

Long-Term Pavement Monitoring Program: Summary of Alternative Development Workshop

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ABSTRACT

The purpose of the Long-Term Pavement Monitoring (LTM) Program Alternative Development Workshop, held October 15-19, 1984, and sponsored by the FHWA, was to discuss basic issues related to implementing a national LTM program for pavements. The results of this workshop are summarized. It was the consensus of the workshop participants that there were many questions of critical importance to financing and managing the nation's highways that could only be answered by a continuing monitoring effort. This appears to be the only way to successfully study the primary effects of mixed traffic and environment on the performance of pavements. The need for flexibility in experimental design offered by a mix of in-service highways, special design sections, and accelerated mechanical testing was recognized. There was strong opinion that active management from a central organization, independent of government agencies subject to political change, would be required for the success of a long-term pavement monitoring program. It was also expected that regional centers would be required to participate with the state highway agencies in the collection of the data, to train personnel, and to conduct much of the specialized field and laboratory testing to ensure data uniformity. It was concluded that the major results from this effort would be improved prediction and design models to more effectively manage the nation's highway system.

The LTM workshop was held in Alexandria, Virginia, October 15-19, 1984, and the results are summarized in this paper.

The purpose of this workshop, sponsored by FHWA, was to discuss basic issues related to implementing a national LTM program. These basic issues included

1. What questions related to the financing and management of the nation's highways need to be answered and can only be answered with a continuing data monitoring effort?
2. What data need to be collected and evaluated in order to answer these questions?
3. What is the best way to collect and evaluate these data in order to answer a number of these basic and important questions?

The question of the need for a long-term pavement monitoring program had been previously answered in the affirmative by strong consensus of the participants in the Pavement Testing Conference held in May 1984. It was the consensus opinion from that conference that long-term monitoring of in-service highways and special design sections was a critical requirement and that accelerated testing with large mechanical testers was also necessary for special studies.

The LTM workshop, held at the Old Colony Inn in Alexandria, Virginia, brought together members of

the AASHTO Joint Task Force on Pavement, Pavement Management Task Group, and representatives of FHWA, state highway agencies (SHAs) participating in the LTM pilot case studies, industry, AASHTO, NCHRP, the World Bank, universities, and the private sector. To fulfill its purpose, the workshop was divided into four workshop groups, each representing a specific need for long-term pavement monitoring. These workshop groups were

1. Group 1--national level,
2. Group 2--state level,
3. Group 3--new design methods, and
4. Group 4--rehabilitation design methods.

The workshop was divided into eight sessions. Session 1 was the opening session, which included presentations that provided background information for the workshop and established workshop objectives. Session 2 included presentations by representatives of the eight state highway agencies participating in the LTM pilot case studies and by the technical support contractor evaluating the data and developing the LTM data bank for these pilot studies. This session provided the experience and insight gained from the pilot case studies. Sessions 3-7 were generally conducted separately by workshop group, with each group considering the specific issues from the viewpoint of the specific interests assigned to it. These sessions addressed the following issues:

- * Session 3--information needs,
- * Session 4--data analysis and outputs,
- * Session 5--data needs,
- * Session 6--implementation issues, and
- * Session 7--synthesis of findings.

Session 8 was the "close-out" session that included

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reports of the findings from the four workshop groups presented by the workshop chairmen; general comments on future LTM plans by Gary Byrd, Interim Director of the Strategic Highway Research Program (SHRP); and close-out presentations by representatives of FHWA, AASHTO, the AASHTO LTM Advisory Panel, and the consultants providing technical support to FHWA for LTM.

RECOMMENDATIONS AND CONCLUSIONS OF WORKSHOP GROUPS

Although there were some differences among workshop groups in terms of the needs identified and the approaches recommended, which reflected their assigned viewpoints (national, state, design equations) and personal interests, these differences were not usually major. Therefore the primary recommendations and conclusions have been combined for the four workshop groups and reported here in terms of the issues addressed.

INFORMATION NEEDS

The following combined information needs were expressed by the four workshop groups:

1. The highest priority information need is for data to support evaluation of existing and development of new, improved design models. These design models are needed for both new pavements and rehabilitation of existing pavements. The core of a design model is one or more relationships that predict performance in terms of pavement structure (dimensions, materials, construction techniques and features, etc.), traffic, rehabilitation techniques, and environment; these predictive equations should also offer opportunity for better understanding of pavement performance and deterioration rates.

2. Because rehabilitation is probably the most important pavement issue facing the United States, it merits special emphasis in experiment design. In addition to the development of design models, better understanding is needed of (a) performance of various rehabilitation techniques, (b) effects of timing of rehabilitation on performance, and (c) effects of maintenance on performance of rehabilitation efforts.

3. Other important information needs include

- Benefits, consequences, and results of various levels of expenditure,
- Condition of the highway system and sub-system,
- Effects of increased loadings on pavement performance and deterioration,
- Effects of construction quality on performance, and
- Evaluation of new materials and techniques.

It was generally concluded that the LTM program could not practically be structured (and funded) to respond to all information needs, so it must be planned to service priority information needs thoroughly and offer support for others to the extent feasible.

DATA ANALYSIS AND OUTPUTS

Because the priority information needs were identified as design models, the consequent highest priority for data analysis is statistically sufficient multiple-regression analyses to develop predictive equations, which may serve as design equations for

models. These equations must be capable of reasonably accurate predictions (established by Group 3 as plus or minus 10 percent) of important dependent variables such as extent and severity of alligator cracking or rutting for flexible pavements, faulting or joint deterioration for rigid pavements, and loss of serviceability for all types of pavements. The measured performance data and the predictive equations may be used both to evaluate existing design models and to "calibrate" existing models to more accurately represent field conditions.

Statistical sufficiency implies that data collection has been both uniform and consistent. This means that uniform data collection procedures and generally the same measurement equipment must be used for all test sections included in the data bank and for the duration of the program. The absolute requirement for such uniformity and consistency was a consensus conclusion of the Pavement Testing Conference in March 1984 and was strongly reaffirmed by all four workshop groups during the LTM workshop. It was generally considered that lack of uniformity would destroy the validity of the data and preclude the reliability required of the output of this major research program.

Although predictive equations developed by regression techniques are expected to be the primary output, sequence graphs or tabulated values may be expected to provide valuable information where statistical techniques are not practical.

DATA NEEDS

This session dealt with what general and specific types and elements of data should be collected to provide an adequate data bank for analysis to satisfy the important information needs. Each workshop group reviewed the data needs in terms of the specific interest (or viewpoint) that it was assigned. Two of the four workshop groups offered specific lists of data items to be collected. The other two made recommendations in broader terms.

It appeared to be the consensus opinion that a number of data items now identified for collection in the current data collection guide could be eliminated without detriment to the data base, but that these would be difficult to identify until the experimental plan was developed. It was also thought that other data items needed to be added, especially those related to evaluating rehabilitation techniques and predicting performance after these techniques have been applied.

Other principal recommendations and conclusions for data needs were as follows:

1. Uniform and standardized data collection is absolutely essential.

2. Inventory data in general are one-time data and not costly, so data items of special rather than general usefulness may be included. However, it is important to limit the monitoring data to those data items of significance to the dependent variables to be studied.

3. For state-level needs, it was concluded that inventory data could best be collected from as-built drawings. However, the members of the workshops for design of new pavements and rehabilitation design thought that it was critically important that layer thicknesses be established by coring and boring and that material properties be based on uniform testing methods applied to cores and samples.

4. Accurate traffic data are extremely important and should be collected at least quarterly for sufficient periods to ensure that representative samples are obtained. Weigh-in-motion equipment should be used for measuring axle load distribution and auto-

matic vehicle classifiers for classification. Traffic should be test-site specific rather than interpolated from other locations.

5. Maintenance data are very important and must be collected in a uniform manner from all states.

6. Measurements of distress, roughness, deflections, skid resistance, and so forth that indicate performance are of primary importance, but measurements could be less frequent than the annual ones now planned. This could allow more test sections for the funds available and result in increased statistical adequacy.

7. Environmental data should be collected on a monthly basis by a central agency such as the National Weather Service instead of by individual SHAs.

IMPLEMENTATION ISSUES

It was the consensus opinion that strong, active management from a central organization, independent of government agencies subject to political change, would be required for the success of a long-term pavement monitoring program. It was also expected that regional centers would be required and that the regional staffs should participate with the SHAs in the collection of the data, to ensure their uniformity, and in training SHA personnel. It was also believed that the central organization would need to conduct much of the specialized field and laboratory testing, probably using regionally deployed equipment, to ensure its uniformity.

The support for the LTM effort was essentially unanimous, with all SHAs participating in the pilot studies wishing to continue and perhaps expand their activities. It was thought that a core group of full-time staff should be established as soon as possible to initiate organizational and experimental planning.

Dedicated, long-term funding will be required for this program, and the level of funding now proposed may need to be supplemented by state HP&R funds. There was general concern that overall state research programs might suffer as a result of LTM funding requirements.

The workshop participants agreed that the data storage facilities should be centrally located on a dedicated computer, but that the data should be accessible by SHAs and all interested parties. Data security would be critically important, with no data changes allowed other than by the central staff.

It was agreed that experiment design to optimize results for the funding available was of paramount importance. In view of the almost limitless possibilities for studies and data collection to accommodate special interests, it will be necessary to carefully select dependent variables for study and to distribute them among in-service highways, special design sections, and mechanical testing to optimize results. SHAs should be encouraged to select design sections for monitoring in newly constructed or rehabilitated pavements because such sections offer better control of the variables than do pavements that have been in service for some time. Appropriate fractional factorials and subexperiments must be considered to provide the output required within practical funding constraints.

The number of the test sections to be implemented was discussed. It was recognized that increasing the number of test sections increases reliability of the results and offers the possibility of more studies, but it was expected that some 1,000 to 2,000 in-service highway sections and 500 design sections would be a reasonable goal.

SUMMARY

It was the consensus of the workshop participants that there were many questions of critical importance to financing and managing the nation's highways that could only be answered by a continuing pavement monitoring effort. This appears to be the only way to successfully study the primary effects of mixed traffic and environment on the performance of pavements. The need for the flexibility in experiment design offered by a mix of in-service highways, special design sections, and accelerated mechanical testing was recognized.

There was general concern expressed that the momentum of FHWA LTM initiatives might be lost during the transitional period for establishing dedicated funding and an organization to manage the program. Appropriate measures to expedite the formation of a core organization and maintain momentum were urged.

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