Volume : 2 | Issue : 4 | April 2013 • ISSN No 2277 - 8160

Research Paper | Engineering

Economic Evaluation of Alternative Proposals for Highway Project: A Case Study of Vapi – Silvassa Four – Lane Road in Gujarat

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ABSTRACT

For developing country like India, roads and road transport play an important role in economic growth. The construction and improvement of roads brings a variety of benefits that are enjoyed practically by all the sectors of the economy. Scarcity of resources and competing demands from various sectors are dominating features of a developing economy. It, therefore, becomes extremely necessary to allocate the scarce resources in the most beneficial manner amongst various sectors and, within a sector, amongst various alternatives. Highway economic analysis, also known as highway project appraisal, is a technique whereby the costs of and benefits from a scheme are quantified over a selected time horizon and evaluated by a common yardstick.Road and Building Department has defined the corridors of movement which are designated to act as catalyst for achieving the target economic development of the state. The Government of Gujarat is keen to restructure and develop the project of Vapi – Silvassa four lanes Road.

In the present study, the economic evaluation has been carried out on the basis of incremental costs and benefits by comparing the total net benefits of following engineering alternatives: widening four lane road of rigid pavement and four lane road of flexible pavement to be constructed between the years 2010 – 2012. The economic evaluation for the proposed four lane road has been done for an analysis period of 20 years from 2007.

would result in loss of land, alteration of the coastal zone and affects coastal ecosystem. From the study, the mitigation measures (engineering measures) and Coastal Zone Management practices that can be taken to protect human life and property from sea level rise are suggested.

KEYWORDS:

Introduction

Highway construction is a major civil engineering activity which involves large sums of investment. Construction of a six lane expressway may cost about Rs 20 crore per kilometer. A well designed rural road with 3.75 m carriageway, shoulder, and cross-drainage works may cost Rs 25-50 lakh per km, depending on the construction methods, topography, subgrade soil, traffic trend and composition and weathering conditions.

Proper economic evaluation is, therefore, an important aspect of highway projects. Study of highway economics and financing mainly involves understanding of various cost components of highway projects, the prioritization of various alternative projects including methods, alternative technology and decision on the scheme of investment in a project at its various stages, funding sources, and policies for road projects.

Highway economic analysis, also known as highway project appraisal, is a technique where by the costs of and benefits from a scheme are quantified over a selected time horizon and evaluated by a common yardstick. The technique is also known as benefit cost analysis.

Economic evaluation serves a number of purposes. These are

(1) Preparation of highway plans at the national, regional or local level, within the overall development plan.
(2) To rank schemes within the highway sector plan competing for scarce resources in order of priority.
(3) To assist in phasing the road programme over a period of time depending upon the availability of resources.
(4) To compare mutually exclusive schemes and select the most attractive.
(5) To determine whether a scheme under consideration is worth investment at all.
(6) To evaluate alternative strategies such as stage construction or full construction:alternative specifications such as flexible pavement or rigid pavement; alternative policies such as increased outlay on maintenance or increased outlay on rehabilitation; alternative design standards and alternative policy options on axle loads.

Objective of the study

The objective of thi study is to evaluate the best alternative for the proposed four lane road using over a specified analysis period under various maintenance and improvement options to evolve best possible alternative by using IRC: SP:30 -1993.

- To carry out economic evaluation of project road for an analysis period of 20 years from 2007.
- The Economic evaluation for proposed Vapi - Silvassa road is carried out on the basis of costs and benefits comparing the total net benefits in following three engineering alternatives:
  - Alt1: "Do nothing" situation of doing only routine and peri odic maintenance for existing road.
  - Alt2: Construction of a new four lane Flexible Pavement
  - Alt3: Construction of a new four lane Rigid Pavement
- The economic justifications of proposed road improvements have been analyzed by using IRC: SP: 30-1993.
- Benefits for two different construction alternatives shall be calculated over a 20 years design life by comparing the vehicle operating cost and road agency cost (i.e. construction & road maintenance costs) for different alternatives.

Data collection

In the present study, field works include traffic data, soil report, weathering data, drainage facility availability, Benkelman Beam Deflection test data, roughness by Bump integrator and Pavement condition survey.

Methodology

After having determined the costs and benefits of a scheme, a method has to be evolved for relating these two so as to arrive at an assessment of the soundness of a scheme in economic terms. A number of methods have been developed and the literature on them is voluminous. The various important methods are explained as follows:

Benefit cost (B/C) ratio method
Discounting Cash Flow Methods
Net present value method
Internal rate of return method

In the first methods the benefits are expressed as the net benefits occurring in a single reference year and the costs are expressed as a net annual cost.

1 Benefit - Cost ratio method

The benefit-cost ratio method is one of the widely used one for evaluation of highway projects. In this method, the ratio of net annual benefits to the net annual costs is determined. The benefits are evaluated for a single reference year, which for convenience can be the first year of operation after construction or the median year of the analysis period. The costs are the equivalent annual charge representing equal amortization and interest payment (at a specified discount rate) spread over the economic life of the project. The benefit cost ratio for a particular project would be

$$\frac{B}{C} = \frac{\text{Benefits in the reference year}}{\text{Annual Costs}}$$

Ratio=

$$\frac{\text{Road user cost for existing road} - \text{Road user cost for improved road in reference year}}{(\text{Equivalent annual highway cost for the improved road}) - (\text{Equivalent annual highway cost for the existing road})}$$

2. Net present value method

Net present value (present worth) method is based on the Discounted Cash Flow (DCF) technique. In this method, the stream of costs/benefits associated with the project over an extended period of time is calculated and is discounted at a selected discount rate to give the present value. Benefits are treated as positive and costs as negative and the net present value are found. Any project with a positive net present value is treated as acceptable. In comparing more than one project, a project with the highest net present value should be accepted.

The net present value is algebraically expressed as

$$NPV0 = (B0 - C0) + \frac{B1 - C1}{1+i} + \frac{B2 - C2}{(1+i)^2} + \frac{B3 - C3}{(1+i)^3} + \cdots\cdots\cdots + \frac{Bn - Cn}{(1+i)^n}$$

3.Internal rate of return method

The internal rate of return is the discount rate which makes the discounted future benefits equal to the initial outlay. In other words, it is the discount rate which makes the stream of cash flows to zero.

The following equation can thus be modified as below, if B0 is zero

$$C0 = \frac{B1 - C1}{1+i} + \frac{B2 - C2}{(1+i)^2} + \frac{B3 - C3}{(1+i)^3} + \cdots\cdots\cdots + \frac{Bn - Cn}{(1+i)^n}$$

Results

Summary of Results

	Flexible Pavement (Rs. in Lakh)	Rigid Pavement Rs. in Lakh)	Existing Pavement (Rs. in Lakh)
COST	1963	1818	1120
VOC	259788	230002	454067
B/C	230	321	
NPV	3926	3500	
IRR	62.4 %	65.7 %	

The Summery of the results shows that the four lane of Rigid Pavement is viable compared to the Flexible Pavement as per economic appraisal carried out using IRC: SP: 30-1993.

- The NPV for four lane Flexible Pavement is Rs 3926 lakh and Rigid Pavement is Rs3500 lakh, which are positive.
- IRR value for four lane Flexible Pavement is 62.4 % and four lane Rigid Pavement is 65.7 %.
- B/C Ratio for four lane Flexible Pavement is 230 and four lane Rigid Pavement is 321, which are greater than 1.
- It is observed from the above Table 7.1 that out from the alternatives Rigid Pavement proves most economical over the span of life.

Conclusions

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