Washington State Department of Transportation Case Study

Guidelines for the Preservation of High-Traffic-Volume Roadways (R26)

Background

Stretching the time between major rehabilitation projects can save transportation agencies money, reduce congestion, and improve safety. For years, transportation agencies have successfully extended the life of lower-volume roadways by applying pavement preservation strategies. Achieving the same results on high-traffic roadways requires a systematic approach that considers a variety of road conditions and proper timing of treatments to control risk and reduce traffic impacts.

Many conventional preservation techniques—and some new ones—can be used to extend the life of high-traffic roadways without major reconstruction and traffic disruption. A **new guide** developed through the second Strategic Highway Research Program (SHRP2) offers the technical background and decision-making framework needed to bring preservation strategies widely into play for high-traffic roads. ***Guidelines for the Preservation of High-Traffic-Volume Roadways*** (R26), and its companion report, ***Preservation Approaches for High-Traffic-Volume Roadways,*** are the first systematic and comprehensive resources designed to expand the use of pavement preservation on high-traffic roads. The guidance is based on the findings from a comprehensive survey of 40 state highway agencies, seven Canadian provinces, and three cities, as well as a review of existing successful preservation techniques. The ***Guidelines*** include a selection process and matrices that enable quick identification of treatment options by various categories, such as rural or urban roads, climate zones, work zone duration restrictions, traffic volumes, and relative costs.

Since 2011, 14 transportation agencies have partnered with the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO) to implement the concepts of R26 through the Implementation Assistance Program (IAP). Under this program, the Washington State Department of Transportation (WSDOT) has received technical assistance and is a Lead Adopter state. In 2014, WSDOT used the guidelines to construct four preservation sections. This case study highlights WSDOT's approach to implementing the ***Guidelines*** product and the challenges it faced, and documents the lessons learned from the process to further the practice of pavement preservation on high-volume roads.

Need for Better Pavement Preservation in Washington State

WSDOT pavements are managed to the lowest life-cycle cost through the diligent monitoring of performance to determine when they have reached the optimum time for rehabilitation (WSDOT 2010). Agency practitioners rely heavily on their Washington State Pavement Management System (WSPMS) to model performance and implement treatments just before the optimum time so as not to "waste" useful life of the previous treatment.

WSDOT has used several preservation treatments over the years. For example, in a program that began in 1993, dowel bar retrofits were completed on concrete pavements, with an accumulated savings of $220 million. Concrete pavements in good structural condition are targeted for diamond grinding, preventing the need for rehabilitation for an estimated 10-20 years. These strategies were primarily applied to higher-volume roadways.

For many years, the primary preservation tool used in Washington for asphalt pavements with up to 5,000 VPD has been chip seals. Chip loss, the risk of claims from broken windshields or headlights, and lengthy traffic control zones were the primary reasons for not routinely using chip seals on higher-volume roads. However, WSDOT had used chip seals selectively on higher-volume routes, and they had performed well. As shown in Table 1, chip seals covered 5,979 lane-miles of the Washington state highway network in 2014. WSDOT maintains the capability to install chip seals using its own employees, but projects of a significant size are more commonly performed by contractors. Crack sealing is used as a preventive maintenance treatment extensively across the state, but the use of other surface treatments such as microsurfacing, scrub seals, or ultra-thin bonded overlays have not been widely used.

Table 1. 2014 Inventory of Network Miles by Surface Type (Courtesy of WSDOT)

Surface Type	**Mainline Network Size, Lane Miles**
Concrete	2,434
Asphalt	10,247
Chip Seal	5,979
Total	18,660

The SHRP2 research and the resulting *Guidelines for the Preservation of High-Traffic-Volume Roadways* were timely for WSDOT in that they complement what WSDOT engineers were already doing. Concurrently with its development, WSDOT was initiating similar efforts to find more cost-effective treatments for high-volume routes. These routes were typically allowed to deteriorate to a poor condition and rehabilitated in kind with hot-mix asphalt (HMA). As revenues for pavements began to shrink, WSDOT realized that it needed alternative approaches to keep more of its pavements in good condition.

WSDOT Approach

WSDOT uses the term "miles due" to indicate the amount of pavement that has been triggered for the next preservation or rehabilitation action by the WSPMS. By 2010, the backlog (or unfunded preservation needs) for asphalt pavement had grown to 1,360 lane-miles. WSDOT prepared a report to the state legislature concerning pavement funding needs and included a strategy that was designed to convert as many lane miles as feasible from asphalt surface to chip seal. The benefit of this strategy is that the average annual cost for a chip seal-surfaced pavement is approximately one-third the cost of an asphalt surface. By implementing this strategy, WSDOT estimates that by 2016 it will have converted 2,270 lane-miles of roadway to chip seal, resulting in a cumulative six-year cost reduction of $100 million. (WSDOT 2015)

Pavement Preservation Demonstration Projects

For its program to implement pavement preservation, WSDOT chose four roadway sections to evaluate WSDOT chip-seal processes. Traffic volumes fit into the high-traffic category where WSDOT was targeting chip seals and ranged from 4,781 to 8,037 VPD. Three of the four treatments (segments 1, 2, and 4) were proposed to be typical chip seals with 0.375-inch single-size aggregate and polymer modified emulsion (CRS-2P) with a choke stone and fog-seal layer; and one (segment 3) was designated as a hot-applied chip seal with 0.375-inch single-size, pre-coated aggregate and a polymer-modified asphalt cement (AC-15P). The objective was to determine if there were advantages from modifying the construction and materials approach.

Pavement condition for all of the segments was classified as *fair*, exhibiting low- or medium-severity longitudinal cracking. According to WSDOT and the R26 guidance, chip seals are recommended treatments for these distress levels. Bids were accepted by the agency, and contractors constructed the chip seals during May and June 2014.

Figures 1 and 2 show hot-applied asphalt cement followed by a chip applicator (the segment 3 treatment). WSDOT observed that the hot-applied chip seal displayed similar features to the conventional treatment. Some notable construction advantages included a substantial reduction in dust, faster return of the roadway to traffic, and final striping at the end of the work day. The reduction in dust resulted from the pre-coating of aggregate with approximately 0.8 percent asphalt. The contractor reported that his production rate was higher than with emulsion-based chip seals due to the traffic control zone being shorter. The time required for the hot-applied chip seals to "set" was much less than emulsion-based chip seals, which allowed traffic control to be removed sooner. Because repeated sweeping was not required, final striping materials were applied at the end of the workday rather than temporary striping.

WSDOT is monitoring the performance of the sections through its routine pavement surveys conducted each year as part of the pavement management system. Performance reviews are expected to be available within three to six years of application; however, WSDOT has already implemented hot-applied chip seals on other high-volume roads, and will continue the process of converting approximately 3,600 lane miles of asphalt-surfaced state routes to chip seal-surfaced roads. The hot-applied chip seal is expected to have similar preservation performance attributes to the emulsified chip seal, but be superior in speed of construction and reduced traffic control. With that advantage, application in more urban settings is possible.

Figure 1. Hot-applied asphalt cement provides the adhesion for chips to the pavement surface.

Figure 2. Pre-coated chips are dropped onto the asphalt cement to provide the wearing surface.

Technology Transfer

With advances in construction techniques proving beneficial, WSDOT conducted a chip seal summit in October 2015. The Pavement Office staff presented comparisons to the emulsion-based chip seal process that included discussion of the planning process, materials management, and the laydown process. The material aspects of the process are the most significant difference. The chip aggregate is processed through the asphalt plant dryer drum to heat and dry, and then the pre-coated aggregate is agitated or "worked" until cool to prevent the particles from forming a cluster. The moisture content should also be kept below 0.5 percent. Since the 2014 hot-applied chip seal project, WSDOT placed another 156 lane-miles in other regions of the state. WSDOT observed a slight increase in the material costs for the hot-seal process, but there may be cost offsets associated with shorter-duration traffic control, the use of less choke stone, and reduced sweeping.

Benefits of R26 Implementation

In addition to evaluating chip seal construction practices, WSDOT is effecting organizational changes through policies and directives addressing preservation. Several stages of preservation strategies were defined in the *Integrated Approach to Pavement Preservation* (WSDOT 2014) to focus attention on preservation and extending the pavement life cycle:

1. Capital Preservation Projects: typically large-scale pavement resurfacing projects that restart the pavement life cycle.
2. Preventive Preservation, made up of the following two components:
   - Strategic Preservation - May be performed early in the pavement life cycle up until approximately two years prior to a planned Capital Preservation Project.
   - Emerging Needs Preservation - Primary goal of this work is to reduce the need to perform Reactive Preservation in the future, with a secondary goal of extending pavement life where possible.
3. Reactive Preservation: Un-planned pavement repair to address immediate pavement needs.

The distinctions in preservation definitions were drawn to establish steps in the asset management process at the regional level. WSDOT requires that a strategic preservation activity precede a capital preservation project by at least two years. To comply with this measure, Regional Managers must look at pavements in better condition to assign applicable treatments, which has the effect of "keeping good roads good" (WSDOT 2014).

WSDOT also promotes a "one touch" philosophy in that road segments must be touched (receive some type of preservation treatment) at least one time between capital projects with the purpose of correcting deficiencies and adding at least two years to the life cycle. Managers use pavement condition data to break down a typical project-length segment to identify what distresses are present and determine local areas that are driving the recommendation for project-level capital preservation. Pertinent activities could be addressing a localized structural failure, milling to correct cross-profile deficiencies, or performing partial-depth patches. Through these actions, WSDOT is harnessing routine maintenance activities into a comprehensive system of pavement preservation.

The agency also created an accountability structure to oversee the implementation of a consistent preservation program across all geographic regions. Instructional letter IL4077.01 established a six-member committee to "set the overall paving policies for the department and oversee the broad prioritization of all paving-related funds across programs and regions, consistent with the various components of the Pavement Preservation Plan" (Laird, 2015). Managers are encouraged to develop a plan based on the tenets of the policy to balance funding sources and personnel resources and meet regional and statewide goals of pavement performance.

Lessons Learned

WSDOT preservation practices complement the R26 *Guidelines* by using preventive maintenance strategies on high-volume roads. The demonstration projects and subsequent actions taken by the agency have strengthened the culture toward preservation of pavement assets. Preservation practices used by WSDOT include:

- Adoption of hot-applied chip seals that provide construction benefits, including shorter work zones and improved resistance to chip loss.
- Agency focus on life-cycle extension of at least two years by using strategic preservation activities.
- Agency accountability for preservation using a committee to set statewide priorities.
- A "one-touch" philosophy that encourages managers to identify sub-segments of project lengths for correction that are triggering the next rehabilitation treatment.
- Adoption of chip seals for appropriate pavement surfaces carrying up to 10,000 vehicles per day as a standard practice, yielding $100 million in cost savings over six years.

Each action translates into a better final product for the public at a reduced cost. The R26 *Guidelines* assisted WSDOT by providing confirmation that other agencies were effectively preserving high-volume roads using preventive maintenance treatments. The agency emphasized preservation to internal staff, effectively changing expectations and practices. WSDOT preservation practices on high-volume routes reinforce the concepts presented in R26 by expanding strategic preservation efforts, contributing to their data-driven pavement preservation program, and minimizing pavement life-cycle costs.

References

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Contacts

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The AASHTO SHRP2 product page is available at http://shrp2.transportation.org/Pages/R26_HighTrafficVolRoadways.aspx.