CONTINUOUS IMPROVEMENT OF PAVEMENT MANAGEMENT DATA

A ROADMAP FOR THE IMPLEMENTATION OF THE AASHTO PROVISIONAL STANDARDS ON PAVEMENT MANAGEMENT DATA COLLECTION

TABLE OF CONTENTS

Introduction 1

Action Item 1 – QC/QA and Certification for Ride Measurement 2

Action Item 2 – Refine Cracking Standard to Allow Adoption by AASHTO 4

Action Item 3 – Rut Depth Definition and Resolution 5

Action Item 4 – Faulting Definition and Resolution 6

Action Item 5 – Certification and QC/QA on Rutting, Faulting, and Cracking 6

Stumbling Blocks 7

First Steps 7

Summary 7

References 8

Participants 8

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Introduction

The 21st century continues to place ever increasing demands on the transportation infrastructure of the United States. Asset management has become a higher and higher priority for public agencies in the United States. Managers are being asked to maximize the performance of the investment that the public has made. There are five key components to any asset management system (FHWA 1998):

- An inventory of assets.
- A method of assessing current conditions or performances.
- A process of determining needs.
- Tools to evaluate and select appropriate strategies to address the needs.
- Methods to evaluate the effectiveness of each strategy.

Many public agencies have struggled with the first two of these five components for many years. In the last decade, automated systems to assess the current conditions have become more prevalent in the marketplace. Though this technology has become more available, there are still issues that surround its use.

Two of the major issues that have hindered the implementation of automated pavement condition data are cost and reliability. Central to that theme are standards or protocols for data collection. With common standards for vendors to design to many, believe that the cost of automated collection would decrease while its reliability would increase.

In the early 1990's, the AASHTO Joint Task Force on Pavements (JTFP) was assigned the responsibility for pavement management activities. Automated data collection was in its infancy. An attempt was made to use the Strategic Highway Research Program's (SHRP) protocols for pavement data collection. In 1993, this was brought to the JTFP in the form of a motion to be forwarded to the Subcommittee on Highways (SCOH). This proposal was rejected since the SHRP protocols were geared toward research methods with 500-foot sections. The States felt that they needed to have the protocols modified to handle network level data collection. The Federal Highway Administration (FHWA) partnered with AASHTO in this process and contracted with Texas Research and Development Institute (TRDI) to have the protocols modified.

Four protocols were originally selected for this conversion; ride, rutting, faulting, and cracking. The JTFP formed a subcommittee to oversee the revisions of the protocols. Ken Fults, Texas DOT; Gary Sharpe, Kentucky Transportation Cabinet; Dan Dawood, Pennsylvania DOT; and Sam Miller, Maryland DOT make up the membership of the subcommittee.

Three of these protocols have now been balloted and passed by AASHTO to become provisional standards.

- PP37-99, *Standard Practice for Determining Roughness of Pavements*
- PP38-99, *Standard Practice for Determining Rut Depth in Asphalt Pavements*
- PP39-99, *Standard Practice for Estimating Faulting of Concrete Pavements*

The fourth protocol on cracking has not passed balloting by AASHTO and is still undergoing revision.

Although these provisional standards have been available, there has not been widespread use of them in the highway community. On October 30, 2000, the Federal Highway Administration and AASHTO hosted an invitation-only workshop in Auburn, Alabama to identify opportunities to improve the quality and reliability of pavement condition data collection and assessment. The outcomes of that workshop are the five action items discussed below in priority order.

Action Item 1 – QC/QA And Certification For Ride Measurement

The consensus of the group assembled in Alabama was that the key issue for implementation of the provisional standards was a QC/QA program to accompany the standard and a certification program for vendors who would comply with this standard. States would like to be able to use a guide specification or best practice when soliciting for these types of services. Vendors could provide a certification that they comply with the AASHTO Provisional Standard in the method which they acquire and process pavement management condition data. Certification/calibration is presently used in skid testing and deflection testing for falling weight deflectometers. Key issues for this action item include.

- What establishes truth in the measurement of ride?

  Rod and level, walking dipstick, and other devices have all been used around the country at various tests to establish what is the true profile of a roadway. Agreement would need to be reached on what are acceptable methods of establishing this control. The Texas Department of Transportation has developed a methodology they are using for comparison of ride measurements around Texas. This may be a resource for the beginning of this task.

- Should the vehicle be certified on some type of track, artificial inputs from a machine, or should the components be looked at separately?

  Many of the test tracks that have been established have a limited diversity in the roughness available to run over. It was stated by several group members that you need the spectrum of roads that range from very smooth to very rough to be able to fully test the capabilities of the profilers. Power spectral density needs to be addressed as a method of looking at the subject roads. One problem with using real roads for your calibration is that very rough roads tend to be overlaid and they are then lost. Closed facilities such as military bases or other compounds may allow better control of the variables involved.

Other methods of calibration could include using some type of machine to simulate a road. The advantage of this is that the road would never change and that operator error would be eliminated. This would probably be very costly to develop. Another option is to certify the parts of the machine, sensor, accelerometer, and software. The disadvantage of this approach is that you would not know that the machine works as a whole.

The issue of who would be the certifying official would also need a decision. Possible sources could be university (ies), private sector firm, or a public agency (ies). Cost for this service could be a factor no matter who performs it. Skid testing calibration costs approximately $10,000. FWD calibration is performed by four State Highway Agencies at no cost for other AASHTO members. This cost would be passed on from the vendors to States as they contracted for services.

- How long is a certification good for?

  The profilers used by the vendors and that SHA use travel thousands of miles per year. Will the certification be good for a fixed period or should a mileage limit be placed on that validation. It will obviously be expensive in terms of both a possible fee and the time it takes for a vendor to have his machine certified. Those are costs that will be eventually borne by the SHA or other purchaser of the service.

- Does the operator as well as the equipment receive a certification?

  There can be a case made that the operator needs a certification as well as the equipment that is used to perform the test. Many SHA presently require some type of certification of technicians who perform quality control testing for construction materials. This certification usually consists of classroom training, a test of knowledge, and a demonstration of the ability to perform the test correctly.

- What level of risk is the vendor and agency willing to take?

  The reliability and history of the testing machines needs to be considered. The risk to the vendors and/or the agency purchasing the data is how much data are you willing to throw out. There may need to be some type of daily check to assure that there is no gross error in the data acquisition. If quality control software could be developed to check data as it is acquired this would be helpful. This type of software was developed for the LTPP program for the collection of deflection data. This software assured that the proper spacing and type of data was collected and that the data was reasonable for the pavement section.

Can an agency validate the data as fast as we can collect it? – Equipment Vendor

Agencies purchasing these services also need a quality assurance plan. They need an independent check on some percentage of the data acquired to assure that it complies with the provisional standard. The larger sample that the agency uses the less risk they have that their database will be populated by questionable data. The trade off for

sampling larger and larger percentages is staff and money. Quality assurance programs need to be handled by either public agency staff or by hiring a third party.

- Are we duplicating efforts underway by ASTM?

  ASTM is developing a standard for precision and bias of profiling. This effort needs to be investigated to see if this can be incorporated into the AASHTO effort or if it is merely a complimentary function.

- Do manufacturers certify each machine they make or the series of the machine?

  It is much more effort for manufacturers to certify each individual machine rather than the design or series of a machine. Most certifications of this type of test equipment in the highway industry are performed on individual machines and not on the series.

Action Item 2 – Refine Cracking Standard to Allow Adoption by AASHTO

> ***"We wrote to what equipment could do rather than what we would like it to do" - Ken Fults, Texas DOT***

The provisional standard for cracking was by far the most intense discussion of any of the subject at the workshop. The discussion varied from the importance of measuring the type of cracking to what width and lengths of cracks do we want to measure.

The present standard is written around determining the quantity of structural and environmental cracking based upon whether that cracking is detected in the wheelpaths or between them. There are options for edge cracks, centerline cracks, and transverse cracks to be quantified as well. Key items include.

- Crack width

  The key for this action item is to be able to determine what width of crack we need to be able to detect. The present draft of Provisional Standard for cracking states that you will be able to detect cracks with a width of 3 mm (1/8 inch). Much of the variability among equipment that detects cracks is that the resolution of much of this equipment is about 4 mm (0.157 inch). Crack sealing is usually accomplished on cracks with a width of 10 mm (3/8 inch) but many states would seal finer cracks with preservation treatments such as chip seals.

  Resolution of crack width concerns not only the minimum crack that can be determined but also the bins use to segregate cracking levels. The present draft Provisional Standard separates severity in 3 mm (1/8 inch) increments. If the resolution were actually in the 4 mm range this would create classification problems when determining cracking severity.

- Type of cracking

Several participants mentioned the need to be able to detect more types of cracking. Those mentioned included reflective cracking and block cracking. With both the limited types and width, the standard as written was not intense enough for a thorough analysis of the cracking. Without clear cracking types there was concern that you would not be able to determine the cause of the cracking. This could lead to treating the symptom and not the disease. Optimization routines used by many of the States need this level of data.

- Sealed versus unsealed cracks

  There is also a need to be able to quantify the cracking that is sealed and that which is unsealed since they are treated differently in the analysis and treatment phase.

- Variability

  There is a very large variability in this measurement today. The major causes of this can be attributed to several of the items discussed above such as crack width and length, type of cracking, and sealed versus unsealed cracks. Another item that need to be better defined is the edge of pavement and wheelpath. This would allow software to be more consistent in the detection of cracking.

- Cost

  For a cost savings to be accomplished in this item it is critical that one standard be developed and adopted by many of the users of the data. If the vendors have to customize their software for numerous users who want to customize this standard to collect data to match their historic definition of cracking there would be little or no savings.

Action Item 3 – Rut Depth Definition and Resolution

Two main issues surfaced in the discussion of rut depth measurement, method of measurement and the desired resolution of the measurement.

- Method of Measurement

  The AASHTO Provision Standard as balloted requires a five-point measurement of rut depth. The majority of the participants felt that the five-point or three-point system for determining faulting underestimated faulting due to the problem of centering the measuring points on the low and high points of the pavement transverse profile. Without a large number of points or a continuous transverse profile, it was felt by some participants that a three-point rut measurement might be just as accurate as the five-point one. A standard definition of the wheelpaths should also be included in the standard.

> ***"[When measuring rut depths] anything between 3 and 100 points is meaningless" - Equipment Vendor***

The development of a low-cost, accurate method to measure hundreds of points across the transverse profile was seen as a major step forward in refining rut measurement. Technology such as a scanning or bar laser may allow for this measurement.

- Desired Resolution

> ***"If States are only interested in triggering for macro data why are we collecting micro data?" - Equipment Vendor***

The vendors were in general agreement that AASHTO had not properly defined what precision they desired in the measurement of rut depths. If you want to measure rut depth to the nearest 5 mm (0.2 inch) you need a resolution 10 times finer (e.g. 0.5 mm [0.02 inches]). Several of the participants felt that we needed a precision of 2.5 mm (0.1inch). Most of the lasers being used today have approximately 1 mm of resolution leaving them short by a factor of four for the precision desired.

A task that needs attention is what level of precision is needed by highway agencies for measuring rut depths. Factors to consider are:

- Rut depths that a State will correct.
- Trigger value for rut depth to allow time for programming work.
- The user needs to define if they are more concerned with maximum rutting, average rutting for a section of pavement, or a spectrum of depths.

Action Item 4 – Faulting Definition And Resolution

The criticism expressed at the workshop was that the Provisional Standard is not fine enough for use by SHA. The standard is written around simulating a Georgia Fault Meter. This action item is very similar to the rutting definition and resolution discussed in Action Item 3. Many participants felt that reporting a minimum faulting of 5 mm (0.2 inch) was to gross of a measurement. Participants were looking for faulting to be recorded to the nearest 2.5 mm (0.1 inch). Many states would be doing corrective work before the 5 mm criteria was reached.

To determine faulting the equipment must first accurately determine the location of the joint/crack while traveling at highway speeds. It needs to then select measurement points that are close to the joint/crack while not being in it. The algorithms also need to consider the presence of spalling and sample data points outside any spalled area while staying as close as possible to the joint/crack. Reporting of faulting by distribution, mean, and/or average fault is also an outstanding issue.

Action Item 5 – Certification And QC/QA On Rutting, Faulting, And Cracking

This item is similar to Action Item 1. Attendees felt that agencies that will be buying the services described in these provisional standards need a method of assuring that the equipment is capable of delivering quality data. Second, there should be quality controls in place by the vendor so that he is providing proper data to the user. Third, the agency should have a quality

assurance plan in place to check the data supplied by an independent method to assure that the equipment and their operations are in accord with the provisional standards.

The certification and QC/QA developed under Action Item 1 can probably serve as a model for this item. There will be key differences to consider as the equipment and software will be drastically different in the area of crack detection and delineation.

Stumbling Blocks

Major obstacles to improving the quality of data collected for pavement management systems were:

- Cost savings

  For States to adopt/insist on data to be collected by the provisional standards they need to see a potential cost savings. Individual agencies will each be giving up something by going to an AASHTO standard and they need to have some positive to weigh against that negative. In many cases this will come down to the financial manager in an agency wishing to save money and the data manager wanting to keep the purity of their data.

- Visual cracking survey

  It is doubtful in the near future that automated crack detection will be able to duplicate the human intelligence in its ability to look at a crack, determine its type and assign a probable cause. If users insist on this capability automated equipment will not likely meet this need and the provisional standard will not receive full implementation.

First Steps

"A journey of a thousand miles begins with a single step" -

To accomplish the action items laid out above several steps need to take place.

1. The subcommittee of the AASHTO Joint Task Force on Pavements must review the discussion at the workshop and determine what revisions are needed and develop a strategy to accomplish them.
2. Scopes of work need to be prepared for each of the action items based on the discussion at the workshop and input from the vendors and expert task group.
3. The AASHTO JTFP must endorse the recommendations from the subcommittee.
4. Funding for further meetings of the subcommittee, expert task group, and possible work by consultants or others from National Cooperative Highway Research Program (NCHRP) and/or FHWA. Depending upon how the work is to be accomplished contracts with consultants or university personnel need to be developed and awarded through these agencies.

5. Vendors need to be involved in the review and refinement of the provisional standards, certification procedures, and QC/QA plans.

Summary

The workshop was very successful in bringing together the players who will influence the implementation of standardized methods of collecting pavement management data. The four provisional standards presently under consideration were thoroughly discussed along with the implication of their implementation. Five action items were formulated and prioritized.

Cost savings are possible with implementation of the provisional standards but that would come with some caveats. The key to cost savings would be that States would completely embrace the standards and adopt them without making changes. If each State changes the standard when they implement it, the savings to the vendor and then the State will be minimal if any.

More important to most of the participants was collecting quality data. Two of the action items discussed above concentrate on equipment certification and the development of QC/QA plans. These items will provide confidence in the data collected under these standards.

Implementation is within the grasp of the pavement management community but there is much work ahead for the journey to be completed. Besides the hard work and funding, the key to successful completion of the journey will be a cooperative spirit among States, FHWA, vendors, and researchers.

References

Federal Highway Administration (FHWA). 1998. National Highway Institute Course No. 13135, *Pavement Management Systems*, Federal Highway Administration, Washington, DC

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