News from the Asphalt Pavement Association of Oregon
Volume XIII, Issue 3
Fall 2004

CENTERLINE

PAVEMENT DESIGN

What's Best for the Taxpayer?

Road Planners Must Consider Many Factors in Choosing Pavement

Selection should be based primarily on economics, and historical data should be used to evaluate cost and performance.

By David Newcomb, P.E., Ph.D.
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This is the second article in a 2-part series on pavement type selection

When road builders consider what type of pavement to construct, they should consult the *1993 AASHTO Guide for the Design of Pavement Structures,* Appendix B, which lists principal factors of traffic, soil characteristics, weather, construction considerations, recycling and cost comparisons.

The first article of the series ("Decisions, Decisions…" *Centerline* Summer 2004) covered several of these factors. This article will address recycling, cost comparisons, and other considerations such as noise, ride quality and safety. Within each of these areas, asphalt offers specific advantages.

Recycling

Asphalt pavements are 100% recyclable. The option to recycle existing pavement material or to incorporate by-product material from other industrial sources is an important consideration. It saves natural resources, landfill space, and can reduce energy requirements in the production of materials. The resulting product can be as good or better than that made from completely virgin aggregate and asphalt.

Cost Comparison

Economics should be the primary consideration in any decision involving the expenditure of public funds. While the *AASHTO Guide* acknowledges there are instances when initial costs may preclude consideration of other factors, it stresses the importance of life cycle cost analysis (LCCA), or studying long-term costs rather than initial expenses. The LCCA period should be sufficient to incorporate major rehabilitation or reconstruction for each pavement alternative considered. In most cases, this period ranges between 30 and 50 years. User delay costs may also be considered in comparative analysis.

The Asphalt Pavement Alliance supports the determination of life-cycle costs as proposed by the Federal Highway Administration (FHWA) in Demonstration Project No. 115. This approach uses the Net Present Value method for determining the costs of different alternatives. It is possible to address all the

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cost considerations mentioned in the *AASHTO Guide* with this methodology, including user delay costs.

Initial Cost

Initial cost should be estimated from bid records of the last two to three years, excluding any small, unusual or emergency projects whose costs could skew data.

Time

Accurate estimation of time from initial construction to first and subsequent rehabilitations is critical in evaluating life cycle cost comparisons. Data should differentiate between performance of new and rehabilitated pavements, as well as thick versus thin overlays.

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INSIDE

What's Best – Continued

Maintenance

Maintenance costs are typically difficult to extract from historical records because other restoration expenditures are often included. Routine maintenance costs are generally not significant enough to affect cost comparisons appreciably, however, and should not factor as heavily as the other cost components listed here.

Salvage Value

Salvage value is a term used to recognize that a pavement continues to have economic benefit beyond the analysis period. It is defined by the FHWA as the cost of the last rehabilitation multiplied by the ratio of years until the end of the analysis period to years until the next (major rehabilitation) activity beyond the analysis period.

Discount Rate

The discount rate should reflect the time value of money, and essentially accounts for the difference between inflation and the interest rate. The FHWA recommends a discount rate between 3 and 5 percent.

Numerous studies show the economic advantages of asphalt pavements. Analysis performed in three different states show initial construction costs of asphalt pavements to be 14-22% less than that of concrete pavements. Operations costs were found to be 60% less over a 40-year period, and maintenance costs ranged from 30-80% less over the life of the structures.

The most economical HMA pavement is perpetual pavement. It is built with an asphalt thickness adequate to avoid bottom-up fatigue cracking and deep structural rutting. The surface is comprised of a rut-resistant conventional HMA mix, stone matrix asphalt (SMA), or open-graded friction course (OGFC). With only periodic resurfacing required, the need for total rehabilitation in the future is eliminated.

Numerous studies show the economic advantages of asphalt pavements

Other Considerations

Asphalt pavements can also provide other benefits – both tangible and intangible. For example, they can be constructed to generate less road noise than concrete pavements. Depending on the mixture, reductions of up to 9 dB(A) have been achieved.

The asphalt pavement construction process also allows building of multiple lifts, resulting in smoother road surfaces. This not only means a more comfortable ride, but also reduced fuel consumption and vehicle operating costs.

And, asphalt pavements can be designed to provide enhanced skid and rut resistance – reducing the potential of hydroplaning in wet weather, and lessening the effect of splash and spray during downpours.

Summary

In making a decision concerning the type of pavement to use, an agency is obligated to determine the best value for taxpayers. Selection should be based primarily on economics, and historical data should be used to evaluate cost and performance. The process should be rational, understandable and defensible. Finally, the advantages of asphalt pavement should be considered in every pavement type decision. ▲

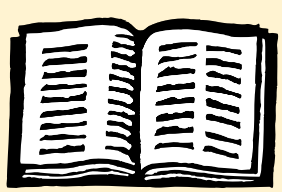
David Newcomb, P.E., Ph.D., is Vice President, Research and Technology for the National Asphalt Pavement Assn.

BITS & PIECES

Oregon Asphalt Conference Slated for March

The 11th Annual Oregon Asphalt Conference is scheduled for March 3, 2005 at the Valley River Inn in Eugene, Oregon. The program will run from 8:00 a.m. to 3:00 p.m., and include presentation of our 35th Annual Paving Awards during lunch.

Each year, the program includes both local and nationally-recognized experts speaking about the latest developments in asphalt technology. Additional program information and registration materials will be mailed in early 2005, and will also be made available online at www.apao.org. If you have any questions, please contact the APAO office for assistance at 503.363.3858.



Upcoming Training and Certification Opportunities at APAO

The Asphalt Pavement Association of Oregon is hosting training and certification classes in six different areas of highway materials testing. Depending on the subject, classes are between 3 and 7 days in length, with class sizes ranging from 12 to 20 students. Those seeking certification may attempt the state examination on the last day of each class.

Certifications include:

- CEBT – Certified Embankment and Base Technician
- CDT – Certified Density Technician
- CAgT – Certified Aggregate Technician
- CAT-I – Certified Asphalt Technician I
- CAT-II – Certified Asphalt Technician II
- CMDT – Certified Mix Design Technician

A total of 24 classes are offered throughout the training season. A class catalog, registration form, schedule and cost information are available at www.apao.org. Prospective students should have some exposure to highway construction and possess high school level math skills. Questions? Contact **Gary Thompson** at 503.363.3858. ▲

CENTERLINE is published four times a year by:
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EDUCATION

Tack Coats 101 – What, Why, When & How?

TACK COATS SERVE AS THE BONDING agent between layers of asphalt pavement. They contribute to the long-term strength of the pavement by bonding successive layers of asphalt, and when applied properly, prevent overlays from sliding – especially where traffic braking and acceleration occur.

Tack coat material is typically asphalt emulsion, but asphalt cement can also be used. Either material can provide a satisfactory bond when properly applied. "One advantage of using asphalt cement is that you can pave over it immediately," said **Dr. Ray Brown, P.E.** and director of the National Center for Asphalt Technology. "The problem with asphalt cement is that you have to heat it to a very high temperature, which contributes to higher energy costs and unfavorable working conditions."

Regardless of the tack material selected, the most important factor in obtaining a good bond is the amount of *residual asphalt* left on the surface after application. Too little will result in an insufficient bond, while too much can lead to sliding or bleed-through.

Typical Application Rates

Existing Pavement Condition	Application Rate (gallons/sy)[1] Residual	Undiluted	Diluted (1:1)
New Asphalt[2]	*.03 to .04*	*.05 to .07*	*.10 to .13*
Oxidized Asphalt	*.04 to .06*	*.07 to .10*	*.13 to .20*
Milled Surface (Asphalt)	*.06 to .08*	*.10 to .13*	*.20 to .27*
Milled Surface (PCC)	*.06 to .08*	*.10 to .13*	*.20 to .27*
Portland Cement Concrete	*.04 to .06*	*.07 to .10*	*.13 to .20*
Vertical Face	*	*	*

1 Rates shown are for slow setting asphalt emulsions (SS1, SS1H) containing approximately 60% bituminous material.

2 A tack coat is typically not required between layers of new asphalt if they are placed within a few days of each other and are kept clean and free of traffic.

* Longitudinal construction joints should be treated using a rate that will thoroughly coat the vertical face without running off.

The amount of residual asphalt required depends on several factors – but primarily on the condition of the existing pavement surface. A clean, tight surface requires .03 to .05 gallons per square yard (g/sy) of residual asphalt, while an aged or oxidized pavement surface will require more – somewhere in the range of .04 to .06 g/sy. Adjustments must also be made to compensate for dirty or milled pavement surfaces, sloped terrain, and humidity or wet weather conditions existing during paving.

Blocked nozzles and non-uniform application of tack coat will result in a poor bond between the existing surface and the new asphalt layer

The rate of tack coat application depends on the type of tack material and the amount of residual asphalt required. In the case of asphalt cement, for example, the application rate is equal to the residual asphalt rate since the material is pure asphalt and loses no content to evaporation. Asphalt emulsions, however, contain only 60-65% asphalt cement, with the remainder of their content consisting of water (35-40%) and a small amount of emulsifying agent. After application, the water will evaporate, leaving only 60-65% of the applied material as residual asphalt. Diluted emulsions require even more material to be applied, but are sometimes preferred in order to achieve more uniform coverage.

With any of these options, you should establish the proper amount of residual asphalt required for the project, and "work backward" to determine how much material to apply

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EDUCATION

Tack Coats – Continued

based on the percentage of asphalt cement in the mixture.

For example, to achieve a residual asphalt rate of .05 g/sy with asphalt cement, your application rate would be .05 g/sy. The tack material is pure asphalt cement, and there is no evaporation involved. In the case of an asphalt emulsion containing 2/3 asphalt cement (66% for the sake of the example), however, the application rate would be .075 g/sy to compensate for evaporation of the water component. If the same emulsion is diluted (1 part emulsion to 1 part water, for example) the percentage of asphalt cement (66%) is decreased by half (33%), and the application rate must double (.15 g/sy) in order to achieve the same residual asphalt rate.

Haul trucks running over the tack coat before it has set will pick up the material and eliminate its bonding capability

Application Rate = Desired Residual Asphalt Rate/Percent of Asphalt Cement Content

Uniform application is also critical, and hinges on several factors. The tack coat material must be kept at the proper temperature inside the distributor and the correct nozzle size must be used. Nozzles must be set at uniform angles (typically 30 degrees to the axis of the spray bar), and the height of the spray bar must be set to allow a double or triple lap. In addition, the bar height must remain constant throughout the application process. It is not necessary for the tack coat material to cover the entire underlying pavement surface. Only 90-95% of the area should be coated.

There has been much controversy as to whether HMA can be applied to asphalt emulsion tack material before it is set, and even before it is broken (the "break" occurs when the water component begins to evaporate; the "set" when the water is gone completely). **Jim Scherocman,** a consulting engineer, notes that it is common practice in Europe to pave over the tack coat before the emulsion breaks. "The key is to apply the new HMA before the break or after the set, not in between," he warns.

There is also the question of whether tack coat is required between layers of new asphalt if they are applied in succession. It is essential, of course, when an overlay is constructed on an old existing pavement surface, but it may not be necessary between new asphalt layers that are placed within a few days of each other and have been kept clean and free of traffic. In fact, the application of a tack coat between new asphalt layers in this situation is not preferred, according to Scherocman.

Scherocman is currently writing a detailed brochure for the National Asphalt Pavement Association on the subject of tack coats. A National Cooperative Highway Research Program (NCHRP) project on tack coats is also scheduled to begin in March 2005. Results of these efforts will be reported when available. ▲