Tech Topic

Flexible Pavement Distresses

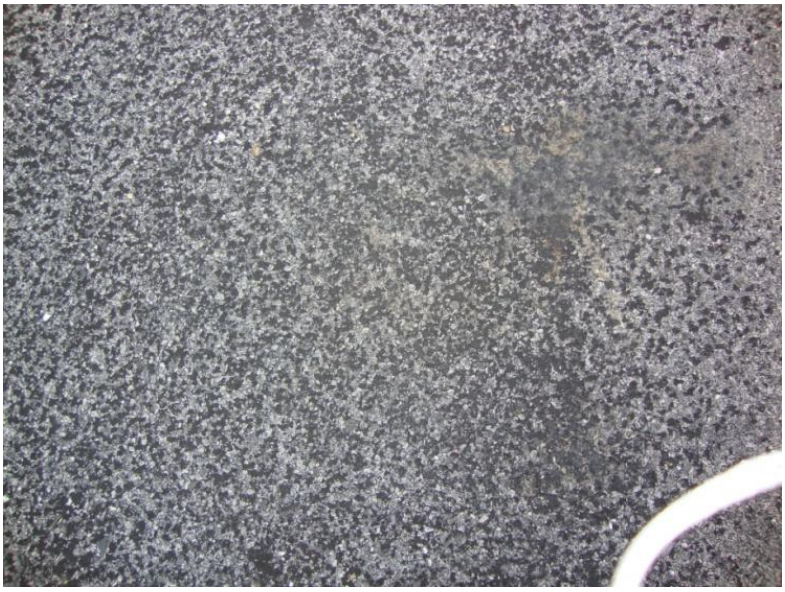
Flexible pavements can suffer from several categories and subcategories of distresses that will lead to progressive deterioration of ride condition, structural strength, and motorist/pedestrian safety. The more common distresses found in the Delaware area are introduced herein.

Bleeding

Description: A film of asphalt binder on the pavement surface, such that the surface will appear shiny and/or have black spots or blotchy areas.

Causes: Bleeding occurs when asphalt binder fills the aggregate voids during hot weather, then expands onto the pavement surface. Since bleeding is not reversible during cold weather, asphalt binder will accumulate on the pavement surface over time. This can be caused by an excess amount of asphalt binder in the flexible pavement mixture and/or low air void content. Bleeding typically originates from poor hot mix production or transportation (i.e., segregation of aggregate and binder).

Leads to: Bleeding reduces the friction characteristics of the road surface. As the skid resistance of the roadway decrease, the likelihood of crashes increases.



Typical Repair Methods: When bleeding is minor, coarse sand can be applied to the pavement in order to absorb the excess asphalt binder. When much of the pavement surface is affected by bleeding, the surface may need to be removed (i.e., milled) and the surface wearing course replaced.

Patching

Description: Patches are localized areas of surface asphalt replacement related to utility work or repair of distressed areas.

Causes: Patches commonly are a reaction to localized pavement deterioration (potholes, alligator cracking, etc.) and are intended to be a short to medium term repair. Other times, patches are a response to utility excavations related to repairs or new installation.

Leads to: More long-term deterioration. Well-constructed patches will minimize water intrusion into the subbase stone (which leads to structural deterioration) and maintain an adequate ride condition, but can still be expected to deteriorate over time. A poorly constructed patch will more quickly deteriorate into additional cracking in the area (due to uneven resistance to forces from wheel loads), differential settlement of the surface, additional ponding, and ultimately, loss of structural strength, renewed cracking, and potholing.

Typical Repair Methods: Patching is a repair method itself, but no matter how well a patch is done, it is considered a defect, because it is, under the best circumstances, a discontinuity in the surface material and will allow water intrusion into the subbase.

Alligator Cracking

Description: A series of small interconnected cracks (often originates along wheel track areas). Usually the cracks are many sided and angled pieces with the longest side being less than 1 foot.

Causes: Alligator cracking usually occurs in high stress areas and is usually caused by repeated and/or heavy traffic loadings together with inadequate structural support from supporting layers underneath. Alligator cracking results when the pavement cannot bear the required stress and flexes beyond its ability to ability to self-heal because of a loss of base, subbase, or subgrade support. Stripping at the bottom of the pavement layer (where the asphalt bonds with the subbase aggregate) can limit the road cross section to act as a structural unit and allow cracking. The excess stress that causes alligator cracking may also be a result of heavier loads than provided for in the design of the road.

Leads to: Alligator cracking allows water intrusion, which then accelerates deterioration of the underlying subbase stone and subgrade layers. Ultimately, loss of subgrade strength spreads and creates more widespread cracking and potholes develop.

Typical Repair Methods: In order to be repaired correctly, the root problem of alligator cracking must be identified first. A small and localized area of alligator cracking indicates a loss of subgrade support. This can be repaired by removing the cracked pavement, replacing the poor subgrade area and fixing the drainage, then installing a patch back over this area. The long-term effectiveness of this will depend upon many factors, including the integrity of the subgrade and subbase and bonding of the new and existing hot mix asphalt layers.

A large area of alligator cracking shows that there is structural damage to the pavement. This typically requires replacement of a larger area with a whole new flexible pavement overlay on the entire road.

Crack Sealing Deficiency

Description: Cracks that have developed and begun to expand unabated. These may be cracks that have been sealed before but are no longer effective in preventing water intrusion or they may be newer cracks that have never been treated.

Causes: Cracks, to some extent, are inevitable in pavements. Crack sealing deficiency is when cracks have been allowed to expand, unabated, in both length and width or have not been monitored for recurrence of open conditions or expanded reach.

Leads to: Cracks allow water intrusion into the pavement, which causes more cracks and debonding and allows accelerated development of

other pavement distresses. Ultimately, the unmaintained roads have to be replaced more often, increasing the life cycle costs of the roadway.

Typical Repair Methods: Crack seal large cracks in pavement periodically to maintain a sealed surface condition and minimize pavement rehabilitation costs over time.

[need another picture of where it WAS crack sealed before but is no longer effective]

Potholes/Debonding

Description: Potholes are bowl shaped voids or depressions in the pavement surface. Debonding is when the surface layer separates from its underlying layer of asphalt.

Causes: Often, potholes begin as alligator cracking; the small cracks cause pieces of pavement to dislodge when cars drive over them causing the pothole to enlarge. However, potholes also result from local poor compaction, inadequate bonding between layers, or segregation of aggregate and binder during placement.

Debonding usually occurs from poor construction of pavement where a thin surface layer does not adequately bond with the underlying material or flexes excessively. Between asphalt layers, debonding is usually related to inadequate tack application, wet paving conditions, or dust/dirt on the underlying asphalt. Debonding between asphalt layers and underlying stone are more commonly a result of too thin an asphalt layer to withstand forces that cause it to flex. Freeze-thaw action can also be a factor with thinner pavement layers.

Leads to: Unsafe surface conditions, further deterioration, and subgrade failure due to water intrusion. Serious vehicular damage can occur, especially at high speeds.

Typical Repair Methods: A patch is usually done in order to help fix the problem of a pothole. It is best to cut liberally around the entire cracking area in a rectangular shape, remove all loose material, tack seal the edge well, fill in with new asphalt, and crack seal the perimeter to avoid water intrusion. But sometimes pot holes are just filled in with new asphalt without cutting around the entire problem area (“throw and go”).

Block and Transverse Cracking

Description: Block cracking is characterized by interconnected cracks that break the pavement into large rectangular pieces. It is different than alligator cracking in that the crack areas tend to be larger, more rectangular, and generally without settlement of the surface material. Transverse cracking forms perpendicular to the centerline of the roadway and usually extends across one or all of the lanes of the road.

Causes: Block cracking occurs from a change in volume of the pavement surface because of temperature conditions, along with the hardening or oxidation of asphalt as the pavement ages. Transverse cracking results more specifically from longitudinal shrinkage of the asphalt surface.

Leads to: The cracks will allow water intrusion and the crack edges will deteriorate by raveling and erode the adjacent pavement. As water enters the underlying layers, the subbase and subgrade will deteriorate and alligator cracking tends to develop, followed by potholes and general pavement section failure.

Typical Repair Methods: Low severity cracks should be crack sealed early to prevent water intrusion and further raveling of the crack edges. In advanced stages of block cracking, milling with an asphalt overlay is generally more effective.

Longitudinal Cracking

Description: Often seen at the centerline, this is any continuous or semi-continuous cracking that parallels the centerline.

Causes: Centerline cracking is usually associated with poor joint construction during the paving operation. However, fatigue can also be a cause, particularly when longitudinal cracking is seen near the edge of pavements where the structural strength of the subbase and subgrade are inadequate.

Leads to: The cracks will allow water intrusion, which damages the underlying support material and leads to crack widening and the erosion of the adjacent pavement. As water enters the underlying layers, the subbase and subgrade will deteriorate and alligator cracking tends to develop, followed by potholes and general pavement section failure.

Typical Repair Methods:

Centerline joint cracks should be avoided to the extent possible through best construction practices during paving operations. When joint cracks do develop, early crack sealing can be an effective means of minimizing the spread of deterioration.

Suggested Further Reading and References:

- Distress Identification Manual: http://www.faa.gov/airports/great_lakes/airports_resources/certification_bulletins/media/09-07%20Attachment.pdf
- FHWA Flexible Pavement Distress: http://training.ce.washington.edu/wsdot/modules/09_pavement_evaluation/09-7_body.htm
- Pavement Condition Rating System, Appendix A: http://www.pavementpreservation.org/publications/PCR%20MANUAL/5pcrappa.pdf
- Distress examples (color photographs): http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_388appendixB.pdf

The Delaware T² Center's full-time Engineer position was established with the primary mission of providing transportation advice and technical assistance to Delaware municipalities. Contact Matt Carter at matheu@udel.edu or at (302) 831-7236 for assistance.