Bump Formation & Prevention In Asphalt Concrete Overlays Which Have Been Crack Sealed

Introduction:
Sealing cracks in asphalt concrete pavements is a widely used effective procedure for extending pavement life. Crack sealing limits water entry into underlying base and subbase layers thereby reducing the rate of pavement deterioration. At some point in most asphalt concrete pavements life spans, overlays are placed to rehabilitate and further extend pavement life. Bumps have been known to form in the mat above areas where crack sealant is present during the compaction process of the hot mix asphalt concrete overlay. They have also formed where there is no crack sealant present at all.

"Bumps" in asphalt concrete overlays is an industry wide concern. With more focus on ride quality and pavement smoothness; paving contractors, asphalt concrete providers, paver manufacturers, and roller manufacturers, engineering firms and agencies have all researched ways to prevent bumps. It is the consensus that there is not one singular reason or cause for bumps. Pavement design, field conditions, paving and compaction equipment and general construction practices are all suspect and have been known factors for bumps in overlays. Crack sealing may also contribute to bump formation in certain overlay projects, however, the presence of crack sealant alone does not predetermine that bumping will occur.

Bump Formation:
In the process of overlay compaction, the rollers tend to shove the mix forward. If this happens on an underlying pavement surface which has uniform restraining characteristics, a smooth finished surface can be achieved. However, if the underlying pavement surface varies significantly due to irregularities or conflicting materials, uneven shoving results in unwanted bumps.

When the hot mix asphalt concrete overlay is placed, the underlying pavement will absorb the heat and expand due to the temperature change. The cracks present will then become more narrow due to the thermal expansion causing the crack sealant to be pushed upwards. Typical crack sealants have adhesive and elastic properties and when pushed upwards may stick to the overlay and limit overlay displacement during the compaction process.

Overlay Construction Bump Formation Factors:
These factors are both materials and procedures related and deal with constructing an overlay which does not experience shoving during the compaction process.

Overlay mixtures with high frictional properties such as open or gap graded, stone mastics, or those with more angular and fractured aggregate tend to experience less shoving than denser mixes or those containing low angular and fractured aggregate.

It has been noted that higher mix lay-down and compaction temperatures that have been used recently due to the use of modified asphalts have increased the tendency toward bump formation. Some paving mixtures seem to experience more shoving at certain temperature ranges during compaction. Modification of rolling patterns to compact at different temperatures may reduce shoving. Speed of the rollers during compaction has been found to influence bump formation. Faster speeds have produced more bumping, and it has been found that slower roller speeds can reduce or eliminate bumping. Also, limiting the number of roller passes to the minimum needed to achieve required compaction can reduce bumping.

Compaction equipment and technique have also been found to influence shoving and bump formation. The use of compaction equipment with non-driven front rollers tend to push and shove the mix. Rollers with power driven front drums tend to pull the mix under the drum and therefore are less prone to shoving.

Tack coat application has been found to influence bump function. Use of stiffer tack coats has resulted in less overlay shoving and less bump formation.

Crack Sealant Bump Formation Factors:

These factors relate to whether or not the sealant can adhere to the overlay to limit mix shoving during compaction.

Hard, stiff sealants may not adhere to the overlay while soft, low melt temperature sealants may soften enough when heated by the overlay to not restrain the mix if it displaces during compaction. Medium stiffness sealants with elastic properties may have a tendency to soften, adhere and restrain the overlay.

As sealant ages, it has a tendency to form an oxidized, non-tacky surface which resists overlay adherence.

Exposure to traffic tends to wear away sealant in pavement surfaces and smooth it level with the pavement surface.

When sealant is applied in a recessed configuration it may not contact the overlay.

Solutions To The Bump Formation Problem:

Procedures to be followed to reduce or eliminate overlay bumps are those that reduce shoving during compaction and/or prevent sealant from adhering to the overlay. Following is a list of solutions that have been found to help reduce or eliminate bumps:

Overlay Construction Related:

1. Use of rollers with power driven front drums.
2. Use of 2 course paving with a thin leveling course.
3. Use of stiffer tack coats.
4. Waiting one or more years after sealing before overlaying.
5. Modifying rolling patterns and temperatures based on operator experience to reduce mix shoving and mix designs.
6. Slowing roller speed during compaction, especially for intermediate and final rolling
7. Rolling to achieve compaction with the minimum number of passes. Do not "over roll"

Crack Sealant Related:

1. Install sealant in routed cracks leaving approximately 3/8 inch (1 cm) low in the crack with no sealant in the surface. (When sealing just prior to the overlay)
2. Apply an isolation or non-stick layer or material over the sealant to prevent adherence. (i.e. lime, sand or other coating)
3. Remove excess sealant and/or avoid excessive sealant applications.

These above listed actions have been found to prevent or reduce shoving and bump formations in overlays. If bumps occur, use of the above procedures should assist in successful overlay construction.

New PolyFlex Type 4 Specifications