RESEARCH
Oregon Department of Transportation

Research Notes

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SMA: Stone Matrix Resists Ruts

Stone Matrix Asphalt is a hot-mixed asphalt pavement developed in Germany during the mid-1960's. It is a tough, stable mixture that relies on stone on stone contact for strength and a rich mortar binder to provide durability. The original purpose of SMA was to provide a mixture that offered maximum resistance to studded tire wear. But after studded tires were banned in Germany it was also found to have high resistance to plastic deformation (rutting) created by heavy wheel loads and high temperatures. It is now in regular use in Germany, Austria, France, Sweden and several other European countries.

SMA was introduced to the U.S. in the early 1990's and has been used extensively in Maryland, Georgia and a few other states. It is more expensive than standard mixes because it incorporates mineral filler and fiber and also has a relatively high asphalt content; but SMA performance has been outstanding in U.S. applications and a long pavement life is anticipated.

The first Oregon Department of Transportation SMA placement was part of a pilot project constructed on Interstate 5 (I-5) in 1996.

After 6 years, this SMA on I-5 still looks good

Four asphalt mixes were placed over a 3-mile section of concrete to evaluate the use of asphalt overlays for repair of studded tire damage in the concrete. The mix types included a coarse SMA (12.5mm), a fine SMA (9.5mm) and two open-graded mixes (ODOT F-mix with and without fibers). The F-mixes were placed in a 2.0 inch lift while the SMA was placed in a 1.5 inch lift for the coarse gradation and a 1.0 inch lift for the fine gradation.

Since the 1996 placement, rut depths (inches) and skid resistance have been measured on all four mix types annually. Results are shown in the tables below:

Annual Rutting

	F-mix (276.15 - 276.63)	F-mix with fiber (276.63 - 277.35)	SMA-coarse (277.35 - 278.05)	SMA-fine (278.05 - 278.38)
test date	LWP Rut + STD	LWP Rut + STD	LWP Rut + STD	LWP Rut + STD
96	0.04	0.05	0.12	0.12
97	0.15	0.16	0.21	0.18
98	0.22	0.21	0.28	0.22
99	0.24	0.24	0.33	0.25
00	0.37	0.31	0.38	0.34
01	0.50	0.43	0.46	0.42
02	0.54	0.50	0.54	0.47

2002 Friction Value

	F-mix (276.15 - 276.63)	F-mix with fiber (276.63 - 277.35)	SMA-coarse (277.35 - 278.05)	SMA-fine (278.05 - 278.38)
test date	LWP Rut + STD	LWP Rut + STD	LWP Rut + STD	LWP Rut + STD
*96	41	39	39	34
#96	43	42	40	43
97	54	54	54	54
98	56	56	59	58
00	49	48	52	50
02	53	51	55	53

*96 Day after construction
#96 Two weeks after construction

Current rut depths are essentially the same for all four mix types, but the SMA mixes had the least increase in rut depth from the initial measurements. The friction values are equivalent and indicate good skid resistance.

The test sections of SMA and F-mixes so far have similar rut resistance, but SMA has an advantage over the open-graded mix when used in snow zones. Because of its smoother surface texture and rich asphalt matrix SMA is less susceptible to snow plow damage. It is also easier to maintain and patch when compared to the open-graded mix.

In 2000, based in part on the successful SMA trial sections on I-5, the first ODOT full-size project was paved using SMA. A section of aging asphalt pavement on I-84 in Eastern Oregon was replaced with 150mm of dense graded mix followed by a 50mm thick SMA lift for the wearing surface. Three additional I-84 projects were paved with SMA in 2001 and 2002. The four projects totaled about 20 miles of paving between Baker City and Ontario and 5 miles paved just east of Portland. To date the SMA pavements have performed very well. After an initial learning period by both ODOT personnel and the contractor involved, the paving of SMA has generally gone smoothly.

In the summer of 2003, ODOT will use another 147,735 tons of SMA to overlay approximately 26 miles of structurally deficient concrete on I-84 near Pendleton and La Grande. The concrete in these sections was placed in the late 1960's and early 1970's and has supported millions of truck loads. The concrete is showing signs of damage from the years of heavy pounding and a four-inch overlay was designed to provide additional structural support and create a new wearing surface. SMA was selected for the wearing course because of its ability to resist the rutting caused by the large numbers of heavy trucks using the road in hot weather.

For the immediate future ODOT plans to use SMA for a few projects each year where its benefits are expected to outweigh the higher cost of the mix. Performance of existing SMA projects will continue to be evaluated.

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