

Study Of Road Infrastructure Cost & Revenue Period with Case Study of Four Lane Project of NH166

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Abstract—Developing high-performing transportation systems is a major factor in attaining and maintaining economic integration and growth at the regional level. Traditionally, Governments have relied on toll financed mechanisms to attract private sector funding for roads, pushing the funding and maintenance burden of roads directly onto the end users. Based on this structure, private sector concessionaires build, operate, and maintain road assets in accordance with established performance standards over a specified period, in exchange for the right to collect tolls from users. Despite this structure, the relationship between the three main stakeholders – governments, private contractors and road users – is often very contentious. There is significant public sentiment and resistance to the tolls on long standing, operational corridors when the capital costs are thought to have been fully recovered. Additionally, there are widespread complaints from users about poor road maintenance and a lack of contractually required amenities including parking bays, public washrooms and roadside rest areas.

This research analyzes the economic and lifecycle costs of the National Highway 166 (NH166) four-lane project, specifically focusing on the 33.609 km portion of the project from Chokak to Borpadale in Kolhapur District in Maharashtra, India. Using the Future Worth Method, this study evaluates the total lifecycle cost of the corridor over a ten-year period, in terms of both the capital outlay and the Operations and Maintenance (O&M) costs, by compounding these amounts together. The empirical modeling of the future worth of the NH166 corridor has been supplemented by conducting a 24-hour traffic count survey, and classifying vehicles falling under distinct categories at the Borpadale Toll Plaza. Financial evaluations estimate that with current toll rates in place, the revenue generated from the NH166 Corridor will total ₹2,958.89 crores over a 20-year period. Assuming that all future costs will be compounded and that future costs amount to ₹2,692.69 crore after 20 years, the baseline toll recovery period has been determined to be 18 months and two months from project construction. The bases of, and subsequent increase of, the ten percent,

bi-annual toll increase mechanism has extended the time period from original toll revenue amounts to exactly 20 years to achieve full financial closure.

The paper concludes with policy recommendations related to risk sharing, dynamic tolls, and local structural changes to minimize revenue recovery periods and to improve safety for commuters on the NH166 corridor.

I. INTRODUCTION

Road transportation is a vital aspect of infrastructure growth in a country; it is crucial to economic progress, industrialisation, the growth of trade and social connectivity. In the Indian context, approximately 65% of freight traffic and 85% of passenger transport occurs on the road, establishing it as the backbone of the overall transportation system. The function of national highways is of particular importance as they link together major urban centres, industrial areas, ports and rural communities. Through the development of national highways, all of these regions become more accessible; the time and cost of travelling (including vehicle operating costs) are lowered, and there is an increase in regional economic activity.



Fig.1. The First Kapsch Toll System in India
Finalized

The National Highways Development Programme (NHDP) has contributed to significant improvements in road infrastructure across India. The Golden Quadrilateral and North-South and East-West Corridors have played key roles in reshaping India's transportation infrastructure. To help fund these major projects, the Government has implemented tolling systems and Public-Private Partnership (PPP) arrangements whereby private investors are responsible for building and maintaining highways in exchange for receiving tolls.

This research is for the National Highway 166 (NH166) project, specifically a four-lane road from Chokak to Borpadale, is to create a better flow of traffic and increase transportation efficiency within this area. The study will measure total road infrastructure costs; toll revenue generated by the project; and how long it takes to recoup the investment. Additionally, the project will assess how effective different toll collection methods are and what effect they have on local economic development.

II. LITERATURE REVIEW

Research has been conducted by multiple scholars concerning toll road systems, financing of expressways, and developing transportation infrastructure. Research conducted by CRISIL indicated that BOT toll projects in India are financially successful due to traffic increases and increases in toll revenues. However, aggressive bidding and increased project costs have impacted the financial results of projects awarded after 2010.

Qamar (2010) noted that private sector involvement is essential for the rapid development of highways in India. This study finds that modern technology and operationally-managed toll collection improve user satisfaction and increase operational efficiency. Chandrasekhar (2010) highlighted the National Highway Fee Rules of 2008, which address the method of collecting tolls, vehicle classes used for determining tolls, toll amounts, and local user concessions.

Ramnani (2009) discussed the commercialization of and maintenance on road assets via public-private partnership models. Shubhara (2014) reveals that the increase in toll revenue in India is due to increased

commercial vehicle movement, as well as increased traffic density along key route segments.

China and Malaysia have both seen the successful implementation of toll-going highways. They have done this through extensive government planning, as in the case of China's expressway network, as well as through the use of PPP models for building and operating expressways in Malaysia. These case studies were instrumental in influencing the country's highway development strategies.

Many of the benefits of the ETC system (Electronic Toll Collection) are related to its ability to reduce congestion, decrease excess fuel use and improve efficiency. ETC systems use RFID technology, as well as other automated vehicle identification solutions, to enable vehicles to pass through and not have to come to a stop. As a result, this technology improves the speed at which vehicles can get through tolls, therefore improving overall traffic flow, and also reduces the negative impact of vehicle idling on the environment via less emissions.

III. OBJECTIVE

The objective of this project is to determine the commercial feasibility and design life cycle costing of the NH166 four-lane expansion from Chokak to Borpadale by analysing a 33 km agricultural and industrial corridor's potential financial performance as an asset using a Compound Cost Flow down method with time-based traffic patterns. The specific objectives include:

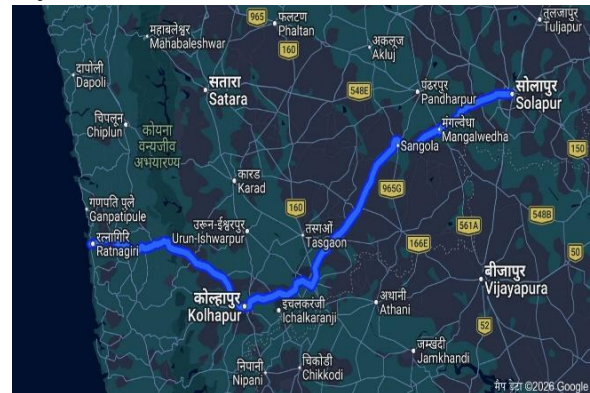


Fig.2 Solapur- Ratnagiri NH166 Highway

1. Life Cycle Costing:

Determine the cumulative life-cycle cost of the Chokak to Borpadale corridor using the Future Value Method to include compounded financing costs and

long-term Operations and Maintenance (O&M) liabilities over a 20-year period.

2. Basic Traffic Studies Analysis:

Determine volume and annual growth rates, for traffic entering into Borpadale fee plaza on a categorical basis and based upon data collected during 24-hour field surveys.

3. Toll Rate Assessment:

To assess the current revenue-generating capacity of the regional toll rates and how the statutory 10% increase in tolls every six months will influence its financial success and viability.

4. Overrun Risk Analysis:

To characterize and assess the various risk factors impacting the project's ability to construct the new highway, including construction delays, material price fluctuations, and challenges associated with acquiring right of way, as well as their impact on the time it takes to recover the capital investment in the project.

5. Policy Recommendations:

To make recommendations regarding the use of dynamic tolls, the use of automated electronic toll collection, and improving safety on the corridor at locations considered to be high risk.

In terms of geographic coverage, the project will be limited to the 33.609 km of the NH166 in Kolhapur and Sangli district of the western part of Maharashtra. There is a high concentration of sugarcane farming, sugar processing facilities, and active industries in this region; therefore, this will provide an excellent representation of the typical mixed-use regional highway.

Economic Development

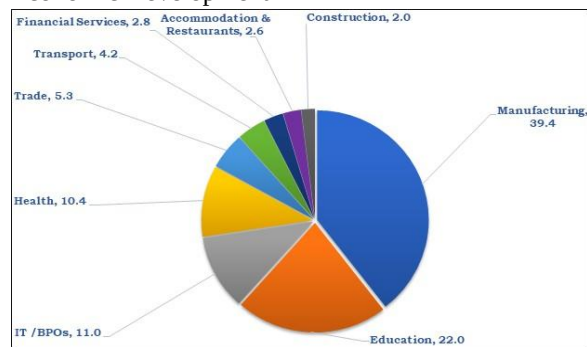


Fig. 3 Percent labour employment in India by economic sectors

The establishment of proper road infrastructure will have an immediate impact on economic development by providing improved transportation methods for the efficient movement of goods to and from markets. A well-developed road network allows for the quick and cost-effective transfer of raw materials and finished goods by industries. Additionally, improved highway systems lower costs associated with the operation of vehicles, reduce the amount of time necessary for travel, and lower rates of accidents. In addition to being economically advantageous, improved road infrastructure creates additional employment opportunities in both the construction and ongoing operations of the use of the road infrastructure.

Road and transportation infrastructure assist agricultural and industrial growth by linking production areas with markets and distributing products through routes. Rural populations see a direct benefit from improved roadway systems due to the ability to move agricultural products with greater efficiency than through other means. Road and transportation infrastructure also enhance tourism and enhance commerce.

The NH166, 4-lane project has contributed to the development of the region's economy through enhanced connectivity between Solapur, Kolhapur, Sangli, and Ratnagiri. Most of traffic that travels along the route consists of commercial vehicles, as well as passenger buses and privately owned vehicles carrying goods and passengers. As traffic volume grows, increased revenue from tolls will support the development of economic activity in these regions.

The Electronic Toll Collection system facilitates economic development by decreasing congestion and fuel waste. Rapid toll processing allows for enhancement of productivity, and decreases the time it takes to move goods by freight. Vehicles on reliable highways can attract investment, which in turn helps improve the caliber of local businesses in developing areas.

Case Study

Investigating the Four-Lane NH166 Project Connecting Chokak to Borpadale the NH166 is a new four-lane highway project that connects the toll plazas on either side of the 33-kilometer stretch between Chokak and Borpadale. The purpose of this project is to relieve congestion and provide safer roadways in this area.

Data from traffic surveys conducted at both the Chokak and Borpadale toll plazas shows a diverse range of vehicle types passing through these locations each day, including automobiles, buses, heavy trucks, and multi-axle commercial vehicles. These commercial vehicles account for the majority of tolls collected because of their higher average tolls and frequency of use.

Continued growth in toll collection can be attributed primarily to increases in traffic volume or construction, and secondary increases in tolls due to increasing economic activity throughout the region. There is, however, widespread dissatisfaction among the public regarding toll charges, with many road users feeling that once they've paid for construction, they shouldn't have to pay tolls any longer.

The study indicates a significant reduction in waiting time and congestion at toll booths using electronic toll collection (ETC) lanes versus traditional manual collection methods. ETC systems provide Improved operational efficiency, while simultaneously reducing fuel consumption due to the elimination of excessive queue lengths at toll plazas.

The project has improved both road safety and travel comfort. Improved road conditions (quality), as well as wider lane widths, have resulted in fewer overall accidents and improved levels of efficiency in traffic flow for all users of the NH166.

IV. METHODOLOGY

Both primary and secondary data collection methods are used for the purpose of this study.

❖Primary Data Collection Processes

The collection of primary data includes:

- Traffic volume survey at toll plaza.
- Field observations of toll operations.
- User satisfaction survey data.
- Observations of congestion and waiting time.

❖Using secondary data sources, including:

Reports published by National Highway Authority of India.

- Toll collection records and reports.
- Reports published by government.
- Research papers and journals.
- Reporting Economic Analysis

❖The economic analysis of this study includes an estimate of the following variables:

Total cost associated with constructing this highway.

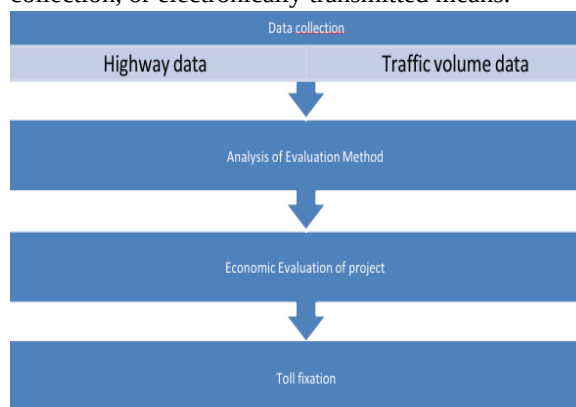
- Annual total generated from tolls collected.
- Number of years needed to recover income from these tolls.

The following formula will be utilised to arrive at number of years required to recover income from the tolls collected:

No. of Years required to recover from Dues from toll

$$= \text{Total cost of highway} \div \text{Total revenue from tolls collected annually.}$$

In addition, an examination of the current practice of the collection of tolls by manual collection, automated collection, or electronically transmitted means.



V. RESULTS

The four-lane NH166 toll road project generated significant tolling revenues due to high volumes of commercial vehicles and traffic density. The implementation of Electronic Toll Collection (ETC) has reduced toll plaza congestion and improved the flow of traffic through the plazas. In addition, safety on the road has improved, travel times have been shortened, and vehicle operating costs have decreased. Connectivity and transportation efficiencies have improved considerably. Regional connectivity and transportation efficiencies greatly improved after the completion of the 4-lane highway.

However, the following problems were noted:

- Continuous toll collection without cost recovery; Manual toll lanes are congested; Public dissatisfaction over the toll rates; Lack of transparency regarding how toll revenues are used.

- Despite these problems, the project has demonstrated significant economic benefits and improved transportation infrastructure in the region.

VI. CONCLUSION AND FUTURE SCOPE

This study analyzed how well the four-lane toll roads on NH166 are working, specifically in the Sangli and Kolhapur districts. These roads are vital for moving sugar, industrial goods, and agricultural products. By looking at four specific toll sections, we measured four main areas: how many vehicles use the road (traffic), how much money is collected (revenue), how the toll booths operate, and the quality of services provided to drivers.

The results show that while the new four-lane highway has made travel faster, the system is not yet "high-performing." There is a gap between what the government promised and what drivers actually experience. In our region, several problems stand out, such as confusing toll policies, poor road repairs, and long waiting times at toll plazas. These issues suggest that simply building a wide road isn't enough; managing it properly is the real challenge.

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