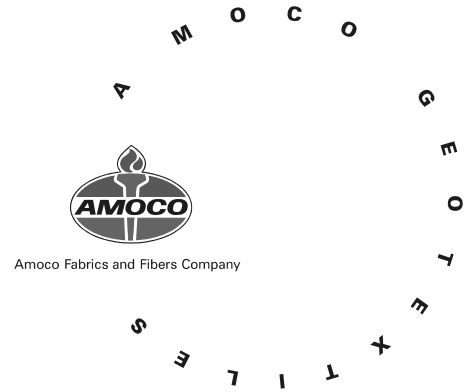


Petromat Use Over Asphalt Concrete Pavements

Case History # 10



In 1997, Maxim Technologies, Inc. performed the most comprehensive study to date documenting the performance of paving fabrics. The Study included an exhaustive review of available research and field performance reports. One major application of paving fabric membrane interlayer systems is in pavement rehabilitation over existing asphalt concrete (AC) pavements and beneath a new AC overlay. This case history contains excerpts from the Maxim Study and a compilation of briefly described case histories of thirty sites where the paving fabric system was evaluated over AC pavements. The full study, including an executive summary on the findings, may be viewed on the Geosynthetic Materials Association (GMA) web site at: www.gmanow.com/techdoc/doc2.html/doc2_ltoc.html.

The application of paving fabrics in the rehabilitation of existing AC pavements was evaluated at the thirty sites identified in Table 1. The twenty one sites within the United States are located within eleven states and the remaining international sites are located in South Africa, France, Germany, Spain, Belgium, and Austria. Almost half (i.e. 13) of the sites were evaluated for more than 5 years and only two of the sites were observed for 10 or more years. Table 1 shows that almost all of the case studies (26 out of 30) found that the use of a paving fabric in the rehabilitation of AC pavements resulted in a significant retardation in the development of reflection cracking. In the four case studies that indicated no real difference in reflection cracking between control and fabric sections the sections were thin overlays of less than 1.5" and one section was exposed to one of the most severe winters on record and one section in Texas was placed on a pavement with subgrade depressions and extensive transverse, longitudinal and alligator cracking.

The results from a Texas case study (Ref. 4) and a combination of results from several other case studies (Refs. 3,20,23) provide information on improvement in performance of AC overlay of existing AC pavements which include paving fabrics. In Figure 1 the impact of AC thickness on the performance of the AC overlay without fabric, as defined by percent reflection cracking, can be observed. The AC overlays of 1.25", 1.5" and 2.0" display similar times to development for various percent reflection cracking, while AC thickness of 2.4" and 2.5" display significantly better performance in retarding reflection cracking. The greater thickness overlays (i.e. 2.4" and 2.5") demonstrate 2 to 3 times the performance of the thinner overlays (i.e. 2" and less). In addition the 1.25" and 1.5" AC overlays exhibited almost immediate reflection cracking (i.e. 10 to 20 percent in the first year), while the 2.0" and thicker AC over-

lays appear to forestall the initiation of reflection cracking for a 1 to 2 year period.

The companion AC/fabric trial sections to those AC overlay sections of Figure 1 are presented in Figure 2. It is interesting to note that the performance trends for these case studies related to reflection cracking are essentially the same regardless of the thickness of the overlying AC thickness. From the Figures it can be seen that approximately 10 percent cracking developed within 3 years, 20 percent in 3 1/2 years and 40 percent within 9 years. These numbers (from Figure 2) can be compared directly with the results for the thinner (i.e. 1.25", 1.5" and 2.0") AC overlay control trial sections (Figure 1), where 10 percent reflection cracking occurred within 1/2 to 1 1/2 years, 20 percent reflection cracking occurred within 1 to 1 1/2 years, and 40 percent reflection cracking occurred within 2 years. For instance, at a 25 percent level of reflection cracking the inclusion of fabric in AC overlays enhanced the performances of the 1.25" and 1.5" AC overlays by a factor of 3 (i.e. 4.5 years versus 1.5 years), the performance of the 2.0" AC overlay by a factor of 1.75 (i.e. 3.5 years versus 2 years) and the performance of the 2.4" AC overlay by a factor of 2.5 (i.e. 5 years versus 2 years).

In the Texas case study (Ref.4) relatively thin AC overlays (i.e. 1.25") were constructed in the Odessa, Texas area. As Figure 3 shows, when the AC overlay thickness was increased from 1.25" to 2.5" (i.e. doubled) the period of time until 25 percent of the original AC pavement cracks reflected through the AC overlay was increased from 1 1/4 years to 7 years, a significant increase in performance. In addition the inclusion of a paving fabric with a 1.25" AC overlay increased the period of time within which 25 percent reflection cracking had developed from 1 1/4 years to 4 1/2 years. Because of the similarity in the time based reflection cracking results for the 1.25" AC overlay with fabric and the 2.5" AC overlay without fabric, it can be inferred that an equivalent AC to fabric thickness of about 1 to 1.25 inches may be appropriate for the conditions similar to Odessa, Texas.

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Table 1. Literature Survey for AC Overlay with Paving Fabric on Existing AC Pavements

Site Location	Opening Date	Time Years	AC Overlay With Fabric on Existing AC Pavements
South Africa 1	Jun 1963	8.0	AC (2") overlay with fabric of existing cracked AC surface (1" AC on cement treated base) yielded 10%, 30% and 60% reflection after 4, 5 and 8 years, respectively, of heavy traffic.
Colorado 2	Aug 1971	5.0	Control section (2" AC overlay) developed 25% reflection cracking in a year and 80% reflection cracking in 5 years, while fabric developed less than 5% reflection cracking
Florida 3	Aug 1971	5.0	Control section (2" AC overlay) developed 56% cracking in three years and 100% within 4 years, while fabric section developed less than 10% in 2 years and 80% within 5 years.
Texas 4	1974	7.0	A number of sections were constructed along IH 20 between Odessa and Midland, Texas. The control section consisted of a 1.25" AC overlay. Other sections included a 2.5" AC overlay, fabric with a seal coat, and fabric with 1.25" AC overlay. The section including the fabric with an overlying seal coat performed the poorest with 75% reflection cracking occurred within 2 years. By comparison the 1.25" control section showed 40% reflection cracking in two years and more than 70% in five years. The fabric with 1.25" AC overlay displayed 5% reflection cracking within 2 years and 37.5% within 7 years. A thicker AC overlay (2.5 " AC) section exhibited about 2% reflection cracking in two years and 25% within 7 years. The similarity in performance of the section with 1.25" AC over fabric and the section with the 2.5" overlay translates into a AC / fabric replacement thickness of about 1.25" (or 0.1').
Georgia 5	Sep 1976	5.8	Control sections (1.5 " AC overlay) developed 10% cracking in 1.5 years, while the fabric sections developed 2% reflection cracking within 1.5 years and 40% within 3 .75 years.

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Table 1. Literature Survey for AC Overlay with Paving Fabric on Existing AC Pavements

Site Location	Opening Date	Time Years	AC Overlay With Fabric on Existing AC Pavements
Oklahoma 6	Oct 1976	4.0	Most control sections exhibited extensive reflection cracking, while the fabric sections displayed significantly less reflection cracking (90% reduction). Reflection cracks that showed were substantially smaller than original reflected cracks in the control sections.
Minnesota 7	Aug 1971	5.0	Control section (2" AC overlay) developed 25% reflection cracking in a year and 80% reflection cracking in 5 years, while fabric developed less than 5% reflection cracking
Oklahoma 8	Dec 1976	5.0	On IH 40, fabric and control sections were constructed with 1.5" AC overlay and a 3/4 " open graded friction course. After 6 months the control section displayed 35% reflection cracking of the transverse cracks, 0 longitudinal cracks and 0.2% of random and alligator cracking, while the two fabric sections displayed only transverse reflection cracking of 0 and 9% respectively. After a year the control section displayed 56% reflection cracking of transverse cracks, no longitudinal cracks and 8% random and alligator cracking, while the the fabric sections displayed only tranverse reflection cracking of 8 and 17% respectively. After 5 years the control section displayed 88% reflection cracking of the transverse cracks, 27% of the longitudinal cracks and 23.5% random and alligator cracking, while the fabric sections displayed tranverse reflection cracking of 34 and 37%, longitudinal reflection cracking of 19 and 27% and 1 and 14% of alligator reflection cracking. Fabric can be used as an anti-reflection cracking treatment for both alligator and random cracking, as well as for open transverse or longitudinal cracks with widths 3/8 " or less.
Colorado 9	Jul 1977	3.3	Control section (1.5 " AC overlay) developed 10% cracking in 1.25 years and 50% within 3.25 years, while fabric section developed less than 2% reflection cracking in 1.25 years and 30% within 3.25 years.

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Table 1. Literature Survey for AC Overlay with Paving Fabric on Existing AC Pavements

Site Location	Opening Date	Time Years	AC Overlay With Fabric on Existing AC Pavements
California 10	Jan 1977	10.0	Paving fabric in an AC overlay resists initial cracking for two to three years longer. The AC equivalent thickness for the fabric interlayer should be at least 0.1 foot, but may be as much as 0.15 foot in AC overlays placed to attenuate reflection cracking. The fabric interlayer is somewhat beneficial in retarding initial cracking in AC overlays of less than 0.40 feet. There is little if any benefit of fabric for overlays of 0.40 feet or greater.
Colorado 11	Aug 1977	3.5	Control section (1.5 " AC overlay) developed 50% cracking in 1.5 years and 75% within 2.5 years, while fabric section developed less than 5% in 1.5 years and 40% in 2.5 years
Massachusetts 12	Oct 1977	3.8	Control section (2 " AC overlay) developed 42% cracking in 1.75 years and 54% within 3.25 years, while the fabric section developed 38% reflection cracking in 1.75 years and 67% within 3.75 years.
Georgia 13	Oct 1977	3.8	Control sections (1.5" AC overlay) developed 9% cracking in 3.75 years, while the fabric sections developed less than 10% reflection cracking in 3/4 year and 50% in 3.75 years.
Oklahoma 14	Jun 1978	4.0	Fabric was evaluated in stage construction of a new highway. After 4 years the control sections displayed longitudinal cracking and wheel path cracking in the driving lane, but no evidence of cracking in the passing lane. The fabric reinforced section was reported in excellent condition with no distress in either lane.
Raton, New Mexico 15	Nov 1978	4.9	Project consisted of four control sections (one with a 4 " AC overlay and three with 2.5" AC overlay) and two fabric sections (with 2" overlays). There was no reflective cracking in either the fabric or control sections for the initial three years. After 5 years the 4 " AC overlay control sections displayed 39% reflection cracking, the three 2.5 " AC control sections displayed an average of 23 % reflection cracking, while the two fabric reinforced sections displayed 27 to 28 % reflection cracking.

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Table 1. Literature Survey for AC Overlay with Paving Fabric on Existing AC Pavements

Site Location	Opening Date	Time Years	AC Overlay With Fabric on Existing AC Pavements
Clines Corner, New Mexico 16		5.1	Project included one control section (with 5.5 " AC overlay) and two fabric sections (with 5.5" AC overlays and fabric). Reflective cracking was not observed in either the fabric or control sections for the first two years. Within years two and three no reflection cracking was observed in the fabric sections; however, 14.6% reflection cracking developed in the control section. After 5 years the control section displayed 51% reflection cracking and the two fabric reinforced sections displayed 22 to 30% reflection cracking.
Truth or Consequences 17		4.2	Project included one control section (with 2 " AC overlay) and two fabric sections (2" AC overlays with fabric). The existing pavement displayed 0 alligator cracking but numerous transverse cracking with widths between 1/4 " and 1" which extended to depths of about 8". During construction these cracks were not completely filled. As a result reflective cracking was observed within the first five months in the fabric sections (i.e. 5% and 12% reflection cracking) and control section (i.e. 42% reflection cracking). Within a year and a half 61% reflection cracking was observed in the control section while an average of 38.6% reflection cracking developed in the fabric sections. After 4.2 years the control section displayed 100% reflection cracking, while two fabric reinforced sections
Ozona, Texas 18	1979	8.0	Project involved installation of 1.75" AC overlays of an existing AC pavement (i.e. 3" AC) which showed subgrade depressions and extensive transverse, longitudinal and alligator cracking in the east bound travel lane, but minimal cracking in the west bound lane. No reflection cracking was observed in the west bound lane during the initial two and a half years but increased to 39 and 60% by the eighth year. Reflection cracking in the east bound lane was less than 25% by the eighth year. The fabric sections performed little better than the control section.

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Table 1. Literature Survey for AC Overlay with Paving Fabric on Existing AC Pavements

Site Location	Opening Date	Time Years	AC Overlay With Fabric on Existing AC Pavements
Amarillo, Texas 19	Sep 1979	9.0	The project involved installation of 1.25" AC overlays of an existing AC pavement (4" AC). The existing pavement conditions were not known. Reflection cracking was observed in both east and west bound lanes within a year. The performance of the control section in the West bound lane was better than the fabric sections, while the fabric sections performed marginally better than the control section in the East bound lane. It appears that even after cracks appear the fabric still acts as a moisture barrier.
Mississippi 20	May 1980	4.0	Control section (1.5 inch overlay) developed 30% cracking in two years and 80% within 4 years, while fabric section developed less than 5% in 2 years and 20% within 4 years
Washington 21	May 1980	4.0	Control section (1.8 inch overlay) developed 30% cracking in 3 years and 90% within 4 years, while fabric section developed less than 8% in 3 years and 90% in 2.5 years. The winter between the third and fourth years was one of coldest in history. The cracks were tighter in the fabric sections.
Oklahoma 22	1981	5.0	Retards reflection of block and alligator cracking; reflected transverse cracks were small in size. Reduction of AC thickness with fabric application is 1 inch.
France 23	Jun 1982	10.0	After 2.5 years the control (non fabric) section displayed 30% reflection cracking, while the fabric section displayed 10% reflection cracking. After 6 years reflection cracking in the control and fabric sections totalled 51% and 30%, respectively. After 10 years the control section exhibited 65% reflection cracking, while the fabric section showed 40% reflection cracking.
Belgium 24	Mar 1987	6.0	After 6 years no cracks appeared in the fabric section. Large cracks which developed in the non fabric sections stopped at the edge of the fabric sections.

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Table 1. Literature Survey for AC Overlay with Paving Fabric on Existing AC Pavements

Site Location	Opening Date	Time Years	AC Overlay With Fabric on Existing AC Pavements
Spain 25	Jan 1988	4.0	At 3 years the fabric sections displayed no cracks, while non fabric sections displayed deflection cracking.
Belgium 26	Oct 1988	4.0	No cracks in fabric sections while cracks observed in non fabric sections.
France 27	Oct 1988	4.0	10 % reflection of existing cracks as fine cracks.
Belgium 28	Oct 1988	4.0	After 4 years 0 cracks were observed in the fabric sections, while cracks appeared in the non-fabric sections.
Germany 29	Sept 1989	2.8	No cracks observed in fabric sections.
Belgium 30	Sept 1989	2.8	No cracks observed in fabric sections.

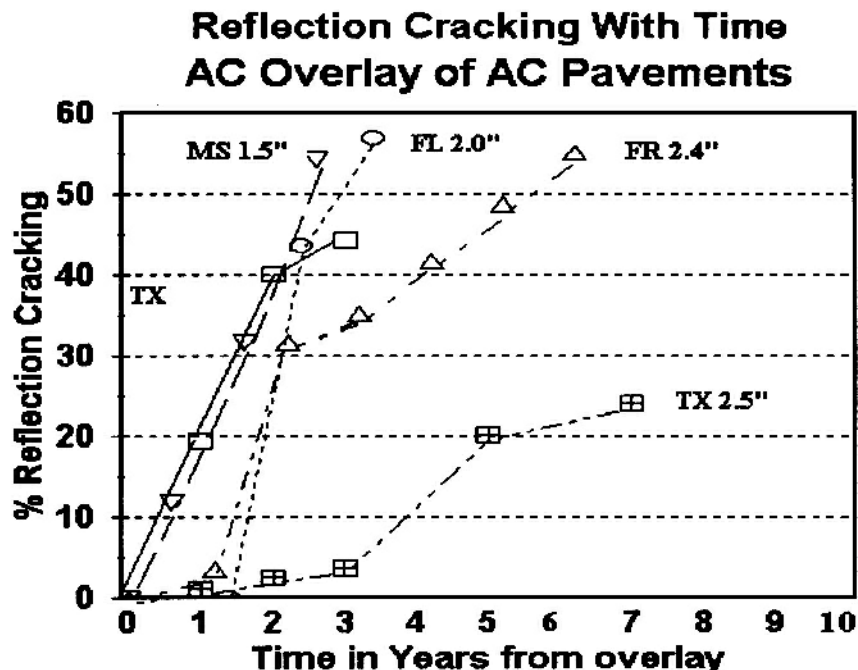


Figure I. A Overlay of AC Pavements- Various Case Studies (Refs. 3,4,20,23)

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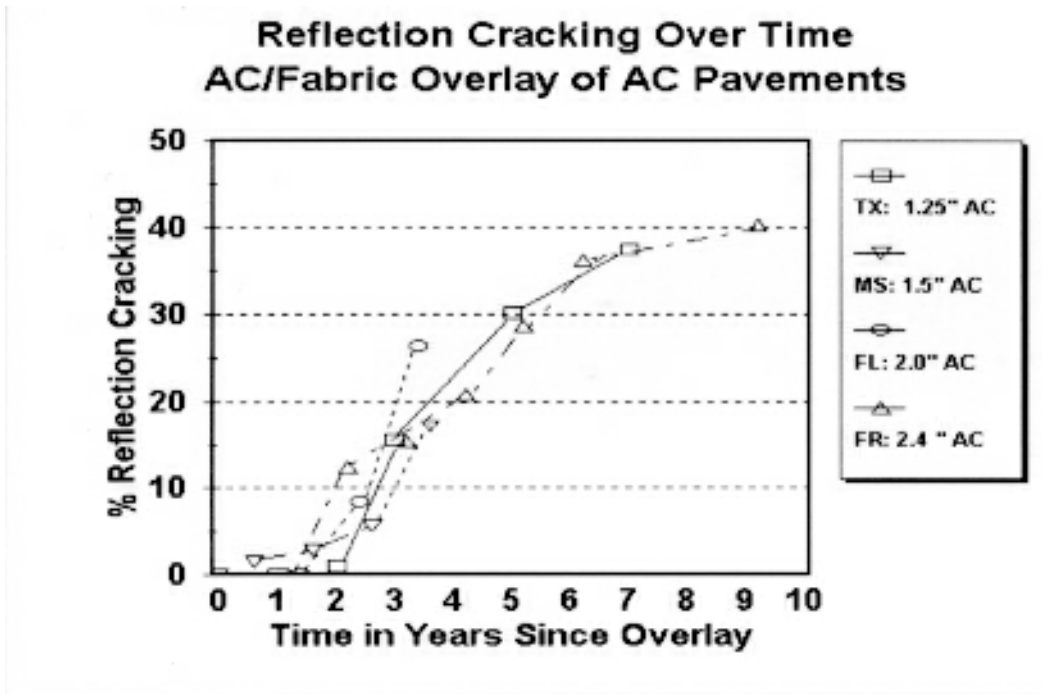


Figure 2. AC/Fabric Overlay of Existing AC Pavements- Various Case Studies (Ref. 3,4,20,23)

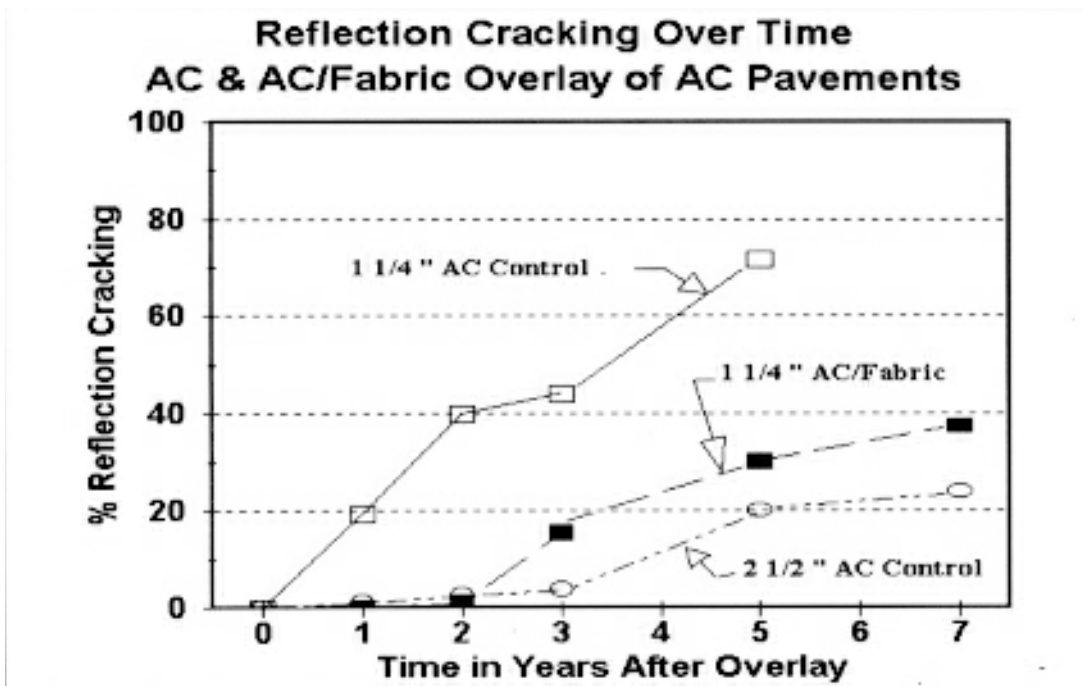


Figure 3. AC and AC/Fabric Overlay of AC Pavements - Odessa, Texas Case Study (Ref.4)