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Wyoming Technology Transfer Center
WY T² LTAP
Local Technical Assistance Program

T² ROADS ON THE RANGE

2014, Issue 1

Wyoming Counties Pavement Management System

By Khaled Ksaibati, Director

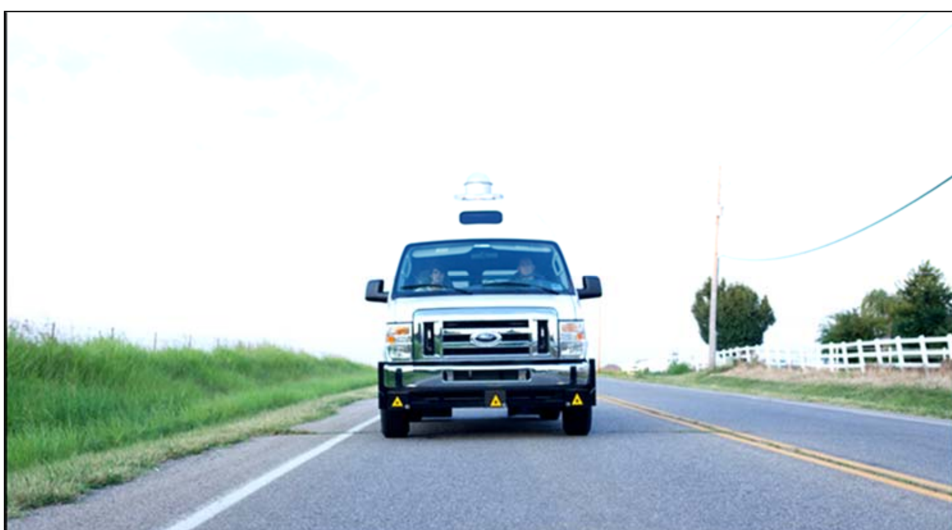
Background

Early in the summer, the Wyoming T²/LTAP center began working on a statewide Pavement Management System for paved county roads. The first year of this program is fully funded by WYDOT and FHWA. Future years of this program will be funded by counties. The pavement monitoring program will enable counties to document the conditions of paved county roads. In addition, it will provide the tools to react appropriately as heavy traffic using paved county roads increases.

Most asphalt county roads within the state of Wyoming were built several decades ago. They were not built to withstand the very heavy loads that often accompany modern industrial activities such as oil and gas drilling. When industrial activities are widely dispersed, roads built to carry lighter traffic are often subjected to more loads than what they can handle. Assessing the condition of these roads before the additional traffic arrives provides baseline information on the county roads' conditions, allowing for realistic and defensible evaluations of the impacts of increased traffic. Such information can also be used to recommend maintenance and structural enhancements to improve a road's ability to carry heavy loads, potentially preventing the expenditure of millions of dollars in unnecessary repair and rehabilitation work by properly applying preventive maintenance.

Paved roads are vulnerable to complete destruction due to an influx of heavy trucks, particularly older ones with limited structural capacity. The cost of reconstructing a paved road largely destroyed by heavy traffic could approach $1 million per mile. The costs of preventing such losses are significantly less. Structural improvements allowing a road to carry more

Pavement Management System, continued on page 2.



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heavy loads generally consist of asphalt pavement overlays or more expensive rehabilitation, depending on a road's current condition and structure. There are no inexpensive options when a paved road fails.

Risk Assessment

In terms of total investment costs, Wyoming county road networks are comprised of paved roads, unpaved roads, and bridges. Unpaved roads, though they are easily damaged by heavy traffic, are relatively inexpensive to repair. Therefore, damage to unpaved roads poses a relatively small risk to Wyoming counties. The greatest undocumented risk due to sudden increases in heavy truck traffic on Wyoming county road and bridge networks is to paved county roads. There are several reasons for this. Most paved county roads have historically served very low traffic volumes. They lack the structural strength to carry many heavy loads, particularly in spring when the base and subgrade materials are wet and soft. Many agricultural producers recognize that when road bases are wet, roads are vulnerable so they try not to use them at these times. They will rely on these same roads a decade from now, so they want them to last. For oil and gas drilling companies, seasonally restricting their activities is not likely to be successful, short of legal means. They must get the rig, the water, or the drill stems to the site now or lots of money will be lost. The combination of heavy loads at all times of the year, structurally weak pavement sections, and high repair and replacement costs makes paved county roads very vulnerable to sudden influxes of heavy traffic. The possibility of rapid, severe, and expensive damage to their paved county roads comprises a major risk to many Wyoming counties.

Counties PMS

Consistency in data collection throughout the state is essential if statewide efforts are to be made to quickly respond to imminent, rapid increases in heavy traffic on paved roads. Ideally, this consistency will apply to both paved county roads and to state highways. WYDOT contracts annually with Pathway Services® to survey the state highways. This study expanded the Pathway contract to include paved county roads. By using the same data collection procedures on the state and county roads, comparisons may be made between the networks. Three types of information will be provided for each paved road segment the pathway van analyzes: Automated roughness data expressed as the international roughness index (IRI); automated rutting data expressed in inches (RUT); and video logs of the pavement and roadside. All roads have been divided into segments so those who operate the van know when to begin and end their data collection. A pavement condition index (PCI) will be generated by observing the video logs from the camera facing the pavement. For each segment, several sections will be sampled and distresses will be measured by Wyoming T^2/LTAP staff member watching videos of the pavement on a computer with specialized software that facilitates distress evaluation. From these distress measurements, the PCI is calculated.

Pavement thicknesses will be established using ground penetrating radar (GPR). This data is collected by specialized vehicles traveling at normal highway speeds. Specialized software is used to convert the signals from the GPR into pavement thicknesses. Resource International, INC. submitted the lowest bid to collect the GPR data on all paved county roads. They are currently in the process of collecting the required data. (There is another article in this newsletter about GPR testing equipment)

Several PMS options were presented by the WY $T^{2/}$LTAP center to WCCA and WACERS. These options included data collection and various levels of data analysis. As shown in Figure 1, WCCA and WACERS selected the option which would provide raw data on all county roads without any post data processing. Each county will have

Upcoming Workshops

November 5, 2014:
Concrete Workshop
Gillette, WY

November 6, 2014:
Concrete Workshop
Casper, WY

November 13, 2014:
Bridges Workshop
Douglas, WY

November 20, 2014:
LPA Certification
Riverton, WY

the opportunity to analyze and use the data in any way they see fit. If all counties can see the benefits of doing further analysis, the T^2 center can step in and provide additional services.

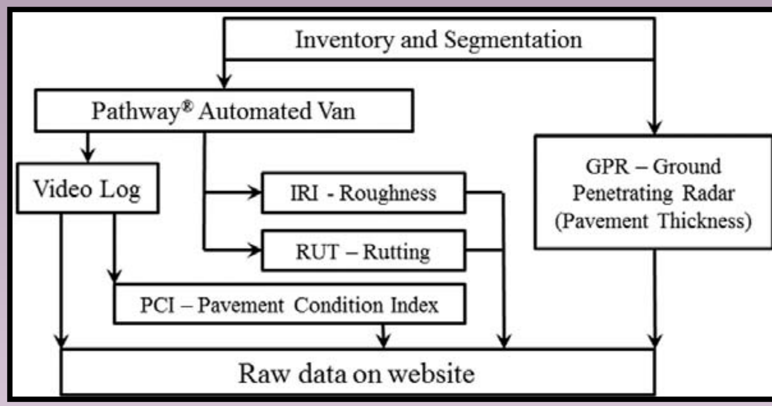


Figure 1. Option Selected by WACERS and WCCA.

Pavement Monitoring Benefits

Several specific benefits may be realized from the county paved road monitoring. The primary benefits would include:

- Current county road surface conditions could be directly identified, allowing appropriate decisions to be made.
- Impacts to paved county roads due to industrial activities could be assessed and evaluated.
- WYDOT pavement management system data and decision processes could be used to provide insights into possible treatment methods on paved county roads.
- Appropriate maintenance, repair and rehabilitation strategies could be developed for individual roads. These strategies could be based on both current conditions and on individual road segments' structural ability to carry anticipated traffic regardless of its source.
- Future maintenance and rehabilitation needs could be projected using surface condition and layer thickness data.
- Counties with limited resources would not need to develop their own methods for monitoring or analyzing their paved roads.
- The state legislature could be provided with defensible data justifying funding for paved county roads.

Ultimately, the greatest single benefit from this monitoring will be to provide county road and bridge supervisors, county commissioners, state legislators, and other decision-makers with adequate information to act in the public's best interests.

Summary

The PMS option selected by WACERS and WCCA provides for collection of all desired pavement condition data. Though no analysis is requested at this time, by collecting this data, analyses may be performed later as it becomes more apparent which analysis will be most useful. This provides considerable flexibility without any commitment of funds for analysis at this time. Thus, analyses may be performed on individual roads, on all roads within a county, or on all paved county roads statewide as needs for information arise. In addition, this data will allow for comparisons to be made between county paved roads and state highways. Overall, this plan provides the most information at the least possible cost while postponing any analysis and associated costs until it becomes more apparent which analyses will be most useful. For more information about this program, feel free to contact us at the center.

Ground Penetrating Radar for Measuring Pavement Layer Thickness

U.S. Department of Transportation
Federal Highway Administration

Highway agencies and contractors now have a new tool for estimating the remaining service life of pavements and selecting the appropriate maintenance and rehabilitation activities—ground-penetrating radar (GPR). GPR systems collect pavement layer thickness data quickly, unobtrusively, and inexpensively. Using GPR, pavement management engineers can survey subsurface conditions at a small fraction of the cost of conventional core sampling and gather data for network-level pavement management.

What is ground - penetrating radar?

GPR is a pulse-echo method for measuring pavement layer thickness and other properties. It works like ultrasound, but uses radio waves rather than sound waves to penetrate the pavement.

Antennas mounted on a moving vehicle transmit short pulses of radio wave energy into the pavement (see figure 1). As this energy travels down through the pavement structure, echoes are created at boundaries of dissimilar materials (such as the asphalt–base interface). The arrival time and strength of these echoes can be used to calculate pavement layer thickness and other properties, such as moisture content.

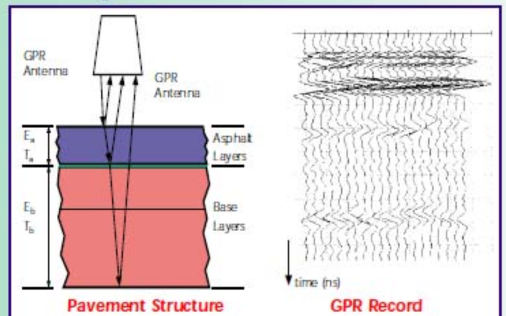


FIGURE 1:
Principles Used for Measuring Pavement Thickness

Why use GPR?

GPR systems yield accurate data in a form ready for management consideration. They survey pavements quickly, cost-effectively, and with minimal traffic disruption and safety risks. The Strategic Highway Research Program (SHRP), the Federal Highway Administration (FHWA), and several States and other agencies have carried out studies of GPR that demonstrate the advantages of this automated surveying system.

The advanced GPR technology is not only available, but it has also been tried and tested. Denmark, Finland, and the United Kingdom are already using GPR in their pavement evaluation programs, as are several States, including Florida, Louisiana, Michigan, North Carolina, and Texas. Some States operate their own GPR equipment and perform their own analyses, and some contract the survey work. Other States, including Wyoming, Idaho, Minnesota, and Kansas, are evaluating GPR options. Field tests and evaluative reviews conducted over the past decade have examined the accuracy and efficiency of GPR performance as a network pavement management tool for measuring pavement layer thickness. The studies have established the following benefits and limitations:

- Lower Surveying Costs— GPR provides 100 percent pavement coverage at a small fraction of the cost of taking conventional core samples.

- Management Utility— GPR thickness data can be imported directly into a pavement management system to provide accurate data for calculating the remaining life of pavement sections, selecting the appropriate maintenance and rehabilitation actions, and developing specific

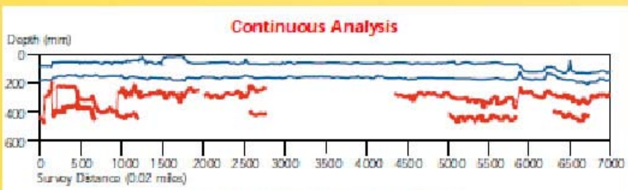
Output of GPR Surveys

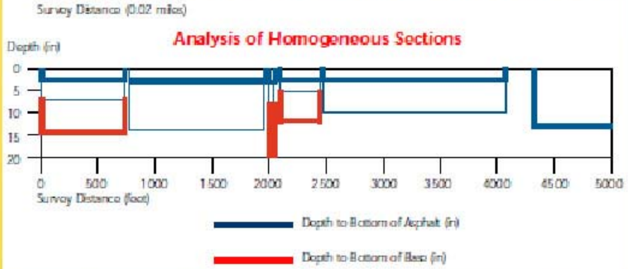
Continuous Analysis

Distance (miles)	Thickness Asphalt (mm)	Thickness Base (mm)
.001	171.338	266.816
.011	172.064	275.062
.021	172.004	261.257
.031	178.452	278.780
.041	169.455	287.135
.051	172.131	295.694
.057	172.730	310.635
.059	181.170	121.075
.069	172.251	110.218

Homogeneous Section Analysis

Station (ft.) Begin	Station (ft.) End	Mean Layer Thickness ASPH	Mean Layer Thickness Base
5	739	7.05	8.25
779	1953	13.96	0.00
1993	2038	8.12	11.50
2087	2448	5.08	7.07
2460	4066	9.74	0.00
4321	6408	12.92	0.00
6421	6489	15.05	0.00
6491	6567	19.68	0.00
6567	6697	15.39	0.00
6701	8773	11.06	0.00





rehabilitation designs. Software converts the radar readings into ASCII file output or graphical representations. Survey data can be displayed in continuous form or for discrete homogeneous sections. GPR can reveal other conditions that are not visible at the surface (like moisture content). When used on concrete, GPR reveals steel reinforcing bars, full-depth asphalt patches, and joint spacing, as shown in these GPR records.

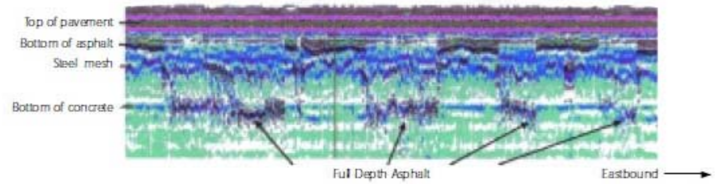


FIGURE 2:
GPR Record of Asphalt-Overlaid Concrete, Showing Evidence of Full-Depth Patching in Concrete

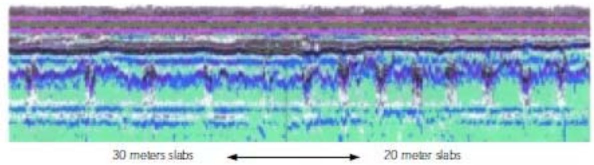


FIGURE 3:
GPR Record Showing Transition in Slab Length from 30 to 20 Meters

- Greater Efficiency— GPR systems are fast and efficient. Radar-equipped vehicles—like those shown here—typically cover as many as 322 km per day (200 miles per day), moving at normal highway speeds. Automated data collection reduces survey time dramatically and makes the process nearly invisible to the traveling public.

- Increased Safety— GPR minimizes the exposure of highway workers to dangerous situations. It requires no road crews, lane closures, congestion, traffic backups, or core patching. Workers are not exposed to high-speed traffic, weather, noise, or pollution, and the traveling public escapes the frustrations, delays, and attendant safety risks of lane closures.

- Adequate Accuracy— GPR pavement thickness data are accurate to within 3–15 percent of data obtained through conventional core samples (Maser, 1996), levels appropriate for network-level pavement management. Accuracy varies slightly with paving material, and research has established typical GPR accuracy levels for GPR surveys of four types of pavement layers:

Ground-Penetrating Radar:
*Range of Accuracy for Pavement Layer Thickness Measurements**

Layer Type	Accuracy (vs. Cores)
New asphalt	3–5%
Existing asphalt	5–10%
Concrete	5–10%**
Granular base	8–15%**

*Maser, 1996

**Requires adequate contrast between layer materials

- Limitations— GPR may not always be able to detect the thickness of concrete pavement or the thickness of the base layer if there is insufficient contrast between the concrete and the base below. Agencies should be aware of the capabilities of GPR and stay within those boundaries, which produce reliable results.

Note: The Wyoming T²/LTP Center will be using similar technology in collecting thicknesses of all county paved roads as part of the statewide PMS.

FHWA Radar Unit

Speed Limits Update

By Josh Jones, Engineer

As most know, a new speed limit law changed the statutory speed limit on unpaved roads from 65 mph to 55 mph in 2011. In addition, new standards were developed for setting speed limits on local paved and unpaved roads in Wyoming. According to the standards, speed studies must be conducted by professional engineers while the speed data can be collected by trained technicians.

To help initiate local speed limit programs in Wyoming, several training approaches were developed by the Wyoming T^2/LTAP Center to satisfy the individual needs of each county and local jurisdiction. Local governments are provided with the following options:

1. Hire a private engineering firm to conduct the speed limit studies.

2. Attend a training workshop and then conduct the speed studies in house with a professional engineer.

3. Receive on-site training and conduct the first few speed studies with the WYT^2/LTAP.

4. Request that the WYT^2/LTAP help in conducting the speed studies on a few high profile roads.

5. Collect the field data and have the WYT^2/LTAP analyze the speed data.

Multiple local governments in Wyoming have set speed limits using the various options detailed above. One county was able to use the techniques learned at the workshop to collect the data and have a professional engineer conduct the data analysis in-house. Another county requested some additional training to help summer interns collect the necessary data for establishing speed limits. The WYT^2/LTAP conducted a few speed studies with several county engineers and technicians. This allowed for on-site training and to provide details about site specific questions. Another county hired an engineering firm to collect the speed data and the WYT^2/LTAP provided the county engineer with a summary to recommend appropriate speed limits. Several other counties have expressed interest in additional on-site training or for speed studies to be performed on some of their high risk roads.

It is a good idea to remember that according to the Wyoming statutes, speed limits must be set by following the standards which can be found on our web site. For additional information/assistance please contact:

Josh Jones – Traffic Engineer
Dr. Khaled Ksaibati – Director
Phone: 307-766-6743

George Huntington

George Huntington passed away August 14, 2014 after a short battle with cancer.

George came to Laramie in 1987 and worked at Western Research Institute before entering the engineering program at UW in 1992. After graduating with a Master degree in Civil Engineering, George became employed with WYDOT as a Materials Staff Engineer. He joined the Wyoming Technology Transfer/LTAP Center at UW in 2003 as a Senior Engineer. George's work at the WY T^2/ LTAP included developing and presenting several training courses related to: gravel roads design and maintenance, basics of soils, work zone safety, and flaggers certifications.

George appreciated many joys in life. He loved downhill skiing, ice hockey, and playing soccer. He was an accomplished musician, photographer, and gardener. George married Anne Marie Powell in 2010 and had two children, Sophie and Sam.

Contributions can be made to a college fund for George's children. Checks can be made out to the children or Anne Marie Huntington, and sent with a letter of intent to Pamela Burgess at UniWyo Federal Credit Union, 1610 Reynolds St.,
Laramie WY, 82072.

Above: George checking retroreflectivity on a pedestrian crossing sign on the UW campus.

Right: George presenting information on Dust Suppression by Incorporating Reclaimed Asphalt Pavement into Gravel Roads

11th International Conference on Low-Volume Roads

The 11th annual international conference on low-volume roads will be taking place in Pittsburgh, Pennsylvania from July 12 – 15, 2015. The conference features the latest information about low-volume road management, design, construction, safety, maintenance, and many other related topics. The conference is for practitioners worldwide in local, state, and federal agencies; universities; private firms; and international organizations. Previous conferences typically have attracted 250 to 300 transportation professional from all continents. Visit the Conference website at: www.TRB.org/Conferences/2015/11LVR for up-to-date information about the conference,

The Wyoming T^2/LTAP Center will be a major participant in this conference which is held once every four years. Six papers will be presented by the Wyoming T^2/LTAP staff. These papers resulted from research projects that were partnered with local governments, Wyoming Department of Transportation, and the Federal Highway Administration. It is never too early to begin thinking about arranging to travel to this important conference. All topics covered in this conference are related to technologies and techniques relevant to low volume roads.

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