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Road TTAP Talk

Adapting into the Future

by Dr. Airton G. Kohls

> ***"Washington Road is a perfect example of two cities coming together to improve traffic flow, independently of jurisdictional borders".***
> ***Glen Bollinger***

Driving through a series of signalized intersections in certain hours of the day can be frustrating. The experience of frequent stop-and-go traffic adds to increased delay, accidents, fuel consumption and harmful emissions, degrading our citizens' quality of life. Available adaptive traffic signal control technology can improve on deployed traffic signal control systems governing our streets today. Some will consider it cost prohibitive but, when compared to the "hidden" costs involved with congestion, adaptive control has the potential to be a smart investment.

Good practice requires agencies to retime traffic signals at least every 3 years. Well designed and deployed adaptive control systems will do that several times every day, seeking to adapt to traffic fluctuations. Detection devices on our streets today serve the simple purpose of asking for service during a red light or extending service during a green light. Adaptive control uses detection devices intelligently, monitoring traffic and allocating green time where it is needed the most. Adaptive control can also seamlessly override the logic of traffic signal controllers, optimizing phase green times. Not all adaptive systems are the same and advancements in technology are creating a competitive and evolving market. Some of the systems available in the market are SCOOT, SCATS, RHODES, OPAC, ACS Lite and InSync.

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Columbia County Traffic Engineer Mr. Glen Bollinger explaining about the county's ITS project.

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From the Director

My focus in this month's column is workforce development. We all know that transportation professionals are a graying crowd (for those of us still having hair!). This has been a concern for some time at both the state and federal levels.

Many of the seasoned professionals who keep our transportation systems functioning smoothly will soon reach retirement age. You may be one of these. While many agencies have begun to address this reality, it will still be a challenge to replace the expertise being lost. Overall, the retiring baby boomer generation is much larger than subsequent generations from which replacements must come. Also, the wave of retirements is not limited to transportation workers, but faces many sectors of the workforce. Thus, transportation agencies must compete against other sectors for a portion of a smaller worker pool.

Absolute numbers do not fully present the problem. American students, particularly women and minorities, have been difficult to attract to the so called "STEM" (science-technology-engineering-math) disciplines needed in many transportation jobs. The competition for those who have STEM qualifications is fierce. While engineering enrollment is up at the University of Tennessee, we still have to convince students to enter transportation related programs, as opposed to trendy areas such as nanotechnology or biosystems engineering. Though many transportation jobs do not require engineering degrees or even a 4-year college degree, qualified candidates still have competing employment opportunities, even in today's weak economy.

To help encourage students to consider transportation as a career choice, we are trying to reach them during the middle school or high school years. Here at UTK, we've worked with school systems to develop curriculum materials with a transportation component. For a number of years, we've also held an annual summer transportation camp, originally for high school juniors and seniors, but now hosting middle school students. The high school version was successful, but we believe we need to reach the students at an even earlier age.

At the same time, we also must work with persons who have already completed their formal schooling, either to prepare them for a career shift into transportation or to help them acquire additional competencies for an ongoing transportation career. TTAP has long provided continuing education opportunities, including a variety of general classes and the TATE certification program. Your suggestions on these are always welcomed.

Collectively, we must sell transportation as a desirable

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From the Director, *continued from page 2*

career choice. This is especially challenging in the public sector where salaries often lag behind those in the private sector. If you have thoughts or suggestions on this topic, I'd be happy to hear them. In fact, your best practices can be featured in this newsletter.

Weatherwise, great spring so far! I hope it continues. As always, TTAP looks forward to assisting you.

David

TTAP Database Update

We are currently updating our TTAP database. It is very important for us to be providing you access to our RoadTalk newsletter and to our workshop brochures. We want to make sure that every city and county in the State of Tennessee continues to receive relevant information on available training and on relevant transportation issues. We are optimizing our mailing list by looking into the activity of our clients in the last 5 years. In the near future, bi-weekly updates on upcoming workshops will be sent to you via e-mail.

Please feel free to request your addition to our mailing list and please let us know if we still don't have your correct address.

Remember, you can view our calendar of workshops at: http://ctr.utk.edu/ttap/training/index.html

You can view our RoadTalk newsletters at: http://ctr.utk.edu/ttap/newsletter/index.html

Adapting into the Future, *continued from page 1*

On a recent visit to Columbia County in Georgia, an adaptive traffic signal control was demonstrated as part of a much larger ITS (Intelligent Transportation System) project. A before-and-after study was conducted on a 1 mile section of Washington Road, yielding significant travel time, stop and delay reductions. The study can be found at http://www.columbiacountyga.gov/Modules/ShowDocument.aspx?documentid=8628. After driving that stretch of roadway during the afternoon peak hour, it was impressive how fluid traffic flow was. It was even more impressive to learn about Columbia County's ITS project. The county is working on the installation of a 200 mile fiber optic cable network and five wireless towers. All traffic signals in the county will be connected, as well as water systems and emergency response; Pan Tilt Zoom cameras are being deployed and will help monitor traffic and full color dynamic message signs and school flashing lights will be programmable from the traffic management center. In addition to that, free WiFi will be available at County recreation parks, libraries, community centers and schools. Mr. Glen Bollinger, the county traffic engineer, pointed out the importance of all the cities in the county getting involved during the design process. "Washington Road is a perfect example of two cities coming together to improve traffic flow, independently of jurisdictional borders", mentioned Mr. Bollinger. The county has a 1 cent sales tax for capital improvement projects that funded the 25% county contribution for the project. Once completed, the project will be self sufficient and the broadband network will be operated by the Columbia County Community Broadband Utility Department.

Finally, adaptive traffic signal control relies on good communications systems. Columbia County is being proactive and with a creative ITS project is certainly adapting into the future.

FHWA through the Every Day Counts initiative is providing agencies with a systematic process to guide adaptive signal control technologies implementation decisions. On August 16, 2012 a nationally broadcasted learning session will allow participants to learn more on "market-ready" adaptive traffic signal technologies.

Measures for Your Curve Advisory Signs

by William Lowery, P.E. (Originally published in issue 3-11 of the TEEX Lone Star Roads newsletter. Reprinted with permission of the Texas LTAP Center and the Texas Engineering Extension Service (teex.org/ltap).

Counties administer thousands of miles of secondary rural roadways that present curves of every conceivable layout, from very sharp to very gradual. When a curve can only be comfortably traversed at a lower speed than typically traveled on the roadway segments approaching the curve, it is very important to provide advanced warning for drivers.

Turn or Curve Sign?

The Texas MUTCD stipulates use of a Turn warning sign if the safe advisory speed is 30 mph or less; use of a Curve warning sign for safe advisory speeds greater than 30 mph. Many conditions are obvious: when a sharp curve/turn requires speeds of 20 MPH or less a Turn sign is necessary, or when a curve can be comfortably traveled at 40 mph or greater a Curve sign is applicable.

Helpful Instrument

When the comfortable speed through a curve is in the range of 25 to 35 MPH, it raises a question about which sign to use. An accurate measure is needed in order to make a good decision. That is where the traditional Ball Bank Indicator is useful. Proper use of the instrument will help identify a defensible safe advisory speed.

Ball Bank Indicator Instrument

The aim in using this instrument is to identify the highest speed that can be traveled around a curve without causing an uncomfortable side throw to vehicle passengers. The table below shows the maximum allowable readings for various operating speeds. A reading of 10 degrees should not be exceeded when a curve is traveled at 35 mph or greater; a reading of 14 degrees should not be exceeded when a curve is traveled at 20 mph or less. A curve traveled at 25 or 30 mph should not yield a reading greater than 12 degrees.

Maximum Reading	Speed Range
10 degrees	35 mph or greater
12 degrees	25 and 30 mph
14 degrees	20 mph or less

Example 1: On a roadway with a high operating speed, if test runs on a curve yield 12 degrees at 45 MPH and 9 degrees at 40 MPH, a 40 MPH advisory speed should be used because the 12-degree reading exceeded the maximum allowable in this range but the 9-degree reading did not.

Example 2: If on a lower speed roadway test runs on a curve yield 15 degrees at 30 MPH and 11 degrees at 25 MPH, then 25 MPH should be used.

Example 3: If on a very low-speed roadway test runs on a curve yield 16 degrees at 20 MPH and 13 degrees at 15 MPH, then 15 MPH should be used because at 20 MPH the reading exceeds that allowable.

Set Up For Use of Ball Bank Indicator

Poor setup or improper test run procedures will yield erroneous results, so care must be taken to follow the procedures outlined below:

1. **Test vehicle:** Uniform tire pressure, calibrated speedometer.

2. **Personnel:** Driver and recorder.

3. **Ball Bank Indicator:** Mounted in vehicle; set at zero with vehicle on level ground (side-to-side is critical; minor front-to-back slope acceptable); and driver and recorder positioned as for test runs.

Test Run Procedure

For each run the driver should reach the test speed well before the curve and must maintain that speed in his "lane" around the curve. On each run the recorder must carefully observe the position of the ball throughout the curve and note the maximum reading to the nearest degree. Runs should be made at 5 mph increments; and in both directions.

Step 1 – Initial Run: Run speed should be made at 10 or 15 MPH lower than the posted speed limit (or the usual operating speed if speed limits are not posted).

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Step 2 – Next Runs: If the initial reading exceeds the limit for run speed, lower speeds should be tested (in 5 mph steps) until the allowable reading for a speed is NOT exceeded. That should then be the chosen advisory speed.

Step 3 – Higher-speed Runs: If the limit for the initial speed is not exceeded, then runs at successively higher speeds (in 5 mph steps) must be run until the reading just exceeds the allowable limit. The next lowest speed should then be chosen as the advisory speed.

Application for Turn vs. Curve Signs

The foregoing procedure can be used to determine the advisory speed to be posted in conjunction with a Turn or Curve sign. However, these signs can be used without posting an advisory speed with them. If, in the judgment of a roadway official, a sign should be posted, the procedure can be used to determine whether an advisory speed is above 30 mph. If so, then the sign should be a Curve sign; if not, it should be a Turn sign.

NOTE: William Lowery is the TEEX Assistant Transportation Training Program Director.

Photos of a custom-built, portable, non-skid mounting for a ball bank indicator. It was built by Tim Storey, TEEX Senior Training Support Technician. For more information about this portable mounting technique, contact TEEX's Transportation Training Program at 979-862-3735.

Pothole Patching

*by Dr. Airton G. Kohls (*Information from Evaluation of Pothole Patching Materials Report)*

Potholes can be considered one of the most aggravating forms of asphalt deterioration and can cause danger for the traveling public. Fixing the problem appropriately can be costly and time consuming. Due to tightening budgets, highway maintenance agencies have been focusing on improved materials and techniques that can lead to more economical and long-lasting solutions to pothole repair. A report on the Evaluation of Pothole Patching Material (FHWA NJ 2001-020) is available online and serves as reference material on mechanisms of pavement deterioration, bituminous patching mixtures, pavement distress types, laboratory testing, pothole repair procedures, design considerations and performance analysis of different patching materials.

Mechanism of deterioration

In flexible pavements, the formation of a pothole usually begins in a weakened area of the pavement caused by water entering cracks due to heavy traffic loads. In rigid pavements, a formation of a pothole usually occurs at joints due to expansion and contraction, or in areas where concrete has deteriorated. Potholes can also be formed on the asphalt layer that exists on top of a rigid base structure due to water entering cracks formed by reflective cracks.

Bituminous patching mixtures

The hot-mixed, hot-placed patching mixture is considered to be the highest quality having the same characteristics as asphalt concrete used for pavement surfacing. The hot-mixed, cold-placed patching mixture is produced with liquid bituminous binders and heated aggregates but is used cold from a stockpile, being workable in all weather. Similarly, the cold-mixed, cold-placed patching mixture is produced with liquid bituminous binders but with unheated aggregates, being considered the lowest quality of all patching mixtures.

Bituminous patching mixtures should have some specific properties like stability, stickiness, resistance to water action, durability, skid resistance, workability and storageability. Briefly, stability is necessary to allow the patch to resist displacement by traffic and is mostly dependent on gradation of mixture and material texture. Stickiness is necessary for the patch to adhere to the sides of the pothole, and is influenced by temperature of the mixture and of the binder. Water resistance is needed to keep the binder from stripping off the aggregate and is affected by compaction and by binder and aggregate types. Durability is important for the patch having satisfactory resistance to disintegration. Skid resistance should be similar to adjacent pavement. Workability is important to enable the material to be easily shoveled and shaped and is affected mostly by temperature (low viscosity binders can help workability). Finally, storageability is necessary so the material will not harden excessively or drain the binder off the aggregate.

Pavement distress types

Knowing the types of distresses and the related failure mechanisms is very important to address the pothole problem. The following table exemplifies some of the most common pavement distresses in cold-mix patching.

PROBLEM OR FAILURE SYMPTOM	PROBABLE CAUSES – FAILURE MECHANISMS
PUSHING, SHOVING	- Poor compaction - Binder too soft - Too much binder - Tack material contaminates mix - Binder highly temperature susceptible causing mix to soften in hot weather - In-service curing rate too slow - Moisture damage – stripping - Poor aggregate interlock - Insufficient voids in mineral aggregate
DISHING	- Poor compaction - Mixture compacts under traffic
RAVELING	- Poor compaction - Binder too soft - Poor cohesion in mix - Poor aggregate interlock - Moisture damage – stripping - Absorption of binder by aggregate - Excessive fines, dirty aggregate - Aggregate gradation too fine or too coarse
FREEZE-THAW DETERIORATION	- Mix too permeable - Poor cohesion in mix - Moisture damage - stripping
POOR SKID RESISTANCE	- Excessive binder - Aggregate not skid resistant - Gradation too dense
SHRINKAGE OR LACK OF ADHESION TO SIDES OF HOLE	- Poor adhesion - No tack used, or mix not self-tacking - Poor hole preparation

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Laboratory testing

It is hard to duplicate pothole field conditions in a laboratory. Nevertheless, testing patching materials is appropriate since failure under ideal conditions usually means failure in the field. Some of the tests used for screening materials with satisfactory performance are stability, adhesion/cohesion, durability, workability, storageability, blade resistance and rolling sieve tests.

Repair procedures

Different techniques exist for pothole repairs. The main difference lies on the preparation of the pothole before the patching material is applied. The "throw-and-roll" method is the most commonly used method and material is simply placed into the pothole which may or may not be filled with water. Compaction is done by driving over the patched hole. In the "semi-permanent method", the water and debris are first removed from the pothole and the sides of the patch area are squared up. The material is placed and compacted with appropriate devices. When using the "spray injection method", the water and debris are first removed from the pothole and a tack coat of binder is sprayed into the pothole, on the sides and bottom. The asphalt and aggregate are then blown into the pothole with enough pressure that compaction is usually not necessary. The patched area is then covered by an aggregate layer. The "throw-and-roll" method usually presents worst performance then the more labor intensive (and more expensive) procedures.

For additional information on pothole patching download the report on the Evaluation of Pothole Patching Material (FHWA NJ 2001-020) at http://www.qprcoldpatch.com/pdf/Rutgers-Study.pdf (*Information from Evaluation of Pothole Patching Materials – Dr. Ali Maher, Dr. Nenad Gucunski, William Yanko and Fotina Petsi).

Design Considerations for Cold-Mixes

DESIGN CONSIDERATIONS	EFFECT ON MIXTURE
BINDER CONSISTENCY (before and during placement)	- Too stiff may give poor coating during mixing - Too stiff makes mix hard to shovel, compact - Too soft causes drainage in stockpile - Too soft may cause stripping in stockpile - Too soft may contribute to "tenderness" during compaction
BINDER CONSISTENCY (after placement)	- Too soft accelerates stripping, moisture damage in-service - Too soft accentuates rutting, shoving - Too soft may lead to bleeding, which causes poor skid resistance - Must cure rapidly to develop cohesion - High temperature susceptibility causes softening and rutting in the summer
BINDER CONTENT	- Maximize to improve workability - Excess causes drainage in stockpile or hot box - Excess may lower skid resistance (bleeding) - Excess may cause shoving and rutting - Low binder content gives poor cohesion
ANTISTRIPPING ADDITIVE	- Correct type and quality may reduce moisture damage
AGGREGATE SHAPE AND TEXTURE	- Angular and rough aggregate gives good resistance to rutting and shoving but is hard to work
AGGREGATE GRADATION	- Reduced fines improves workability - Excess fines can reduce "stickiness" of mix - Coarse (>1/2 in) mixes are hard to shovel - Open-graded mixes can cure rapidly but allow water ingress - Well-graded mixes are more stable - Dirty aggregate may increase moisture damage - Too dense a gradation will lead to bleeding or thin binder coating, and a dry mixture with poor durability - Open or permeable mix may be poor in freeze-thaw resistance
OTHER ADDITIVES	- Short fibers increase cohesion, decrease workability

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