National Corrugated Steel Pipe Association

Life Cycle Cost Calculator

Equations

Overview

This section provides the equations embedded in the *Life Cycle Cost Calculator.* The calculator is based on conventional financial analysis techniques to determine present value.

Real Discount Rate

The real discount rate (d_r) and its corresponding nominal discount rate (d_n) are related as follows:

$$d_r = \frac{1 + d_n}{(1 + I)} - 1 \quad \text{or} \quad d_n = (1 + d_r)(1 + I) - 1$$

where I = the general rate of inflation.

The real discount rate can be calculated based on a user selected nominal discount rate and general rate of inflation. For example, a 10% nominal discount rate and a 3% inflation rate results in a real discount rate of 6.8% (Note: This is slightly different result than the arithmetic difference between 10% and 3%).

Total Present Value

The calculator takes the user specified data for *Material and Installation Cost (MI), Refurbishment Cost (R), Annual Recurring Costs (AR), Residual Value (RV)* and calculates the total present value for each alternate *(TPVAlt) as:*

$$TPVAlt = MI + PVR + PVAR – PVRV$$

- The calculator assumes Material and Installation Costs to occur in the base year (year zero), so they are not discounted.

Future costs expected to occur at a single point in time (Refurbishment, Residual Value) are discounted to the present by multiplying their estimated cost, in base year dollars, by the single present value factor as follows:

Tab 5
Equations
November 2003   1

$$PVA_s = A_s \left[\frac{1}{1+d_r} \right]^n$$

Where: A_s = Single Amount
d_r = the real discount rate
n = number of years until a future expenditure occurs.

- The present value Annual Recurring Costs that are expected to occur in the same amount (in constant dollars) from year to year are calculated as:

$$PVA_r = A_r \left[\frac{(1+d_r)^{n-1}}{d_r(1+d_r)^n} \right]$$

Where: A_r = Annual Recurring Cost
d_r = real discount rate
n = number of years (project design life)

Discount Rate Where Alternate is Equal to #1 Rank

The program calculates the Total Present Value for each alternate and ranks them. It then solves for the discount rate that would make the present value of the two alternatives equal. This is accomplished by looking at the differential cash flow between the #1 rank and other alternates and using the Internal Rate of Return (IRR) function embedded in Microsoft Excel. The result is printed underneath the # 2 and/or #3 alternates.

Using the information for the example in the detailed instructions:

Year		A (CSP)	B (RCP)	Diff. (A-B)
"0"	Material & Installation:	$ 150,000	$ 180,000	$ (30,000)
40	Refurbishment:	37,500	--	37,500
	Total:	$ 187,500	$ 180,000	$ 7,500

Discount Rate at which the $ 7,500 difference = "0" :   *0.56%*

Proof:
If discount rate = 0.56%
And refurbishment cost in year 40 = $37,500
Then PVR =

$$= \quad \$ 37,500 \left[\frac{1}{1 + .0056} \right]^{40}$$

$$= \quad \$ 29,993 \text{ or approx. } \$30,000 \text{ at which point the differential}$$

present value between Alts. A & B would be zero.

Tab 5
Equations
November 2003   2

Interpretation

This result can be viewed two ways. First, it can be directly compared to the real discount rate of 6.80% as determined by the user input. Since the 0.56% is much lower it suggests that even large reductions in the cost of Alt. B would not likely change the ranking. However, if the difference between the two discount rates were small, the user may want to conduct a sensitivity analysis to determine whether reasonable variations in the key assumptions change the ranking of the results.

Alternatively, the user can regard the 0.56% discount rate as an incremental return on investment. By investing $30,000 more in Alt. B ($180,000 - $150,000) to avoid the future refurbishment cost of $37,500 yields a 0.56% return on investment to the owner. The owner can then decide, based on their value of money, whether the added initial cost is economically justified.

Remember, the above discount rates are REAL rates; net of inflation. To approximate nominal discout rates add in the assumed general inflation rate. In the case it would be 0.56% real rate + 3.00% general inflation or approximately 3.6% nominal discount rate or return on investment.

Tab 5
Equations
November 2003   3