A2B04: Committee on Pavement Rehabilitation
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Pavement Rehabilitation

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Pavement rehabilitation is a major activity for all highway agencies and has several consequences on agency resources and traffic disruptions because of extensive and extended lane closures. The traffic volumes on the primary highway system, especially in urban areas, have seen tremendous increases over the last 20 years, leading in many instances to earlier-than-expected failures of highway pavements. The aging of the Interstate highway system and other primary systems built during the 1950s and 1960s has resulted in the expenditure of a large portion of highway funds on pavement rehabilitation. Efforts continue to be made to develop techniques and procedures that will result in cost-effective and longer-lasting pavement rehabilitation to serve the nation’s highway system well into the 21st century.

The process of pavement rehabilitation involves the following procedures:

1. Prioritization of pavements in need of rehabilitation, which incorporates monitoring activities to assess the functional and structural condition of pavements;
2. Development of feasible rehabilitation strategies;
3. Selection of the most cost-effective rehabilitation strategy given a set of constraints, which may include reduced service life, life-cycle costs, and budgetary constraints; and
4. Adequate measurement of performance of the rehabilitated pavements.

STATE OF THE PRACTICE

The state of the practice of pavement rehabilitation is good but can be better. In the last 10 years, significant improvements have been made in pavement evaluation techniques and in rehabilitation equipment and procedures.

Pavement Evaluation

Considerable progress has been made in techniques to evaluate pavement condition. Equipment for measuring surface profiles and for assessing the structural capacity of pavements is widely used by highway agencies and other practicing pavement engineers. The common availability of the falling weight deflectometer (FWD) has resulted in a more objective assessment of the structural capacity of pavements and timely rehabilitation of underdesigned or overloaded pavements. Additional details on issues related to pavement evaluation technology are presented in the section Future Developments.

Asphalt Pavement Rehabilitation

Asphalt pavement rehabilitation typically involves milling and resurfacing of the existing asphalt pavement to mitigate the effects of per ride rutting, cracking, and other distresses. Resurfacing thickness may depend on the condition of the existing pavement, anticipated future truck traffic, and available funding. Under heavy truck traffic, the expected service life of the rehabilitated pavement is typically about 8 to 12 years. The routine use of stone-matrix aggregate (SMA) and Superpave mixes for pavement rehabilitation will certainly help extend the service life of rehabilitated pavements.

Asphalt pavements are also rehabilitated using a conventional concrete overlay or the newer technique of ultrathin whitetopping (UTW). The UTW technique is of recent origin and long-term performance data are not yet available.

Concrete Pavement Rehabilitation

Concrete pavement rehabilitation may involve use of concrete pavement restoration (CPR) techniques, asphalt overlay over existing or fractured concrete pavement, bonded concrete overlays, or unbonded concrete overlays. The rehabilitation is performed to correct for poor ride, joint faulting, slab cracking, high-severity joint and crack spalling, and other specific distresses.

Many agencies prefer to use a standard thickness of asphalt overlays over existing concrete pavements to minimize traffic disruptions, especially in urban areas. However, such practices typically result in shorter service life for the overlaid pavement. On the other hand, use of the longer-lasting concrete overlays typically requires more extensive lane closures and results in more extensive traffic disruptions. Use of concrete for pavement rehabilitation has benefited from the use of accelerated paving techniques incorporating high-early-strength concrete and zero-clearance paving equipment. Many agencies continue to wrestle with the age-old problem: longer delays now and longer service life versus shorter delays now and shorter service life.

Pavement Recycling and Reclaiming

Pavement recycling and reclaiming is another important process for rehabilitating asphalt pavements. Construction equipment and materials have greatly evolved over the last few years to allow for low-cost, in-place recycling and reclaiming of asphalt pavements.

Optimizing Pavement Rehabilitation

Many agencies are using life-cycle cost (LCC) analysis to help them rationally select the best rehabilitation technique. However, the inability to properly account for user delay costs is a major limitation of LCC analysis. Many agencies continue to wrestle with an extension of the age-old problem: lower initial costs, reduced traffic delays, and lower service life versus higher initial costs, extended traffic delays, and longer service life.

Traffic Management During Rehabilitation

Efficient traffic management during construction on urban and heavily trafficked rural roads has been a long-sought objective. The need to maintain traffic flow through construction zones requires heavy use of nighttime work or longer construction schedules. Efforts continue to be made to improve traffic flow through construction zones by better scheduling of construction activities, use of appropriate paving materials, and public awareness and education.

SPECIAL CASE: AIRPORT PAVEMENT REHABILITATION

Many of the foregoing issues also apply to airport pavement rehabilitation. The high growth in air travel continues to put heavy demand on airport pavements. The increased use of wide-body and long-range aircraft with heavier wheel loads, new gear configurations, and higher tire pressures is expected to become routine at larger airports.

Although airport pavements have their own unique design and construction requirements, almost all developments resulting from improvements in highway pavement rehabilitation technology are applicable to airport pavements. Durable pavement rehabilitation is also a necessity for airport pavements.

FUTURE DEVELOPMENTS

As the review of current practice indicates, the challenge in pavement rehabilitation continues to be the achievement of longer-lasting pavement rehabilitation while efficiently managing heavy traffic through construction zones. As such, improvements in technology need to be continually made to improve the whole process of pavement rehabilitation. The key areas that will benefit from improvements include the following:

1. Assessment of the in situ condition of existing pavements. Use of ground-penetrating radar, seismic techniques, and other nondestructive techniques needs to be expanded to complement FWD testing. Also, there is a need to standardize pavement evaluation and testing protocols.
2. Use of durable paving and repair materials that can carry truck traffic within a few hours after placement.
3. Use of zero-clearance paving equipment that will minimize extensive lane closures.
4. Procedures to reliably estimate future truck traffic.
5. Development of rehabilitation design procedures that clearly address mitigation of specific distress types and rationally account for future truck traffic loading.
6. Concrete pavement restoration techniques (e.g., dowel bar retrofit technique) and reflection cracking mitigation techniques.
7. In-place recycling and reclamation technology.
8. Use of comprehensive LCC analysis procedures that account for all appropriate cost elements associated with pavement rehabilitation.

ACTIVITIES TO IMPROVE PAVEMENT REHABILITATION TECHNOLOGY

Pavement rehabilitation in today’s environment is always a complex and challenging process. For improvements to continue in pavement rehabilitation technology in a climate of reduced spending by the federal government on research and development activities, the industry will be tasked in the new millennium with a leadership role in implementing innovations in pavement rehabilitation. The increased use of warranty construction, performance-based specifications, and design/build/operate agreements will create the proper conditions for the industry to meet the challenges.

Other activities that will benefit developments in pavement rehabilitation include the following:

1. Better communication among technologists, practitioners, and legislators;
2. Narrowing the gap between innovation and implementation;
3. Fast-track validation of new paving materials and construction techniques through use of accelerated load-testing machines and dedicated test tracks;
4. Support of research and development activities in pavement rehabilitation through partnerships between the federal agencies, state highway agencies, industry, and the Transportation Research Board’s National Cooperative Highway Research Program; this support would include the ongoing Long-Term Pavement Performance (LTPP) program, which includes a large experimental component on pavement rehabilitation techniques;
5. Establishment of undergraduate and graduate college courses on pavement rehabilitation; and
6. Technology transfer programs at regional, national, and international levels.

Pavement rehabilitation will continue to be a challenging and dynamic area, with major innovations still to come. Leadership on the part of the federal and state agencies and industry working as partners will be necessary to ensure that the massive investments in highway and airport pavements continue to support the economic development and otherwise benefit the well-being of transportation users.