ASPHALT WINS!

Maryland Intersection Contest Results In Clear Winner: ASPHALT

In a head-to-head pavement competition that started in 1994, the asphalt section is still going strong, but the concrete one has been completely removed and replaced with asphalt.

By Ron Corun

Some transportation agencies today share the belief that Hot Mix Asphalt (HMA) pavements in high-stress intersections will rut. These same agencies believe that building high-stress pavements using Portland Cement Concrete (PCC) is the only effective means to remedy this problem. A head-to-head competition between the HMA industry and the PCC industry initiated by the Maryland State Highway Administration in 1994 has demonstrated that these beliefs need to be reconsidered.

A comparison of the performance of asphalt and concrete pavements at adjacent intersections on U.S. Route 40 in Elkton, Maryland, came to an end in July 2000. After five and one half years of service, the cracked PCC pavement had to be completely removed and replaced with HMA. The HMA intersection, built six months prior to the construction of the PCC intersection, has rutted less than 1/16 of an inch and is still in excellent condition.

The reasons for the success of this HMA intersection are tied to developing an effective intersection strategy, which includes:

- Conducting a forensic analysis of the existing intersection to determine the appropriate pavement design and thickness;
- Using the Superpave system correctly to select the proper mix design and PG (performance graded) asphalt binder; and
- Building the project as it was designed.

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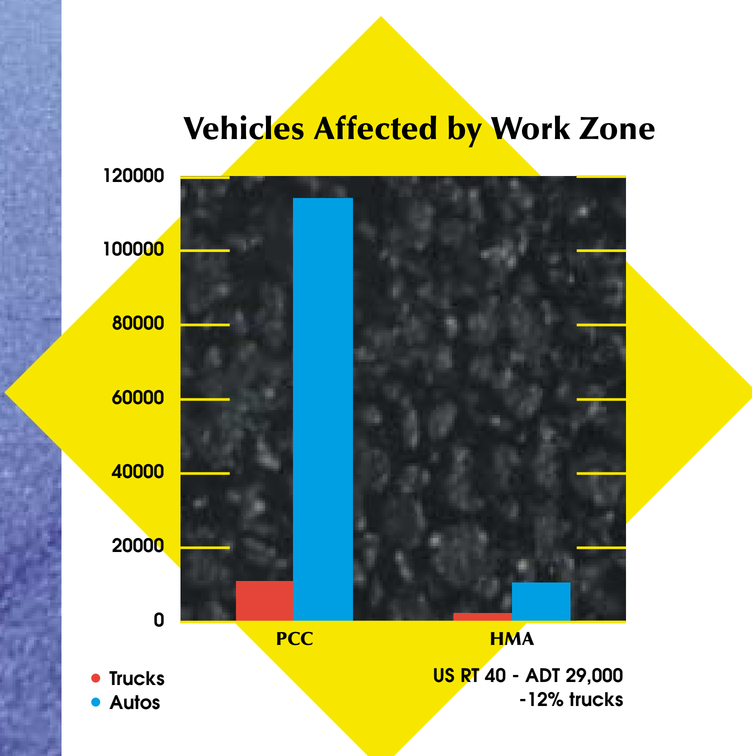
Intersection strategy

Pavement designers must recognize that intersections are different from posted-speed highways. The slower speeds and turning movements associated with intersections may cause rutting. These factors need to be considered while using the Superpave system to develop a Hot Mix Asphalt pavement strategy. If these differences are not recognized and addressed in the intersection design and construction, then the pavement will not perform effectively.

A strategy must incorporate assessment of the existing roadway designated for rehabilitation. This means the designer should first go to the site and perform a forensic analysis to determine what needs to be removed and replaced. Forensic analysis includes pavement coring and/or trenching to determine the depth of rutting in the pavement structure because all failing pavement layers must be removed. The finished pavement section must be thick enough to ensure structural adequacy for the anticipated traffic.

Next, a focus must be placed on materials selection and mix design. In this regard, the Superpave mix design system provides the tools that a designer needs in order to select the appropriate aggregates and PG asphalt binders to design mixes to meet the needs of an intersection project.



Final responsibility for a successful strategy and project falls on the contractor. If the contractor does not construct the project as designed, then the project is not going to be successful. Thus, responsibility for a high-performance HMA intersection involves everyone — including the specifying agency, the pavement designer(s), and the contractor.

Maryland intersection competition

The Maryland intersection project was unique. In 1993, the Maryland State Highway Administration (MD SHA) decided that they did indeed have a problem with intersections and rutting. They formed a team within their own department in order to identify solutions. After meeting for a year and not finding any solutions, they developed a new plan. This plan established a competition between the HMA industry and the PCC industry.

In 1994 two adjacent intersections, US 40 at MD Rt. 213 and US 40 at Landing Lane, were assigned to the two industries. The MD SHA team told the HMA and PCC industries that they could use any technology available and could ignore the current Maryland Department of Transportation (DOT) specifications. The only requirement was to work within a given budget for each intersection. Both industries were allotted the same budgets. Winning would be determined solely on pavement performance — the best performance would win.

Taking a team approach

The Maryland Asphalt Association Inc., representing the HMA industry in Maryland, decided to approach the competition as a team. A task force was formed with members of the Maryland Asphalt Association, the National Asphalt Pavement Association, and the Asphalt Institute. The first step was to perform a forensic analysis on the existing roadway to determine what was wrong and then to decide what was needed to fix it. The task force was also open to considering new technology during this process.

The analysis showed that the existing US 40 eastbound intersection had rutted at approximately one inch per year. As part of the forensic analysis, a trench was cut across the width of the slow lane. The trenching revealed eight inches of HMA over an existing PCC roadway. Rutting was evident in the top six inches of the 8-inch HMA pavement.

Four-inch-diameter cores were taken as samples from various areas of the roadway in order to confirm that the depth was consistent. Two 10-inch diameter cores were also cut. These showed the various existing Marshall mixes that Maryland had used. Examining these two cores showed that, even in the coarse mixes with large aggregate, very little stone-to-stone contact existed. The team believed that stone-to-stone contact was necessary to withstand the heavy truck loadings at this intersection.

The team then used the Hamburg wheel tracking device to test these two larger cores for rutting performance. The Hamburg device runs a steel wheel back and forth over a sample for 20,000 passes. When it reaches 20 mm of rutting, it is considered a failure. The two cores from the existing intersection failed at fewer than 4,000 passes of the Hamburg wheel, whereas the new Superpave mix that was used to replace this pavement actually rutted no more than 4 mm at 20,000 passes using the same testing methods.

Asphalt pavement design and binder selection

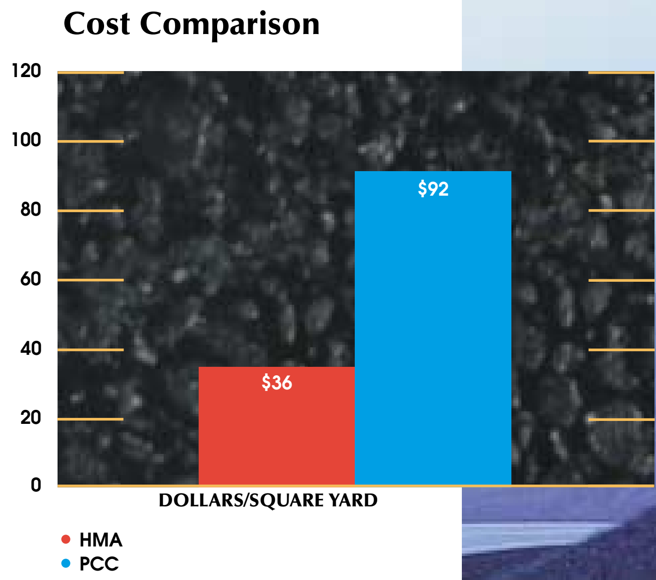
The team decided to replace all eight inches of the existing HMA pavement. Superpave mixes were chosen, rather than the mixes MD SHA was using at the time, for a couple of reasons. First, a coarser aggregate structure was desired in order to achieve stone-on-stone contact that was not evident in the existing pavement. Second, the team wanted to be able to specify an asphalt binder to meet both climatic and traffic conditions of this particular intersection.

The intersection was designed in three sections. The first section was the test section to be compared to the PCC intersection. In this section, eight inches of pavement was milled and replaced with two 3-inch layers of 25-mm base course and a 2-inch surface layer of 19-mm surface course.

The second section was a 5-inch thick pavement that was milled and replaced with a 3-inch lift of the 25-mm base and a 2-inch lift of 19-mm surface. This section was paved with five inches in order to compare its performance with the performance of the 8-inch test section to see if five inches would have been a sufficient repair.

Finally, the third section was on the westbound side of US 40. The state resident engineer for Cecil County wanted the entire intersection paved so that it all looked the same. Therefore, on the westbound side, two inches was milled and replaced with a 2-inch thick, 19-mm surface course for cosmetic reasons.

The standard grade for asphalt binders in Maryland was a PG 64-22. Traffic data for this intersection showed 12.8 million ESALs in a 20-year period, with 12 percent of the traffic being trucks. The Superpave system requires the high-temperature grade for the PG asphalt binder to be “bumped” two grades higher for stopped traffic at an intersection. Therefore, an asphalt grade of PG 76-22 was selected, and a stabilized SBS polymer-modified asphalt was used.



In 1994, very few laboratories in the United States were equipped to perform Superpave mix designs. Therefore, the aggregate materials and the asphalt binder were sent to the Asphalt Institute, which produced the mix designs for this project.

Speed of asphalt construction

In eight nights, 15,000 square yards of milling and paving were accomplished and the project was completed prior to Labor Day 1994. The contractor, T. C. Simons Inc., established a night paving schedule, in which all work was performed from 7 p.m. to 6 a.m. As a result, there was little or no disruption to the motoring public.

In contrast, the PCC intersection, built in the spring of 1995, took twelve days and nights to construct only 1700 square yards of paving. The PCC construction schedule included 24-hour lane closures for four consecutive days for three consecutive weeks.

Continued performance testing

Since this project was completed, performance of the intersection has been assessed annually. The California-type profilograph was used to measure ride quality for both the asphalt and concrete intersections one year after completion. Test results in fall 1995 showed a substantial difference in ride.

Hot Mix Asphalt tested 13 inches of bumps per mile while PCC tested 41 inches of bumps per mile.

Using a transverse profilograph, rutting has been examined every fall since the project was completed. In fall 2000, after six years of testing, only 1/16 inch of rutting was found in the HMA intersection.

PCC Intersection

The PCC industry's intersection had the same existing pavement section as the HMA industry's intersection, eight inches of HMA over an existing PCC pavement. Their pavement design called for milling off six inches of HMA, leaving one inch of HMA as a bond breaker. They then placed six inches of PCC whitetopping in spring 1995.

By late 1999, the PCC pavement showed cracking and open joints. In spring 2000, a failed area had to be patched with HMA. In July 2000, the condition of the PCC intersection was so poor that the MD SHA decided that the PCC pavement would have to be removed because it was no longer fit for traffic. The original contractor for the HMA intersection, T. C. Simons Inc., removed the concrete pavement and replaced it with HMA in 22 hours.

It took the PCC industry 288 hours to install the original pavement. It was removed and replaced with HMA in 22 hours.

Costs

Initial cost comparisons of the test sections showed that it cost $36 per square yard to mill and replace the existing intersection with full depth, eight inches, of Hot Mix Asphalt. In contrast, it cost $92 per square yard to mill and replace the existing intersection with six inches of PCC whitetopping.

Conclusions

Intersections require special treatments. Designers need to develop an intersection strategy for each project that includes:

- Forensic investigation;
- Adequate structural strength;
- Proper aggregate structure;
- Correct asphalt binder grade; and
- Good construction practices.

Superpave provides excellent solutions for high-stress intersections at substantial cost savings compared to PCC.

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Asphalt Pavement Alliance

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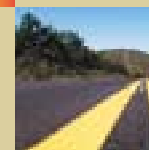

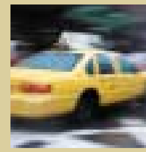

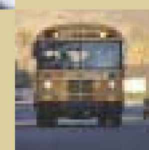

The **Asphalt Pavement Alliance** is a coalition of the Asphalt Institute, the National Asphalt Pavement Association, and the State Asphalt Pavement Associations.

The Asphalt Pavement Alliance's mission is to implement a unified, industry-wide plan that furthers the use and quality of asphalt pavements.The Alliance will accomplish this through engineering, research, technology transfer, education and innovation.