Use of Pavement Evaluation Techniques in Maintenance Management

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Pavement evaluation techniques have important applications in maintenance management. In the determination of present conditions and remaining service life in important pavement systems, managers can eliminate the problems associated with subjective ratings and accomplish management planning on a sound technical basis. Also the ability to determine the future date or dates when major pavement rehabilitation will be required, permits management to accomplish optimum scheduling of the rehabilitation work and of interim maintenance measures as well.

Obviously, this type of evaluation has particular application on important arterial routes and major highway networks such as the Interstate System. It also has proved to be a valuable tool in maintenance programming on a number of major toll road systems throughout the northeast.

PRESENT SERVICEABILITY INDEX

Essentially, the pavement evaluation techniques consist of utilizing the Present Serviceability Index (PSI) concepts and pavement performance curves developed during the AASHO Road Test at Ottawa, Illinois. The PSI is a measure of a pavement's momentary ability to serve traffic. The PSI concept was developed to monitor the effect of axle-load applications on a variety of pavement designs. A pavement serviceability rating panel was appointed to make a subjective judgment of the ability of 138 different pavement sections to service traffic. The panel's judgment was indicated by a rating value ranging from 0 to 5 with adjective designations of very poor (0-1), poor (1-2), fair (2-3), good (3-4), and very good (4-5). AASHO personnel then measured variations in longitudinal and transverse profiles as well as the amount of cracking and patching on each of the pavement sections. Using mathematical analyses, these quantitative measures were related to the mean rating value as established by the rating panel to produce an equation to predict a quantitative counterpart of the mean rating value.

SURVEYS AND ANALYSES

A number of devices are available to measure the pavement profile. A profile measurement system developed at the AASHO Road Test employed the Chloe profilometer. A number of states have acquired this instrument. Its major limitation is in its slow operating speed (±5 mph) and sensitivity to moisture and temperature changes. A more practical instrument for general field operation is the BPR-type road roughness indicator, which measures the accumulated inches of roughness while traveling over the pavement surface at 20 mph. Our firm has purchased a road roughness indicator and is currently using this instrument in pavement evaluation studies.

To establish the PSI of a pavement it is necessary to conduct a survey of the pavement roughness using the road roughness indicator or an alternative instrument and to conduct a visual survey of the patching and cracking conditions on the pavement surfaec.

The roughness survey records the surface deformation resulting from effect of traffic loads, age and environment. This phase of the field survey consists of taking measurements to determine the rideability of the pavement surface recorded in inches of roughness per mile of roadway. The BPR-type road roughness indicator consists of a single test wheel mounted on a towing frame with two single-leaf springs and precision damping devices. As it is towed along the wheelpath of the roadway, the wheel deflects with respect to the towing frame in proportion to the roughness of the road.

Figure 1. BPR-type, road roughness indicator, Model CT-444.

Figure 2. Roghometer test wheel is towed in the outside lane to record most severe condition.

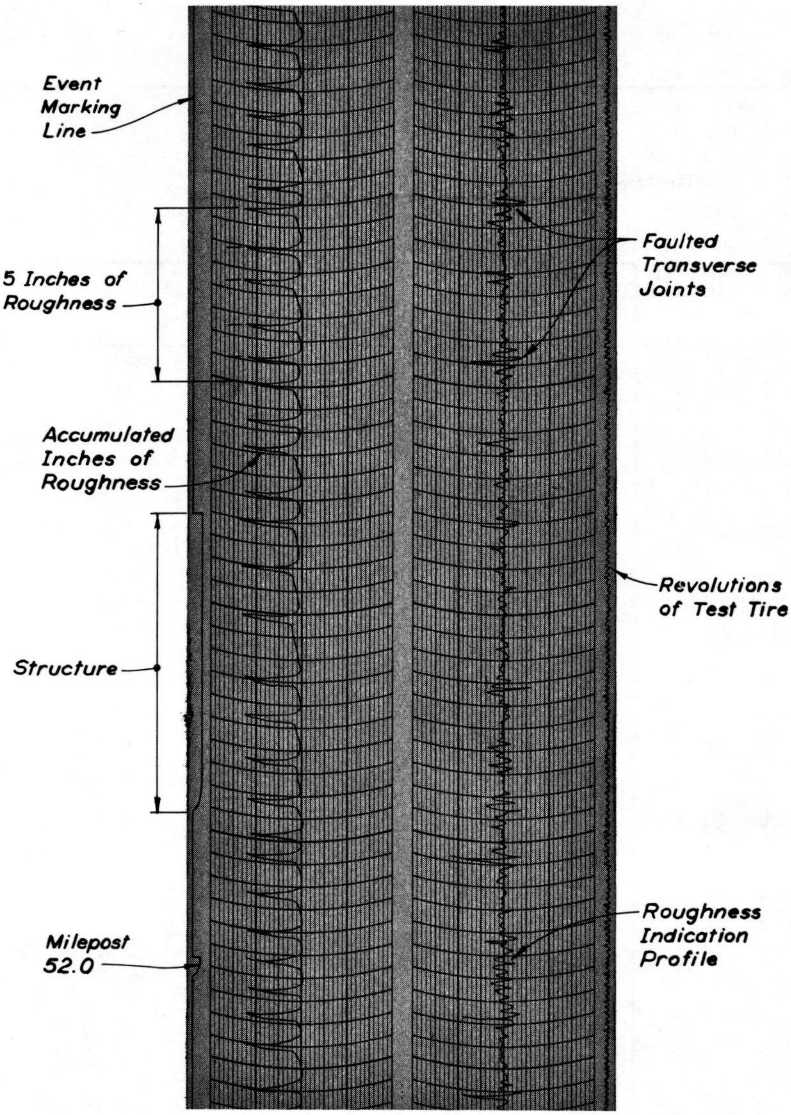


Figure 3. Continuous tape record of pavement roughness survey, electronically registered by road roughness indicator.

The total downward movement recorded in inches per mile of roadway represents the roughness index. The downward movement is electronically recorded on the instruments contained in the towing vehicle. These instruments also provide an accumulative record of the inches of roughness to one 1000th of an inch and a continuous profile of the roughness of the road recorded on tape.

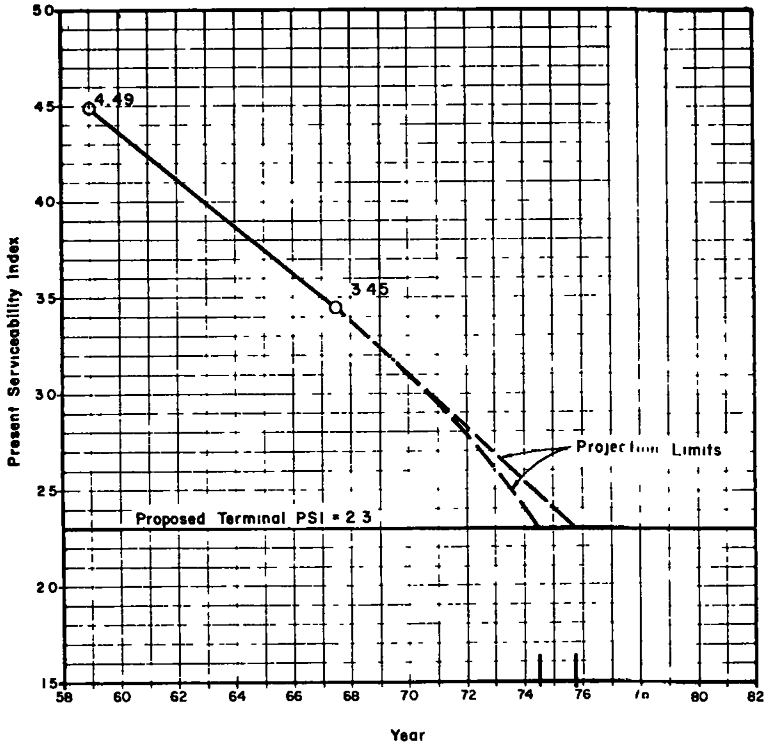
The visual survey consists of observing the pavement surface and recording the quantities of pavement deficiencies noted. While cracking and patching are the only quantitative values required to compute the PSI, it has been our practice to observe and record other conditions which could affect the structural integrity of the pavement, i.e, pumping, faulting, scaling, and other signs of disintegration of the pavement surface as well as defects in shoulders, drainage, and appurtenances. The data are recorded on special forms for each mile of mainline pavement and for each ramp or con-

NEW YORK STATE THRUWAY
1967 PSI VALUES

WESTBOUND MAINLINE

MILEPOST FROM	MILEPOST TO	STRUCTURES DIST	STRUCTURES RI	STRUCTURES PSI	TYPE	PAVEMENT DIST	PAVEMENT RI	PAVEMENT PSI	AVE PSI
114.CC	115.CC				R	1.00	116	3.12	
						1.00	116		3.12
115.CC	116.CC				R	1.00	103	3.40	
						1.00	103		3.40
116.CC	117.CC				R	1.00	106	3.33	
						1.00	106		3.33
117.00	118.CC				R	1.00	115	3.15	
						1.00	115		3.14
118.CC	119.CC				R	1.00	110	3.25	
						1.00	110		3.25
119.CC	12C.CC				R	1.00	105	3.36	
						1.00	1C5		3.35
120.CC	121.CC				R	1.00	108	3.29	
						1.00	108		3.29
121.CC	122.CC				R	1.00	115	3.15	
						1.00	115		3.14
122.CO	123.CC				R	1.00	118	3.08	
						1.00	118		3.06
123.00	124.CC				R	1.00	113	3.19	
						1.00	113		3.19
124.CC	125.CO				R	1.00	134	2.75	
						1.00	134		2.75
125.CC	125.39				R	0.39	128	2.87	
125.39	125.47	C.08	133	2.59					
125.47	126.CO				R	0.53	126	2.91	
						0.92	127		2.90
126.CC	127.CO				R	1.00	129	2.85	
						1.00	129		2.85

Figure 4. Typical print-out of pavement sections and PSI values from computer program.



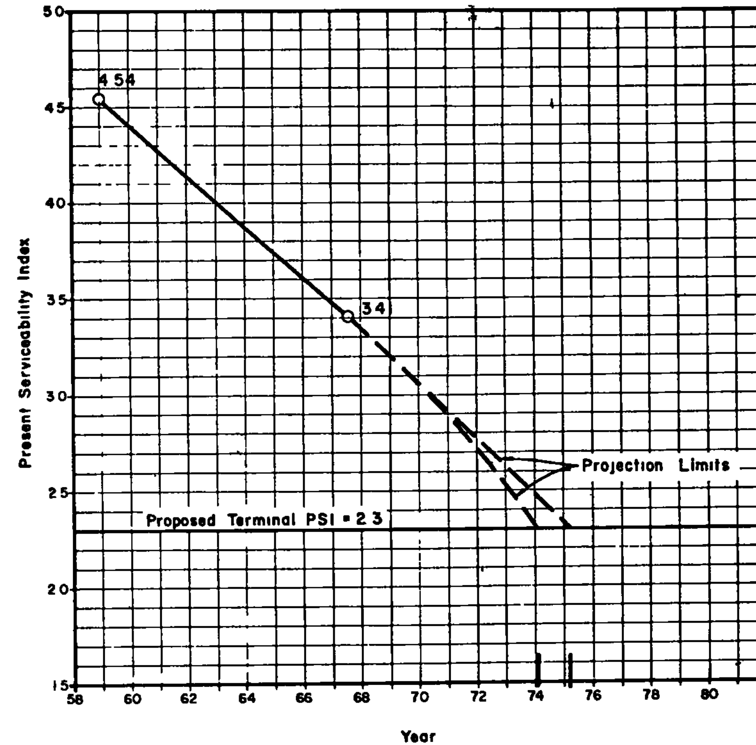


Figure 5. Typical service life curve; projection limits set by alternative future traffic growth estimates.

necting roadway for the pavement section under study. The visual survey can be conducted by a crew operating on the shoulder of the highway where a paved or graded shoulder is available. The visual survey crew consists of a vehicle driver and an observer and recorder riding perferably in the open bed of a pickup truck, traveling at an average speed of 3 to 5 miles per hour.

With the cracking and patching data in hand and the roughness index (RI) values established, the PSI values can be computed for each pavement section using the appropriate equation where the cracking factor (C) is in units of linear feet of cracking per thousand square feet of area and the patching factor (P) is in units of square feet of patching per thousand square feet of area. PSI values can be computed for each segment of highway and plotted on a bar chart to permit inspection and analysis. Generally, it has proved practical to compute PSI values for each half-mile pavement segment and then to average the PSI values over longer pavement sections so that programming of major rehabilitation work can be scheduled for significant pavement lengths.

DEVELOPMENT OF LONG-RANGE PROGRAMS

Service life curves are the graphic illustration of the loss of PSI values as a result of repeated axle-load applications and environmental influences acting over a period of time. In the AASHO Road Test analysis, equations were developed to show the loss of PSI as a result of repeated axle-load applications of a known magnitude for various pavement designs. Because the AASHO Road Test was performed over a relatively short period of time, no relationship with time and environmental factors was established. In evaluating existing pavements, many of which have been subjected to environmental influences over a number of years, it is necessary to account for that loss of service life associated with factors not related to axle loads. Our firm has developed a procedure to identify the influence of time and environment in what we refer to as a K factor. By expressing both the axle factor and the K factor in the same mathematical form, they can be incorporated into a single expression where K is used to convert time and environmental influences into equivalent axle units. For large axle-load applications, the K factor becomes insignificant. Conversely, it may become the primary factor when axle-load applications are relatively small on older pavements.

The AASHO Road Test curves plotted loss of service life against accumulated axle loads. In order to convert axle loads to time, it is necessary to perform an extensive analysis of the character and magnitude of the traffic to which the pavement has been subjected since its opening and to analyze and develop projections of traffic volumes and traffic load classifications over the service life period of the pavement. With adequate traffic information in hand, and through the computation of equivalent 18-kip axle loads for the mixed traffic flow to which the pavement is subjected, it is possible to establish a direct correlation between accumulated axle loads and calender years. Thus the service life curve can be plotted with PSI values as the ordinate and calendar years as the abscissa. The point at which the projected service life curve intersects the minimum acceptable PSI value then identifies the year in which major rehabilitation of the pavement section can be anticipated.

Service life curves can be computed for each of the pavement sections using the PSI values established by the survey as the current point on the curve. Where no prior pavement evaluation studies have been performed on a pavement section, initial PSI values must be assumed in order to determine the loss of service life associated with current values. This assumption can be based on PSI surveys on nearby newly constructed sections of pavement built to comparable standards or it may be established by a purely judgmental assignment of initial values. Obviously, the warrants for periodic PSI surveys and the establishment of additional points on the service life curves are strongly indicated if a high degree of accuracy is to be anticipated in projections of the service life curves over more than a few years in the future.

With pavement service life curves computed for each significant contiguous segment of a roadway system it is possible to identify the year in which each pavement segment can be expected to reach its minimum acceptable PSI value. Resurfacing programs can be scheduled from these data, and practice grouping of sections to provide optimum contact size, to minimize repeated traffic interruption and to balance out annual betterment programs can be accomplished.