TEXAS TECH UNIVERSITY
CENTER FOR MULTIDISCIPLINARY RESEARCH IN TRANSPORTATION

Research Project Summary Report 0-1787-S

Project 0-1787

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PROJECT SUMMARY REPORT

Seal Coat Constructability Review: Summary

This research project conducted a formal constructability review of TxDOT seal coat practices. The essence of any "constructability review" is the identification of best practices. It is a technique that is being widely implemented by the federal government, state DOTs and other public agencies.

The researchers picked apart, piece by piece, the seal coat process from planning to construction completion, looking for those portions of the process that are inherently variable and difficult to replicate in the field. The performance of a seal coat project is influenced by a number of factors including the following:

- Percent embedment
- Material quality
- Material application
- Climatic conditions during construction
- Time elapsed between application of binder and aggregate
- Compaction method and duration
- Time interval between construction completion and opening to traffic

What We Did…

The primary focus of this research was to identify those construction practices that consistently produce a good seal coat and to develop and conduct a district training program. This project was comprised of four phases. Phase I included a comprehensive literature review and a structured interview process conducted by researchers visiting each district to determine that district's seal coat practices. Each district was asked to identify areas that need improvement and to identify five seal coat projects that are representative of district seal coat practices. Data from these projects were analyzed to identify factors that influence seal coat quality. Phase II involved the analysis of data from district interviews and test projects with focus on preparing district seal coat training packages. Phase III involved the development of training packages. Each package included an evaluation of district strengths and areas that require further improvement. In Phase IV, training workshops were conducted at each district. Two products, a draft seal coat specification and a seal coat field guide, were also developed.

What We Found…

The findings from this research project are presented under headings representing the five basic elements: planning and design, materials, construction quality, equipment and construction, and contract issues.

Seal Coat Planning and Design

In some districts, seal coating is done to roads that require rehabilitation but for which funding is not

Figure 1. A Typical Texas Seal Coat

available. This effectively defeats the purpose of using seal coat as a preventive maintenance measure. On the other hand, some districts use a comprehensive project selection process. Most districts make project selection and prioritization decisions subjectively.

It is advantageous for area engineers to have the autonomy to run their own seal coat operations in the manner they find optimum. However, benefits from a constructability review are greatly enhanced by centralized operations. Not only does the designer have a greater population of projects from which to gather experiential data, but the use of a single consistent approach continually modified by direct field experience has the highest probability of producing a consistent final product.

Districts use either the Modified Kearby Method or an experience-based method for seal coat design. In addition, some districts use variable binder rates across the lane while others use a constant rate. This constructability review did not reveal conclusively that one method provides superior performance compared to the other.

Districts have to rely on experienced seal coat personnel for design and construction supervision due to the critical adjustments needed at the time of construction. Many districts indicated that losing experienced inspection personnel is a major problem. Having an established design procedure such as the Modified Kearby Method enables districts to train inexperienced personnel more effectively.

The performance of a seal coat under traffic depends to a large extent on types of vehicles on the roadway. Distresses such as flushing and bleeding are often caused by embedment of seal coat aggregate into the underlying layers, mostly due to heavy vehicles. Most districts use average daily traffic (ADT) as the traffic parameter in design, while a few districts also consider heavy vehicle volume.

Materials

Dust on aggregate surface is one of the major causes of seal coat aggregate retention problems. The purpose of conducting the aggregate decantation test in seal coats is to assess the amount of dust in stockpiled aggregates. TxDOT Standard Test Method *Tex-217-F: Decantation Test for Asphalt Aggregates* is designed primarily for hot mix asphalt. It attempts to mimic the hot mix asphalt production process at the plant by shaking the aggregate while sieving. However, this procedure has no relationship to the seal coat process.

Departmental specifications typically require that aggregates be sampled from the source. However, this practice neglects the changes that occur to the aggregates during transportation and handling before they are placed on the road.

It is important to use aggregate and binder that are compatible to maximize the benefit from various bonding mechanisms. Almost all districts indicated that they need some guidance on the aggregate-binder compatibility issue. Most districts specify Grade 4 (or Grade 4 modified) aggregate instead of the larger Grade 3 aggregate to reduce windshield breakage. However, the smaller aggregates are less forgiving to variations in binder application rate. Designers must specify binder/aggregate combinations based on the specific characteristics of the highway to minimize distresses.

There are two dominant philosophies on the selection of binders. One is to select a less expensive binder to maximize the number of miles sealed each year. The other is to use a more expensive, high-quality binder to get more years out of the seal coat. Observed performance data did not seem to show that one approach was better than the other. However, it was verified that if a district's seal coat team gains experience with a particular binder, the team is able to consistently use that product in a satisfactory manner.

Construction Quality Assurance

Inspection of seal coat work by an adequate number of experienced and qualified inspectors would ensure good performance. In many districts, the over-decentralization of seal coat work has made the available experienced inspector pool very thin.

The seal coat technical vocabulary is often different from one district to another. For example, the words *flushing* and *bleeding* are used interchangeably to mean the same thing, as well as to mean different things. Differences in usage cause confusion during communication between districts.

Equipment and Construction

Many districts wait until emulsion breaks before aggregate is applied. This practice goes against conventional wisdom. Research has shown that spreading aggregate before emulsion breaks improves bonding.

The size and production rates of distributors are on the increase, and the

Figure 2. An Asphalt Distributor at Work

other equipment in the seal coat production train, particularly the rollers, has to keep up with the increased distributor production. More attention is needed to ensure that an adequate number of rollers is available at the job. There are a few districts that specify a minimum rolling time to cover a specified area to ensure adequate rolling. The minimum rolling times used by districts varied from 2000 to 6000 sy per hour.

Contract Issues

Seal coat contract documents are relatively simple and straightforward, and therefore should be easily understood, bid, administered, and executed. However, this research found several areas in which improvements are needed.

The general practice is to pay for binder by volume. This may motivate contractors to apply binder at the highest possible temperature, causing a deviation from design asphalt thickness. Asphalt cement may swell as much as 5% when heated an additional 50°F. At that rate, an application rate of 0.40 gal /sy will leave only 0.38 gal /sy at design temperature, thus reducing the embedment. Payment by weight of binder will ensure that design asphalt thickness is adhered to, no matter what the application temperature.

When a weight-based pay unit is used for crack sealing, contractors are rewarded for using as much crack seal as possible both by sealing as many "cracks" as they can find and by leaving wide squeegee patches. If squeegee patches are allowed, hot pour crack seals tend to cause flushing over the crack seal. Oversealing not only wastes money on crack seal material, it is also bad for the pavement. Payment for crack seal by lane mile would ensure that only the cracks that need to be sealed receive the appropriate quantity of sealing material. Patching and level-up prior to seal coats need to be completed a minimum of six months prior to the seal coat to allow time for the patches to cure. However, current scheduling practices often make this impossible. In many instances, patching is done just ahead of the seal coat operations, causing problems over the fresh patches.

Many contractors would bid the smaller contracts with the hope of staffing up with additional personnel and equipment if they win. Districts that let seal coat contracts in excess of $2 million were generally happy with the quality of contract seal coat work. Districts that consistently let contracts in the range of $1 million or less typically reported problems.

There are two contract administration philosophies in the Department. The first views the annual seal coat contract as a less than desirable responsibility, and therefore, seal coat work is rotated among the district area offices. The other philosophy suggests that seal coat is more "art" than "science," recognizing that experience is the most important factor in successful seal coat operations. For this reason, the annual seal coat program is assigned to the same group every year in hopes of benefiting from the experience base that is developed.

The Researchers Recommend...

The following recommendations are the result of experience gained from both interviewing and observing seal coat operations in all 25 districts. Many of these recommendations can be immediately implemented.

Planning And Design

A comprehensive approach should be adopted in the project selection process to eliminate projects that are better candidates for rehabilitation work.

A formal design method such as the Modified Kearby Method can effectively serve to guide inexperienced personnel through the "art" of seal coat design.

The percentage of heavy vehicles should be used as a design criterion. This may be done either by considering percent trucks in addition to ADT, or by calculating the number of equivalent passenger vehicles using a conversion factor.

Materials

For seal coat aggregates, Test Method *Tex-406-A: Decantation Test for Concrete Aggregates*, or an alternate method, shall be used to check for dust content. Aggregates should be sampled from the stockpiles and/or from the aggregate spreader.

It is important to ensure that the aggregate and binder are compatible. In the case of precoated aggregates, the precoating binder shall be compatible with the seal coat binder. It is recommended that each district construct an aggregate-binder compatibility matrix for locally available materials.

Construction Quality

A post-contract evaluation is strongly recommended. Districts shall constitute a seal coat task group that meets several times a year to plan, evaluate and execute seal coat contracts. Information on actual seal coat rates used, construction conditions and seal coat performance should be captured. A simple revision of the current daily report can provide all the information that is required.

Seal coat vocabulary shall be standardized, and a seal coat project should have a minimum of three people in an inspection team.

Contract Issues

Seal coat contracts shall be as large as possible (at least $2 million wherever possible). Districts should preferably have one permanent seal coat team to effectively use its experience base. Pavement length (lane miles of roadway) shall be used as crack sealing pay quantity. Asphalt shall be measured by weight except when small quantities (less than 6000 gal.) are involved.

Equipment and Construction

The seal coat planning cycle should be advanced to permit maintenance crews to repair roads well ahead of seal coating. When emulsion is used, aggregate should be spread as soon as possible before the emulsion breaks. Districts should specify a sufficient rolling rate in general notes. The medium pneumatic roller is recommended, particularly for hot asphalt, because its higher tire contact pressure provides more efficient rolling and its larger width is often capable of providing a more desirable rolling coverage across the lane. Lightweight pneumatic rollers may be desirable where aggregate that has the potential to get crushed during rolling is used.

For More Details…

The research is documented in the following:

PR5-1787-03, Seal Coat Manual

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TXDOT IMPLEMENTATION STATUS
May 2004…

The recommendations included in the project summary report have already been implemented in the new Seal Coat Manual developed under IPR 5-1787-03. The new Seal Coat Manual is also available on TxDOT Crossroads intranet site and the TxDOT library located at: http://library.ctr.utexas.edu/index.htm.

For more information, contact; Dr. German Claros, P.E., Research and Technology Implementation Office, (512) 465-7403, gclaros@dot.state.tx.us.

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