

PRESENT SERVICEABILITY RATING AND PRESENT SERVICEABILITY INDEX CONCEPTS

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The purpose of this presentation is to review concepts that are associated with the present serviceability rating (PSR) and the present serviceability index (PSI). In his opening remarks, Carey introduced philosophical and practical considerations for these concepts. I shall discuss the concepts from an analytical point of view. There is, of course, much overlap among the philosophical, analytical, and practical aspects of PSR-PSI concepts. I have separated my remarks into topics that start with general considerations in experimental research and then progress through the conceptual and analytical steps that were taken at the AASHO Road Test.

EXPERIMENTAL PAVEMENT RESEARCH

If research by experiment is to be successful, it is necessary to have clear-cut objectives for the experiment and to have a sound experiment design for the experimental units, their treatments, and their observation. It is also necessary to analyze the observations in ways that are consistent with the experiment design and objectives. It is not a simple matter to maintain consistency among objectives, design, and analysis. At the very least, the experiment design should provide an appropriate basis for determining relations that are implied by the objectives and that can be expressed as effects of the design factors on the observed variables.

Road tests are one form of experimental pavement research in which the general objectives are to learn how pavement behavior depends on built-in pavement characteristics and/or external influences such as environmental conditions and loading factors. In these terms the experimental units are test sections. Treatments are those factors that describe how test sections are constructed and subjected to environmental and loading conditions. Pavement behavior is a response, or a combination of responses, of test sections to treatments that have been applied.

In a road test it is possible to define a large number of variables that describe elements of pavement behavior, and for each variable there may be several alternative measurement systems. At the AASHO Road Test many individual elements of behavior were observed and analyzed with respect to the design factors. In addition, it was clearly desirable to define, observe, and analyze pavement performance as a "supervariable" that could represent the overall response of a test section to its treatment.

PAVEMENT PERFORMANCE

It was decided that pavement performance should indicate the amount of traffic carried at an acceptable level of service. When more specifically formulated, pavement performance becomes a "supervariable" for the external behavior of a pavement section and can therefore be analyzed with respect to experiment design factors.

PRESENT SERVICEABILITY

The concept of pavement performance implies that, from the viewpoint of a perceptive user, a pavement provides a particular level of service at any point in time. Thus the concept of pavement performance leads to the concept of present serviceability.

PRESENT SERVICEABILITY RATINGS

If the concept of present serviceability is to be useful for describing pavement performance, then users can presumably discern various levels of serviceability among pavements whose physical conditions cover the full spectrum of interest. The PSR of a pavement is a user's judgment of the level of service that a particular pavement provides at a point in time.

In the AASHO Road Test studies, raters were asked to judge present serviceability in 1 of 5 categories: 4.0 to 5.0, very good; 3.0 to 4.0, good; 2.0 to 3.0, fair; 1.0 to 2.0, poor; or 0.0 to 1.0, very poor.

It was found that the average PSR given by a panel of raters was reproducible within and among various panels. The next question was whether and how PSR was correlated with objective measures of pavement condition.

PRESENT SERVICEABILITY CORRELATES

Candidates for correlation with PSR include only those variables whose variations can be sensed by the present serviceability raters. Thus the list of potential correlates includes surface irregularities and defects that can be measured in terms of longitudinal and transverse profiles, cracking, spalling, faulting, and so forth.

There are also many alternative PSR correlates for longitudinal profiles, ranging from surface elevations and their derivatives to measurement system values for the integrated roughness of a given length of pavement.

PRESENT SERVICEABILITY INDEXES

A PSI was defined to be an algebraic function of PSR correlates. Moreover, the PSI concept incorporated the view that coefficients in the function should be determined through multiple regression analysis of the form $Y = A_0 + A_1 X_1 + A_2 X_2 + \dots + E$, where Y is an average PSR for a pavement section; X_1, X_2 are PSR correlates; $A_0 + A_1 X_1 + A_2 X_2 + \dots$ is a PSI determined by the regression analysis; and E is a discrepancy between the PSR and the PSI. In other words, $PSR = PSI + E$. Multiple regression procedures were used to find the set of correlates (X_1, X_2, \dots) that minimized the sum of E^2 and that excluded correlates that did not contribute significantly to the goodness of fit provided by those correlates that were included.

PRESENT SERVICEABILITY HISTORIES

A PSI value relates to only one point in time and is not in itself a measure of pavement performance. If PSI values for a particular pavement are plotted against time, however, it becomes possible to see (or to project) the period of time during which the pavement provided (or will provide) acceptable service, regardless of the serviceability level that is selected as being acceptable.

PAVEMENT PERFORMANCE INDEXES

The serviceability-time history of a pavement is necessary but not sufficient for determining pavement performance because the performance concept includes the amount of traffic that has been served.

The major performance index used to analyze AASHO Road Test data was $\log N_p$, where N was the number of axle loads of a given weight that the pavement carried at a serviceability level greater than p .

ANALYSIS OF PERFORMANCE DATA

The biweekly measurement program at the AASHO Road Test produced serviceability data for each test section. From these data a PSI was computed, and a PSI history was thus maintained. At the end of the test, performance indexes were computed (or extrapolated) for $p = 2.5$ and 1.5 .

Finally, the performance index values were analyzed for their relation with pavement design factors and loading factors.

CONCLUDING REMARKS

The main objective of the AASHO Road Test was to determine how pavement performance depends on pavement design factors such as thickness and on loading factors such as axle load and axle spacing. In this presentation we have tried to show how performance was defined and evaluated through the concepts of PSR's and PSI's.

The measurement of surface profile was a dominant element for the implementation of all these concepts. We are therefore pleased to see the continued interest and concern that this workshop shows for the evaluation of surface profiles and pavement serviceability.