

Similarly, in the case of the SPS-5 datum points, the slope of the best-fit line is 0.20. The null hypothesis (that the slope is zero) is rejected with 95% confidence, because the calculated  $F$ -value of 17.74 exceeds 3.92, the upper 5% of an  $F$ -distribution with 1 and 124 degrees of freedom. Furthermore, an  $F$ -test of the relationship of the initial postoverlay IRI to the preoverlay IRI was conducted for every individual overlay treatment within the SPS-5 experiment, and the relationship was found to be statistically significant in every case.

These results suggest that flexible pavements overlaid when they are rougher tend to have a somewhat higher initial roughness with the overlay than pavements overlaid when they are smoother. No significant differences in initial postoverlay IRIs were detected among the different SPS-5 overlay treatments.

### Long-Term Effects on Roughness

The first step in the analysis of long-term treatment effects involves testing for significant effects by treatment type, while holding age, traffic, climate, and so forth constant. This is done by selected multiple comparisons. Rather than compare the means for many sections within different treatment groups, one analyzes the mean difference between specific groups of test sections. Paired-difference tests are used to determine which if any of those mean differences are significantly different from zero. This prevents the within-treatment (i.e., site-to-site) variation from masking significant between-treatment differences.

The design of the SPS-5 experiment (Table 1) makes possible the following interesting comparisons of long-term performance:

- No overlay (Section 501 or linked GPS) versus overlay (Sections 502 through 509);
- Recycled (Sections 502, 503, 508, and 509) versus virgin (Sections 504, 505, 506, and 507) overlay mixes;
- Minimal (Sections 502, 503, 504, and 505) versus intensive (Sections 506, 507, 508, and 509) preparation; and
- A 2-in. (Sections 502, 505, 506, and 509) versus a 5-in. (Sections 503, 504, 507, and 508) overlay thickness.

Because there are four comparisons of interest, the significance level,  $\alpha$ , used for each individual comparison should be selected so that  $(1 - \alpha)^4$  is equal to the desired overall level of confidence. For four comparisons to yield a 95% overall level of confidence, the required  $\alpha$  is 0.01274.

The long-term effect of each rehabilitation treatment on roughness is analyzed by using IRIs obtained from the most recent profile measurements. The IRI data available for these analyses covered a range of time from 2.6 to 10.8 years, with an average of 7.8 years.

### Overlay Rehabilitation Versus No Rehabilitation

The long-term effect of overlay versus no overlay on IRI was analyzed by evaluating the means for 80 pairs of IRI measurements: the control versus each of the eight treatments at 10 sites for which control section IRI data were available. In nearly every case, the control IRI was greater than the overlay IRI, and the mean difference was significant. These results indicate that over the time period that the data cover, the overlaid sections performed better than the nonoverlaid control sections in terms of IRI, as one might expect.

### Recycled Versus Virgin Overlay Mix

The long-term effect of recycled versus virgin asphalt overlay mixes on IRI was analyzed by evaluating the means for 69 available pairs of IRI measurements. At each site, the difference in IRIs was calculated for each of the following pairs of sections:

- 2-in. overlays with minimal preparation, recycled (Section 502) versus virgin (Section 505) mix;
- 5-in. overlays with minimal preparation, recycled (Section 504) versus virgin (Section 503) mix;
- 2-in. overlays with intensive preparation, recycled (Section 509) versus virgin (Section 506) mix; and
- 5-in. overlays with intensive preparation, recycled (Section 508) versus virgin (Section 507) mix.

The results indicate that over the time period that the data cover, there was no significant difference overall in the performance of recycled mixes versus that of virgin mixes for IRI. At higher IRIs, there was a very slight tendency for virgin mixes to perform better than recycled mixes.

### Minimal Versus Intensive Preoverlay Preparation

The long-term effect of minimal versus intensive preoverlay preparation on IRI was analyzed by evaluating the means for 70 available pairs of IRI measurements. At each site, the difference in IRI was calculated for each of the following pairs of sections:

- 2-in. overlays with virgin mixes, minimal (Section 505) versus intensive (Section 506) preparation;
- 2-in. overlays with recycled mixes, minimal (Section 502) versus intensive (Section 509) preparation;
- 5-in. overlays with virgin mixes, minimal (Section 504) versus intensive (Section 507) preparation; and
- 5-in. overlays with recycled mixes, minimal (Section 503) versus intensive (Section 508) preparation.

The results indicate that over the time period that the data cover, there was no significant difference overall in the performance, for IRI, of overlays with minimal preoverlay preparation versus that of overlays with intensive preoverlay preparation. At higher IRI levels, there was a very slight tendency for overlays with minimal preparation to perform better than overlays with intensive preparation.

### A 2-in. Versus a 5-in. Overlay Thickness

The long-term effect of overlay thickness on IRI was analyzed by evaluating the means for 70 available pairs of IRI measurements. At each site, the difference in IRIs was calculated for each of the following pairs of sections:

- Virgin mixes with minimal preparation, 2-in. (Section 505) versus 5-in. (Section 504) overlay thickness;
- Recycled mixes with minimal preparation, 2-in. (Section 502) versus 5-in. (Section 503) overlay thickness;
- Virgin mixes with intensive preparation, 2-in. (Section 506) versus 5-in. (Section 507) overlay thickness; and
- Recycled mixes with intensive preparation, 2-in. (Section 509) versus 5-in. (Section 508) overlay thickness.