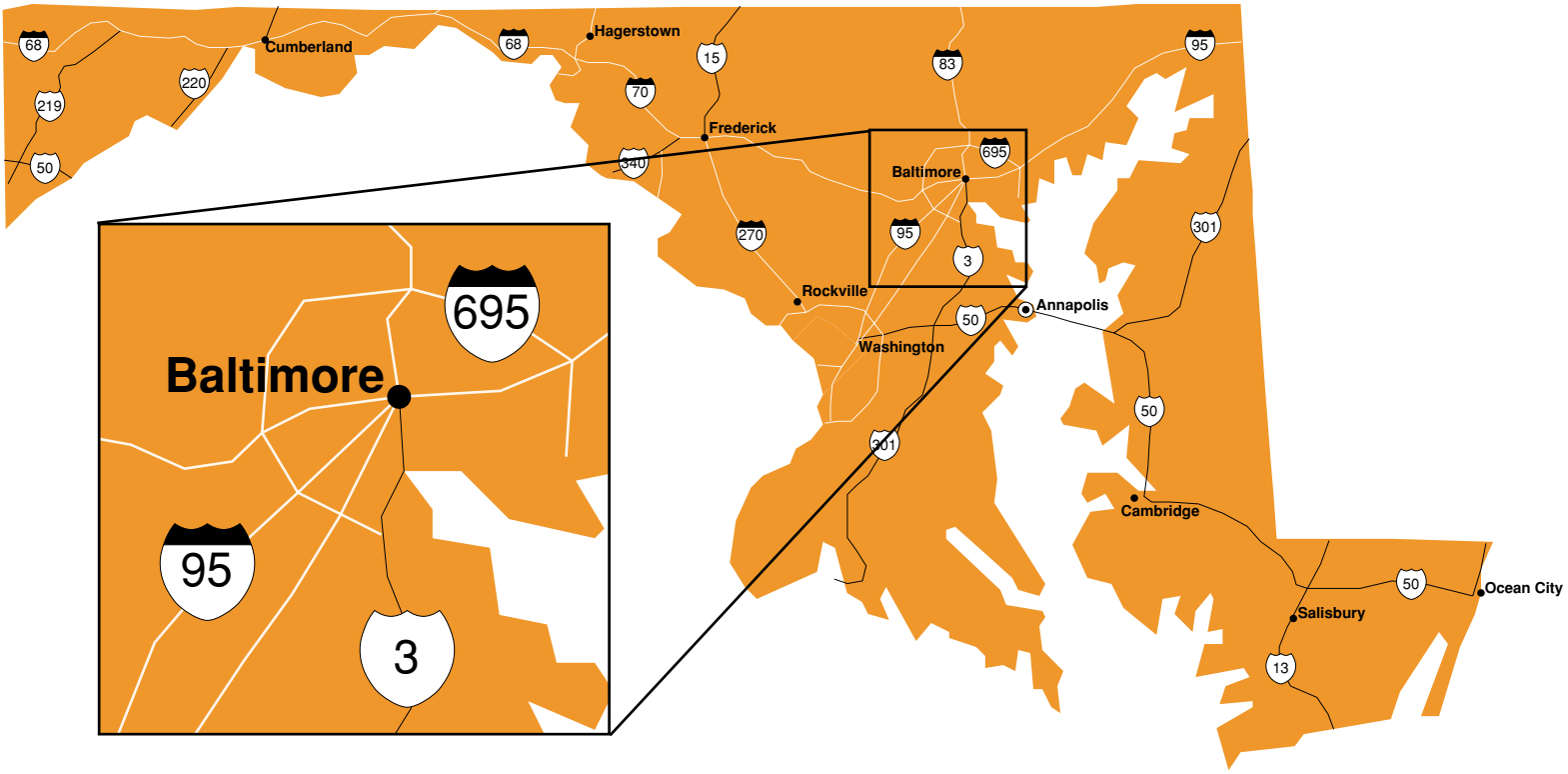


I-695 —a Classic Example of Perpetual Pavement

Perpetual asphalt pavements are fast becoming the pavement of choice by Department of Transportations (DOTs) for heavy-use highways around the country. If properly designed and constructed, these perpetual pavements will last indefinitely. No removal or reconstruction is required—just proper periodic resurfacing.

I-695 around Baltimore is a classic example of a properly designed and constructed perpetual asphalt pavement. The new travel lanes in each direction around the Beltway are designed to withstand high volume, heavy-duty traffic with resurfacing every 12 to 20 years. These pavements are thick enough and tough enough to resist the high average daily traffic (ADT) that pound the asphalt surface every day.

Simple Concept

An asphalt perpetual pavement such as I-695 is really a simple concept. It requires a stable subbase, a flexible but fatigue-resistant hot mix asphalt (HMA) base, an intermediate HMA course with high modulus material and a rut-resistant HMA surface course. The I-695 lane widenings on the 4.37-mile-long section from Reisterstown Road to the Jones Falls Expressway contain all of these elements.

This section was widened from six to eight lanes and twenty-foot-wide shoulders were added next to the median. Now three years old, the section handles more than 175,000 vehicles per day with about 9 percent heavy trucks. It is performing well. Traffic projections for this section in the year 2020 exceed 236,000 ADT with 9 percent trucks.

Good Mixes

"The reason the pavement works so well is that we used good mixes," says Dave Parkhurst, Maryland State Highway Administration (SHA) design engineer for the 4.37-mile Beltway section.

"We used a 37.5mm-sized mix in a 12-inch-thick base course, and we placed it on 6 inches of graded aggregate subbase." He says that all heavy-use roads in the Piedmont region around Baltimore require an aggregate subbase. The subbase is compacted to 92 percent maximum density.

Parkhurst says that good aggregate interlock and stone-on-stone contact was an essential ingredient in the mix design. "We felt it was a critical part of the design," he says. "That's why we wanted to go with the new Superpave mixes—37.5mm and 25mm. At the time of construction we were in transition from old Maryland SHA mixes to the new Superpave mixes. The new mixes gave us good aggregate interlock and stone-on-stone contact."

Thick Enough

The total thickness of the new lanes on the 4.37-mile Beltway section is 21.5 inches, including 15.5 inches of HMA and 6 inches of aggregate subbase. A base course of three 4-inch lifts of 37.5mm-sized mix was placed on the aggregate subbase. Then 1.5 inches of 25mm-sized mix with PG 70-20 was placed on the base course. The new lanes, along with the six existing lanes, were then surfaced with 2 inches of stone matrix asphalt (SMA).

Thickness was a primary consideration when the SHA designed the roadway. Structural failure for thin asphalt pavements is much higher than for thick asphalt pavements. If the asphalt is too thin, it will exhibit strain from bending, say SHA design engineers. If it is thick enough, it will resist fatigue.

Angela Smith, SHA pavement design engineer for a 2.73-mile section of I-695 currently under construction, says that 12 inches of thickness or more provide structural integrity where sustained and heavy loads are continuous. She cites US 183 in Maryland as an example of thick pavement to sustain heavy loads. "It is 17 inches thick," she says.

"A lot of the reason for the good performance of the road," says Parkhurst, "is the thickness, the SMA surface, the large-size rock in the base and intermediate courses and the good stone-on-stone contact throughout the pavement structure."

Parkhurst says the Maryland SHA used a 30-year design analysis period for the new lanes. "We used 76 million ESALs for the 30-year period design analysis and 28 million ESALs for the period from the 1998 opening to the first overlay, which is scheduled in 12.5 years."

Existing Lanes

As part of the 1997-98 rehabilitation, Maryland SHA also milled and paved the existing PCC roadway on I-695 with an HMA overlay. The existing PCC was placed in 1966, diamond-ground in 1988 and overlaid with 4.5 inches of HMA in 1992. The contractor milled off one-half inch of the existing HMA, then placed a 2-inch thick SMA surface across the Beltway's entire 8-lane roadway. Dick Corporation of Pittsburgh was the general contractor for the widening/overlay project. Flanagan & Sons of Baltimore was the paver.

Drainage Factor

The SHA installed underdrains at the shoulders on both sides of I-695, as well as underdrains in the median area. The pavement and drainage system now extends from shoulder to shoulder.

"We provide a positive drainage system on all of our major roadways," says Parkhurst. "It's an inexpensive way to ensure longevity."

Rutting and Roughness

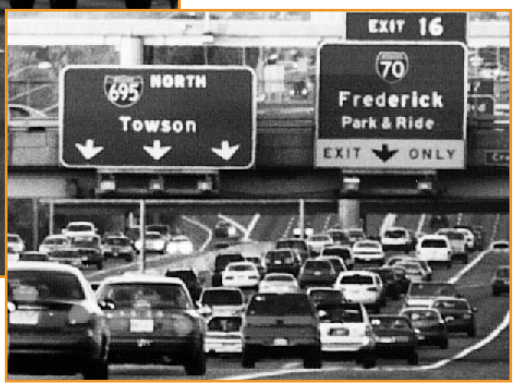
The three-year-old I-695 pavement shows little or no deformation and has a smooth riding surface. Paul Dorsey, Maryland SHA Pavement Management Engineer, says that there is very little rutting on the 4.37-mile pavement surface. Using an ARAN (automated road condition vehicle) to measure rutting and smoothness, Dorsey says that data for the year 2000 shows less than 1/10th of an inch of surface deformation.

ARAN data also shows that surface smoothness measures in the "good" range. On International Roughness Index (IRI) ratings, the Federal Highway Administration (FHWA) says that 0 to 60 is very good and 60 to 95 is good. Over 95 is "fair." The ARAN shows that the average roughness on the new lanes is between 78 and 84. That is in the good range.

Dorsey adds that an SMA surface measures a little rougher because of its texture. "But the ride is smooth," he says, "and the overall rating of the SMA surface is very good."

Rut-Resistance in Upper Layers

Perpetual pavement designers agree that rut resistance in the upper layers depends on good aggregate interlock, asphalt binder that is stiff enough to resist deformation, and air voids at a reasonable level—between 4 and 6 percent. The surface mix must also resist thermal cracking.



The SMA surface course on the 4.37-mile stretch, together with the PG 76-22 polymer modified asphalt binder used in the mix, meet these requirements.

Traffic Maintenance

During the widening of the 4.37-mile section from six lanes to eight lanes, SHA and the contractor had to keep six lanes open from 6 AM to 7 PM everyday. "One lane was closed at 7 PM and another at 10 PM, says Bob Steffy, SHA traffic engineer. "All construction equipment had to be off the road at 5 AM."

Steffy says there was some vehicle back up when the lanes first closed, but that back up quickly dissolved. He says that Dick Corp. of Pittsburgh did an excellent job of traffic control. Penalties were assessed at $50 per minute if Dick Corp. and the paving contractor did not have their equipment off the site at 5 AM. Steffy says few if any penalties were levied because the contractor was always ahead of the deadlines. Parkhurst says the traffic handling was the best he has ever seen on a major project.

Summary/Conclusion

Although traffic handling and scheduling is critical on major interstate projects such as the I-695 widenings, it is the design and construction of the roadway that ensures it will be a perpetual pavement. The essential ingredients of this design and construction are:

- A base course that supplies an indefinite fatigue life.
- A surface that is custom-designed for specific loads and applications.
- A surface course that is renewable and that can be milled and filled every 12 to 20 years.
- A road that is smooth and reliable and one that is enjoyable to use.

These are the essential ingredients that describe I-695.