

IOWA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
BUREAU OF OPERATION

OFFICE OF MATERIALS

DETERMINING THE LOSS OF SERVICE LIFE
ON SECONDARY ROADS OR CITY STREETS USED
FOR PRIMARY ROAD DETOURS

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The Code of Iowa in Chapter 313, Improvement of Primary Roads, Section 28 and 29 authorizes the Department of Transportation to establish temporary primary road detours. These secondary roads or city streets are designated as temporary primary road detours for the purpose of establishing, constructing, or maintaining a primary road. Prior to revoking this designation, it is the responsibility of the Department of Transportation, Highway Division, to:

- 1) Restore the secondary road to as good condition as it was prior to the detour, or
- 2) Determine the amount which will adequately compensate the county for the excessive traffic, or
- 3) Reconstruct the road if this is the only way to restore the road to its original condition

The subject of this paper, determining the loss of service life, is a necessary determination to calculate the compensation in responsibility no. 2 above.

STEPS TO DESIGNATE A DETOUR

To better understand temporary primary road detours, a study of the D.O.T. procedures to establish and complete a detour is needed. Once it has been determined a detour may be necessary, the following steps are taken:

1. The Design Department furnishes the District with a cost estimate of building the project under traffic.
2. The District investigates possible detour routes and prepares a structural analysis of the secondary roads or city streets that are being considered.
3. The District may request a Road User Benefit Analysis on all detour routes being considered, including primary roads.
4. Considering all costs of various alternates, the District prepares a report and recommends detour routing to the Central Maintenance Department. Final determination is made; and if secondary roads or city streets are used, agreements are needed.
5. The District negotiates agreements with the counties and/or cities, and signed agreements are presented by the Maintenance Department to the Commission for approval.
6. Upon approval of a detour involving secondary roads or city streets, the Maintenance Department informs the Central Materials Department of need for a Present Serviceability Index Study.
7. The Commission Order establishing a detour will trigger the development of a signing layout by the Safety and Traffic Department. This department will prepare the layout and send copies to the Resident Maintenance Engineer for review.
8. Approximately two (2) to three (3) weeks prior to traffic being detoured, the Resident Construction Engineer will notify the Materials Department so a P.S.I. can be run.
9. When a Resident Construction Engineer requests a P.S.I. survey from the Materials Department, a copy will be sent to the

Resident Maintenance Engineer. This will initiate a review of the route by the Resident Maintenance Engineer and County or City Engineer. The Resident Maintenance Engineer will make a report to the District Maintenance Engineer on pre-detour maintenance necessary. If this includes traffic line painting, the District Maintenance Engineer will schedule work.

10. The Resident Construction Engineer will coordinate with the Resident Maintenance Engineer when the actual detour will be established.
11. While the detour is in operation it is considered a primary road; therefore, during its operation the Resident Maintenance Engineer will maintain it to the same standards as any other primary road.
12. When the Resident Construction Engineer considers the project complete to the extent it could be open to traffic, he will notify the District Construction Engineer.
13. After the detour is removed, the Resident Maintenance Engineer will review the detour route with the County or City Engineer to determine if any additional maintenance is needed by state forces. This work should be done before final P.S I. readings are taken. When repairs have been made, the Resident Maintenance Engineer will notify the District Office, and the District Office will request final P.S.I.
14. The Maintenance Department will analyze the P.S.I. study and prepare a report for the District.
15. The District, using the Maintenance report, will negotiate with the County or City on damages due them because of the detour use.

PRESENT SERVICEABILITY INDEX DEFINED

Steps 8 and 13 of this procedure involve the Central Materials Department completing a Present Serviceability Index Study. The PSI concept was developed by the AASHO Road Test at Ottawa, Ill. in 1960. It is an objective means of evaluating the ability of the pavement to serve traffic. Present Serviceability is primarily a function of longitudinal profile with some influence from cracking, patching, and rut depth. The AASHO PSI rating scale for pavement is:

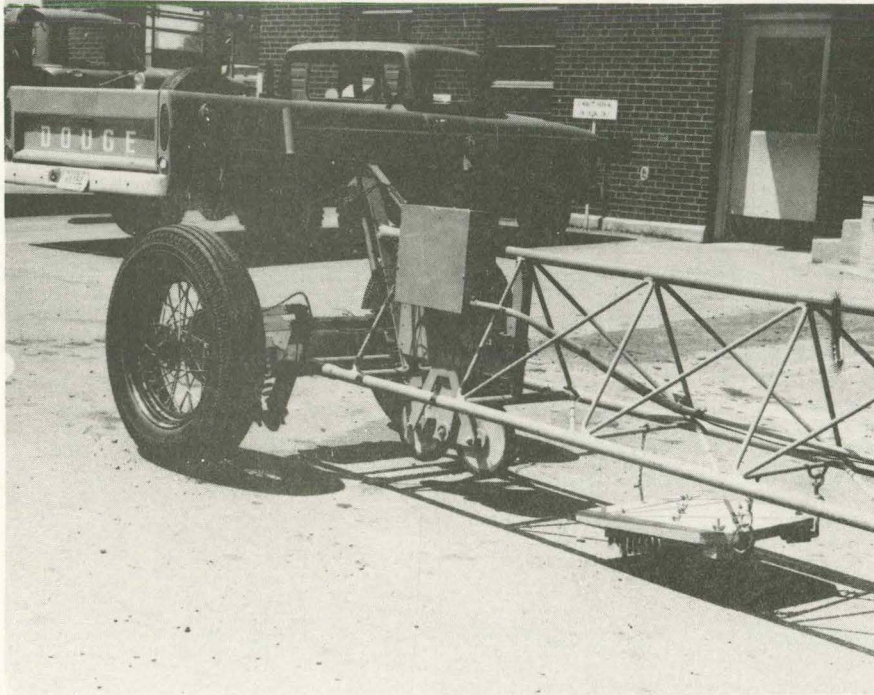
<u>Rating</u>	<u>PSI</u>
Very Poor	0 - 1
Poor	1 - 2
Fair	2 - 3
Good	3 - 4
Very Good	4 - 5

The test to determine PSI of a secondary road/city street used for a detour is conducted in two parts: (I) Determination of the Longitudinal Profile Value (LPV) and (II) Determination of the Deduction for Cracking, Patching, and Rut Depth.

Part I: Determination of LPV

The Iowa Department of Transportation uses three methods for determination of the longitudinal profile value.

1. CHLOE Profilometer



The CHLOE profilometer was developed at the AASHO Road Test in 1960. Simply stated, the CHLOE measures slope changes of the pavement at six inch intervals relative to a fixed plane. An increase in the average slope change indicates a rougher pavement and a lower PSI rating. Since the CHLOE operates at 5 mph or less, it is primarily used to test urban sections. Since the CHLOE is used as the standard for serviceability determinations, the IJK Ride Indicator and BPR Roughometer values are correlated to the CHLOE's values.

2. Bureau of Public Roads Roughometer



The BPR Roughometer is a towed trailer which has a testing wheel mounted in a frame on special shock absorbers. The trailer is towed at 20 mph. An integrator records the one way movement of the wheel up and down relative to the chassis of the trailer. An increase in roughness means a lower PSI rating. The roughometer is correlated yearly to the CHLOE to give equivalent PSI ratings.

3. IJK Ride Indicator

The IJK Ride Indicator is attached to a standard passenger automobile which operates at 50 mph. The Ride Indicator is mounted on the rear axle and accumulates the amount and magnitude of the roughness. This testing device is also correlated yearly to the CHLOE to give equivalent PSI ratings.

Detours are normally tested with the BPR Roughometer. The roughometer is capable of testing both urban and rural sections since it tests at 20 mph. The IJK Ride Indicator at 50 mph operates too fast for urban sections and the CHLOE profilometer at 5 mph operates too slowly for rural detour sections.

PART II: DETERMINATION OF DEDUCTION FOR CRACKING, PATCHING, AND RUT DEPTH

The purpose of this portion of the test is to determine the value of the Present Serviceability Index lost due to physical deterioration of the roadway.

The evaluation is conducted according to general procedure established by the AASHO Road Test and described in detail in the "Highway Research Board Special Report 61E".

The equation used to determine the "Present Serviceability Index" for flexible pavement is:

$$PSI = LPV - \overset{.01}{\blacksquare} \sqrt{C+P} - 1.38 \overline{RD}^2 \text{ in which}$$

PSI = Present Serviceability Index.

LPV = Longitudinal Profile Value.

C+P = A measure of the cracking and patching.

\overline{RD} = A measure of rutting in the wheel paths.

Cracking, C, is defined as the square feet per 1000 sq. ft. of pavement surface exhibiting Class 2 and Class 3 cracking. Class 2 cracking is defined as that which has progressed to the state where cracks have connected together to form a grid-type pattern. Class 3 cracking is that in which the bituminous surface segments have become loose. Patching, P, is the repair of the pavement surface

by skin or deep patching expressed in square feet per 1000 sq. ft. of pavement surfacing. Rut depth, \overline{RD} , is defined as the mean depth of rut in both wheelpaths under a 4-ft. straight edge.

The equation for "Present Serviceability Index" of rigid pavement is:

$$PSI = LPV - .09 \sqrt{C+P}$$

PSI = Present Serviceability Index

LPV = Longitudinal Profile Value

C+P = Measures of cracking and patching of the pavement surface.

Cracking, C, is defined as the total lineal feet of Class 3 and 4 cracks per 1000 sq. ft. of pavement area. A Class 3 crack is defined as a crack opened or spalled at the surface to a width of 1/4" or more over a distance equal to at least one-half the crack length. A Class 4 crack is defined as any crack which has been sealed. Patching, P, is expressed in square feet per 1000 sq. ft. of pavement surface.

COMPLETING THE PSI STUDY

A Present Serviceability Index survey is usually completed approximately one week prior to and one week after completion of the detour in order to determine the loss of service life. When the detour route information is received by the Materials Department, the secondary route is divided into sections. The sections are determined by different surface and structural types, different years built, and by different jurisdictions.

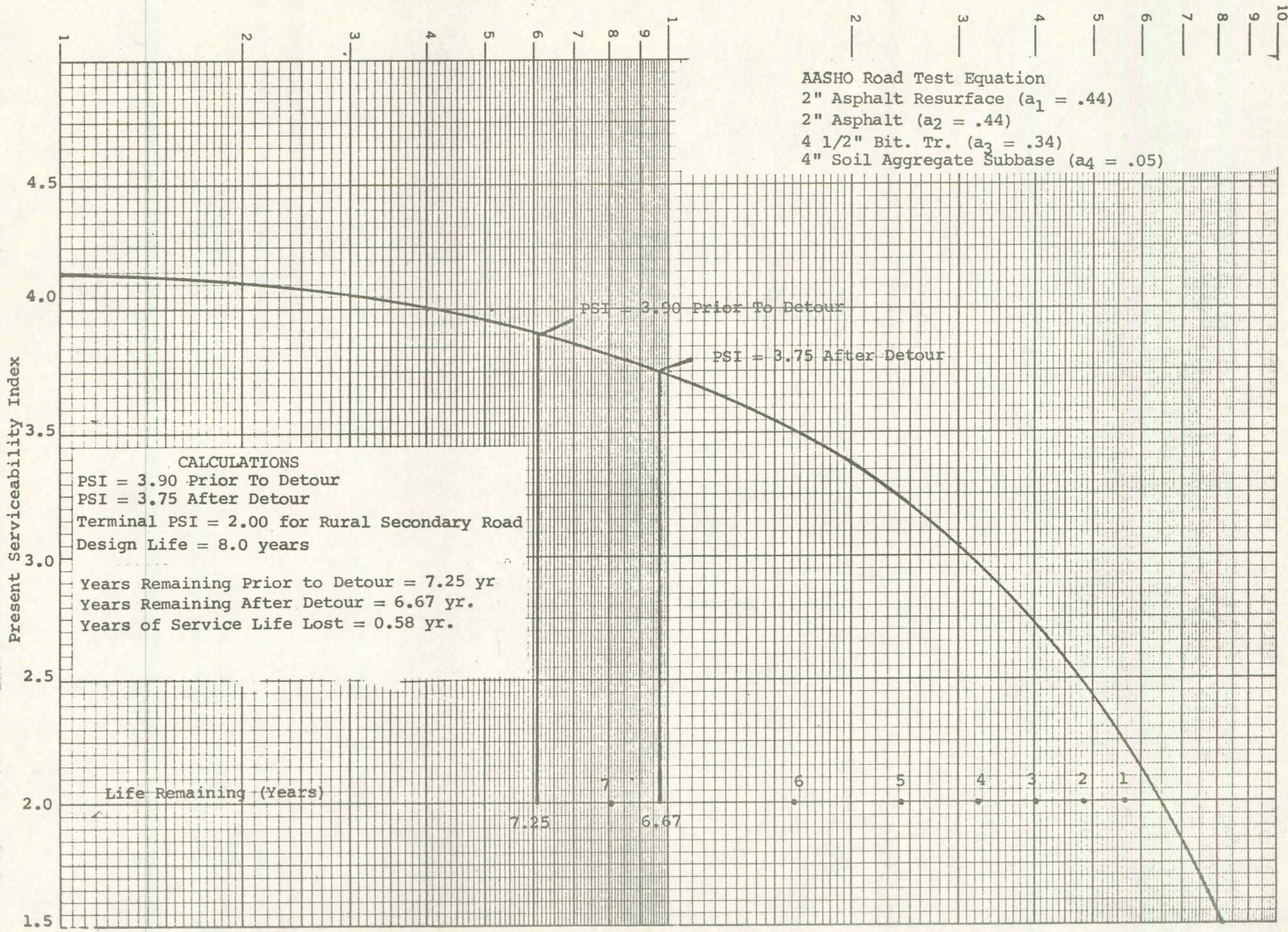
Once the data has been collected for the initial and final serviceability indexes, the loss of service life is determined in the Central Materials Office. This determination is based on the AASHO formulas in the "Highway Research Board Special Report 61E"

for estimating the reduction in service life. Each section has a graph plotted based on the section's surfacing, base and sub-base. The graph plots the serviceability index versus design life in years of the section. Based on the following design lives of roads, the remaining life in years of the road is calculated prior to and after the detour.

<u>Type of Pavement</u>	<u>Design Life</u>
Portland Cement Concrete	26 years
Asphaltic Concrete	14 years (initial)
Asphaltic Concrete	8 years (after resurfacing)
Prepared Base with bituminous seal	8 years (initial)
Prepared Base with bituminous seal	5 years (after resurfacing)

The difference between the initial and final P.S.I. readings indicates the loss of service life while the road was subject to primary road traffic. This change in serviceability can then be converted to "years of service life lost". The example on page 10 shows a typical loss of P.S.I. converted into "years of service life lost".

In this instance an initial P.S.I. of 3.90 would convert to an anticipated service life of 7.25 yrs. prior to the detour and a final P.S.I. of 3.75 would convert to an anticipated remaining service life of 6.67 yrs. after the detour or a loss of 0.58 yrs.



AASHO Road Test Equation
 2" Asphalt Resurface ($a_1 = .44$)
 2" Asphalt ($a_2 = .44$)
 4 1/2" Bit. Tr. ($a_3 = .34$)
 4" Soil Aggregate Subbase ($a_4 = .05$)

CALCULATIONS
 PSI = 3.90 Prior To Detour
 PSI = 3.75 After Detour
 Terminal PSI = 2.00 for Rural Secondary Road
 Design Life = 8.0 years
 Years Remaining Prior to Detour = 7.25 yr.
 Years Remaining After Detour = 6.67 yr.
 Years of Service Life Lost = 0.58 yr.

CALCULATING THE AMOUNT OF REIMBURSEMENT

The Maintenance Policies and Procedures Manual, No. 2, Sec. IX, explains the basis for reimbursement to the county or city for damage to the roadway. It states:

1. When Portland Cement pavement or asphaltic concrete pavement is used as a detour, the County will be reimbursed the difference in the capitalized worth, amortized at 6% of the cost of a 3 inch A.C. resurfacing, between the adjusted service life and the original service life. If after use as a detour the P.S.I. is below 2.5, the County will be reimbursed a proportionate share of the cost of immediate resurfacing.
2. In the event that a seal coat road without a prepared base is used for a detour, the County will be reimbursed in the amount of the cost of a single inverted penetration seal coat on the portion of secondary road used, plus agreed cost of leveling or special surface preparation prior to seal coat necessary to bring road to approximate existing condition before the use as a detour.
3. Gravel roads used for detour shall be repaired as agreed with County representative but no additional reimbursement shall be provided.
4. Payment for the materials used by Maintenance in restoring or maintaining a secondary road used as a detour shall be charged to the construction project for which the detour was provided.
5. In addition to correction of repairable damage and compensation for reduction in service life, the County shall be reimbursed

for increased surface maintenance which will occur prior to the calculated date of resurfacing. The increased maintenance allowance shall be based on a present value of cost of maintenance amortized at 6% interest. Increased maintenance costs will be assumed to be \$20.00 per mile per year.

6. The amount of any monetary reimbursement due the County for reduction of service life, repair and increased maintenance shall, after approval by the County Board of Supervisors and the Commission, be certified by the Accounting Department to the State Comptroller. The Comptroller will be requested to credit the amount to the secondary road fund of the County.



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