Cracking and Seating of Concrete Pavement on I-74 Part I

J. J. Sudol
Research Manager
Division of Research and Training, IDOH

The desire to eliminate, or at least reduce, reflection cracking has always been an obsession with highway engineers ever since asphalt was first used to overlay concrete. Over the years many crack reduction techniques were tried with only limited success. Most of these efforts did manage to delay the development of reflection cracking. Sometimes this delay was prematurely reported as a successful crack reduction technique and aroused some excitement. If such delays in crack development were spread over the whole life of the overlay, this would be all right, but most of the time the bulk of cracks reflect within four to five years, despite any crack reduction measures one can take. The general view is that if crack reflection is delayed during the initial two or three years of overlay life, it is likely that cracks may emerge with a vengeance during the fourth and fifth years.

One of the most effective reflection crack control techniques is adding more asphalt to the base and binder mixtures. This is still being used by some states and can be used on low volume roads. However, due to the high volume of traffic that we have on our interstates, we have to reduce the asphalt content. This has the tendency to bring on even more reflection cracks sooner. This is the past history—new approaches may be more successful.

One of the newest techniques of crack control, that has gained considerable popularity, in the last few years, is a method called "Cracking and Seating". It's not busting and seating, or breaking and seating; it's definitely cracking and seating. Kentucky calls it fracturing and seating and they seem to be getting by. Incidently, Kentucky likes their cracking and seating so much that they are going to crack and seat their bridges next.

The procedure involves cracking the concrete pavement with a heavy impact hammer into approximately 2-ft squares. It's really a way of making flexible pavement out of concrete pavement. On the assumption that the pavement contains voids underneath, it is then rolled with a 50-ton roller to obtain seating.

Many states are doing this, but the unofficial leaders in our area are Kentucky and Wisconsin. Last year these two states cracked and seated and overlayed over 100 miles of concrete pavement using this procedure.

Not to be outdone, last year we awarded 12.4 miles of I-74 for cracking and seating. This contract runs through Boone, Hendricks and Montgomery Counties. The project is strictly experimental. Its prime objective is to find out what thickness of overlay works best over the cracked and seated pavement. What thickness of overlay to use on our cracked and seated pavement became an immediate question as soon as we started planning the I-74 job. Most of the states that were doing this kind of work said they were placing less overlay thickness on their cracked and seated pavements than we were on our uncracked pavements.

Some adjoining states were experimenting with overlay thickness as high as 7 in. The advice that we got was that after cracking and seating we still could overlay it with our customary 4 ½ in. without any trouble. We finally decided on four different thicknesses of overlay on our I-74 experiment:

1. We have a control section where we undersealed the pavement but we didn't crack it. Here we overlayed it with our customary 4 ½ in. We are using this section to compare crack development on the other cracked and seated sections.
2. We have a section that was not undersealed but was cracked and seated and then overlayed with 5 in. of bituminous mix. In view of what we have learned since then, this section might give us trouble.
3. We have a third section which also was not undersealed but was cracked and seated only. This we overlayed with 6 ½ in. of bituminous mix.
4. On our fourth section, as before, we also did not underseal it but only cracked and seated it. On this section we went hog-wild and overlayed it with 8 ½ in. of hot mix.

To complicate things, after the job got started, we added polymeric fibers to the hot mix on one of our control sections and to one cracked and seated section with the 5-in. overlay. The fibers were put into base and binder but not the surface. The decision to test the fiber mix on the contract was prompted by some very promising indication on a short experimental section, on I-65, near Lafayette. Here the fibers appeared to impart a high degree of stability to the hot mix—helping it to resist deterioration and rutting. When this contract on I-74 is completed, our Research Division will be evaluating its performance annually for the next five years.

We did learn something during the production of hot mix for this I-74 job. It seems that using fibers in the mix reduced segregation in

a drum mix plant. The mix also looked noticeably more uniform on the road. We had some problems cracking the pavement on I-74—see the following paper by Tom Spessard.

During the cracking and seating operation our research section had a dynaflect on the job testing the pavement before and after cracking as well as after seating. We got a lot of good data and they indicate that the cracking by itself causes the pavement to lose from 30 to 50% of its original strength. We checked with the other states on this. They indicate that this loss in strength is well within the criteria for a well cracked pavement. If this loss is not obtained, experts in the field indicate the pavement is not adequately cracked.

On the seating side, our data indicate that rolling with the 50-ton roller in most instances did not improve the seating of the cracked pavement. In fact if rolling was continued beyond three passes, a loss of seating occurred. Because this was an experiment we had to roll it, but a maximum of three passes was established to prevent possible damage. Other states, it seems, do not monitor seating after rolling so we were not able to determine what they consider as adequate seating. Based on our division's experience with testing for undersealing, we feel that we can say, with some assurance, that on this particular contract the seating operation was ineffectual and very likely could have been omitted without causing any harm to the quality of the job. On the other hand, had we not monitored it and rolled the pavement with more than three passes, we could have done some damage due to unseating of the pieces.

We don't know why the cracked pavement becomes unseated by the roller. Perhaps the heavy blow of the hammer deforms the subbase and subgrade underneath. Or because the pavement on I-74 seemed to be in compression during the whole operation, the cracking permitted some of the short sections to lift off the subbase due to buckling. My feeling is that because the pavement was faily well seated to start with, the roller could not do much to improve it.

Whether the same seating situation will materialize on our future cracking and seating jobs remains to be seen. If we do a job like this again, it may be worthwhile to determine at the start if seating can be improved by rolling. If not, we could save ourselves some money and omit this part of the operation. In any event I feel that the seating operation should be monitored with the dynaflect so that the cracked pavement is not damaged by excessive rolling.

What is showing up on the horizon with respect to cracking and seating in other states? My sources indicate that there is some heavy re-thinking going on. By telling this, don't think that I'm pouring cold water on the procedure. Some of my conclusions are as follows:

1. It appears that some previously active states are holding back on cracking and seating. Early successes led to high expecta-

tions which did not always materialize. An assessment appears to be taking place.

2. On the overlay thickness side, a minimum of 7 in. is being considered. The thinner overlays in many instances are not performing well. No one that I talked to is recommending thin overlays now. The feeling is that cracking and seating should be considered as the last alternative before complete removal.
3. Another message that I'm getting is that only the roads that have good subgrade and drainage should be considered as candidates for cracking and seating. On I-74 we have excellent drainage, so this is not a problem.
4. And finally again, I'll throw in what we have learned so far—and that is that one should question the effectiveness of the seating operation and don't let it go on unmonitored.