Intersect Strategy 2

by Carlos Rosenberger, Senior District Engineer, Asphalt Institute; and Mark Buncher, Director of Technical Services, Asphalt Institute

This article is the second in a series on obtaining better performance from asphalt pavement intersections. The first article, published in the last issue of *Asphalt* (Winter 1999), discussed why intersections require special attention and what the key steps are to establishing an "intersection strategy." The key steps are:

- ensuring structural strategy,
- selecting and controlling materials,
- following proper construction practices,
- and implementing the plan.

This article covers the first of those key steps—ensuring structural adequacy. The second and third steps are covered in *Intersection Strategy 3*, also in this issue. As with any road or highway, an intersection pavement must have sufficient structural capacity to perform well throughout its design life. For existing intersections, the keys are to assess the pavement's current ability to support traffic and then, if needed, choose an appropriate repair alternative to restore that ability.

Assessment

Part of a sound intersection rehabilitation strategy includes determining the extent of any rutting that has occurred. Rutting is the largest and most frequently occurring problem when dealing with asphalt intersections. The rutting may or may not have been related to a structural problem. Assessing any rutting condition will serve as the basis for selecting the most cost-effective, sound repair alternatives.

There are four general types of rutting, each related to a different cause. Only the fourth general type listed here, Mechanical Deformation, relates to insufficient structural capacity.

1) **Consolidation** — occurs when there is insufficient compaction during the construction of the pavement. A mix with insufficient density is prone to further compaction under traffic, especially in hot weather and at intersections where the loads are slow moving or static. With consolidation, a depression occurs in the wheel path with no humps on either side of that depression (Figure 1).

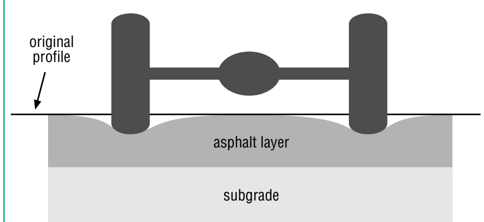

Figure 1. Rutting from Consolidation or Surface Wear

2) **Surface Wear** — takes place because of the surface abrasion of chains and studded tire use in the winter. The subsequent depression on the surface is similar to that

Ensuring Structural Adequa

caused by consolidation, but with the appearance of abrasion.

3) **Plastic Flow** — results when there is insufficient stability in the hot mix asphalt (HMA). Some of the more common reasons for mix instability are too much asphalt and insufficient air voids, too much rounded aggregate, or too high minus #200 material. If plastic flow occurs, it is typically with the surface mix but may also occur in lower lifts. Intersections are especially prone to this type of rutting due to slow moving and static loads. Plastic flow will normally appear as longitudinal ruts in the pavement with humps of material on either side of the rut. The humps are created as the material is squeezed out from under the heavy loads. (Figure 2).

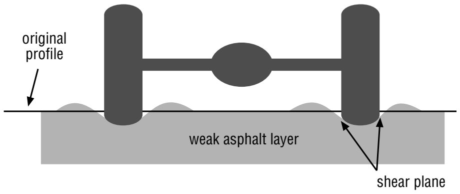

Figure 2. Rutting from Weak Mixture

4) **Mechanical Deformation** — results from insufficient structural capacity of the pavement system. The strength and thickness of the pavement layers are insufficient to support the existing traffic on the given subgrade (Figure 3).

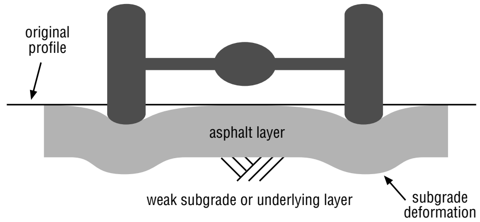

Figure 3. Rutting from Weak Subgrade

Mechanical deformation is usually accompanied by longitudinal and/or alligator cracking, which typically initiates at the bottom of the asphalt layer where there are excessive tensile stresses (Figure 4).

Figure 4. Alligator (fatique) cracking

Besides identifying the type of rutting, the physical assessment of the intersection also needs to provide the location limits and depth of rutting. Walking the intersection with a straightedge or stringline is recommended for this.

Further physical evaluation is possible by either trenching or coring. By measuring the depth of each asphalt lift across the lane width, one can likely determine if there was plastic flow in any of the layers and from what layer any deformation occurred. Trenching, while more intrusive than coring, is the preferred method because a stringline can be run along the top and bottom of each asphalt lift (Figure 5). Any aggregate base should also be evaluated at this time to determine if it has been contaminated with clay

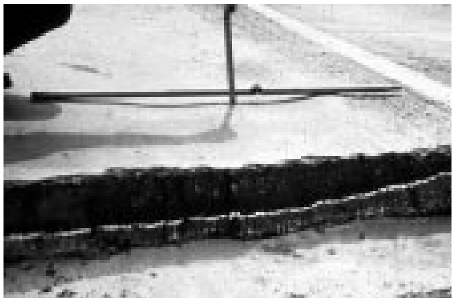

Figure 5. Trenching

from pumping of the subgrade.

In addition to the physical evaluation, the assessment should include the calculation of the required pavement design thickness as if it were a new pavement. Designs should be performed in accordance with AASHTO, state or local agency procedures. The Asphalt Institute promotes design publications for high volume roadways, such as MS-1 and MS-17, and also has publications dealing with lower volume roads.

The estimate of design equivalent single-axle loads (ESALs) should reflect several directions of traffic since many points in the intersections are

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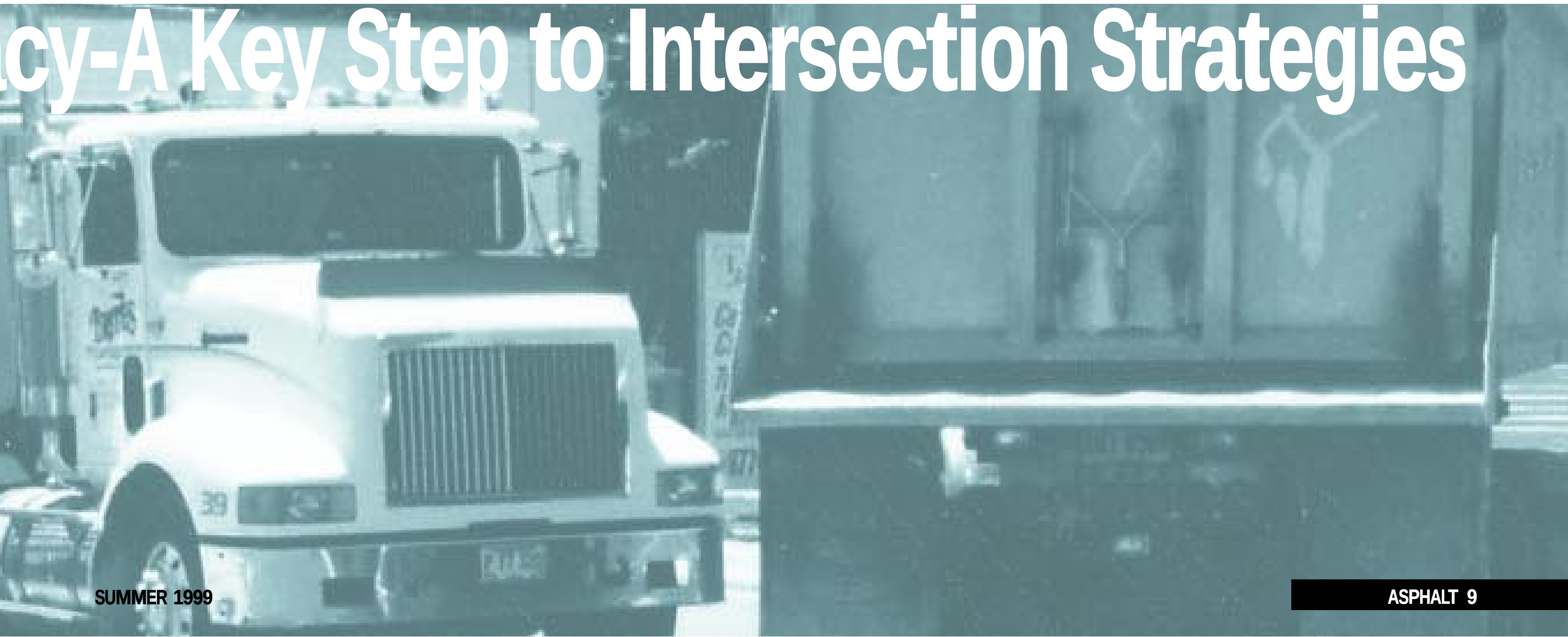

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loaded by vehicles traveling from several directions. As a safety factor, some states routinely increase the design thickness by as much as 25 percent, which pays big dividends in term of reducing future user delay costs.

Falling Weight Deflectometer (FWD) testing is another tool which can be used to assess the existing structural ability of a pavement and help determine required overlay thicknesses.

Choosing the Appropriate Repair Alternative

Once the assessment is complete, the appropriate repair alternative needs to be selected. Each of the scenarios listed below has a different appropriate repair method.

1. **No Rutting, or Rutting Caused by Consolidation/Surface Wear** — It is generally not necessary to mill the surface. There will be times when milling will be required to maintain proper curb height, drainage, etc. Other reasons to mill may include removing surface distresses such as raveling or non-structural cracking.

   After milling, or if milling is not performed, a scratch or leveling course should be placed prior to the overlay. Any other surface preparation such as crack sealing and spot repairs should be accomplished prior to placing the scratch or leveling course.

2. **Rutting Caused by Plastic Flow** — It is important to identify the extent of the rutting in terms of both location and depth, preferably by trenching. Those layers which exhibit plastic flow should be removed typically by milling. Any exposed subgrade or gravel base should be recompacted prior to placing the new hot mix asphalt. Simply paving over unstable hot mix asphalt will likely result in reoccurring ruts.

3. **Rutting Caused by Structural Failure** — All failed and cracked asphalt pavement should be removed. Paving over existing asphalt that suffers from alligator cracking will likely just delay the same structural problem.

   If the existing aggregate base is contaminated with subgrade material, it should also be removed. If new aggregate base is to be a component of the rehabilitated pavement section and the subgrade is clay or silt, then a geotextile may be placed on the subgrade to prevent the upward migration of fines. This will retain the structural integrity of the aggregate base. The use of Full-Depth asphalt will not require the use of a geotextile.

   Structural failures are often the result of poor drainage. Existing drainage should be evaluated and if drainage is found to be inadequate, sufficient drainage should be included in the rehabilitation plans.

   After all failed layers are removed, new layers should be placed on recompacted subgrade or base layers. New hot mix asphalt should be placed to a depth of at least the minimum required design thickness.

By assessing the existing condition of the intersection, then selecting an appropriate repair method based on the assessment, we can ensure that an intersection will have the structural capacity to perform well through its design life.▲