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PavementPrinciples

Pavement Engineering Inc.

Influences on pavement treatment decisions

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The last issue of PavementPrinciples discussed how to determine if an existing pavement is structurally adequate or requires strengthening. This issue addresses pavement conditions that influence decisions regarding pavement maintenance or rehabilitation.

As pavement maintenance and rehabilitation professionals, our primary objective is to preserve and improve the pavement system. Virtually all budgets are inadequate to provide a pavement system in satisfactory condition. With that in mind, one important objective in determining pavement treatments is user satisfaction.

User satisfaction

Pavement user satisfaction is determined almost exclusively by ride quality, visual appearance and surface smoothness. The traveling public perceives smooth pavements as acceptable, regardless of other pavement conditions such as cracking. Pavement users want smooth pavements, particularly following some type of maintenance and rehabilitation.

Ride quality

Often the choice between shorter term maintenance and longer term rehabilitation comes down to ride quality. Ride quality has downsides as well as upsides. The major downside, at least for the agency, is travel speed. The smoother the pavement, the safer a driver perceives the roadway. The natural reaction is to increase travel speed. Thus a rough residential street with average travel speeds in the 20-25 mph range may experience travel speeds of 35 plus when ride quality is significantly increased.

When planning a pavement maintenance / rehabilitation project, ride quality should always be taken into account. Ride quality not only impacts consumer perceptions, it also affects pavement life. Smoother pavements last longer, particularly with increased travel speed. The greater the travel speed, the greater the pavement life from smooth pavement.

Visual appearance

Visual appearance also affects user satisfaction. Different pavement surface colors, multiple patches, crack sealing material, paint marking condition and other visual roadway surface features affect how pavement users perceive road quality. A uniform surface appearance promotes the perception of pavement quality even though it is only "skin" deep and may not actually lengthen a pavement's performance.

Texture also has an impact on pavement users. Rough surface textures produce more tire noise and are less usable by bicyclists, skateboarders and pedestrians.

Because surface smoothness of HMA (asphalt) pavements is usually lost due to raveling, rough pavements typically are associated with old pavements. However, some pavement maintenance / rehabilitation treatments, such as chip seals, also provide a rougher surface than new HMA pavements, for example.

Pavement cracking

Pavement cracking directly affects the longevity of a pavement system. Cracks allow water to enter the pavement system, reducing structural capacity and accelerating aging. Cracks result either from the environmental influences of sun and water or from loading related to vehicular traffic.

Age cracking

Exposure to sun and water cause asphalt binders to oxidize and lose volatiles, which over time causes the paving material to lose volume

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Influences on decisions

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and shrink. Shrinking results in stress cracks when the shrinking stresses exceed the tensile strength of the binder.

Shrinkage or age cracking usually starts with widely spaced traverse and longitudinal cracks. Longitudinal cracks often appear first at paving joints and then progress into block cracking, eventually becoming smaller and smaller blocks. On very old pavement, block cracking may be reduced to four-inch by four-inch dimensions.

With aging causing an increase in binder stiffness, the loss of surface fines, commonly called raveling, may appear. The loss of fines may become so severe that pavement thickness is severely compromised in wheel paths.

Another aspect of binder aging is spalling (flaking) at cracks. As a pavement ages and becomes brittle, the edges of cracks break off or spall. Spalling can increase the effective crack width several times. Thus a relative minor one eighth-inch crack deeper within the pavement may be a half-inch or wider at the surface. Spalling significantly increases pavement roughness and decreases ride quality.

Most environmental or age-related cracking occurs across the entire pavement surface without regard to loading.

Structural cracking

Structural cracking is related to loading and is located in the wheel paths of vehicular traffic, particularly heavy trucks. Passenger cars and trucks do not significantly contribute to structural pavement cracking unless the pavement is very light duty.

Structural cracking normally appears in thinner pavements (six inches or less) as alligator cracking. This cracking occurs as the cumulative strain at the bottom of the HMA layer begins to exceed the tensile capacity of the HMA materials. Cracking begins at the bottom of the pavement layer and progresses upward to the surface, so however bad the cracking may look on the surface, it is likely much worse on the bottom.

On pavements sufficiently thick to preclude tensile strain from exceeding its stress capacity, top-down cracking can occur. Normally, it is limited to the top layer of asphalt. Bonding between layers is an important contributing element in this type of cracking.

The quality of the initial paving materials has a significant impact on cracking resistance.

It is worth noting that it's possible a HMA layer has exceeded its structural (flexural life) while the entire structural section is adequate to support the current and anticipated loading.

Summary

User perceptions of ride quality, pavement texture and visual appearance will determine how they judge pavement treatments. Addressing pavement cracking conditions also is a critical element in choosing pavement treatments.

Next issue: how these elements apply to structurally adequate pavements requiring pavement preservation treatments.

News you can use - A decade ago, a Federal Highway Administration (FHWA) survey revealed that road condition was the public's number one criterion for satisfaction, and pavement smoothness was the single most important indicator of performance from the standpoint of the traveling public. A National Cooperative Highway Research Program analysis showed that improved smoothness extends pavement performance life by as much as 50 percent and enhances driver safety, fuel efficiency, ride quality and vehicle wear and tear.

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