CHAPTER 5

PROCEDURE FOR PERFORMING ECONOMIC ANALYSIS OF M&R ALTERNATIVES

5-1. Introduction

The results of the pavement condition evaluation and the guidelines for M&R selection may indicate that the engineer should consider more than one M&R alternative. Selecting the best alternative often requires performing an economic analysis to compare the cost-effectiveness of all feasible alternatives. This chapter presents an economic analysis procedure which compares M&R alternatives based on present worth.

5-2. The procedure

The procedure for determining the present worth of each M&R alternative consists of the steps described below.

a. Economic analysis period. Select an economic analysis period (in years). The period generally used in pavement analysis ranges from 10 to 30 years, depending on future use of the section (abandonment, change of mission, etc.). The analysis period should be the same for all alternatives.

b. Interest and inflation rates. Interest and inflation rates to be used in calculating the present cost should be obtained from the installation comptroller. This is a very important step, since the selected rates have a significant impact on the ranking to the alternatives with respect to their present worth. The selection of the rates, therefore, should be based on Army policies and guidelines. It should also be noted that the inflation rate used to compute present worth is the differential inflation rate, i.e., the rate of cost increase above the general inflation rate. Therefore, if the cost increase of a specific item is in line with the cost growth experienced by the economy, the differential inflation rate is assumed to be zero. For example, if the cost of M&R for asphalt pavements is increasing at an annual inflation rate of 14 percent while the general inflation rate is 8 percent, the differential inflation is 6 percent.

c. Annual cost estimation. The annual cost should be estimated for each M&R alternative for every year work is planned during the analysis period. The cost of rehabilitation at the end of the analysis period for each M&R alternative should also be determined so that the pavement will be equivalent to a new pavement. All cost estimates should be based on current prices.

d. Present worth computation. The present worth (PW) for each M&R alternative is computed as follows:

$$\text{Present worth} = \left[\sum_{i=0}^{n} C_i \times f_i\right] + R \times f_n \qquad (Equation\ 5\text{–}1)$$

where—

n = number of years in the analysis period.

C_i = M&R cost for year i based on current prices.

f_i = present worth factor for i^{th} year that is a function of the interest rate (r_t) and inflation rate (r_f).

$$f_i = \left(\frac{1 + r_f}{1 + r_t}\right)^i$$

R = cost of rehabilitation at the end of the analysis period so that the pavement will be equivalent to a new pavement. The cost is computed based on current prices.

f_n = present worth factor at the end of the analysis period.

$$f_n = \left(\frac{1 + r_f}{1 + r_t}\right)^n$$

The physical interpretation of equation 5-1 is that the present worth of any M&R alternative is the sum of all the discounted M&R costs during the analysis period plus the cost of rehabilitating the pavement at the end of the analysis period (so that it will be equivalent to a new pavement), discounted to the present. After the steps described in a through d above are completed for each M&R alternative, the present worth's of all M&R alternatives are compared to help the pavement engineer select the most cost-effective repair alternative

e. Predictions and assumptions. A number of predictions and assumptions must be made to perform the economic analysis. The engineer must therefore use judgment in selecting the best inputs.

5-3. Computations

If automated PAVER is used, the present worth computations are performed by the computer. (See fig 7-4 for an illustration of the computer output.) If a manual paver system is used, DA Form 5148R, Present Worth Computation Form (fig E-4), is used when performing this computation. A completed DA Form 5148-R, Present Worth Computation Form, is at figure 5-1 and is an example computation for one M&R alternative. The values in this example were computed as follows for year 0:

$$f_i = \left(\frac{1 + r_f}{1 + r_t}\right)^i = \left(\frac{1 + .06}{1 + .10}\right)^0 = 1;$$

and with $C_i = 14{,}410$, the Present Worth (PW) $= 14{,}410 \times 1 = 14{,}410$; and with $C_i = 6{,}000$, PW $= 6{,}000 \times 1 = 6{,}000$.

For year 5, $f_i = \left(\frac{1 + .06}{1 + .10}\right)^5 = 0.831$; and with $C_i = 1000$, PW $= 1000 \times 0.831 = 831$.

For year 10, $f_i = \left(\frac{1 + .06}{1 + .10}\right)^{10} = 0.690$; and with $C_i = 1500$, PW $= 1500 \times 0.690 = 1036$.

For year 15, $f_i = \left(\frac{1 + .06}{1 + .10}\right)^{15} = 0.574$; and with $C_i = 1500$, PW $= 1500 \times 0.574 = 861$.

For year 20, $f_i = \left(\frac{1 + .06}{1 + .10}\right)^{20} = 0.477$; and with $C_i = 12{,}000$, PW $= 12{,}000 \times 0.477 = 5721$.

PRESENT WORTH COMPUTATION
For use of this form, see TM 5-623; the proponent agency is USACE.

M&R ALTERNATIVE PATCH JOINTS THEN OVERLAY WITH 2 INCH ASPHALT CONCRETE.

ANALYSIS PERIOD 20 YEARS INTEREST RATE 10 %

DIFFERENTIAL INFLATION RATE 6 %

YEAR	M&R WORK DESCRIPTION	COST $	f	PRESENT WORTH $
0(1980)	PATCH JOINTS	14,410	1.0	14,410
0(1980)	OVERLAY WITH 2 IN. A.C.	6,000	1.0	6,000
5(1985)	FILL CRACKS	1,000	0.831	831
10(1990)	FILL CRACKS	1,500	0.690	1,036
15(1995)	FILL CRACKS	1,500	0.574	861
20(2000)	REPLACE 2 IN. A.C. USING COLD MILLING.	12,000	0.477	5,721
			TOTAL	$28,859

DA FORM 5148-R, NOV 82

Figure 5-1. An example of a completed DA Form 5148-R, Present Worth Computation Form.