDLER CO. COMM.
COUNTY COURTHOUSE
METTER, GA 30439

EDDIE GRANT
COUNTY COMMISSIONER
CANDLER COUNTY
302 HERBACH DRIVE
METTER, GA 30439

CO. ROAD SUPERINTENDENT
COURTHOUSE
MILLED, GA 30442

HON. CHARLES BRAGO CHM.
JEFFERSON CO. COMM.
COUNTY COURTHOUSE
MILLED, GA 30442

HON. ROBERT FRIES
MAYOR
P.O. BOX 929
CITY HALL
MILLED, GA 30442

HON. FORREST BOYER
CITY ADMINISTRATOR
CITY ADMINISTRATOR
CITY HALL
MILLED, GA 30442

HON. FORREST BOYER
CITY ADMINISTRATOR
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HON. FORREST BOYER
CITY ADMINISTRATOR
COURTHOUSE
MT. VERNON, GA 30445

HON. BILL ENGLISH
DISTRICT 21
214 GOLD DR.
SWAINSBORO, GA 30401

HON. BILL ENGLISH
DISTRICT 21
214 GOLD DR.
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HON. BILL ENGLISH
DISTRICT 21
214 GOLD DR.
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<td>Mr. Barney R. Taylor</td>
<td>Public Works Supt.</td>
<td>245 W. McIntosh St. Elberton, GA 30635</td>
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<td>Mr. Charles Yeargin</td>
<td>District 14</td>
<td>P.O. Box 584, Elberton, GA 30635</td>
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<tr>
<td>Mr. Dean Stewart</td>
<td>Mayor</td>
<td>212 North Main St. Greensboro, GA 30642</td>
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<td>Mr. Edward Ellington</td>
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<td>Hartwell Police Dept. Hartwell, GA 30643</td>
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<td>Mr. Edward Ellington</td>
<td>G.A. Tech Research Inst.</td>
<td>Regional Office 235-B South Main St. Madison, GA 30650</td>
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<td>Mr. Roy Lambert</td>
<td>District 66</td>
<td>P.O. Box 169, Madison, GA 30650</td>
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<td>Mr. Robert Ellington</td>
<td>Co. Road Superintendent</td>
<td>Courthouse Monroe, GA 30655</td>
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<td>Mr. Eno B. Bell</td>
<td>Mayor</td>
<td>770 Franklin Stgs. Royston, GA 30662</td>
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<tr>
<td>Mayor</td>
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<td>DISTRICT 2</td>
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<td>KAREN CAUSBY</td>
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<td>William Barton</td>
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<tr>
<td>Hon. A. A. McNeil Jr.</td>
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<tr>
<td>Hon. Allen Shepherd</td>
<td>City Engineer</td>
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<td>Hon. James Raines</td>
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<td>OFFICE OF HWY PLANNING</td>
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**AGENCY CODES**

1. UMTA
2. NHTSA
3. MATERIALS RESEARCH BOARD
4. RESEARCH & SPECIAL PROGRAMS ADMINISTRATION
5. AIRPORT GROUND TRANSPORT ASSOCIATION
6. FHWA
7. GEORGIA TECH
8. HERPICC--PURDUE UNIVERSITY
9. FRA
10. USDA
11. GEORGIA OFFICE OF HIGHWAY SAFETY
12. KANSAS DOT
13. S. E. TRUSS MANAGEMENT ASSOCIATION
14. FEDERAL EMERGENCY MANAGEMENT ADMINISTRATION
15. GDOT
16. PENNSYLVANIA DOT
17. URBAN CONSORTIUM
18. TRB
19. UNIVERSITY OF CALIFORNIA
20. MILITARY TRAFFIC MANAGEMENT COMMAND
21. U. S. ARMY CORPS OF ENGINEERS
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**SUBJECT CODES**

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2. SAFETY
3. HAZARDOUS WASTES
4. TRANSPORTATION INFORMATION
5. AIRPORTS
6. ASPHALT PAVEMENTS
7. SWAMP USAGE
8. MANAGEMENT
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10. TRAFFIC SIGNALS, ENGINEERING
11. CONSTRUCTION MACHINERY
12. BRIDGES
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THE ENGINEER'S POTHOLE REPAIR GUIDE
- COLD REGIONS TECH DIGEST, 1984 12 11
  Agency - 21  Subject - 19  Newsletter - 14

THE ENVIRONMENTAL IMPACTS OF BART
- METRO TRANS COMM, 1979 20 1
  Agency - 29  Subject - 24  Newsletter - 0

THE EUROPEAN PARATRANSIT EXPERIENCE
- ECOPLAN INTER. FRANCE, 1981 42+ 1
  Agency - 24  Subject - 2  Newsletter - 0

THE HOLE STORY
- AMER PUB WORKS ASS, 1983 20+ 10
  Agency - 24  Subject - 6  Newsletter - 12

THE IMPACT OF TRAFFIC ON RESIDENTIAL AREAS
- US DOT, 1982 34 1
  Agency - 24  Subject - 1  Newsletter - 0

THE INTERSTATE HIGHWAY TRADE-IN PROCESS VOL 1
- POLYTECH INST NY, 1982 25+ 1
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THE INTERSTATE HIGHWAY TRADE-IN PROCESS VOL 2
- POLYTECH INST NY, 1982 60+ 1
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THE PAVEMENT MANAGEMENT SYSTEM OF MARICOPA COUNTY ARIZONA
- AZ DOT, 1982 13 1
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- FHWA, 1985 21 5
  Agency - 6  Subject - 2  Newsletter - 0

THE ROLE OF REHABILITATION IN TRANSIT FLEET REPLACEMENT
- PUGET SOUND COUN OF GOV, 1983 58+ 1
  Agency - 24  Subject - 1  Newsletter - 0
THICKNESS DESIGN ASPHALT PAVEMENTS FOR HEAVY WHEEL LOADS
- ASPHALT INST., 1986 72 1
  Agency - 36  Subject - 6  Newsletter - 0

TIEBACKS
- SCHNABEL FOUNDATION CO MARYLAND, 1983 219+ 1
  Agency - 6  Subject - 18  Newsletter - 0

TIEBACKS EXECUTIVE SUMMARY
- SCHNABEL FOUNDATION CO MD, 1982 15 1
  Agency - 6  Subject - 18  Newsletter - 0

TIME BASED COORDINATION UNIT
SPECIFICATIONS
- STORCH ENGS. CT, 1982 39 1
  Agency - 6  Subject - 28  Newsletter - 0

TRAFFIC CONTROL FOR STREET AND HIGHWAY
CONSTRUCTION AND MAINTENANCE OPERATIONS
- BYRD TALLAMY MACDONALD & LEWIS VA, 1978 200+ 1
  Agency - 6  Subject - 2  Newsletter - 0

TRAFFIC CONTROLLER SYNCHRONIZER FIELD TEST
EVALUATION
- OFF OF R&D, 1982 20+ 1
  Agency - 6  Subject - 10  Newsletter - 0

TRAFFIC DETECTOR HANDBOOK
- FHWA, 1985 318 1
  Agency - 6  Subject - 10  Newsletter - 0

TRAFFIC ENGINEERING SERVICES FOR SMALL POLITICAL
JURISDICTIONS
- AMER PUB WORKS ASS, 1977 133 2
  Agency - 6  Subject - 10  Newsletter - 0

TRAFFIC SIGN HANDBOOK FOR LOW VOLUME RURAL ROADS
- NY DOT, 1985 103 1
  Agency - 32  Subject - 10  Newsletter - 0

TRAFFIC SIGNAL MAINTENANCE
- GA DOT, 1982 20+ 1
  Agency - 15  Subject - 10  Newsletter - 0
TRAFFIC SIGNAL OPTIMIZATION PROGRAMS
- A COMPARISON STUDY
  - C CLATERBLOS KANSAS, 1984 54 2
    Agency - 6  Subject - 10  Newsletter - 0

TRAFFIC SIGNAL TIMING A BIBLIOGRAPHY
  - UNIV OF CALIF , 1983 20 1
    Agency - 19  Subject - 10  Newsletter - 0

TRAFFIC SIGNAL TIMING --BEFORE AND AFTER STUDIES: A BIBLIOGRAPHY
  - UNIV CALF , 1983 6 1
    Agency - 19  Subject - 10  Newsletter - 0

TRAFFIC STRIPE REMOVAL
  - FHWA , 1980 60 1
    Agency - 6  Subject - 16  Newsletter - 0

TRANSIT MANAGEMENT WORKSHOP
  - UNIV WIS , 1982 5 1
    Agency - 1  Subject - 1  Newsletter - 0

TRANSIT SUBSIDY ALLOCATION TECHNIQUES
  - THE OMEGA GROUP INC. WASH DC, 1983 31+ 1
    Agency - 24  Subject - 1  Newsletter - 0

TRANSIT WORKS: 10 RURAL CASE STUDIES
  - IND DOT , 1982 100 1
    Agency - 24  Subject - 1  Newsletter - 0

TRANSPORTATION ENERGY CONTINGENCY PLANNING:
  QUANTIFYING THE NEEDS FOR TRANSIT ACTIONS
  - NY DOT , 1983 111 1
    Agency - 24  Subject - 21  Newsletter - 0

TRANSPORTATION ENERGY PLANNING:
  TRANSIT FUEL SUPPLIES UNDER DECONTROL
  - CABOT CONS GROUP WASH DC, 1982 38 1
    Agency - 24  Subject - 21  Newsletter - 0

TRANSPORTATION ENERGY MANAGEMENT:
  CURRENT TRANSIT OPERATOR ACTIVITIES
  - METRO SEATTLE, 1982 24+ 1
    Agency - 24  Subject - 21  Newsletter - 0
TRUSS RATING AND ANALYSIS PROGRAM TRAP JR
- RTAP TECH TRANSFER CENTER, 1986 100+ 2
  Agency - 40 Subject - 32 Newsletter - 16

UPGRADING DEFICIENT THROUGH TRUSS BRIDGES
- SHELADIO ASS. MD, 1983 122 2
  Agency - 6 Subject - 12 Newsletter - 4

URBAN TRANSPORT PLANNING IN THE UNITED STATES: A HISTORIC OVERVIEW
- US DOT, 1986 149 1
  Agency - 24 Subject - 1 Newsletter - 0

USE OF UTPS FOR SUBAREA HIGHWAY ANALYSIS: A CASE STUDY
- US DODT, 1985 56 1
  Agency - 24 Subject - 32 Newsletter - 0

UTCS FUNCTIONAL HARDWARE SPECIFICATIONS HANDBOOK
- FHWA, 1986 100+ 2
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USER-SIDE SUBSIDY PROGRAMS FOR SPECIAL NEEDS TRANSPORTATION
- UMTA, 1983 97+ 2
  Agency - 1 Subject - 1 Newsletter - 0

USER'S MANUAL MICROCOMPUTER PROGRAM FOR BRIDGE ANALYSIS AND RATING
- FHWA, 1985 100+ 2
  Agency - 6 Subject - 32 Newsletter - 16

VALUE ENGINEERING CONTRACT PROVISIONS ON FEDERAL-AID HIGHWAY CONSTRUCTION PROJECTS
- FHWA, 1984 24 1
  Agency - 6 Subject - 28 Newsletter - 0

VALUE ENGINEERING STUDY OF DRAINAGE MAINTENANCE
- FHWA, 1982 19+ 1
  Agency - 6 Subject - 13 Newsletter - 0

VEHICLE MAINTENANCE PRACTICES AMONG GRANTEES
- WASH DOT, 1981 27+ 1
  Agency - 24 Subject - 1 Newsletter - 0
WAGE SURVEY OF ROAD AND STREET EMPLOYEES IN INDIANA COUNTIES AND CITIES-1984
- PURDUE UNIV, 1984 34 1
  Agency - 8 Subject - 24 Newsletter - 0

WHAT HAPPENS WHEN YOUR PROPERTY IS NEEDED FOR A FEDERAL-AID HIGHWAY
- GA DOT, 1980 20 1
  Agency - 15 Subject - 28 Newsletter - 0

WHO'S GOING TO CALL THE FIRST MEETING
ACTION GUIDE FOR LOCAL DRUNK DRIVING PROGRAMS
- NHTSA, 1983 50+ 1
  Agency - 2 Subject - 34 Newsletter - 0

WILDLIFE CONSIDERATIONS IN PLANNING AND MANAGING HIGHWAY CORRIDORS
- US DEPT OF INTERIOR, 1982 93 1
  Agency - 6 Subject - 27 Newsletter - 0

WORK ZONE TRAFFIC CONTROL
- FHWA, 1980 77+ 4
  Agency - 6 Subject - 2 Newsletter - 11

WORLD'S FAIR TRANSPORTATION SYSTEM EVALUATION 1982
- TENN DOT, 1982 174 1
  Agency - 1 Subject - 1 Newsletter - 0

YOUR RIGHTS AND BENEFITS AS A HIGHWAY DISPLACEE
- OFF. OF ROW, 1981 46 1
  Agency - 6 Subject - 28 Newsletter - 0
VIDEO TAPE LIST
VIDEO TAPES NOW AVAILABLE FROM THE TECHNOLOGY TRANSFER CENTER

The Technology Transfer Center is beginning a video tape library. The VHS tapes listed below may be borrowed, at no charge, for a two week period. Please phone or write and request no more than two tapes at a time. Specify the tapes you want by the number in the left hand column.

SAFETY AND TRAFFIC

ST-201 The Winners--The Losers (13 minutes)
Safe use of lift trucks including inspection and hazards facing operators.

ST-205 Traffic Control and Tort Liability (50 minutes)
Gives suggestions concerning traffic control devices for local jurisdictions to help avoid tort liability suits.
Tort Liability (60 minutes)
Discusses tort liability and local jurisdiction responsibility with respect to design and operation of transportation facilities.

ST-212 Night Safety at Worksites (12 minutes)
Specifications for providing a safe nighttime environment in construction zones.
Work Area Flagging (25 minutes)
When and where to use flagging, responsibilities and requirements of flaggers, and proper flagging procedures.
Selection and Use of Traffic Control Devices (30 minutes)
Objectives of work area traffic control, selection of proper control devices.

ST-213 Introduction to Work Area Traffic Control (30 minutes)
Basic principles of work area traffic control and inputs into selecting proper traffic control.
Partners in Safety (15 minutes)
Describes work area traffic control and how to use it properly to achieve cooperation between the road user, contractor and flagger.
Sample Applications of Work Area Traffic Control (30 minutes)
Devices used as work area traffic control for both mobile or short and long term construction zones.
Speed Zoning by Montana Highway Patrol (30 minutes)
Describes background and misconceptions of speed zoning and the procedures for determining speeds of highways and local roads.

MAINTENANCE

M-201 The Snowfighters (24 minutes)
Methods, procedures, and equipment for snow removal on streets and highways.
M-202  Down is Up (20 minutes)
Preventive maintenance is stressed to reduce down time on construction sites.

M-203  The Choice is Yours (18 minutes)
Preventive maintenance on diesel engines is stressed to get maximum life from the engine.

M-204  Signals: Read 'Em or Weep (20 minutes)
Indications of problems with equipment.

M-205  Upgrading Gravel Roads (20 minutes)
Discusses how gravel and asphalt roads can be recycled using low cost alternatives.

Rural Roads, A New Approach (27 minutes)
Discusses gravel road problems and solutions to these problems including the use of filter fabrics on gravel roads and strengthening old bridges to handle modern loads.

M-206  Introduction to Bridge Inspection (25 minutes)
Prepared for agencies that are required to inspect bridges in their jurisdiction. Covers federal requirements, reference materials, condition inspection and rating, structural inventory, and safety considerations.

Pre-Stressed Concrete Bridge Inspection (50 minutes)
Describes pre-stressed concrete bridges, inspection sequence, and how to prepare for an on-site inspection.

Inspection of Pin and Link Details on Bridge Structures (32 minutes)
Discusses pin and link details and inspection procedures.

M-207  Steel Truss Bridge Inspection (50 minutes)
Discusses inspection of small truss bridges including equipment, reporting forms, and what to look for.

Timber Bridge Inspection (50 minutes)
Describes common problems with timber bridges and demonstrates how the inspection is conducted.

M-208  Roadway Maintenance Cost Analysis--Part I (50 minutes)
Discusses equipment costs including depreciation, fuel, oil, grease, maintenance, repair, and capital investment.

Roadway Maintenance Cost Analysis--Part II (50 minutes)
Discusses maintenance operating costs relating to labor, equipment, materials, and overhead.

M-209  Roadway Maintenance Cost Analysis--Part III (50 minutes)
Discusses the cost of deferred maintenance.

Roadway Maintenance Cost Analysis--Part IV (50 minutes)
Gives ideas on how to present budget data to county commissioners and city councils.
M-210  Maintenance of Highway Safety Hardware (45 minutes)
How to provide safe roadside environments through periodic maintenance of the road side and its safety hardware.

M-211  Maintaining Granular Surfaced Roads (18 minutes)
Instructional guide to enable road grader operators to provide better maintenance of granular surfaced roads.
Snow Removal on Iowa’s Secondary Roads (20 minutes)
Instructional guide for snowplow operators for winter road maintenance of secondary roads.

M-212  Ditchmaster (10 minutes)
Demonstration of the ditchmaster, a cost effective machine for improving roadside drainage and maintenance.
Lee-Boy Asphalt Maintainer (15 minutes)
Demonstration of the Lee-Boy, an asphalt and maintenance machine.
Rosco Asphalite Maintainer (15 minutes)
Demonstration of a pot hole repair machine.

M-213  Techniques for Pavement Maintenance and Rehabilitation Using Asphalt--Part I
Introduction (15 minutes)
Introduction to a series of tapes dealing with using asphalt for pavement maintenance and rehabilitation.
Asphalt Components, Materials, Tests, and Basics of Design (40 minutes)
Discusses the components of an asphalt paving structure from subgrade to the asphalt top.

M-214  Techniques for Pavement Maintenance and Rehabilitation Using Asphalt--Part II
Pavement Deterioration Ratings (30 minutes)
Discusses graphs involving pavement deterioration, cost of rehabilitation, pavement life and rating of pavement deterioration.
Types of Patching and Crack Sealing (52 minutes)
Examples of pavement deterioration and discusses methods of patching, crack sealing and equipment used.

M-215  Techniques for Pavement Maintenance and Rehabilitation Using Asphalt--Part III
Sealing of Joints in Portland Cement Concrete (25 minutes)
Discusses cleaning and sealing of joints in Portland cement concrete roadways.
Surface Treatment of Pavement (54 minutes)
Discusses objectives and methods of applying seal coats, spraying of liquid asphalt, surface condition variables, spraying oil onto pavement and spreading aggregate.

M-216  Techniques for Pavement Maintenance and Rehabilitation Using Asphalt--Part IV
Cost Analysis (20 minutes)
Discusses methods and strategies for determining which method of maintenance is needed. Cost analysis is emphasized.
Recycling Procedures (35 minutes)
Describes recycling procedures with asphalt and shows some of the equipment used.

**DESIGN AND CONSTRUCTION**

**DC-201**
800 Miles of Winter (28 minutes)
Construction of the Trans-Alaskan pipeline.

Men Against Rock (30 minutes)
Discussion of construction in rocky areas on a variety of projects including drilling, blasting, earth moving and tunneling.

Why Handle It Twice? (16 minutes)
Construction and reclamation of an open-pit coal mine using scrapers.

The New Shape of Value (14 minutes)
Demonstrates the capabilities of the Caterpillar D-10 unit including ripping, push loading of scrapers and dozing.

Versatility with a Boom (10 minutes)
Shows multiple uses of hydraulic excavators.

**DC-202**
The Roll of Drums (18 minutes)
Discusses taking unnecessary chances on construction work sites.

Shake Hands with Danger (23 minutes)
Safety procedures for operating and maintaining earth moving machines.

Making the Most with Scrapers (23 minutes)
The productive use of scrapers.

Operating Tips: Elevating Scrapers (11 minutes)
Discusses inspection, start-up procedures and work alone features such as cutting and loading material.

Operating Tips: Wheel-Tractor Scrapers (18 minutes)
Discusses inspection, start-up procedure, and operating techniques.

**DC-203**
Operating Tips: Push-Pull Scrapers (12 minutes)
Discusses cut and fill operations for pairs of scrapers.

Operating Tips: Off-Highway Trucks (17 minutes)
Discusses inspection, start-up procedure and off-road operations.

Operating Tips: Track-Type Tractors (15 minutes)
Considerations for safe and efficient operation including inspection, dozing, land clearing, ripping and push loading scrapers.

Loading Logic (17 minutes)
Efficient choice and use of loaders and trucks for hauling soil.

Operating Tips: Wheel-Tractor Scrapers (18 minutes)
Discusses inspection, start-up procedure and operating techniques.

Operating Tips: Track-Type Loaders (10 minutes)
Discusses inspection, start-up procedure and excavation for a variety of cases.

Operating Tips: Wheel Loaders (10 minutes)
Discusses inspection, start-up procedure and operation.

**DC-204**
Tied Concrete Shoulder (10 minutes)
Shows construction of tied concrete shoulders, undersealing of
existing pavement and full-depth repair of the pavement.
Recycling D-Cracked Concrete Pavement (12 minutes)
Discusses the reasons for the use of concrete recycling over conventional methods of construction.
Bonded Concrete Overlay (12 minutes)
Shows a bonded concrete overlay on existing concrete pavement.

DC-205 Interstate Reconstruction--Part I (12 minutes)
Recycling existing D-Cracked pavement as aggregate for new concrete pavement.
Whitetopping (7 minutes)
Discusses placing a concrete overlay on distressed asphalt concrete.
Design for Quality (12 minutes)
Shows recycling of concrete pavement and replacement with continuously reinforced concrete pavement, bonded concrete overlay and tied concrete shoulders.

DC-206 Interstate Reconstruction--Part II (13 minutes)
Shows add-on tied concrete shoulders, diamond grinding for smoothness, and establishing new transverse joints.
Recycling Continuously Reinforced Concrete Pavement (10 minutes)
Shows the recycling of existing continuously reinforced concrete pavement as aggregate for new concrete pavement.
Unbonded Concrete Overlay (12 minutes)
Construction of a full-depth unbonded overlay over a reinforced concrete pavement.

DC-207 Testing of Asphalt Cement (24 minutes)
Procedures for various tests of asphalt cement including flashpoint, penetration, ductility solubility, spot softening point, specific gravity and thin film over tests.
Determination of Asphalt Content in Paving Mixtures (20 minutes)
Procedures for determining asphalt content for proper life and serviceability of asphalt cement.
Budgeting for Rehabilitation (25 minutes)
Presents economic situation of restoring paved highways and evaluation of pavements for determination of priority for restoration.
Asphalt Emulsion Spray Applications (20 minutes)
Reasons for using asphalt emulsions, what constitutes asphalt emulsions, how they work, and processes for applying asphalt emulsions.
Aggregate Blends (40 minutes)
Demonstrates graphical procedure for blending aggregate sources to meet proper specifications.

DC-208 AASHO Road Test
Construction and Materials (27 minutes)
Discusses materials and construction of extensive test facilities constructed in 1956 by AASHO to test different types of road surfacings, bases, bridges and methods of construction.
Pavement Research (37 minutes)
Objectives, methods, and principle results of pavement research in
the AASHO Road Test.
The Road to Better Roads (14 minutes)
Summarizes the purposes and procedures of the AASHO Road Test and
discusses what is being done today to improve roads.

DC-209 Verglimit--Mixing and Laying (10 minutes)
Proper procedures for handling, storing, mixing and laying
verglimit asphalt cement, ice and snow retarders.

DC-210 I-90 The Final Link (20 minutes)
The completion of I-90 near Seattle; its design and construction
problems.

Basics of the Local Road Engineer (50 minutes)
The basic components of road engineering are covered, emphasis on
traffic safety.

DC-211 Energy Conservation in Community Water Systems (25 minutes)
Conservation methods used in water systems to help reduce operating
expenses and operating budgets.

The Importance of Road Drainage (40 minutes)
Describes how to make an inventory of drainage structures for
easier maintenance by mapping these structure and problem flood
areas; fundamentals of design and sizing of culverts and ditches.

DC-212 Stabilization for Low-Volume Roads (10 minutes)
Describes adding soil stabilizing agents to low volume roads to
increase drainage capabilities, base stabilization and reduce
maintenance costs.

Oklahoma Slide Show on Geotextiles (25 minutes)
Experiments using geotextiles cloth overlayed with gravel in
roadways during wet conditions.

Stabilization, Holding the Road (20 minutes)
Demonstrates the process of building a stabilized road and shows
the advantages of stabilized roads over surface treated roads.

Lime: The Versatile Soil Stabilizer (25 minutes)
Use of lime in road stabilization, its history, advantages, uses,
process for making lime, and how to use lime in the construction
process.

DC-213 Standard Soil Tests (40 minutes)
Describes several standard AASHTO soils tests.

Concrete Field Testing and Sampling (25 minutes)
Complete process for the concrete field tester. Shows tests for
slump, air content, unit weight, chase indicator, kellyball and
preparation of concrete cylinders for strength tests.

AASHTO T-99 (12 minutes)
Determines the moisture-density relationship of soils.

AASHTO-27 (20 minutes)
Sieve analysis for both fine and coarse aggregates.

DC-214 Design of Urban Streets--Part I
Conceptual Approach to Urban Street Design (25 minutes)
Introduction to series of tapes on urban street design.
Capacity (30 minutes)
Describes concepts of road capacity and level of service, peak hour factor, load factor as references from the highway manual.

Techniques for Maximizing Capacity to Traffic Studies (30 minutes)
Describes techniques for maximizing capacity on roads and at intersections.

Street Design Elements--Part I (30 minutes)
Discusses location design of urban streets and coordination of facilities. Also includes discussion of metric units in design.

Design of Urban Streets--Part II
Street Design Elements - Part 2 (30 minutes)
Describes cross-sectional design and horizontal alignment design.

Street Design Elements - Part 3 (30 minutes)
Describes vertical alignment design, design of vertical curves, drainage design and design for access control.

Intersection Design Elements (30 minutes)
Describes the basic intersection types, types of channelization, corner design pedestrian movement, vehicular movement and turning movements.

Intersection Design Elements (Continued) (30 minutes)
Describes intersection control, problem identification and improvement techniques for problem areas. It also describes some type of urban and freeway techniques.

Design of Urban Streets - Part III
Traffic Signal Design and Operation (30 minutes)
Basic principles of signals, advantages, disadvantages, the various types of signals and operations of different traffic signals.

Illumination, Signs and Markings (30 minutes)
Advantages of lighting arterial streets, types of lights and elements considered in designing lighting systems, importance of signs and markings in street design and uniformity of signs and markings.

Pedestrians, Bicycles and Transit Considerations (30 minutes)
Discusses the integration and design of pedestrian, bicycle and transit facilities into the urban street plan.

Factors Impacting Street Design (30 minutes)
Special factors which affect the design of urban streets.

Design of Urban Streets - Part IV
Social and Economic Impacts (30 minutes)
Social and economic impacts by the upgrading or design of new urban roadway facilities.

Environmental Consideration (30 minutes)
Environmental impact caused by urban street design. Emphasis on air and noise pollution.

Project Documentation (30 minutes)
Evaluation techniques for comparing design alternatives and selections.

Administration and Management (30 minutes)
Consultant selections, bid procedures, contractor prequalifications, supervision of work and legal aspects of the design and designer.
Asphalt Paving Inspection (28 minutes)
Discusses sampling of aggregate, storage, cold feed, mixing plant and plant inspection.

Pothole Repair (12 minutes)
Demonstrates traffic control during repair, marking, cleaning, filling and cleanup.
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Technology Transfer Center
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Georgia Institute of Technology
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ROADWAY MAINTENANCE
WORKSHOPS SUMMARIES
ROADWAY MAINTENANCE WORKSHOP  
MAY - JUNE, 1986  
STATEWIDE SUMMARY

<table>
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<th>WORKSHOP LOCATION</th>
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-- percent of state's 159 counties represented: 35.85

-- average workshop: 47.4 persons, 8.1 counties, 12.4 cities

-- comparison to 1983/1984 Roadway Maintenance Workshop:

10.3% more persons (332 vs. 301)  
12.3% fewer counties (57 vs. 65)  
52.6% more cities (87 vs. 57)
### ROADWAY MAINTENANCE WORKSHOP  
**JANUARY - FEBRUARY, 1988**  
**SUMMARY**

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</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>285</strong></td>
<td><strong>55</strong></td>
<td><strong>51</strong></td>
<td><strong>54</strong></td>
<td><strong>161</strong></td>
</tr>
</tbody>
</table>

Percent of State's 159 counties represented: 32%
Percent of those attending who were GDOT personnel: 35%
Percent of those attending who paid the registration fee: 56%
Average workshop attendance: 40.7

Comparison to 1986 Roadway Maintenance Workshop:
- 14.2% fewer persons (285 vs. 332)
- 10.5% fewer counties (51 vs. 57)
- 37.9% fewer cities (54 vs. 87)
NEWSLETTERS
GEOTEXTILES—They can be cost effective!

A geotextile is any permeable textile material used with foundation, soil, rock, earth or any other geotechnical engineering or related material, as an integral part of a man-made project, structure, or system. Geotextile generally refers to knitted, woven, and nonwoven fabrics.

Geotextile use covers primarily four areas, i.e., separation (protection of granular material from clay intrusion or contamination, filtration and drainage (filtered groundwater entering an under-drain system causing subsequent contamination and plugging), erosion control (helps prevent loss of fine material into adjacent streams, ponds, etc.), and reinforcement fabric reinforced for earth retaining walls.

For thousands of years non-soil materials have been used together with soil to improve certain desirable properties or to correct some undesirable properties of soil materials. Some of the examples in the natural world are nests of insects, birds, and beaver dams. Man-made examples include adobe bricks and corduroy roads.

Table 1 shows where the geotextile fabric was used in 1982 with an estimated value of business in the United States of more than $100 million per year.

There are a number of processes involved in the manufacture of geotextiles. Geotextiles and geotextile related products are usually made from synthetic polymers, i.e., polypropylene, polyester, polyethylene, polyamide, and nylon. These man-made polymers are highly inert to biological and chemical degradation.

Natural fibers (wool, cotton, etc.) are seldom used in geotextiles because they are biodegradable and will rot when in contact with soil.

There are ten types of geotextiles and geotextile related products that are commonly recognized based on their manufacturing process. They are listed as follows: knitted, woven, nonwoven and composite geotextiles. Geotextile related products include webs or webbings, mats, nets, grids, formed plastic sheets, and prefabricated composite structures.

TABLE 1 — GEOTEXTILE FABRIC BY END-USE-1982

<table>
<thead>
<tr>
<th>End-Use</th>
<th>Square Yard (in millions)</th>
<th>Percent of Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Roads (New and Repaving)</td>
<td>33.6</td>
<td>28.3%</td>
</tr>
<tr>
<td>Stabilization</td>
<td>28.3</td>
<td>23.3%</td>
</tr>
<tr>
<td>Secondary and Access Roads</td>
<td>18.6</td>
<td>15.5%</td>
</tr>
<tr>
<td>Drainage</td>
<td>13.6</td>
<td>11.1%</td>
</tr>
<tr>
<td>Erosion Control</td>
<td>12.0</td>
<td>9.9%</td>
</tr>
<tr>
<td>Other</td>
<td>7.2</td>
<td>5.9%</td>
</tr>
<tr>
<td>Railroads</td>
<td>6.2</td>
<td>5.1%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>120.0</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>


Continued on page 3
DEEP PATCHING WITH PREMIX

Asphalt cracks occur for different reasons and in different forms. The maintenance of each crack depends on the crack type and cause of occurrence. Deep patching with premix is used to repair alligator and slippage cracks and severe potholes.

Alligator cracks are numerous and short in length, forming small blocks which resemble the skin of an alligator. They are caused by a relatively stiff pavement which is deflected excessively. The most common cause of this failure is a spongy subgrade of unstable base material resulting from saturation of the base. Initially, alligator cracking is not critical, but it will deteriorate rapidly under traffic into other types of deficiencies such as potholes.

Slippage cracks are crescent (half-moon) cracks in the direction of traffic flow with the two ends pointing away from the direction of flow. They are caused by the asphalt concrete surfacing sliding on the underlying surface due to the lack of a tack coat. They may also occur when the pavement is deflected excessively due to the braking of heavy vehicles. For failures resulting from lack of bond, the correct repair method is spot patching with premix. When failure is caused by excessive deflection, deep patching with premix is a good solution.

Crew required:
- Equipment operators: 2
- Truck drivers: 2
- Laborer: 1
- Flagmen: 2

Equipment required:
- Dump trucks: 2
- Portable roller: 1
- Motor grader: 1
- Asphalt kettle: 1
- Grader or front end loader: 1
- Concrete saw or air compressor: 1

Material required:
- Hot premix asphalt concrete
- Liquid asphalt tack coat
- Base material (if required)
- Underdrain pipe (if required)

Repair procedure:
1. Place signs and other safety devices.
2. Break out and remove old pavement. Cut vertical edges 6 inches outside the distressed area on all sides. Make cuts square with roadway centerline.
3. Install underdrains if required.
4. Recompact base material and replace unsuitable material.
5. Apply light even tack coat of heated asphalt to the vertical sides of the area.
6. Place hot premix into area using a motor grader or by hand and spread material in layers not exceeding 3 inches. Roll each layer before applying another layer.
7. Compact the surface with a portable roller.
8. Check the surface with a straight edge to assure it is level and flush with the adjacent surface.

Continued on page 9
The uses mentioned above have all proven satisfactory time and time again; however, use of geotextiles in pavements to prevent reflection cracking have not been proven as cost effective method. You might say that its use in pavements is in somewhat of experimental stage. Geotextiles can be cost effective way of solving a problem condition and/or selection of an alternative and satisfactory method.

It is important that the correct geotextile for a specific condition be selected. This is not easy to do for the inexperienced person as noted in the above discussion. Also, proper installation is very important. It is suggested that guidelines be developed by experienced users and manufacturers of geotextiles.

As you may have noticed in the Fall issue of TechTrans, we have changed editors. The new editor wants to clean house, and you can help. Please write or call and request the publications which we advertise as available from the Center. They are free, and they are for you. (I do not need two hundred copies of Improving Guardrail Installations on Local Roads and Streets.)

You will see in this issue that we finally have video tapes. This is completely new for us, and we are very excited about building our video tape library. These tapes may be checked out from the Center for a two week period. At this time, we have seventeen different tapes available. Some tapes contain more than one presentation. We will be getting additional tapes and will let you know what they are. Again, they are free, and they are for you. Please make use of this service.

The Technology Transfer Center still has data collection equipment which we will loan to you. We will be more than happy to show you how to use the equipment and to help you analyze your data. There is frequently a short waiting list for the use of the data collection equipment, so call right away and let us know when you will be needing it.

The Technology Transfer Center is here to serve you, but you must let us know what you need. Give us your input on what subjects you are interested in—for publications, tapes, and workshops. We are here to assist our friends in Georgia. Let us know your needs.
The French colony of Saint-Pierre-et-Miquelon, located some 20 kilometers off the southern coast of Newfoundland, is said to have the second-highest concentration of automobiles in the world, after the South Pacific island of Norfolk. The total number of cars has been estimated at more than 3500, although there are only 37 kilometers of roads to serve the island's 6000 residents. Observed one native "Driving is our illusion of escape."

Motorists will be paying an average of $0.22 in state and federal taxes for every gallon of gasoline purchased, according to a new motor fuel tax survey the Highway Users Federation. State gasoline taxes average $0.13 per gallon and the federal tax is an additional $0.09 per gallon.

The Bureau of Labor Statistics reports that the average nationwide pump price was 89.5 cents-per-gallon in July, down from 95.8 cents in June. That figure includes all taxes. All federal taxes on motor fuel go into the Federal Highway Trust Fund, which finances the Federal-aid Highway Program, including Interstates and other major roads and bridges. But unless Congress passes needed legislation, money from the 9 cents-per-gallon federal gasoline tax will stop flowing back to the states.

Traffic citations issued by a governmental entity may be challenged, and you may very well lose your case. Some recent citations issued pursuant to traffic control devices (signs, signals, and markings) violations have been challenged. In some instances, governmental entities have lost their cases since the devices did not comply with the Manual of Uniform Traffic Control Devices (MUTCD) as required by state statutes.

Traffic accidents in the mineral industry, the front end loader leads all other equipment in fatalities. Most fatalities occur when the unloaded equipment is being driven from one worksite to another and most accidents occur when backing up.

The Texas Transportation Institute Proving Grounds have verified that truck tires do hydroplane. At inflation pressures of 75 psi, truck tires in the hydroplane test trough began hydroplaning at near legal highway speeds.

Results of a study performed by the Arizona Department of Transportation indicate that the standard issue surface thermometers do not provide accurate indications of the actual surface temperature. Test results suggest that temperature variations of 15-20°F can be expected between shade and sunlight aided readings and that electronic handheld temperature probes are more accurate and reliable.

The state of Oklahoma loses $11,000,000 in tax revenues every time the price of a barrel of oil drops by $1.00.

The Navy's Civil Engineering Laboratory has developed the following guidelines for removing graffiti. For crayon, china markers, and ink products, scrub with a stiff bristle brush in a warm solution of trisodium phosphate (2 oz./gallon) and water. Allow one to two minutes of solvent action and then rinse with water. To remove painted markings from unpainted surfaces, scrub with a stiff bristle brush in methylene chloride or similar commercial remover. For removal of painted markings from painted surfaces, cautiously test one of three solvent mixtures—methyl ethyl ketone, xylene, or an equal volume of the two—to determine which is the most effective.
Traffic Accidents on and Near Narrow Bridges

Better land use control around bridge sites may be an effective accident countermeasure. This is one of several conclusions resulting from a study of data on 11,889 bridges and 24,809 accidents that occurred on these bridges or within their approach areas (1). The authors, Charles K. Brinkman of the Federal Highway Administration and King K. Mak of Texas Transportation Institute, used computerized bridge and roadway inventory data files from the states of Arizona, Michigan, Montana, Texas and Washington covering a 3-year period, as the basis of a comprehensive statistical analysis to determine the relationship, if any, of accident frequency, rate, and severity to traffic and bridge and approach characteristics. For the study, a bridge was considered "narrow" according to the following definition:

- One lane, a total width of 18 feet or less
- Two lanes, a combined total width of 24 feet or less
- Total approach roadway width greater than total bridge width. These bridges were further categorized based on whether the bridge shoulder width was less than 50 percent of the approach shoulder width.

Study Criteria

Only bridges on state highway systems were studied. Ninety percent of the study bridges were in rural areas and about 80 percent were two-lane, single structures on rural arterials and collectors. About 12 percent of the study bridges were two-lane twin structures—most of these being on interstate highways.

The authors emphasize that "the study findings apply only to bridges meeting the study criteria and should not be extrapolated to bridges not meeting these criteria." In addition to the requirement of being on the state highway system, the criteria for inclusion in the study were:

- Bridges had to be overpass structures (excluding culverts) carrying mainline vehicular traffic. For twin structures filed as two separate bridges, only the first was selected for analysis.
- No traffic control signals could be on the bridges or within the approach areas to the bridges.
- All key data elements on the bridges had to be known.

About 72 percent of the single structures were found to fit the definition of "narrow." These narrow bridges were more prevalent in rural areas and on the lower functional classes. The old design practice of aligning the approach roadway to accommodate the bridge alignment resulted in most of the studied bridges being straight and level.

| Table 1. - Accident frequencies and rates by functional classification |
|------------------|------------------|------------------|
| Functional Classification | Accidents per year per bridge | Accidents per million vehicles |
| Urban: | | |
| Interstate | 2.04 | 0.517 |
| State | 3.68 | 0.932 |
| Minor arterial | 1.38 | 0.439 |
| Collector | 0.20 | 0.069 |
| Average (weighted) | 0.46 | 0.137 |
| Rural: | | |
| Interstate | 1.09 | 0.288 |
| State | 1.71 | 0.470 |
| Minor arterial | 0.71 | 0.190 |
| Collector | 0.20 | 0.059 |
| Average (weighted) | 0.38 | 0.109 |

Accident rates were computed on the basis of the bridge length plus 500 ft (152.4 m) in each direction.

| Table 2. - Distribution of accident severity |
|------------------|------------------|------------------|
| Functional Classification | Percent incapacitating and fatal injury |
| Urban: | | |
| Interstate | 6.6 |
| State | 5.6 |
| Minor arterial | 4.7 |
| Collector | 3.0 |
| Average (weighted) | 4.5 |
| Rural: | | |
| Interstate | 18.7 |
| State | 12.2 |
| Minor arterial | 9.3 |
| Collector | 6.7 |
| Average (weighted) | 11.0 |

| Lane configuration | Percent incapacitating and fatal injury |
|------------------|------------------|------------------|
| One-lane | | |
| Single-lane, undivided | 7.0 |
| Two-lane | 11.4 |
| Four-lane | 5.6 |
| Single-lane, divided | 4.1 |
| Four-lane | | |
| Total structures | 7.7 |
| Tied | 3.7 |
| Other | | |
| Overall average (weighted) | 5.9 |
**RURAL RATES HIGH**

As shown in Table 1, accident frequencies (accidents per year per bridge) were higher on urban bridges than on rural bridges. However, this result is due to the higher traffic volumes on urban bridges and thus the overall accident rate (accidents per million vehicles) was higher on rural bridges. Accident rates also increased with lower functional class.

Table 2 shows accident severity (defined as percent incapacitating and fatal injuries) according to functional classification and lane stratification. As may be seen, accident severity was significantly higher (11.4 vs 5.8 percent) on rural bridges than on urban bridges; the authors observe that this is "possibly because single-vehicle accidents were more frequently (51.9 percent) on rural bridges while multi-vehicle accidents were predominant on urban bridges." They also note that additional factors such as higher speeds on rural highways may contribute to this difference in severity.

**IMPACTS INVOLVING PARAPET ENDS SEVERE**

For single-vehicle accidents, it was found that impacts involving parapet ends resulted in incapacitating and fatal injuries in 30 percent of the reported accidents compared to only 9.5 percent and 12 percent for guardrail and bridge rail collisions, respectively.

**EFFECT OF BRIDGE NARROWNESS**

Table 3 summarizes the effect of bridge narrowness on safety. The authors caution that the higher mean accident rate for one-lane bridges wider than 18 feet than for bridges less than 18 feet in width "was not statistically significant and the sample size was too small for reliable results."

As seen in Figure 1, for two-lane undivided single structures, the mean accident rate generally decreased with increasing bridge width if the width of the bridge was less than that of the approach roadway. Perhaps surprisingly, for those bridges that were wider than the approach roadway, the mean accident rate was not highest for the narrowest bridges but for those having widths between 20 and 22 feet.

Note also that the mean accident rate for bridges narrower than the approach width were significantly higher than for bridges wider than the width of the approach up to bridge width of 20 feet. No significant difference was found for widths greater than 20 feet.

**EFFECT OF PHYSICAL AND OPERATIONAL FACTORS**

Based on their statistical analysis of the data, the authors list, in order of importance, the physical and operational factors that distinguish "bridges with accidents" from "bridges with no accidents":

- Average daily traffic
- Roadside distraction
- Percent shoulder reduction
- Degree of bridge curvature
- Curb presence
- Bridge length
- Approach curvature
- Delineation

The authors are careful to note, however, that these variables "are not necessarily causal factors."

The study findings also "indicated that accident severity on bridges is little affected by the physical and operational characteristics at the bridge sites."

As helpful as accident studies may be, they are limited by a number of factors such as inaccurate accident locations and the large sample sizes necessary. Thus, the authors observe, "safety design decisions also must be based on the pure physics of the problem, traffic operational measures of effectiveness, and human factors research."

An in-depth study of 124 single-vehicle bridge accidents in which the first impact was with a guardrail, bridge parapet end, or approach guardrail, revealed that one-quarter of the vehicles were yawing at greater than 30 degrees at impact. Since yawing could increase the severity of impacts with bridge rail or parapet and guardrail ends, the authors suggest that yawing "possibly should be a parameter in the design of barrier systems."

The overall conclusion of the report is that "bridges are more dangerous than the highway system as a whole, and narrow

**HAVE YOU HEARD THIS ONE?**

This conversation was heard between a foreman and a project manager. The foreman called from the field to say that his crew got out to the job site and discovered they had forgotten their shovels. The manager's response was, "Well, they will have to send someone back to the shop to get the shovels. In the meantime, though, the workers can lean on each other."

bridges can be a safety problem." As noted earlier and below, the results of the study can assist in identifying safety problems and possible countermeasures. The authors caution, however, that "It is essential to maintain design consistency in applying bridge accident countermeasures so that driver expectancy will not be violated; the application of countermeasures should be considered both on an individual basis and on a systemwide basis."

Acknowledging the above caveats, the following may be inferred from the study results:
The Technology Transfer Center is beginning a video tape library. The VHS tapes listed below may be borrowed, at no charge, for a two week period. Please phone or write and request no more than two tapes at a time. Specify the tapes you want by the number in the left hand column.

ST-201 The Winners—The Losers (13 minutes)
Safe use of lift trucks including inspection and hazards facing operators.

M-201 The Snowfighters (24 minutes)
Methods, procedures, and equipment for snow removal on streets and highways.

M-202 Down Is Up (20 minutes)
Preventive maintenance is stressed to reduce down time on construction sites.

M-203 The Choice Is Yours (18 minutes)
Preventive maintenance on diesel engines is stressed to get maximum life from the engine.

M-204 Signals: Read 'Em or Weep (20 minutes)
Indications of problems with equipment.

M-208 Roadway Maintenance Cost Analysis—Part I (50 minutes)
Discusses equipment costs including depreciation, fuel, oil, grease, maintenance, repair, and capital investment.

M-209 Roadway Maintenance Cost Analysis—Part III (50 minutes)
Discusses the cost of deferred maintenance.

M-210 Maintenance of Highway Safety Hardware (45 minutes)
How to provide safe roadside environments through periodic maintenance of the road side and its safety hardware.

M-211 Maintaining Granular Surfaced Roads (18 minutes)
Instructional guide to enable road grader operators to provide better maintenance of granular surfaced roads.

M-212 Ditchmaster (10 minutes)
Demonstration of the ditchmaster, a cost effective machine for improving roadside drainage and maintenance.

Lee-Boy Asphalt Maintainer (15 minutes)
Demonstration of the Lee-Boy, an asphalt maintenance machine.

Rosco Asphaltite Maintainer (15 minutes)
Demonstration of a pot hole repair machine.
Spot patching with premix is commonly used to repair potholes which are caused by poor design or construction practices such as too thin an asphalt surface, poor drainage or inadequate base. During bad weather, temporary repairs can be made to eliminate the potholes. This involves cleaning out the hole and filling it with premixed patching material. However, as soon as possible permanent repairs should be made by spot patching with premix.

**Crew required:**
- Truck driver 1
- Laborers 2
- Flagmen 2

**Equipment required:**
- Dump truck 1
- Portable roller or vibrating tamper 1

**Material required:**
- Hot asphalt concrete
- Liquid asphalt tack coat

**Repair procedure:**
1. Place signs and other safety control devices.
2. Cut a neat vertical edge with saw or jackhammer 4-6 inches outside the distressed area on all sides. Make cuts square with roadway dimensions.
3. Clean hole of debris and as much water as possible. Heat with torch if necessary.
4. Apply a tack coat to the vertical sides and bottom of the hole. The heated asphalt should be light and uniform.
5. Place hot asphalt concrete premix into the hole to be patched with layers not exceeding 3 inches and roll surface.
WORKSHOPS AND COURSES

USING THE NACE ACTION GUIDES AND TRAINING GUIDES
April 9 - 10, 1987
Atlanta, Georgia

This workshop is a one-and-a-half-day discussion of the 21 NACE Action Guides and 7 NACE Training Guides. The Action Guides offer county engineers and other public works executives guidance on the management and technical aspects of local roads and similar public works activities. The Training Guides are aids to training road crews and crew foremen. They will be provided as course materials.

The workshop will be held at the Radisson Inn in Atlanta. The registration fee is $20.00. If you plan to attend, please let us know by March 25, 1987.

SURFACE TREATMENT WORKSHOP
February 3, 4, and 5, 1987
Atlanta, Macon, Tifton

The Technology Transfer Center and the Georgia Department of Transportation will offer three workshops on Surface Treatment. The workshop will explore the different types of surface treatment and their applications, advantages and disadvantages of surface treatment, materials and equipment which could be utilized, and inspection techniques.

The workshops will be held in the following locations on the following dates:

- Atlanta: February 3, 1987
  (GDOT Research Lab—Auditorium)
- Macon: February 4, 1987
  (Farmer's Market—Conference room)
- Tifton: February 5, 1987
  (District DOT Office—Conference room)

These workshops are offered at no charge, and course materials will be provided. Please let us know by January 25 if you plan to attend.

CIVIL ENGINEERING REFRESHER COURSE
February 28 - March 28, 1987
Atlanta, Georgia

This refresher course in the fundamentals of Civil Engineering is intended to help those persons preparing for the Civil Engineering portion of the Professional Engineer's Examination this year. This course will be held for five consecutive Saturdays from 9:00 a.m. to 4:00 p.m. beginning on Saturday, February 28.

Topics include:
- Structures
- Engineering Economy
- Surveying
- Hydraulics
- Soil Mechanics
- Transportation Engineering
- Environmental Engineering
- Materials of Construction

The course fee is $300.00 and includes all necessary classroom materials. To register by telephone, please call (404)894-2400. Also, brochures are available from the Technology Transfer Center. Please register by February 18.

This course is a continuing education course, and participants who successfully complete the course will earn 3.0 Continuing Education Units.
Copies of the following publications are available free from the Technology Transfer Center:

- **CALIBRATION PROCEDURES FOR ROADMETERS**
  Federal Highway Administration, 1986
  This study, conducted by the Georgia Department of Transportation, compared roughness measuring devices in a carefully controlled field testing program. Using the results, a correlation program was conducted and a recommended calibration procedure was developed for response-type devices.

- **COMPARISON OF THREE COMPACTORS USED IN POTHOLE-REPAIR**
  U.S. Army Corps of Engineers, 1984
  This report is a summary of the results of a compaction study using recycled hot mix asphalt concrete conducted during August 1983 in an indoor facility at CRREL in Hanover, New Hampshire. This study compared three kinds of compactors for optimum performance, and also considered such factors as temperature of the asphalt concrete mix, number of passes, size and depth of patches, and the number of lifts to fill the holes.

- **COUNTMEASURES FOR SIGN VANDALISM**
  Federal Highway Administration, 1986
  This manual describes how the nature and magnitude of a highway agency's sign vandalism problem can be determined, and the various countermeasures available. It presents guidelines for planning, implementing and evaluating anti-vandalism countermeasure program activities.

- **CULVERT INSPECTION MANUAL**
  Federal Highway Administration, 1986
  The Culvert Inspection Manual provides practical guidelines and procedures for inspecting the various types of box, pipe and long span culverts. Inspection procedures are outlined and illustrated in detail. Sample documentation forms are provided for recording each inspection. This manual is a supplement to the Bridge Inspector's Training Manual and was prepared in accordance with its procedures and rating systems.

- **DETECTING WOOD BRIDGES - INSPECTION AND PREVENTIVE & BENEFICIAL MAINTENANCE**
  U.S. Department of Agriculture, 1985
  This manual provides information on the characteristics of decay in wood bridges to aid bridge inspectors and bridge maintenance crews.

- **FIELD MAINTENANCE MANUAL FOR GEORGIA COUNTIES LOCAL ROADS AND STREETS**
  Georgia Department of Transportation, 1977
  This manual has been prepared to assist maintenance personnel in Georgia counties to identify roadway deficiencies and to determine the best procedures for correcting them. The manual is intended for use on a daily basis by field personnel and not as a shelf reference by top management.

- **IMPROVING GUARDRAIL INSTALLATIONS ON LOCAL ROADS AND STREETS**
  Federal Highway Administration, 1986
  This pamphlet is intended as a general guide to effective, low cost methods of enhancing highway safety with guardrail. The guidelines and recommendations included are based on actual situations and observations found in a series of national reviews. They reflect the actual needs and opportunities for highway safety improvements existing on many local road and streets.

- **RAILROAD-HIGHWAY GRADE CROSSING HANDBOOK, 2ND EDITION**
  Federal Highway Administration, 1986
  This handbook provides general information on railroad-highway at-grade crossings, including the physical and operational devices recommended for use at crossings and procedures for analyzing the traffic hazards present at crossings. Also included are statistical data on the 200,000+ crossings currently in active use. This handbook is an updated version of a previously distributed handbook.

- **WORK ZONE TRAFFIC CONTROL: STANDARDS AND GUIDELINES**
  U.S. Department of Transportation, 1980
  This publication is a reproduction of Part VI of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD). The standards contained in this
The following publications may be ordered from the Federal Highway Administration. Specify by report number, and send requests to: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161

* CONCRETE REMOVAL WITH ABRASIVE JET Report No. FHWA-TS-85-221 ($9.95)

This report provides an introduction of the waterjet techniques; a description of the abrasive waterjet system equipment used in the testing, and a discussion of the test results.

* IMPROVED METHODS FOR PATCHING ON HIGH-VOLUME ROADS Report No. FHWA/RD-86/076 ($16.95)

In 1983, a Federal Highway Administration contract study was initiated to identify and evaluate methods for patching pavement defects on high-volume roadways. Included within the scope of the work was the development and offering of suggestions for the improvement of the identified patching methods.

* STATE-OF-THE-PRACTICE RETRO-REFLECTIVE MEASUREMENT DEVICES FOR PAVEMENT MARKINGS Report No. FHWA-TS-84-222 ($11.95)

This implementation project was conducted to identify the current usage and availability of instruments used for making retroreflective measurements of pavement markings, as well as associated standards and causes of retroreflection from pavement markings.
RURAL TWO-LANE HIGHWAYS MOST HAZARDOUS

Rural, two-lane highways comprise 97 percent of the total rural highways in the United States. Travel on this two-lane system amounts to 66 percent of rural highway travel and 30 percent of all U.S. highway travel. The accident rate on these highways is higher than that on all other kinds of rural highways except four-lane, undivided roads. Two-lane, rural highways also have a higher percentage of both head-on and single-vehicle accidents than any other kind of rural highway. An FHWA study of safety problems on the two-lane, rural system revealed the following:

*Intersections, horizontal curves and bridges show the highest probability of accidents.

*Low-cost safety improvements such as signing and delineation tend to give high benefit-cost ratios even when the accident effectiveness is small.

*If a signing project reduces accidents to any degree, usually it will be cost-effective.

*High priority should be placed on standardizing traffic control devices, being careful to avoid unnecessary signs.

Although signing and delineation improvements were found to be "highly cost effective," other cost effective improvements included the following:

o placement of centerlines on curves,

o placement of guardrails on the outside of curves,

o pavement marking at intersections,

o low-cost sight distance improvements at intersections.

The study results indicated that $4 billion to $9 billion in safety funds for two-lane, rural highways may be justified over the next 20 years.

The problems and needs of agencies having jurisdiction over two-lane, rural highways are unique. A vast network of highways must be managed, and on most of the highways the occurrence of an accident is rare. Determining whether a section of, or particular spot on, a highway truly constitutes a safety hazard is difficult, and treating such a hazard often is not cost effective.

The goal at the federal level then is to support the optimization process at the state and local levels by providing training in processes for improving safety; analysis procedures and programs; general guidelines on countermeasures; benefit-cost effectiveness; and detailed statistical data on accident rates, accident severeness and kinds, accident-reduction factors, operational benefits, and improvement costs and service lives.

Reprinted from Northwest Technology Transfer Center Bulletin, Winter 1985, No. 5).
The Georgia Tech Technology Transfer Center is very happy to be presenting a workshop on the NACE Action Guides and Training Guides. (More details are given in the workshop announcement in the back of this issue.) This workshop is the first workshop that the Technology Transfer Center has held here on campus. We hope that this location will be convenient for everyone involved; because we want you to see us in our natural habitat. Please note that the NACE Action Guides and Training Guides (a $95 retail value) will be provided as course materials. Call as soon as possible to register, as space is limited.

Our video tape library continues to grow. A listing of the tapes which we have acquired since the winter issue of Tech Trans is given in the back of this issue. (If you have lost your copy of the original list, please contact the Center, and we will provide you with another one.) We have had many requests for video tapes already, but there is certainly room for improvement in the response. Please contact the Technology Transfer Center and request the tapes you need. If they are already checked out, we can put you on a waiting list.

The data collection equipment will soon be available again. Call and sign up to get this equipment for your spring counts!

Thank you to everyone who helped clean out the office by requesting publications. Unfortunately, everyone seemed to want the ones of which we only had ten or fifteen. There are still plenty of the following publications:

- **Comparison of Three Compactors Used in Pothole Repair**
- **Improving Guardrail Installations on Local Roads and Streets**

We will provide multiple copies of these publications with great reluctance.

As editor of Tech Trans, I am very interested in having you contribute to this publication. You can help to "transfer technology." Write an article about innovative practices that you have tried and your experience with it, good or bad. You might also want to contribute an article about someone in your agency who is particularly outstanding. Maybe you just want to let the rest of Georgia know what is going on in your area. If you have information which you feel would benefit the rest of us, let us know. You may get your name in print! Thanks!
MAINTENANCE TIPS
UNPAVED SHOULDER
REPAIR

RESHAPING SHOULDERS

When rutting, corrugations, or ridges occur on an unpaved shoulder, the reshaping of the shoulder becomes necessary. Ruts, corrugations, and ridges in earth shoulders are caused by erosion and/or improper compaction of the shoulder material. These deficiencies are normally found in shoulders with slopes greater than 5:1 and in shoulders that have little or no ground cover to prevent erosion. Corrugations may show up in newly reconditioned shoulders within 6 months after construction. Initial ruts, corrugations, and ridges are not a severe deficiency. However, if they are allowed to remain they will create drainage problems that may result in areas of low shoulder and hazardous driving conditions for vehicles.

Crew required:
- Equipment operator: 1
- Laborers: 2
- Flagmen: 1

Equipment required:
- Motor grader: 1

Material required:
- None

Repair procedure:
1. Place signs and other safety control devices.
2. Remove roadway signs and mailboxes from shoulder to be repaired.
3. Cut high spots with motor grader, pulling material toward the roadway.
4. Blade the material back onto the shoulder making sure all low spots are filled. Make certain the new shoulder is level with the adjacent pavement and sloped toward the ditch to permit drainage of water.
5. Roll with motor grader wheels to compact loose material.
6. Replace signs and mailboxes.
7. Clean up area and remove signs.

RECONDITIONING SHOULDERS

When unpaved shoulders are high, low, or narrow, they should be repaired by reconditioning the shoulder.

High shoulders are those in which the shoulder surface is higher than the adjacent pavement, preventing pavement drainage. They are caused by buildup of vegetation along the shoulders or improper drainage of shoulder allowing the buildup of earth.

A low shoulder is one where the surface of the shoulder is below the surface of the adjoining pavement. It is caused by a buildup of the pavement surface and settlement or erosion of the shoulder. Often pavements are overlaid causing a rise above the shoulder equal to the depth of the overlay. This condition creates a safety hazard for the driver. Low shoulders may also result in wide gaps at the pavement-shoulder joint, allowing water to penetrate into the subgrade and cause edge or alligator cracking.

Narrow shoulders are those which are too narrow to permit a vehicle from pulling completely clear of the roadway (less than 8 feet wide). Most narrow shoulders are the result of insufficient width of right-of-way at time of construction or decrease of shoulder width due to widening of the pavement. Narrow shoulders are not a serious deficiency as long as a minimum shoulder width of 4 feet is maintained at all times and areas 8 feet wide are provided at intervals of every one-half to one mile.

Crew required:
- Equipment operators: 2
- Truck drivers: 2
- Laborers: 2
- Flagmen: 2

CONTINUED ON PAGE 5
Local government offers the most for the money when compared to second-place federal and third-place state governments, according to "1986 Changing Attitudes on Government and Taxes." The Gallup survey, for the Advisory Commission on Intergovernmental Relations, found that local government has been rated at the top, or tied for the top, five times since 1972. Responses to other important questions involving local, state, and federal government can be found in the report, available for $3 from the Commission in Washington, DC 20575.

In the course of a single project, Aiken County, South Carolina, obtained a landfill without buying or preparing the land, reclaimed strip-mined areas, made money from solid wastes, and fostered public/private cooperation.

The county saved $3 million by renting a former strip mine for $1 per year. Its 60-acre capacity was filled with solid wastes and covered. Grass and trees were planted. The company that formerly used the mine contracted to mine the methane gas generated from the landfill. Another firm constructed 22 shallow wells to tap the gas and pipe it to a nearby plant.

The completed landfill became a revenue producer. The former mine owner pays Aiken County a royalty for the gas ($1,600 in the first year of production). Project start-up costs were privately funded and no cost to the county. The mine owner meets its annual fuel needs at a 25% savings. An estimated 300,000 cubic feet of methane gas is produced daily, enough to heat 300 houses for one year.

Ceremonies at Auburn University, Auburn, Alabama, an agreement was signed between the National Asphalt Pavement Association (NAPA), Education Foundation and Auburn University formally establishing the National Center for Asphalt Technology (NCAT), a national center for research into 11 phases of asphalt pavement design, construction and performance.

The NCAT is a scientific and technical research institute under the funding auspices of the NAPA Education Foundation which also acts as a central repository and distribution center for all manner of resources and information on asphalt. Headquartered at Auburn University, the center will provide a national and international focus to conduct asphalt research, to develop model education and training programs and to provide methods for bridging the gap between theory and field practice.

A new and innovative informational exchange, the Steel Bridge Forum, has been established to communicate to all involved in the bridge market the latest ideas for improving the cost effectiveness and performance of the nation's steel bridges. The Forum currently functions under the auspices of the American Iron and Steel Institute (AISI).

Its activities—promulgating the most successful bridge design, construction and rehabilitation techniques—will reflect the needs and interest of all key groups involved with steel bridges. These include owners, consulting engineers, general contractors, steel producers, steel fabricators and erectors.

Highway construction costs increased 4.1% in the third quarter of 1986, notes Federal Highway Administrator Ray Barnhart. This increase coupled with delays in construction starts caused by the failure of Congress to agree on the Highway Program Reauthorization may continue to hike project costs.

Hollywood, Florida, has saved money by contracting out for vehicle repairs. In April 1985, the city entered into an agreement with the Sheridan Vocational Technical Center under which the center's students do auto body repairs on all city-owned vehicles.

The program has worked very well. An average of six vehicles per month are brought to the center for repair. Hollywood has reduced auto body repair.
expenses about 40%. The city projects a savings of $17,853 over the first full year of the program's operation. In addition, average turnaround time has been reduced from 30 days to 18 days. Students doing the work are supervised carefully and the quality of the repairs has been excellent.

Reauthorization of the federal-aid highway program will be top Senate priority in 1987, according to Quentin Burdick (D.-N.D.), incoming chairman of the Senate Environment and Public Works Committee. During a meeting of the American Transportation Advisory Council last November, held at the American Road & Transportation Builders Association (ARTBA) headquarters, he assured industry leaders of early action.

Burdick told ATAC members that he and outgoing committee chairman Sen. Robert Stafford (R.-Vt) would work closely together to guide the highway bill quickly through committee. He predicted the full Senate would consider the highway bill shortly after repassing the Clean Water Act, vetoed by President Ronald Reagan in November.

The new chairman said he believed the differences existing between the Senate and House versions of the reauthorization legislation could be resolved. He suggested that compromises already reached in the 99th Congress' conference committee should stand.

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FROM PAGE 3

Equipment required:

- Dump trucks: 2-4
- Roller: 1
- Motor grader: 1
- Front end loader: 1

Material required:

- Gravel or imported borrow

Repair procedure:

1. Place signs and other safety devices.
2. Remove roadway signs and mailboxes on shoulder.
3. Cut shoulder wedge approximately 4 inches deep at pavement edge and slope to desired shoulder width (8 foot minimum if right-of-way available, 4 foot absolute minimum).
4. Work material cut from shoulder back into wedge. If additional material is required, spread material from truck and work in with motor grader. If excess material at shoulder, remove and haul away.
5. Shape shoulder with motor grader to conform with roadway and slope toward ditch.
6. Roll as required for proper compaction.
7. Replace roadway signs and mailboxes.
8. Clean up area and remove signs.
Secretary of Transportation Elizabeth Hanford Dole recently reported that "more motorists than ever before are buckling up" and that "the increased usage of safety belts is saving hundreds of lives."

The Secretary said a new DOT survey in 19 major cities—conducted the first six months of 1986—found that safety belt use by drivers reached 34.2 percent, up from 23 percent a year ago.

"Safety belt usage in the United States is on the rise as more and more Americans realize the importance of protecting themselves when riding in cars," Secretary Dole said. "Since 1982, when we began a national effort to encourage belt use, usage has more than tripled. But more importantly, many lives have been saved and countless injuries have been reduced in severity or avoided altogether."

The Secretary said there was a seven percent reduction in front seat occupant fatalities in eight states that had mandatory safety belt use laws in effect for at least part of 1985.

"The increase in usage is helped considerably by belt use laws that have been enacted in 26 states and the District of Columbia," she said.

The Secretary noted that states with belt laws reported increases in use from an estimated 15 to 20 percent before a law to about 40 to 50 percent after a law became effective. Two states, Hawaii and Connecticut, report belt use above 70 percent.

"The full benefits of safety belts will be realized only when all occupants buckle up every time they get in an automobile," the Secretary said. "Belgium, Germany and the United Kingdom have shown that belt use rates over 90 percent can be achieved and sustained."

Secretary Dole also noted that the 19-city survey showed the percent of children in cars who were in child safety seats was 68.4 percent compared to 56.2 percent for the July-December 1985 reporting period. She said the rate for toddlers (ages 1-4) was 68.8 percent and the usage rate for infants (under 1 year of age) was 63.7 percent. All 50 states have laws requiring children to be protected while riding in cars.

The DOT survey, which was first initiated more than a decade ago, includes these cities: Boston, MA, Providence, RI, New York, NY, Baltimore, MD, Pittsburgh, PA, Chicago, IL, Minneapolis/St. Paul, MN, Fargo/Moorhead, ND, Miami, FL, Atlanta, GA, Birmingham, AL, New Orleans, LA, Seattle, WA, San Francisco, CA, San Diego, CA, Los Angeles, CA, Phoenix, AZ, Houston, TX, and Dallas, TX.

One of the Federal Highway Administrator's primary concerns is the safety of motorists, pedestrians, and construction workers on federal-aid projects. Work zone safety is not a new issue, but it is a persistent one.

More than 10 years ago, FHWA initiated a rulemaking that resulted in requirements for stricter traffic control through and around construction areas. We took some heat on this 1978 rule from some of the states and from the construction industry, but we believe its implementation has helped to improve work zone safety and traffic flow.

Today, maintaining the safety of work zones requires more vigilance than ever due to the increasing amount of resurfacing, restoration, rehabilitation and reconstruction work spurred by the 1982 Surface Transportation Assistance Act. This work has led to increased congestion and accidents, and some serious problems are occurring.

For example, increased exposure over the last four years has resulted in a rise in work zone fatalities from about 500 in 1982 to about 700 last year. During this period, work zone fatalities just on the Interstate system increased from about 90 to 200. This increase is of concern even considering that the Interstate system carries high traffic volumes and has experienced an increase in the number of construction and maintenance projects.

The most common type of work zone fatality during daylight hours involves vehicle-to-vehicle collisions. This points out the need to provide proper guidance and information to the driver so that he will know what to expect and what action to take.

More than 50 percent of work zone fatalities occur at night, usually when a vehicle collides with a fixed object, such as a roadside barrier or barricade. This indicates that we need to properly place and maintain these devices and provide clear delineation.

Occasionally, I hear that drunk drivers are the cause of a disproportionate number of work zone accidents. Our analyses have found that alcohol involvement is about the same for work zone fatalities as for all highway fatalities. However, it is apparent that all drivers, whether impaired or not, will have difficulty negotiating a poorly delineated work zone.

Interestingly, tractor trailers are over-represented in work zone fatalities. Normally, tractor trailers are involved in about 10 percent of all fatal accidents. In work zones, they are involved in more than 20 percent of fatalities. Pedestrians in work zones, particularly workers, also experience a higher than average fatality rate.

All in all, this accident data shows that there has been a rising trend in work zone fatalities and we have a legitimate cause for concern.

We know that the safest work zone is one where there is no traffic, but in most cases, detouring traffic around a work area is not possible. The next best solution is to develop effective traffic control plans.

CONTINUED ON PAGE 9
Thomas D. Moreland, Commissioner of the Department of Transportation, reports that 1986 legislation included HB 705, a single-bid bill. This bill authorizes the department to award contracts when only one bid is submitted for state-funded and federal-aid projects. Before enactment, the department was prohibited by law from awarding such contracts. Over the past year alone, Moreland says, the old law required rebidding of 119 projects, many of which were in rural areas. The new law continues to reserve the right of the department to reject single bids when deemed appropriate. The new law also authorizes the department to negotiate with the lone bidder on state-funded projects, if the bid exceeds the department's cost estimate.

HB 1259 covered fiscal year 1986 state supplemental appropriations. State budget surpluses in recent years have allowed state lawmakers to begin funding Georgia's Economic Development Highway Program—a 2,500-mile, $4.5-billion, state-funded system of multi-lane highways designed to link communities with the Interstate system. The department was budgeted $80 million to continue work on two segments of this system—the Appalachian Highway in North Georgia and Corridor Z, and east-west route in South Georgia. Since motor fuel tax funds go directly to the DOT and are used for funding the regular highway program, funds for the Developmental Highway Program come from state general funds. Also, supplemental funds totaling $24 million were appropriated for Georgia's Local Assistance Roads Program.

HB 1300 covered general appropriations. The department was budgeted an additional $20 million in general funds for the Economic Development Highway Program. This appropriation authorized work on new parts of the system.

HB 1320 made it a felony to interfere by violent means with DOT enforcement officers in the discharge of their duties. These officers enforce laws governing commercial trucking.
ACKNOWLEDGEMENT

The Technology Transfer (T2) Program is a nationwide effort financed jointly by the Federal Highway Administration and individual State Departments of Transportation. Its purpose is to translate into understandable terms the latest state-of-art technologies in the areas of roads, bridges, and public transportation, to local and county highway and transportation personnel.

The T2 Center at Georgia Tech is sponsored by the Georgia Department of Transportation and provides information and counsel to more than 500 municipalities and counties in our state. This newsletter is designed to keep you informed about new publications, new techniques, and new training opportunities that may be helpful to you and your community. Individuals wishing to receive future copies of this newsletter at no cost may send their requests to:

M. John Moskaluk  
Technology Transfer Center  
School of Civil Engineering  
Georgia Tech  
Atlanta, GA 30332

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FROM PAGE 7

(TCPs) which provide a safe working environment while maintaining a smooth flow of traffic.

Safe traffic handling has to be designed into the project, not added as an afterthought. Preconstruction strategies favored by FHWA include: improving traffic engineering on alternative routes; promoting the use of high-occupancy vehicle (HOV) lanes; using incentive/disincentive clauses in contracts to accelerate construction progress; and, early coordination with community officials, the public and contractors.

To emphasize the need for greater use of these strategies, a national conference was held this September in Chicago, hosted by FHWA and the Transportation Research Board.

However, the best TCP in the world is no good unless it is properly implemented during construction. One growing problem is driver disregard for traffic control devices in work zone areas. Contractors and government officials must be certain they are not contributing to the problem by allowing the use of inappropriate and improperly maintained signaling devices. These result in driver disrespect and poor compliance.

Work zones should be reviewed frequently by other than project personnel to assess the effectiveness of the traffic control procedures. These assessments are useful for identifying successful procedures and techniques as well as areas needing improvement.

Last, but not least, we must recognize that despite diligent planning and design, certain strategies may not work on any given project. A willingness to make changes where necessary is vital.

Other areas that need improvement include work zone accident analysis, training of flaggers and other workers, and public information and education. FHWA will be emphasizing these in the future.


IT'S AS CLOSE AS YOUR PHONE.  
CALL 1-800-282-1275
A WORKSHOP ON:
NACE ACTION AND TRAINING GUIDES
ATLANTA, GEORGIA
APRIL 9 AND 10, 1987

This workshop is a one-and-a-half-day discussion of the 21 NACE Action Guides and 7 NACE Training Guides. The Action Guides offer county engineers and other public works executives guidance on the management and technical aspects of local roads and similar public works activities. The training guides are aids to training road crews and crew foremen. These guides are a $95 value and will be provided at no charge as course material.

The workshop will be held at Georgia Tech in Room 215 of the Instructional Center. (The location of this workshop has been changed since the last newsletter and the brochure have gone out, so please make note of this correction.) There is no registration fee, but it is necessary that you register as soon as possible, since space is limited.

* COMPARISON OF THREE COMPACTORS USED IN POTHOLE-REPAIR
U.S. Army Corps of Engineers, 1984

This report is a summary of the results of a compaction study using recycled hot mix asphalt concrete conducted during August 1983 in an indoor facility at CRREL in Hanover, New Hampshire. This study compared three kinds of compactors for optimum performance, and also considered such factors as temperature of the asphalt concrete mix, number of passes, size and depth of patches, and the number of lifts to fill the holes.

* IMPROVING GUARDRAIL INSTALLATIONS ON LOCAL ROADS AND STREETS
Federal Highway Administration, 1986

This pamphlet is intended as a general guide to effective, low cost methods of enhancing highway safety with guardrail. The guidelines and recommendations included are based on actual situations and observations found in a series of national reviews. They reflect the actual needs and opportunities for highway safety improvements existing on many local road and streets.
The Technology Transfer Center now has a video tape library. The VHS tapes listed below have recently been added to the library. (Please check the winter issue of Tech Trans for the previous listing.) The tapes may be borrowed, at no charge, for a two week period. Please write or phone and request no more than two tapes at a time. Specify the tapes you want by the number in the left hand column.

**DC-204** Tied Concrete Shoulder (10 minutes)
Shows construction of tied concrete shoulders, undersealing of existing pavement and full-depth repair of the pavement.

Recycling D-Cracked Concrete Pavement (12 minutes)
Discusses the reasons for the use of concrete recycling over conventional methods of construction.

**Bonded Concrete Overlay (12 minutes)**
Shows a bonded concrete overlay on existing concrete pavement.

**DC-205** Interstate Reconstruction - Part I (12 minutes)
Recycling existing D-Cracked pavement as aggregate for new concrete pavement.

Whitetopping (7 minutes)
Discusses placing a concrete overlay on distressed asphalt concrete.

**Design for Quality (12 minutes)**
Shows recycling of concrete pavement and replacement with continuously reinforced concrete pavement, bonded concrete overlay and tied concrete shoulders.

**DC-206** Interstate Reconstruction - Part II (13 minutes)
Shows add-on tied concrete shoulders, diamond grinding for smoothness and establishing new transverse joints.

Recycling Continuously Reinforced Concrete Pavement (10 minutes)
Shows the recycling of existing continuously reinforced concrete pavement as aggregate for new concrete pavement.

**Unbonded Concrete Overlay (12 minutes)**
Construction of a full-depth unbonded overlay over a reinforced concrete pavement.

**DC-207** Testing of Asphalt Cement (24 minutes)
Procedures for various tests of asphalt cement including flashpoint, penetration, ductility, solubility, spot softening point, specific gravity and thin film over tests.

**Determination of Asphalt Content in Paving Mixtures (20 minutes)**
Procedures for determining asphalt content for proper life and serviceability of asphalt cement.

**Budgeting for Rehabilitation (25 minutes)**
Present economic situation of restoring paved highways and evaluation of pavements for determination of priority for restoration.

**Asphalt Emulsion Spray Applications (20 minutes)**
Reasons for using asphalt emulsions, what constitutes asphalt emulsions, how they work, and processes for applying asphalt emulsions.

**Aggregate Blends (40 minutes)**
Demonstrates graphical procedure for blending aggregate sources to meet proper specifications.

**DC-208** AASHO Road Test

Construction and Materials (27 minutes)
Discusses materials and construction of extensive test facilities constructed in 1956 by AASHO to test different types of road surfacings, bases, bridges and methods of construction.

**Pavement Research (37 minutes)**
Objectives, methods, and principle results of pavement research in the AASHO Road Test.

**The Road to Better Roads (14 minutes)**
Summarizes the purposes and procedures of the AASHO Road Test and discusses what is being done today to improve roads.
Accident reports can be a valuable tool in helping you find problem areas, but sometimes they can be more humorous than helpful. The statements below are taken from actual insurance forms.

* Coming home, I drove into the wrong house and collided with a tree I don't have.
* I collided with a stationary truck coming the other way.
* I had been driving over 40 years when I fell asleep at the wheel and had an accident.
* The indirect cause of the accident was a little guy in a small car with a big mouth.
* The other car collided with mine without giving warning of its intentions.

* I had been shopping for plants all day and was on my way home. As I reached an intersection, a hedge sprang up obscuring my vision, and I did not see the other car.
* My car was legally parked as it backed into the other vehicle.
* I told the police that I was not injured, but on removing my hat found that I had a fractured skull.
* In my attempt to kill a fly, I drove into a telephone pole.
* I was on my way to the doctor with rear-end trouble when my universal joint gave way, causing me to have an accident.
Mowing accidents are costly in terms of both human suffering and equipment damage. All tractors and mowing machine operators should be thoroughly trained in proper handling of their equipment, as well as proper mowing techniques. The following operator tips should help reduce accidents that occur while driving and operating mowing machines:

- Wear only high-top work shoes or boots that are in good condition. Never wear tennis shoes while operating a mower. Clothing should fit well and not have large or heavy cuffs. Loose jewelry that might become caught in the machine's moving parts should not be worn.

- Never operate a mower that has a serious mechanical defect. If there is any indication that the mower is not in good working order, have it checked before taking it out into the field. Make sure that your machine is up-to-date on its maintenance upkeep.

- Never climb onto or off the tractor while it is in motion. Maintain three points of contact (for example, both hands and one foot) while getting on or off the tractor. Fasten your seat belt before starting the engine. It is a proven fact that the safest place you can be in the event of a tractor accident is belted on the machine within the protection of the safety frame.

- Never allow any passengers on the tractor. Tractors are designed for only one person—the operator—and additional riders can disturb the stability of the machine. Also, never allow anyone to stand between the tractor and the mowing implement. Any sudden movement of either could cause a serious injury.

- Put all gear shift levers in the neutral or park position before attempting to start the engine. If your tractor has a standard transmission, depress the clutch before starting the engine.

**Driving on Public Roadways**

Exercise extreme caution while driving and maneuvering the tractor on public roadways. The operator is responsible for keeping the mower under control at all times. Driving at excessive speeds results in a large number of tractor accidents. The risk of overturning increases when the tractor is being driven at road speeds. Quick maneuvers also increase the likelihood of overturning and must be avoided. Some tractors can be overturned by turning too quickly at only 8 m.p.h. or less on level ground. Using the brakes while turning can also cause the tractor to overturn.

Twenty-five percent of all tractor fatalities each year occur when the tractor is being driven on public roads and highways. Many of these accidents are related to the fact that the tractor is driven at a much slower speed than other traffic. Before taking your machine out on the highway, always be sure that it has prominently displayed slow-moving vehicle signs, as well as working warning flags and lights.

Operating the tractor at high speeds on the highway is extremely dangerous. It can cause the tractor to go out of control and run off the road, or cause the mowing implement to hit a fixed obstruction. If
EDITOR'S NOTE

The Technology Transfer Center wishes Mr. Tom Moreland all the best in his future endeavors. We welcome Mr. Hai Rives as the new Commissioner and hope that he will continue to support the Center in the future as Mr. Moreland has in the past.

A total of 94 persons participated in the Surface Treatment Workshops which were held recently. We appreciate the work of the GDOT in making this workshop possible. We are especially grateful to our instructors, Otis Babcock, Gene Slaughter, and Bob Adams.

We have two workshops coming up very soon. A workshop dealing with the new uses of geotextiles will be held in late June. Workshops on the transportation applications for microcomputers will be held at various locations in mid-July. Be looking for announcements concerning these workshops.

I would like to call your attention to the article on page three of this issue entitled, The Value of Training. This article is a good background for my sales pitch concerning the Technology Transfer Center. It discusses the importance of keeping up with current technology through workshops, conferences, and courses. You are in us, the Technology Transfer Center, a wonderful opportunity to do just that. We are here to provide training and information to you at little or no cost to you or your organization. I urge you to take advantage of our services, and then let your managers and elected officials know how you benefited. We need your moral support to maintain our financial support.

CONTINUED ON PAGE 4
THE VALUE OF TRAINING

by Harry Bisco, P.E.
Director of Public Works
City of Allentown, Pennsylvania

Practically everyone is qualified for a job when first employed by a firm or municipality. That is, if the person interviewing us for the position does his interview properly. By virtue of our education, training, or experience, or by a combination of all three, we are selected to begin work for that particular firm or municipality. After a trial period, usually 90 days, we become permanent employees, and along with that, comes a feeling of security.

How long we hold a job depends on several conditions: Is the job we have undergoing change? Or is it one that has had few innovations or improvements over the years? There are very few jobs of this type. So, we can't relax and have one year's experience and repeat that same experience year after year until retirement.

Everything is undergoing change. Some occupations change more rapidly than others, especially in the municipality workers' area. At one time, the only way you could get a job in this type of work was through political avenues. Once established in the job, you had security as long as that party or elected officials were in power. We are fortunate that most of this is gone today. Those chosen are mainly selected because of their ability, qualifications, and experience. This change was brought about by public awareness, when many realized that unqualified people spending their tax dollars were a burden on their pocketbooks.

Today, the shadow of "Privatization" shows over our shoulders, threatening the positions of those people who are not innovating, progressive, and cost-conscious.

Professional associations have, for years, developed new ideas, training programs, and more efficient equipment to cut the cost of services.

Every association or profession offers training courses that are taught by the leaders in their field, most of whom are volunteering their services in order to keep the cost down. Most fees are used for lodging, food, and transportation, but even those costs have risen with inflation. Many municipalities feeling the financial crunch are reluctant to fund training; however, the dividends returned to them in savings as a result of such training are many, many times the cost. Using the cost of training as an excuse not to send an employee to a school is doing a disservice to the community.

I have never attended a conference where I have not saved my municipality several times the cost of attending.

Last year, I was engaged as an Expert Witness in three lawsuits against three different municipalities. My job was to testify as to what were the standard procedures followed by a majority of municipalities when plowing snow. I was instructed to find out how many courses on snow removal were offered in the last five years within 100 miles of the municipal employees being sued, and what the costs were of such courses.

There were courses conducted by the Department of Community Affairs of that State each of the five years. One was 15 miles from the community being sued. Due to the fact that these employees did not follow accepted practice, and had not attended any courses of any time, they were found negligent. The judge admonished the employees, and said that it was no excuse that the community could not afford to send them. They were told that they should have paid their own way, as they have as much responsibility to know the latest techniques as their elected officials.

In all three cases, the question of punitive damages were brought up, and the responsibility was placed on the employee for not obtaining the necessary training to do the operation efficiently with the latest techniques.

Last, but not least, training makes leaders out of men; and leaders are more likely to get promoted than survivors or followers.

The great Henry Ford once said, "The best investment a man can make is in himself!"

The value of training—PRICELESS!

RTAP, Moving Forward Newsletter, April 1987, Vol. 4, No. 4. The Pennsylvania Local Roads Program, The Pennsylvania State University, University Park, PA.
CONTINUED FROM PAGE 2

blue school bus. The fellow parks his bus on busy street corners and sells the hubcaps for around $25 each.

Sounds farfetched? Well, at one location there were four potholes—two in the west bound lanes, and two in the east bound lanes. In two days, he amassed "about 400 hubcaps" from that one location. The moral of this is there's more to the problem of pothole repair than sometimes meets the eye—"you need to look at the hole" story!

Highlands County, Florida has instituted an educational program to reduce the incidence of theft and vandalism of signs. They have enlisted the aid of the high schools in the county, presenting slide programs to driver training classes and high school seniors. The programs focus on the possible consequences of a stop sign being stolen, etc.

School bus vandalism has been reduced significantly in Montbéliard, France by a campaign to enlist the cooperation of local high school students in designing the bus interior. Design competitions among local high schools resulted in new bus seats, interior posters, a distinctive exterior for "Cool Le Bus," and installation of a stereo hi-fi tape recorder on the bus. Students bring cassettes to play during the bus ride which has created a new problem: students ride past their stops waiting to hear the end of the tape. Transit buses might benefit from similar programs.

Legislation has been introduced in the Senate that would impose a new federal excise tax on gasoline and motor fuels for deficit reduction purposes. The measure, S. 798, was introduced by Sen. Lowell Weicker (R-Conn.) on March 19.


The proposed tax is estimated to raise over $50 billion, according to Weicker. The senator commented, "More revenues are needed to reduce the deficit and continue our investments in humanity.

The American Automobile Association recently changed its position on the mph speed limit, urging that state should be given the option of selective increasing the maximum speed limit of some limited access highway segments.

The policy change was based on declining popular support for the law and a decline in the highway fatality rate, despite rising average highway speeds. A study showed that public support declined from 72% in July, 1985 to only 50% in September, 1986.

The AAA recommendation urges that the 55-mph limit be kept for heavy vehicles in view of the higher stopping distance required for those vehicles. It is further stated that any legislation for selective increase should require appropriate follow-up study of the effects of such increases on safety.

Drivers who fall asleep on Britain motorways may soon be awakened by a whining noise and vibration if the swerve towards the emergency hard shoulder portion of the road.

Three British counties are carrying out tests of the new proprietary system called "Vibratone." Originally developed in the Netherlands, it has now been patented and is being marketed in Britain. "Vibratone," consists of specially selected rumble strips seeded with tiny glass beads to reflect car headlights.

The British company which distributes the Dutch system says: "When a driver strays onto the line, the bumps in it cause noise and vibration also travels through the steering of the car. It is not enough to cause a panic, but it alert the driver who may have started to close his eyes." While the cost of the system is said to be three times that of conventional road markings, British police and highway officials have welcomed it as a possible aid to road safety.
ASPHALT AND LOW VOLUME ROADS
by Robert M. Willls
Engineering Staff Officer
Mark Twain National Forest

Many gravel roads reach a time when someone decides that an asphalt surface is necessary. There are many reasons for this decision, and often it centers around dust, volume of traffic, or a desire to improve the running surface. Often the asphalt is placed on the existing aggregate after grading. The new road will perform for a period of time and then begin to show distress. Usually this means large areas of cracking accompanied by base and subbase failure. It is time for another decision: Should the road remain asphalt or be returned to gravel?

This decision tends to be complex. Economics should be a big factor, and the cost of restoring the existing pavement may cost more than the original paving. Other factors are use safety, and public input.

Removing asphalt can be done a variety of ways. Chip seal, road mix, and some cold mix can be removed using a grader with scarifiers or rippers. All of the material has to be worked to get it down to a minimum size to leave on the road. Two inches is a typical requirement, but it could go up to three or four inches. Many asphalt roads can easily be restored to gravel, and the savings significant compared to the cost of maintaining pavement that does not have adequate base or subbase. In some cases, additional aggregate is required to stabilize soft areas that developed under the paving.

Repairing paving on roads with poor base preparation means strengthening the base. This requires removal of the asphalt, but the existing surfacing can be used along with additional aggregate to provide a good base. Of course, pulverizing is necessary, similar to the process used for removing surfacing. However, additional aggregate is required to improve the base and the existing base, addition base, and care with the base will substantially improve the performance of the paving and

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RAISING A MANHOLE LID
by Lawrence J. Curles, P.E.
City Engineer, Port Orchard, Washington

If road surfaces were level, raising manhole lids would be simple. Unfortunately, road surfaces are never level--making a chore out of what would appear a simple operation. An old town, with its old roads, has an infinite variety of geometric surfaces. And, no matter how hard you try, that lid will never raised in the right manner to fit into the existing surface of the street.

Port Orchard is trying to reduce stormwater infiltration into its sewer system. An obvious solution was to raise the existing manholes (which were depressed below the street surface) so that they would cease acting as storm drains. We tried a variety of methods.

Commercial manhole lid raisers did not fit our irregular road geometry. No matter what was tried, there was always one side of the lid that left a lip on the travel surface. We tried using asphalt to raise and secure the lid. However, asphalt was not durable enough and rapidly cracked around the lid. Also, asphalt was not always available because the plants close during inclement weather--no rare occurrence in the Pacific Northwest.

Fortunately, the assistant superintendent of public works developed a simple and economical method to raise manhole lids, no matter what the condition of the road surface. The procedure requires only two men, a jack hammer, a piece of 18-by 80-in. sheet metal, two screw jacks, and a minimal amount of concrete. The procedure is as follows:

1. Using the jack hammer, cut the road surface away from the existing lid. Typically, the road surface would be cut 8 to 12 in. from the lid's frame.

2. Place the sheet metal into the manhole frame opening and shape the sheet metal in a circular configuration. The metal will serve as a concrete form. Use the two screw jacks inside the sheet metal to brace the metal and to get a good circular form that will not distort.

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BRIDGE CURB AND RAILING REPAIR

Damage to bridge curb and railing could be the result of any accident or deterioration which decreases their effectiveness. Curb and railing damage may create a severe safety hazard, particularly if the railing is completely torn away. If not repaired, further deterioration may ultimately cause considerable damage and result in extensive repairs. The proper repair method for bridge curb and railing is shown below.

CREW REQUIRED:
- Skilled laborers: 2
- Laborers: 2
- Flagmen: 2

EQUIPMENT REQUIRED:
- Tool truck: 1
- Flat dump truck: 1
- Portable concrete mixer or portable welder: 1

MATERIAL REQUIRED:
- Cement/sand/aggregate (as required)
- Plywood
- Metal hand rail (as required)

REPAIR PROCEDURE:
1. Place signs and other safety devices.
2. Remove damaged material and clean area.
3. If metal rail, weld new rail into position. If concrete, place forms. Install reinforcing steel and pour concrete. Cover with wet burlap.
5. Clean up site and remove signs.

DECK REPAIR

Any damage to concrete bridge decks such as cracking, scaling or spalling of the concrete is referred to as deck damage. Damage to concrete bridge decks is caused by weathering, improper construction, lack of expansion joints, and/or inferior materials. Normally deck damage occurs in new bridges within a year of construction, in bridges subject to extreme temperature change and freezing, or where de-icing chemicals are used.

Deck damage is not severe as long as it is limited to isolated areas. If large areas of the bridge deck show signs of damage, then the deck should be repaired as soon as weather permits to prevent further deterioration and to provide a good riding surface. Crack filling with asphalt is one technique for repairing bridge decks.

CREW REQUIRED:
- Laborers: 2
- Flagmen: 2
- Truck driver: 1

EQUIPMENT REQUIRED:
- Asphalt kettle: 1
- Air compressor: 1
- Dump truck: 1

MATERIAL REQUIRED:
- Liquid asphalt
- Sand

REPAIR PROCEDURE:
1. Place signs and other safety control devices.
2. Clean out crack with stiff broom and compressed air.
3. Fill crack with liquid asphalt using a pouring pot and a squeegee. Do not overfill and cause excess asphalt on surrounding pavement.
4. Sprinkle surface with dry sand to prevent pick-up by traffic.
5. Clean up area and remove signs.

BRIDGE TIMBER REPAIR

Damage to bridge timber is usually caused by weathering, and it appears in the form of rotting, splitting or cracking. Detecting and repairing the timber as soon as possible is essential to prevent further deterioration.
Crew Required:

- Crane operator: 1
- Skilled Laborers: 3
- Laborers: 1
- Flagmen: 2

Equipment Required:

- Tool truck: 1
- Winch truck: 1
- Lumber truck: 1
- Truck crane: 1
- Portable generator: 1

Repair Procedure:

1. Place signs and other safety devices.
2. Remove deteriorated section.
3. Replace with new lumber.
4. Clean up area and remove signs.

WORKSHOPS

THE FOURTH INTERNATIONAL CONFERENCE ON LOW-VOLUME ROADS
August 16-20, 1987
Ithaca, New York

Cornell University will host the Fourth International Conference on Low-Volume Roads on the campus in Ithaca, New York. The conference is sponsored and organized by the Transportation Research Board.

Approximately 250 local highway officials, particularly from county-level government, are expected to attend. It is anticipated that nearly every state in the U.S. will be represented, and visitors from twenty to thirty foreign countries will participate in the meeting. A total of about 77 papers are scheduled to be given on topics ranging from financing low-volume roads to roadway maintenance.

The conference registration fee will be $100, and $75 for companions. It is not necessary to be a member of the Transportation Research Board to attend the conference. If you would like to register for the conference, write to:

Fourth International Conference on Low-Volume Roads
Transportation Research Board
2101 Constitution Avenue, NW
Washington, DC 20418

or call the Cornell Local Roads Program at 607/255-8033.

The conference hotel will be the Ramada Inn in downtown Ithaca, and they have extended excellent rates for the meeting. Please get your reservations in as soon as possible.

TRAFFIC ENGINEERING
August 17-21, 1987
Atlanta, Georgia

This course in traffic engineering, sponsored by Georgia Tech's School of Civil Engineering, is designed to help those people responsible for traffic engineering learn more about the basis of their work. The five-day program's main emphasis is on general principles of traffic engineering.

The course will be taught by Georgia Tech faculty and experienced traffic engineering personnel. Questions about the program should be addressed to Dr. Donald O. Covault, School of Civil Engineering, Georgia Institute of Technology, Atlanta, GA 30332. Phone: 404/894-2235.

The course fee of $650 includes all necessary classroom materials. Participants will earn 3.5 Continuing Education Units.

To register by telephone, please call 404/894-2400.

Be on the lookout for announcements on upcoming courses sponsored by the Technology Transfer Center. A workshop on Geotextiles will be held in late June. Also, our ever popular workshop on Microcomputers will be held at various locations around the state in mid-July.
cause the machine to tip over. If your equipment permits, back up the incline. If backing is not possible, climb the hill at an angle to the slope is steep, use a lower gear to prevent the engine from stalling. If the engine does stall, set the brake. Apply power gradually after restarting the engine or back down to level ground and use a lower gear.

The tractor chassis is built high off the ground so it can clear low obstacles. This means that the tractor has a high center of gravity and is somewhat top-heavy for use on slopes. Consequently, it has a dangerous tendency to overturn when driven sideways on steep slopes. If the tractor does start to tip, steer the front wheels downhill, not uphill. Turning downhill will quickly increase the tractor's stability and help prevent an overturn.

Keep the tractor in gear when going downhill and let the engine act as a brake to slow down the load. If the load brakes too much, open the throttle slightly. If the engine doesn't supply enough braking action, assist it by pressing on both brake pedals.

Never take the tractor out of gear when going downhill. A tractor that is not in gear runs a great risk of going out of control. Also, remember that it is safer to go downhill at an angle to the slope.

While mowing, be alert for other hazards and obstacles, such as rough ground and hidden culvert holes, that might cause the machine to overturn. If possible, check the area beforehand to locate natural obstacles like hidden rocks, tree stumps, low hanging branches and overgrown gullies. Take note of any man-made obstacles, such as signs, posts, fences and mailboxes, that might be in the path of the mower. Remember that at even relatively slow speeds, running over a hidden object can raise one side of the tractor and threaten its stability.

Be especially careful when moving around signs posted along the roadways. If you accidentally knock one down, report it to your supervisor to be sure that it is replaced.

When mowing with a rotary mower, always disengage the power take-off and lift the mower before reversing the tractor.

Driving too close to the edge of a
ditch or bank is another major cause of mower accidents. As a general guide, estimate the depth of the ditch and stay an equivalent distance from the edge.

In the event that the tractor wheels become stuck in a ditch or muddy area, do not place something under the front of the rear wheels to provide traction. Likewise, do not increase speed and engage the clutch quickly. Either of these practices can cause the front end of the tractor to rise and rotate around the rear axle, possibly causing injury to the operator.

If the tractor wheels become stuck, first try backing out. You may place a board behind the rear wheels to help provide traction. If this does not work, dig out the area in front of the rear wheels, shift into low gear, use moderate engine speed and engage the clutch slowly. It may also help to dig out the area in front of the front tires if they are not already on solid ground. If none of these procedures helps, it may be necessary to attach a tow line to the drawbar of the stuck tractor and pull it out with another tractor.

The bottom line in operating dangerous equipment is to safeguard yourself and others by using mature judgment. Follow all traffic and safety regulations. Remain alert and cautious while operating mowing equipment, and never use it for any purpose for which it was not intended.

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("RAISING A MANHOLE LID, SIMPLY")

3. Position the top of the sheet metal as necessary to get the correct lid elevation.

4. Once the sheet metal form is in place, concrete is put in the excavated area. On this concrete and over the form, place the manhole frame. Enough concrete should have been prepositioned so that the frame is about 1/2-in. higher than the desired elevation. The frame is then tapped into place and more concrete is poured in the excavated area around the lid. The lid is placed on the frame when the concrete has set enough to support the extra weight. The frame has been raised and the time consuming effort of placing blocks under the frame has been eliminated.

Typically, you will only need 3 to 5 cu. ft. of concrete per manhole. We have discovered that a concrete batch plant will sell this small amount at a reasonable price if you pick it up at the plant. The city uses an old 55-gal. barrel in a pickup truck to get its concrete. The concrete can then be troweled to conform with whatever irregular surface the road may present.

In this manner, two unskilled employees can rapidly raise a manhole lid and provide a durable product. The concrete should set for two days and will resist all the punishment that the road and the environment can deliver.

Oregon Roads Newsletter, Oregon Technology Transfer Center, Salem, OR. Reprinted from Public Works, August, 1986.

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("ASPHALT AND LOW VOLUME ROADS")

improve its life. In most cases, all of the paving does not have to be ripped. Only those sections that show distress and large areas of base failure need to be treated. This distress is often associated with clay areas in the subbase, and may not be evident when the road is gravel. These clay areas have a tendency to hold moisture under paving.

Repairing a section that has been paved with hot mix is more of a problem. Removal of the asphalt will be more difficult. It will usually require a dozer with a ripper and must be reworked with special equipment to get to a size that can be used as a base. With massive base failures, it may be less expensive to remove the hot mix for recycling and add aggregate to the base. In all cases, the quality of the base is critical to the life and stability of the paving. The effort taken with adequate base depth and compaction saves many future dollars.

Asphalt Pavement Rutting—Western States, Report No. FHWA-IP-84-211

by Office of Implementation

Limited copies of the following publications are available at no cost from the Technology Transfer Center. Requests may be made by writing or telephoning the Center.

Films for Highway Safety and Traffic Engineers, Report No. FHWA-IP-86-25
by Office of Implementation

This technology sharing report contains a catalog of audiovisual aids of potential interest to highway safety and traffic engineers. Special efforts have been taken to make it easy for a user to learn of available audiovisual aids by subjects. Each description contains an abstract, source, cost information, and key subject words.

by Office of Implementation

This Guide describes a procedure for investigating and analyzing roadside trees which considers safety, economic, and environmental aspects in prioritizing accident countermeasure alternatives.

State and Local Highway Training and Technology Resources
by National Highway Institute

This Directory contains information on subject matter, location, price, and availability of highway training and technology resources available to the rural technical assistance program sponsored T2 Centers. The directory will be supplemented with additional data periodically. Material is appropriate for local roads government agencies serving populations of 50,000 or less.

The following are brief descriptions of selected items that have been completed recently by State and Federal highway units in cooperation with the Office of Implementation, Offices of Research, Development, and Technology (RD&T), Federal Highway Administration. Some items are of special interest to highway agencies.

When ordering from the National Technical Information Service (NTIS), use PB number and/or report number with the report title and address requests to:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

Asphalt Pavement Rutting—Western States, Report No. FHWA-IP-84-211
by Office of Implementation

A series of workshops were conducted in late 1983 to develop a set of guidelines to assist the Western Association of State Highway and Transportation Officials (WASHTO) States in preventing or reducing rutting in asphalt pavements. Representatives from most of the WASHTO States participated and provided input. It was agreed that because so many variables contributed to asphalt rutting, it is unlikely that a single cause or solution could be identified. Nevertheless, it was the consensus of the States that the highest short-term payoffs could be achieved by improving and strengthening State procedures in mixture design, materials, and construction practices. Recommendations for aggregate acceptance, paving asphalt cements, mixture design criteria, compaction control, traffic data, and information exchange were developed. In general, it was felt that rutting could be prevented or reduced if most or all of the recommendations were adopted. This report reflects the discussions at the workshops and summarizes the recommendations.

The report may be purchased from NTIS (PB No. 86 156460).

by Office of Implementation

Conventional glass bead traffic stripes generally provide poor delineation under wet-night conditions. Many States,
OREGON DOT SENDS BILLS TO ACCIDENT CAUSING DRIVERS

Drivers have paid a record $826,000 or accident damage to Oregon's highways so far this year.

Repairs are not covered by tax dollars, so the Oregon Highway Division billed the 436 drivers at fault, according to Cindy Carter, Assistant Attorney General for the Division.

"If you went out and injured someone else's property, you would expect to pay for it. It's no different with state property," Carter says. The typical items the highway division can bill a driver for include damage to guardrails, signs, bridges, the road surface, cleaning up a ruck spill, or providing traffic control.

"If you are involved in an accident and you fail to pay for the damages that result, stiff penalties are imposed," Carter says. "The highway division will contact the Motor Vehicles Division, and they will suspend your driver's license and the registration of your vehicles in your name until the claim is paid."

This means the loss of driving privileges for individuals, Carter says. Trucking companies can have their entire fleet sidelined for failure to pay. With that kind of incentive, it's no surprise that the highway division collects in 95% of the cases.

Passenger cars were billed for damages in 56% of the cases, and commercial vehicles drivers were billed in 44% of the cases. Claims abandoned by the division as un-collectable total $42,360 so far this year.

ACKNOWLEDGEMENT

The Technology Transfer (T2) Program is a nationwide effort financed jointly by the Federal Highway Administration and individual State Departments of Transportation. Its purpose is to translate into understandable terms the latest state-of-art technologies in the areas of roads, bridges, and public transportation, to local and county highway and transportation personnel.

The T2 Center at Georgia Tech is sponsored by the Georgia Department of Transportation and provides information and counsel to more than 500 municipalities and counties in our state. This newsletter is designed to keep you informed about new publications, new techniques, and new training opportunities that may be helpful to you and your community. Individuals wishing to receive future copies of this newsletter at no cost may send their requests to:

M. John Moskaluk
Technology Transfer Center
School of Civil Engineering
Georgia Tech
Atlanta, GA 30332
especially in the north, have complemented
the stripes with reflectors positioned
adjacent to or in line with the normal
striping. Reflectors, placed in recessed
grooves, have shown low susceptibility to
damage from snowplows.

Manually installing reflectors after
the pavement has been placed requires
cutting the pavement to provide the groove. 
Approximately 45 percent of the installa-
tion cost is for the diamond cutting blades
required to cut the pavement. This report
documents the results of an FHWA study that
tested and evaluated candidate systems for
forming the grooves during paving opera-
tions. Recommendations are included for
field testing and additional research
needs.

The report may be purchased from NTIS
(PB No. 86 164696).

Longitudinal Edge Drains in Rigid Pavement
Systems, Report No. FHWA-TS-86-208
by Office of Implementation

This report documents the findings of
a four-State study of longitudinal edge
drain systems used in rigid pavements.
Design philosophies and criteria, construc-
tion practices, and field performance com-
parisons are discussed, as well as where
edge drains may not be advisable.

M. JOHN MOSKALUK
TECHNOLOGY TRANSFER
SCHOOL OF CIVIL ENGINEERING
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332

Trench drains and drainable asphalt
concrete layers were found to be cost-
effective in terms of their original cost
and in their ability to remove water. Per-
formance comparisons with 7-year-old pave-
ments without drainage provisions indicate
that edge drains can extend pavement life.
Maintenance of the edge drain system con-
tributed to pavement performance.

The report may be purchased from NTIS
(PB No. 86 168317).
PROBLEMS WITH PAVEMENT CUTS?

Maintaining a smooth riding surface of local roads and streets is becoming increasingly difficult. This is, in part, due to utility employees or contractors making street cuts that are not being properly restored due to insufficient control. Therefore, it is extremely important that any local governing body, large or small, develop and enforce ordinances for use of its right-of-way by utilities.

The ordinance that you develop must be explicit and uniformly applied to municipal agencies as well as contractors. Items which should be included in a good ordinance are:

**BONDS**—Amount should be based upon the potential for road damage. It should remain in effect for two years to ensure proper restoration of the road.

**PERMITS**—All work conducted in your right-of-way should require a permit prior to construction. Plans should be required with each request involving a street cut or utility installation. Fees can be based upon the project size or a flat fee may be assessed. Any paper work processing needs time. The utility company must know what advanced notice is expected to your agency prior to construction and what specifications they are to meet. Identify emergency-cut procedures and outline suitable traffic-control procedures.

**SPECIFICATIONS**—Develop specifications. Use PennDOT’s Regulations Chapter 203—Work Zone Traffic Control and Chapter 459—Utility Occupancy. The specifications should outline requirements for pavement cutting, type of material to be used for backfill, minimum compaction standards, restoration of sub-base, flexible base, wearing course standards, and paint and identification.

**INSPECTIONS**—Restoration will be no better than the inspection effort made. The specifications must be followed. A clause should be in the permit declaring that the utility owner is ultimately responsible for adherence to local specifications. A good policy is to require notification 24 to 48 hours prior to actual work. Follow-up inspections should be made 6 to 24 months after the repair. All inspections should be documented.

**PENALTIES FOR NONCOMPLIANCE**—Set a target date for compliance. If work is not completed satisfactorily, make the necessary repairs and bill the utility. If they do not pay for the repair, the performance bond is available for this purpose.

**POTENTIAL PROBLEM AREAS**—When the utility requesting/making cuts is owned by your government, discretion must be used in deciding if a permit is required, how to enforce your city’s specifications, and who will do inspections.

- Compacted backfill, the road-base structure, is the most important element. Visual checking cannot verify the density. Density tests by an independent firm should be a routine check, the cost to be paid by the contractor.

- Traffic control in some cases is inadequately addressed. During this permitting phase, be sure to review the applicant’s plans.

- Inspection and documentation of work could be the single most important part of effective patch repair. Be sure you have a qualified person to monitor the restoration of the road.

- Do you have so many patches that you don’t know which one is whose? Assign color codes for utilities and have them paint colors on curb or patch to identify responsibility for failure.

**SUGGESTIONS**:

- Get to know your utility construction people and develop a good rapport.
The most desirable features in a day-night construction zone marker were:
* A streamlined profile.
* A microscopic cube-corner, sealed prismatic air cell, cube-corner reflex, or multiple-glass lens reflector.
* A balance between the reflector and casing area exposed to the driver.

Further research is needed to find an adhesive better than the butyl pad for temporary markers, Davis says. The butyl requires a primer that must be allowed to dry, and a vehicle must then be driven over the marker. In practice, these steps may not be followed and the marker may fall off the pavement. There are also problems with cold, rough pavement, and incompatibility with some markers.

Hot-melt adhesives should be investigated. In comparison to butyl, they:
* Require no primer.
* Conform to pavement irregularities.
* Work in a wide range of temperatures.

**Marking Patterns**

Temporary pavement marking patterns in work zones were studied at the Texas Transportation Institute, Texas A&M University, and reported at the same TRB meeting by Conrad L. Dudek, R. Dale Hutchinson, and Donald L. Woods.

The objective of the study was to investigate 10 candidate temporary marking treatments—one base treatment consisting of 4-ft. stripes with 36-ft. gaps, and nine other treatments using variations in stripe length, gap length, and reflective and nonreflective raised pavement markers. Daytime studies were conducted first; then the best six daytime studies.

A number of significant points resulted from the daytime studies. Drivers rated the 1- and 2-ft. stripes with gaps of 38 ft. or more as the least effective among the striping patterns tested. Treatments with 4-ft.-long stripes and 48- and 38-ft. gaps were found to have the greatest number of erratic maneuvers. Treatments using reflective pavement markers were preferred.

In general, nighttime studies supported the findings of the daytime studies which found that 8-ft. stripes with 32-ft. gaps were the most effective in terms of driver preference when reflective pavement markers were not used. Drivers found treatments using reflective pavement markers highly effective.

All reflective pavement marker systems were substantially preferable to the control treatment—4-ft. stripes with 36-ft. gaps. But, no single RPM treatment was deemed best.
MAINTENANCE TIPS

ABUTMENT REPAIR

Abutment repair is needed when cracks occur at abutments, endwalls, wingwalls, and/or retaining walls. These cracks are the result of base settlement, improper construction techniques, and/or weather deterioration. They are found in bridges with heavy loads or within a year after construction of a new structure.

Abutment cracking is not a severe problem when it is properly repaired and maintained. If not repaired, structural failure may occur, forcing closure of the bridge and extensive structural repairs. The repair method is outlined below.

CREW REQUIRED

Skilled laborers 2
Laborers 3
Flagmen 2

EQUIPMENT REQUIRED

Tool truck 1
Dump truck 1
Portable concrete mixer 1
Air compressor 1

MATERIAL REQUIRED

Cement/sand/aggregate
Lumber

REPAIR PROCEDURE

1. Place signs and other safety devices.
2. Remove material from around section to be repaired.
3. Apply bonding agent (neat cement can be used).
4. Replace deteriorated section with concrete.
5. Cure and rub new concrete.
6. Clean up area and remove signs.

STRUCTURAL PAINTING

Structural painting is needed when there is bridge painting due to lack of painting or general disrepair due to vandalism.

Structural members of bridges should be painted to prevent deterioration and ultimate failure. Intermittent painting may be correct damage caused by vandalism.

While lack of painting over periods exceeding 8 years may create a deficiency, damage by vandalism does not lead to a severe deficiency.

The proper method of painting bridge structures is described below.

CREW REQUIRED

Sandblast operator 1
Painters 2
Laborers 2
Flagmen 2

EQUIPMENT REQUIRED

Stake truck 1
Dump truck 1
Air compressor 1
Sandblaster 1
Paint sprayers 1

MATERIAL REQUIRED

Sand
Paint

REPAIR PROCEDURE

1. Place signs and other safety devices.
2. Position scaffold.
3. Sandblast only area that can be primed on same day.
4. Apply primer.
5. Allow drying time. Apply finish coat.
6. Remove scaffold and clean up.

ABUTMENT CRACKING is not a severe problem when it is properly repaired and maintained. If not repaired, structural failure may occur, forcing closure of the bridge and extensive structural repairs. The repair method is outlined below.

MATERIAL REQUIRED

Concrete

REPAIR PROCEDURE

1. Place signs and other safety devices.
2. Remove material from around section to be repaired.
3. Apply bonding agent (neat cement can be used).
4. Replace deteriorated section with concrete.
5. Cure and rub new concrete.
6. Clean up area and remove signs.

"When London Bridge fell down, how much was the city sued for?"

APWA REPORTER / JULY 1987
As budgets tighten in many cities and counties, discussions of whether or not to defer maintenance and rehabilitation of streets and highways have become more heated.

In addition to budgetary constraints, other factors may require postponing maintenance activities. Especially in small jurisdictions, these are normally unforeseen or unusual environmental conditions. Heavy floods that severely damage drainage facilities or unusually heavy snowfalls are two environmental examples. Nonenvironmental examples could include major incidents such as the collapse or closing of a bridge or an unusually devastating accident.

Although cost consequences on a specific road are difficult to determine, there is a growing body of information about the economic and technical consequences of deferring major maintenance activities, especially those related to surface maintenance.

While discussions regarding maintenance deferral often imply that an optimal schedule for routine and periodic maintenance exists for each road in a jurisdiction, this is never the case. For most rural jurisdictions, the maintenance schedule resides in the experience of maintenance supervisors and their knowledge of current street and highway conditions.

A few jurisdictions are beginning to implement maintenance management systems and pavement management systems that provide them with a more formal schedule of activities. But as anyone who has worked with these systems knows, the output is not perfect.

What Can Be Deferred and How Long

A wide variety of routine and periodic road maintenance activities can be deferred for varying periods of time without incurring undue costs. Since little has been written regarding the costs and benefits of deferring maintenance activities, maintenance supervisors' perceptions regarding the desirability of maintenance deferral vary according to their attitude and experience.

One of the maintenance functions that is least susceptible to deferral is the maintenance of drainage facilities. For example, if the maintenance schedule calls for drains to be cleaned and maintained at the beginning of the dry season, this activity can be postponed until just prior to the rainy season. However, it would be very costly and dangerous to postpone the repair and cleaning of drainage facilities into a rainy season. Damage could be done, not only to the drainage structure but to the entire roadway system, if there are failures in the surface or subsurface drainage. In addition, a washout or similar incident could make the road unusable for extended periods of time, causing great economic loss and social disruption.

Patching, especially on paved roads, is another routine maintenance activity which probably should not be deferred. Failure to repair potholes promptly causes at least three very important results. Probably the first to come to the attention of the maintenance supervisor is an increase in the number of complaints by road users. The second and equally important result is that potholes left unrepaired may lead to continued and increasingly rapid disintegration of the surface. The third is that potholes may be a contributing factor to an increase in accidents.
year, it is natural to look at that roadway, think of the past seven years' deterioration rate and make a judgment to defer the rehabilitation of the roadway. Such a decision can be disastrous, both in terms of the physical condition of the roadway and the financial consequences for the jurisdiction. The figure would indicate that in the next 12 percent of the pavement's life, which in this case is only one year, the road will deteriorate from a fair to a very poor condition. At this point, what would have cost $1,000 to rehabilitate to an almost new condition the year before will now cost $4,000 to $5,000.

Looking at those costs in another way, the first seven years of life incurred an average annual cost to rehabilitate of approximately $150 ($1,000 divided by 6.75 years, which is 75 percent of a nine-year life). Deferring rehabilitation beyond that critical point could cost an additional $3,000 to $4,000 for one year.

Many readers may argue with these figures, and the documentation of this curve for all types of lightly paved roads is not complete. Nevertheless, as experience accumulates in developing information of this nature, it is clear that the cost of deferring surface rehabilitation increases as roads age. These costs increase rapidly each year rehabilitation is postponed until finally the road fails.

Although there is less documentation regarding the deterioration of gravel and aggregate roads, they appear to be less susceptible to the accelerating rate of deterioration than paved roads. Also, the cost to rehabilitate gravel roads may be much closer to a linear function of accumulated traffic volume and time. In other words, deferring maintenance on aggregate roads is less likely to result in disproportionate rehabilitation costs over the short run, i.e., a year or two. This is not to say that the costs for rehabilitation will not increase, because they will, but they are less likely to increase rapidly. Specifically, if it has taken four years for an aggregate road to deteriorate to a condition that would normally lead to regravelling or other rehabilitation, and the estimated cost is $1,000 per unit, then a postponement of a year might increase the cost to about $1,300.

Strategy

Based on the preceding and the uncertainty of budgets in many local jurisdictions, one may wish to adopt a more conservative strategy for the rehabilitation of paved roadway surfaces. If "fair"-surface condition is identified as the optimal point for surface rehabilitation, then a more conservative strategy would argue for a periodic maintenance involving surface rehabilitation at an earlier time. This would not minimize total costs if budgets were assured, but it would provide a buffer so that pavement rehabilitation could be deferred in a tight

Continued on page 6
Continued from page 5

budget year (or even two) without adverse pavement deterioration and the accumulation of added costs to the community.

Applying the specific strategies would involve determining the probability of tight budgets, their timing and duration. A risk analysis using such estimations can identify a strategy to provide for both technical and budgetary flexibility, as well as minimum costs over the long term.


NEWS BRIEFS

Do you know what roadside obstacle is hit most often? Fences are the number one roadside obstacle. When the vertical support posts are hit and forced down, the upper horizontal rail slips out of the rail splice sleeve, spearing the oncoming vehicle. A low cost solution is simply to leave the expensive top rail out of the installation. The fence will stand up but the danger is reduced, saving both lives and money.

The Federal Highway Administration had a contract with a subsidiary of Kodak to develop a crack detecting device for network surveys of roads. The goal is an affordable tool ($50,000) that State highway agencies can use to perform an automatic condition survey of the statewide network. The Kodak subsidiary, Ektron of Bedford, Massachusetts, is designing the device to fit in any normal size van. It will operate at highway speeds under normal daytime conditions.

The device is based on the principle that much less light is reflected from a pavement crack than from a continuous pavement. The dark area can be sensed and the magnitude of light recorded. Ektron has developed an instantaneous light meter to do this. It will be connected to a computer and printer so a recording of the pavement cracks can be tabulated. The FHWA is optimistic that a usable device will be developed by next fall. It will then be made available for evaluation by interested State highway agencies under the FHWA implementation program.

Charles J. Funnny, Commissioner of Public Works for the City of Atlanta, was selected by the American Public Works Association at one of this year's Top Ten Leaders in Public Works. He was selected for his initiation and design of Atlanta's Three Rivers Water Quality Program. Funnny's plan consolidated wastewater plant discharges from two streams to a major river, producing a major treatment cost reduction.

There is a microcomputer users group called "TIME" consisting of public transportation professionals interested in exchanging experiences, ideas and software with similar microcomputer users. Membership is open to the public at no charge and includes regular receipt of TIME CAPSULE. To join, write the TIME Support Center, Department of Civil Engineering, Rensselaer Polytechnic Institute, Troy, NY 12180-3590.

An experiment conducted at three sites in Britain by the Transport and Road Research Laboratory has determined that flashing warning signs, triggered when vehicles follow too closely, can help decrease rear-end collisions. In the three sites chosen, the experiment involved a blank sign which turns into a flashing message when gaps between passing vehicles fall below a predetermined level. The two signs evaluated were of similar appearance to the dot matrix signs used on main highways.

Results of the experiments showed a clear effect of the signs on driver behavior—specifically, a reduction of about one third in the number of drivers following less than one second apart at the first monitoring site, spaced 400 to 500 meters after the sign. An effect was still apparent, though slightly diminished at the second and subsequent monitors, up to 1,900 meters from the sign.

The National Committee on Uniform Traffic Control Devices continues its efforts to assist in the development of standards, guides, and warrants for traffic control devices. Recent signs of progress include the Federal Highway Administration's adoption of 18 changes to the Manual on Uniform Traffic Control Devices (MUTCD). Also, the U.S. Government Printing Office has distributed revision #4 to the 1978 MUTCD. Other committee actions include preparation of a detailed reply to FHWA's request for comments on standards for performance of retroreflective traffic control devices and of the need for a new MUTCD without such conditions as "should" and "may."
The Technology Transfer Center has added five new tapes to its video tape library since the last listing. The tapes may be borrowed, at no charge, for a two week period. Please write or phone and request no more than two tapes at a time. Specify the tapes you want by the number in the left hand column.

### DC-203 Operating Tips: Push-Pull Scrapers
- **Duration:** 12 minutes
- **Description:** Discusses cut and fill operations for pairs of scrapers.

### DC-206 Operating Tips: Off-Highway Trucks
- **Duration:** 17 minutes
- **Description:** Discusses inspection, start-up procedure and off-road operations.

### DC-207 Operating Tips: Track-Type Tractors
- **Duration:** 15 minutes
- **Description:** Considerations for safe and efficient operation including inspection, dozing, land clearing, ripping and push loading scrapers.

### DC-208 Loading Logic
- **Duration:** 17 minutes
- **Description:** Efficient choice and use of loaders and trucks for hauling soil.

### DC-209 Operating Tips, Wheel-Tractor Scrapers
- **Duration:** 18 minutes
- **Description:** Discusses inspection, start-up procedure and operating techniques.

### DC-210 Operating Tips: Track-Type Loaders
- **Duration:** 10 minutes
- **Description:** Discusses inspection, start-up procedure and excavation for a variety of cases.

### DC-211 Operating Tips: Wheel Loaders
- **Duration:** 10 minutes
- **Description:** Discusses inspection, start-up procedure and operation.

### DC-212 Design of Urban Streets - Part II
#### Street Design Elements - Part 2
- **Duration:** 30 minutes
- **Description:** Describes cross-sectional design and horizontal alignment design.

#### Street Design Elements - Part 3
- **Duration:** 30 minutes
- **Description:** Describes vertical alignment design, design of vertical curves, drainage design and design for access control.

### DC-213 Intersection Design Elements (30 minutes)
- **Description:** Describes the basic intersection types, types of channelization, corner design, pedestrian movement, vehicular movement and turning movements.

### DC-214 Intersection Design Elements (Continued)
- **Duration:** 30 minutes
- **Description:** Describes intersection control, problem identification and improvement techniques for problem areas. It also describes some type of urban and freeway techniques.

### DC-215 Design of Urban Streets - Part III
#### Traffic Signal Design and Operation
- **Duration:** 30 minutes
- **Description:** Basic principles of signals, advantages, disadvantages, the various types of signals and operations of different traffic signals.

#### Illumination, Signs and Markings
- **Duration:** 30 minutes
- **Description:** Advantages of lighting arterial streets, types of lights and elements considered in designing lighting systems, importance of signs and markings in street design and uniformity of signs and markings.

#### Pedestrians, Bicycles and Transit Considerations
- **Duration:** 30 minutes
- **Description:** Discusses the integration and design of pedestrian, bicycle and transit facilities into the urban street plan.

#### Factors Impacting Street Design
- **Duration:** 30 minutes
- **Description:** Special factors which affect the design of urban streets.

### DC-216 Design of Urban Streets - Part IV
#### Social and Economic Impacts
- **Duration:** 30 minutes
- **Description:** Social and economic impacts by the upgrading or design of new urban roadway facilities.

#### Environmental Consideration
- **Duration:** 30 minutes
- **Description:** Environmental impact caused by urban street design. Emphasis on air and noise pollution.

#### Project Documentation
- **Duration:** 30 minutes
- **Description:** Evaluation techniques for comparing design alternatives and selections.

#### Administration and Management
- **Duration:** 30 minutes
- **Description:** Consultant selections, bid procedures, contractor prequalifications, supervision of work and legal aspects of the design and designer.

### DC-217 Asphalt Paving Inspection
- **Duration:** 28 minutes
- **Description:** Discusses sampling of aggregate, storage, cold feed, mixing plant and plant inspection.

### DC-218 Pothole Repair
- **Duration:** 12 minutes
- **Description:** Demonstrates traffic control during repair, marking, cleaning, filling and cleanup.
OUR OWN FLEET
MANAGEMENT PACKAGE

by William Moscan, Project Manager
Transportation Energy Management Program
Ontario Ministry of Transportation and Communications, Toronto, Canada

Although there are many computerized fleet management systems available commercially, we developed our own. Why did we bother to spend the time and money?

Several reasons indicated that most computerized fleet management packages are not appropriate for municipal applications.

The most important reason involves flexibility. Many fleet management systems are "canned" packages that cannot be altered or enhanced to meet user needs. As a result, the municipality is forced to change the way it operates to fit the package's requirements. The other option is to retain a software developer to make the necessary changes—a costly, time-consuming approach.

When we developed our Municipal Fleet Management Information System (MFMIS), we made flexibility requirements part of our design objectives. We felt that a municipal fleet management system should be flexible enough to:

- Handle a wide variety of fleet sizes;
- Handle a mixture of vehicle and equipment types;
- Allow internal programming changes to suit different municipal modes of operation.

Another reason for developing our own system relates to the fact that most existing fleet management systems are designed to manage trucking fleets. This means that the system is intended for use on a three to five different vehicle and equipment types. A municipal public works fleet can have up to 100 different vehicle and equipment types. MFMIS can monitor virtually all combinations of vehicles and equipment. Based in Sudbury, the system covers our entire fleet including chainsaws, lawnmowers, graders, 10-ton dump-trucks, and heavy-duty snowplows. The system also monitors fleets used for transit, parks and recreation, libraries, and the fire department. The fire department even monitors light bulbs in its stations.

User-friendliness of existing systems was also a factor in our development of MFMIS. Many fleet management packages are difficult to operate, require multiple data entry, and most importantly, cannot be improved or altered to alleviate these shortcomings. MFMIS was designed with the user in mind. We knew that the principal users of the software would be "shop floor" people, mechanics, and fleet managers—people who know very little about computers and their applications. MFMIS enables these people to operate the system with relative ease. The system is menu-driven, which means that there is always a list of options to select from. MFMIS workscreens contain operating commands which, once selected, perform the work you request. On-line help screens describe data-entry formats and specifics about required information. The system also prompts correct data entry formats automatically while users input data. To enhance user-friendliness further, we are incorporating system formats that appear on the screen for quick reference. We also have a good set of system documents including user manual, implementation guide, production manual, and a two-volume systems manual.

From a municipal perspective, the most important reason for developing our own fleet management system was cost. Many existing software packages hit purchasers three times in the pocketbook. The software costs money; system enhancements and consulting services for implementation are expensive; and microcomputer hardware configurations or more are required. To combat these costs, we offer our system free to Ontario municipalities. We also supply complete system documentation, some preliminary implementation assistance, and ongoing support.

To train staff, Ontario's Ministry of Colleges and Universities offers a training grant of up to 50%. Municipalities wishing to make major changes to the system can do them in-house or employ a consultant. Those choosing to hire a consultant should expect fees ranging from $5,000 to $15,000, depending on the number and type of changes. However, it should be noted that there are many variations to MFMIS and as the number of users increases, so will the number of variations. Eventually, new users will be able to select features that suit their needs from existing systems, minimizing enhancement costs.

We have also cut costs in hardware. As noted above, most commercially-available fleet management systems require at least a minicomputer. MFMIS takes advantage of the improved memory capability of microcomputers. The system runs in a stand-alone micro format, saving money in both computing and hardware costs. System hardware requirements are estimated to cost between $3,000 and $13,000.

A fleet management system must perform two key functions: minimize fleet costs and maximize vehicle availability. MFMIS minimizes fleet costs by cutting down maintenance and breakdowns and, through careful monitoring, maximizing fuel efficiency, vehicle life, and engine life. MFMIS also manages shop floor efficiency, labor efficiency, and parts inventory. In each case, standards are set and incorporated into the software program. If these standards are not met or are exceeded, the system flags them automatically. These failed standards are compiled into reports which can be produced on demand or on a regularly scheduled basis. This
Vehicle availability is also addressed by MFMIS. The system maximizes vehicle availability and use by mining a coordinated maintenance program, ensuring availability of parts, mechanics, and bays. Again, standards are used to evaluate these items and monitoring is performed with on-line reports or card-copy reports.


WHY DID IT HAPPEN TO ME?

by Harvey Kuester

It is a human trait for anyone who has had an accident to ask "why did it happen to me?" There are probably two reasons why an individual will ask such a question: (1) to feel sorry for himself and to receive sympathy from others, or (2) to objectively analyze what happened and try to determine what could have been done differently to prevent the accident.

There is nothing wrong with either reason. We need sympathy and reassurance, but when we stop there, there is a tendency to place the blame on another person or charge it to fate. Objectively analyzing the factors which lead up to the accident is more rewarding in the long run because it can help us avoid getting into another accident.

If the accident was vehicular, we might ask ourselves some of the following questions:

1. Was I using the right tools for the work I was doing?
2. Was I wearing the proper attire for the work I was engaged in?
3. Was I following the accepted safe standards for the work I was performing?

When we ask ourselves these questions, we are performing our own accident investigation. While we can all benefit from accident investigation, all of us will agree that preventing an accident is the best approach. Job training, protective equipment, teamwork, a cooperative, inquiring attitude, and discussing the safety aspects of our work at safety meetings are some of the accident prevention tools which are available.

Accident prevention then, is the key to avoiding accidents. If we keep this in mind during the course of our work and other daily activities, we can substantially reduce the need for sympathy and accident analysis. We can instead say, "it doesn't have to happen to me." In addition, we can be proud of our ability to perform work safely and efficiently without our work environment.

GETTING WHAT YOU PAY FOR

An often neglected area in municipal maintenance is quality control or getting what you pay for. It may not seem important at the time, an unnecessary expense or an annoyance, but you either pay now or pay later. Quality control begins with four basic questions.

1. What do you want?
2. How do you order it?
3. Did you get what you ordered?
4. What do you do if you do not get what you wanted?

The first question is very important because the proper techniques used at the proper time can really stretch your budget. For instance, a pavement management program that you can develop by using a computer or by hand can assure the quality you want. How you order and assure maintenance quality is by using the proper specifications—specify exactly what you want and order exactly what you want. A variety of standard specifications are already written and available from American Society of Civil Engineers (ASCE), American Association of State Highway and Transportation Officials (AASHTO), National Association of County Engineers (NACE), and from other transportation-related agencies.

Did you get what you specified? The best answer may be to have a qualified inspector supervise the work. Many municipalities rely on their road superintendents or road crews to conduct the necessary inspections. Although these individuals are usually versed in the lore of roadwork, many processes such as seal coats are not as simple as they appear. It is difficult for individuals who do not have specialized training to inspect seal coats. The inspector's job is to monitor the worksite, take samples of job materials for lab testing, and record the progress of the project. They must also check to see that the proper equipment is used and that it is calibrated properly.

What do you do if you don't get what you want? This depends on the contract. Is the contract adequate? Did the contract specify exactly what you wanted? If so, there are methods used to assure satisfaction in contracts, such as liquidated damages, maintenance bonds, and performance bonds. Discuss these and other techniques with your municipal solicitor before you write your specifications and contract. Make sure that you build protection into your contract before awarding it.

RTAP, Moving Forward Newsletter, January 1987, Vol. 4. No. 3.

NACE SEMINAR EXAMINES COMPUTER USE FOR COUNTIES

Computers and computer software were a prominent topic at the recent National Association of County Engineers' (NACE) meeting, recently held in Orlando, Florida. A formal session, Office Automation for Today's County Highway Department, was moderated by Ruth W. Stidger, Editor-in-Chief, Better Roads. Panelists included Jack Dier, Superintendent of Pennington County Highway Department, Rapid City, South Dakota; Albert Prast, Systems Engineer, Orlando IBM office; Dennis Polhill, Vice President of Pavement Management Systems, Denver, Colorado; and Galen Stuwe, National Project Coordinator, MCS Group, Rapid City, South Dakota.

Why Computerize?

There is a real urgency for state, county and city highway departments of all sizes to computerize, Dier said, speaking to the group. And, it costs money to not computerize, whether the highway engineer realizes it or not. Dier's department started using the County Highway Resource Information System (C.H.R.I.S.) more than three years ago.

The makeup of Pennington County is especially interesting, because it points up the fact that an average county can use computers profitably. The county has 900 miles of road—one-third of that is asphalt and two-thirds gravel. There are 212 bridges. There are 2800 square miles within Pennington County. There are 40 employees—37 in the crew and three in the office, including Dier (three three do all of the work with the computer system). There are 115 pieces of equipment, and the budget is $3.1 million.

Dier opened his remarks with a theme that continued throughout the session: just being an engineer or a superintendent is not enough. County engineers must be managers, Dier said, and this is their most important responsibility. Computers can help in this task of managing personnel, equipment and funds.

"Every day that [highway departments] are on a manual system," Dier said, "I am convinced that they are losing money."
Computers help prevent errors in reports, allow
fast handling of numbers (hours rather than
years), and ensure that costs and other information
is available when needed. Payrolls, job costs, and
equipment costs used to take four to five days per
month in Pennington County, Dier says. With com-
puters, they take about 2.5 hours.

C.H.R.I.S. allows costing by job, by phase; by
road; by bridge; by piece of equipment. Management
ports are essential, too, Dier says. The system
owns job costing (labor, material, equipment rental)
each project (road, bridge, and so on). Overhead
costing is done in seconds with a computer. Budget
ports will allow immediate access to information about
dedged amounts of money spent and funds remain-
ing. In the use of gravel, for instance, Dier says
that daily costs of labor and equipment are
immediately available using the system. Dier also
shows daily how many tons of gravel were placed on
specific road, per mile.

Engineers should try not to be afraid to
computerize, Dier says. He learned how to operate a
computer for the first time when the system was
installed. "Operating a car is more difficult than
operating a computer system," Dier said.

Selecting Systems

Albert Prast, IBM, gave some parameters for
selecting computer systems. Hardware, software, and
service and support are the three areas to evaluate,
Prast said.

In choosing hardware, important factors are
whether it will run needed software and make the
system interfaces with other hardware. It must also
have adequate storage.

In evaluating software, Prast said, consider the
system's operating software—will it allow you to run
needed application software? MS-DOS is fast becom-
ing the standard system for micros, for instance, and
such software is based on this operating system.

Service and support evaluation factors include:
need of repair, in-office repair availability, and
sts. On-site training and continued education
ould also be considered.

Pavement Management Systems

Eventually, there may be an integration of a
pavement management system, an office accounting
system, and an equipment maintenance management
stem, so that data used to operate each segment
feed into the other programs. If such a system
doles, it is almost certain that Dennis Polhill and
ement Managements Systems will be a part of it.

e company is probably the only one marketing
ement management software that makes its entire
iness pavement management. A high ratio of
ineers who daily work on pavement management
ects ensures that the company's software is
sed on in-field experience.

To evaluate a pavement management system,
Polhill told NACE seminar attendees, it is first
ecessary to remove yourself from the promises that
are made by software suppliers.

Instead, for each area of work concern—
pavement management or any other area—try to
think about cost versus exactness. Every manage-
ment decision comes down to that, Polhill said—cost
versus accuracy. This can be applied to each ele-
ment of a pavement management (or other) software
ystem. For example, take structural testing. It is
ossible to make 10 tests a mile, 100 tests a mile, or
,000 tests a mile. The more that are taken, the
greater the accuracy. But, Polhill said, you must
weigh the costs—deciding how much accuracy you
can afford to have.

Implementing Automation

Computerization allows the county engineer to
manage taxpayers' money responsibly, Galen Struwe,
MCS Group, said. MCS is also interested in forming
the vehicle maintenance, office automation, pavement
management software link. Billions of dollars are
managed by county engineers. But, when you talk
about this money, and the way it's been managed,
it's time to look at something new, Struwe said.

Elected officials should be made aware of the
consequences of management with irrelevant informa-
tion, Struwe said. A county software program must
be a program that operates as C.H.R.I.S. does—full
integrating fund accounting and job costing. Very
few such programs exist, Struwe said.

"A lot of departments try to do it themselves,"
Struwe said—using a local programmer to adapt a
genera program. "Some departments take two or
more years to convert a program that still may not
work right. These packages may almost fit," Struwe
said, "but this is not enough."

Questions focused on the county engineer's
control of hardware, to allow use of desirable soft-
ware, and the virtues of stand-alone systems versus
those that are integrated with computers completing
other county (non-highway) functions. Some
participants favored high department autonomy, while
others wanted integration.

Perhaps the answer goes back to Polhill's rule
for decision making—measure cost versus effective-
ness. If a specific software package will provide
ough effectiveness, when software and needed
ardware costs are measured, then that extra hard-
ware cost (for an additional system) may be justified.

EDITOR'S NOTE

This issue of TechTrans is the last one for 1987. It will be the last red issue for all of you who were wondering why this Yellow Jacket was publishing a newsletter on red paper.

This issue is significant for a second reason. The fall issue will be our last issue before our contract renewal. We think we have rendered a valuable service to you all and should be renewed for another year. Don't you agree? Please let Commissioner Rives know if you appreciate and support our efforts at the Technology Transfer Center.

You will notice toward the back of this newsletter that we have added new tapes to our videotape library. Please make use of all of our tapes. Frequently your selections are unavailable, but I will send what I can find.

We will hold our workshop on microcomputers in October. The specific dates for presentation in each district have not been determined at the time of this writing, so be on the lookout for a brochure or give us a call.

I hope to see you all there.

M. JOHN MOSKALUK
TECHNOLOGY TRANSFER
SCHOOL OF CIVIL ENGINEERING
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332

PUBLICATION

The following publication is available free from the Technology Transfer Center:

Outdoor Testing of Reflective Sign Materials
by the U. S. Forest Service and FHWA

The report summarizes the results of outdoor testing of numerous test samples using different material combinations and application techniques. The purpose of the outdoor testing was to find a combination of materials and techniques which would produce a durable retroreflective sign that would remain in service for at least 7 years with little or no maintenance. Recommended combinations and techniques for such a sign are made in the report.

The report is intended primarily for use by State, county, and city traffic and highway engineering departments, sign manufacturing personnel, and others who are responsible for installation and maintenance of street and highway signs.
TECHNOLOGY TRANSFER DATA SHEET

NAME ___________________________ DATE __________
TITLE ____________________________________________
AGENCY __________________________________________ PHONE __________
ADDRESS ______________________________________________________________________________________

BACKGROUND INFORMATION ON AGENCY

o NUMBER OF AGENCY PERSONNEL ___________

o NUMBER OF TRANSPORTATION PERSONNEL _______

Position/Title       Classification       Experience (yrs)

Available Equipment

Roadway Mileage

Public Transportation   Yes ___  No ___
Number of Buses

Annual Agency Budget
Annual Transportation Budget

EXPERIENCE WITH TECHNOLOGY TRANSFER PROGRAM

GENERAL KNOWLEDGE
Do you receive the Tech Trans? Yes ___ No ___

Has the Newsletter been of value to you or your agency? Describe.

How could the Newsletter be modified to be of more value?

Further comments—
TECHNICAL ASSISTANCE

Have you utilized the Technical Assistance component of the program? Yes ___ No ___

Describe-

Has this service been of value?

How can this service element be improved?

Further comments-
TECHNICAL MATERIALS

Have you or your agency used the Technical Materials component of the program? Yes ___ No ___

What materials have you requested? Received ___ Not ___

How can this service of the program be improved?

Further comment-
TRAINING (WORKSHOPS)

Have you participated in Technology Transfer workshops? Yes ___ No ___

Have others in your agency participated? Yes ___ No ___
Who?

Have the workshops been of value to you and your agency? Yes ___ No ___
Describe-

Based on your experience, what are your comments or recommendations regarding:

Workshop location-

Frequency, size and/or location-

Subject Material-

Other subject areas for workshops you consider important--

Your suggestions for revised format to better serve your agency--
GENERAL SUBJECT AREAS FOR DISCUSSION WITH SELECTED INDIVIDUALS AS APPROPRIATE

1. Technology Transfer Program -- are locals aware and familiar with the program? Also, the roles of Federal, State, and T2 Center?

2. Innovative ideas relating to improvement of the Program and its ability to provide needed services.

3. The local feeling regarding the Program and the relative importance of the four services (Newsletters, Assistance, Materials, and Workshops) being provided.

4. Suggestions regarding evaluation or measurement of the Program's values to the locals.

5. Neglected activity areas in which the center could or should be involved.

6. The need for locals to react to the Program. The Federal, State, and the Center needs local response to the specifics of the Program.