Fall 2007

Technology NEWS

Iowa LTAP
Local Technical Assistance Program

Providing transportation technology transfer for Iowa's cities and counties

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Iowa State University's Center for Transportation Research and Education (CTRE) is the umbrella organization for the following centers and programs:

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Construction Management & Technology
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Focus on recent ISU research for improving local roads

Several ISU researchers have recently completed projects with implications for local roads. This issue of *Technology News* briefly summarizes three studies: improving the performance of granular shoulders, best practices for successful cold-in-place recycled asphalt pavements, and using contracts with flexible start dates. Full reports for all projects, plus brief technical summaries, are online: www.ctre.iastate.edu/research.htm. Click "Completed research," or search for keywords using the Search CTRE function at the top of the page.

Improving granular shoulder performance

Stabilizing granular shoulders through a variety of materials and techniques can improve shoulder performance and safety to some degree, and reduce the need for repair activities.

These conclusions were recently reported by David White, associate professor of civil engineering at ISU. Along with a team of professors and students, White inspected various granular shoulders across the state, evaluated several stabilization techniques, and provided recommendations and tools for designing and constructing granular shoulders.

The project was sponsored by the Iowa Highway Research Board (TR-531).

Potential cost/performance issues

Roadway shoulders perform important functions. They provide space for extra-wide agricultural vehicles, emergency stops, and recovery of errant vehicles, as well as structural support and drainage for the pavement. Depending on traffic and other factors, those can be some pretty hefty performance requirements.

Compared to paved shoulders, granular shoulders can cost as much as 30 percent less to construct. But they also can experience performance problems like edge drop-off (figure 1), rutting (figure 2), erosion, irregular slope, and settlement.

Granular materials are commonly used for roadway shoulders in Iowa, and local agencies can expend significant effort and money for frequent regrading, placement of additional virgin material or recycled hot-mixed asphalt or concrete, and recompaction, increasing short- and long-term maintenance costs.

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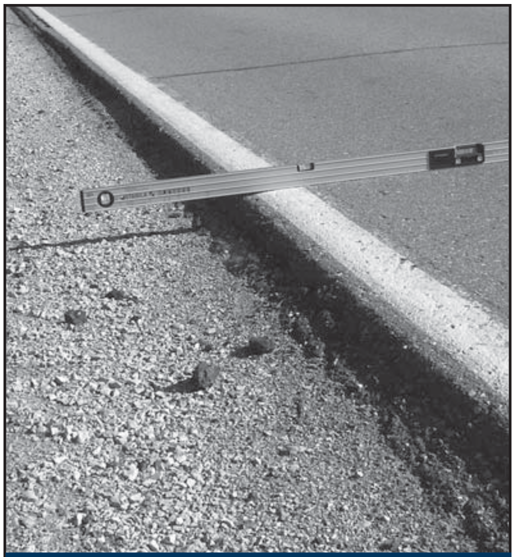

Figure 1. Edge drop-off was a feature of several granular shoulders examined in White s study

Acronyms in *Technology News*

AASHTO	American Association of State Highway and Transportation Officials
APWA	American Public Works Association
CTRE	Center for Transportation Research and Education (at ISU)
FHWA	Federal Highway Administration
Iowa DOT	Iowa Department of Transportation
ISU	Iowa State University
LTAP	Local Technical Assistance Program
MUTCD	Manual on Uniform Traffic Control Devices
NACE	National Association of County Engineers
TRB	Transportation Research Board

U.S. Department of Transportation
Federal Highway Administration

Iowa Department of Transportation

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Shoulder conditions

Two problems showed up most often on granular shoulders inspected by White and his team:

- Edge drop-off (approximately 60 percent of inspected sites had an edge drop-off greater than 1.5 in.).
- Soft subgrades (about 50 percent of inspected sites had California bearing ratio [CBR] values less than 10 at depths between 8 and 10 in.).

Edge drop-off can be a safety issue (see "Pavement edge drop-off," *Technology News*, September–October 2006, www.ctre.iastate.edu/ pubs/Tech_News/2006/sep-oct/edge_drop-off.pdf). Soft subgrades can contribute to shoulder rutting problems.

Recommendations

White's team tested various stabilization materials and techniques on both the granular material (primarily to reduce edge drop-off) and the soft subgrades (primarily to reduce rutting).

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Figure 2. Rutted, unstabilized shoulder (top)
Another shoulder area seven months after being stabilized with fly ash (bottom)

Iowa LTAP Mission

To foster a safe, efficient, and environmentally sound transportation system by improving skills and knowledge of local transportation providers through training, technical assistance, and technology transfer, thus improving the quality of life for Iowans.

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The field tests, along with data from corresponding lab tests, were used to develop charts for designing granular shoulders for minimum rutting and predicting the rutting behavior of existing ones. Variables include CBR values of subgrade and of granular layer, axle loads, and rut depth.

In both the lab and the field, stabilizing soft subgrades with fly ash or geogrid was effective at reducing rutting (figure 2).

In lab tests, stabilizing the granular shoulder materials with portland cement, polymer emulsions, or soybean oil showed promise for inhibiting edge rutting or drop-off.

Field results with these materials, however, were disappointing. Edge ruts redeveloped over a short time. The team hopes to conduct additional research, focusing on improved mixing and compaction methods and equipment.

To reduce rutting, the team recommends designing granular shoulders with appropriate CBR values for both the subgrade and granular layers, accounting for expected traffic level and loads.

The weighted average CBR value of the granular layer should be at least 10. The weighted average CBR value of shoulder fill and subgrade up to a depth of 20 in. should be at least 12. Dynamic cone penetrometer and Clegg impact tests can be used to assess in situ CBR values during shoulder construction.

The increased initial construction costs of these stabilizing techniques will not be totally offset by reduced maintenance activities. Stabilized granular shoulders have the potential, however, to enhance performance and safety, which can be difficult to quantify.

For more information

Contact David White, 515-294-1463, djwhite@iastate.edu. The full project report, including design charts, and a technical summary are online, www.ctre.iastate.edu/pga/detail.cfm?projectID=-28778605. ■

CIR continued from previous page

The CIR pavement layer appears to act as a stress-relieving layer. Within the range of data analyzed, a less stiff and more porous CIR layer performs well. An appropriate range of values for stiffness and air voids has not been determined but will likely be different from those for hot-mix asphalt.

Recommendations

Decision makers are encouraged to use available tools for determining if a specific pavement is a good candidate for CIR.

In particular, consider using falling-weight deflectometer or dynamic cone penetrometer (figure 3) testing to evaluate the subgrade's ability to provide proper support.

Life-cycle cost analyses should reflect CIR performance curves developed in this study.

For more information

Contact Chuck Jahren, 515-294-3829, cjahren@iastate.edu. The full project report, including design charts, and a technical summary are online, www.ctre.iastate.edu/research/detail.cfm?projectID=1063747601. ■

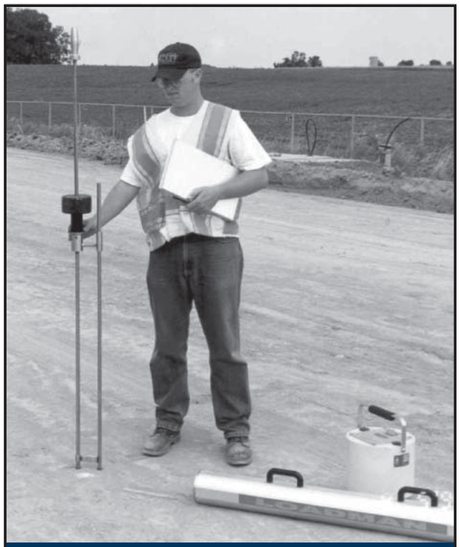

Figure 3. Operating dynamic cone penetrometer