

Fixation of Toll charge for Six Lane Highway

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Abstract— Toll rates and traffic volumes (or demand) are the two major factors affecting revenue as well as investment strategies on toll roads. Although it has been experiencing dramatic growth in its highway systems during the past 10 years, there has been a lack of understanding in maintaining and operating its toll roads. Since most of the freeways in India are toll roads, it is necessary to establish a methodology for the toll road system based on the characteristics of India’s transportation systems and social economy. A methodology to determine the toll rates for India's toll road systems is introduced. Factors affecting the toll rate are analysed, including gross domestic product, total number of vehicles, growth rates of passenger and freight transport, and roadway conditions

Keywords:- Growth of traffic, Congestion, Vehicle characteristics, VOC.

I. INTRODUCTION

Toll tax is collected to recover the total capital outlay which includes the cost of construction, repairs, maintenance, expenses on toll operation and interest on the outlay. The new facility thus constructed should provide reduced travel time and increased level of service. In India most of the highway projects are given on PPP basis, i.e. Public Private Partnership. In this the private organization finances and constructs the facility and recovers the capital from the users in the form of toll tax. This tax is collected for a reasonable period of time after which the facility is surrendered to the public. Of late, toll tax is being levied on parking of vehicles in the urban centers in a move to decongest the streets and reduce the pollution levels. This concept is known as Congestion Pricing.

II. OBJECTIVES

Following are the objective of study area:

- 1) To forecast the toll travel demand for the study area
- 2) To study about the existing methods of fixation of toll charges.
- 3) To compare the various methods of fixation of toll charges.
- 4) To optimize the toll charges for the proposed study area.

III. STUDY AREA

The study corridor between Km.388.200 to 509.000, and being design a part of the National highway No.8, it passes through many urban settlements, industrial centers viz.

Sabarkantha and Gandhinagar, etc. As the important link in the National Highway network of India, it probably carries the densest traffic in the country.

IV. TRAFFIC ASSESSMENT

Different types of survey were carried out on the study corridor from Km 388.200 To 509.000 of National Highway No.8, at different location and duration to appreciate the traffic and travel characteristics.

Vehicle Type	Traffic Growth rate (%)
Two-wheeler	5.5
Car/jeep	7.5
Bus	4.0
LCV,HCV,MAV	4.5
Tractor, Trailor	4.0

Table. 1: Growth rates obtained as per IRC: 108-1996

mode	2013 Veh/Day	2023 Veh/Day	2033 Veh/Day	2040 Veh/Day
Car	2886	5948	12259	20339
Bus	455	674	997	1312
Truck	1009	1567	2433	3312
MAV	706	1045	1547	2036
Total	5056	9234	17237	26998

Table. 2: Classified Volume Count Survey Year 2013 to 2040 at Vantda

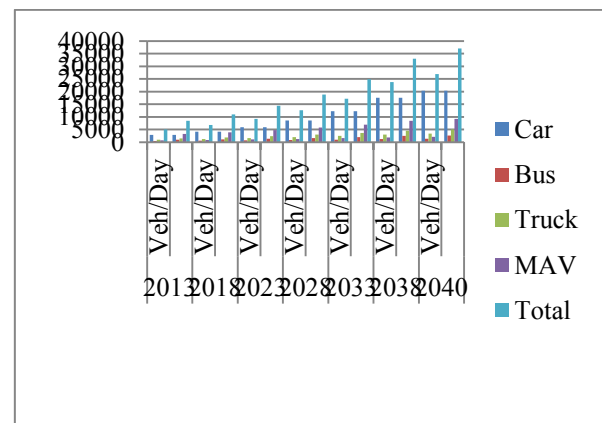


Fig.1 :Yearly Traffic variation in AADT at Vantda

	2013	2023	2033	2040
Mode	Veh/Day	Veh/Day	Veh/Day	Veh/Day
Car	2887	5950	12264	20346
Bus	703	1041	1540	2027
Truck	998	1550	2407	3275
MAV	752	1113	1648	2168
Total	5340	9654	17859	27817

Table. 3: Traffic Assessments At Kathpur

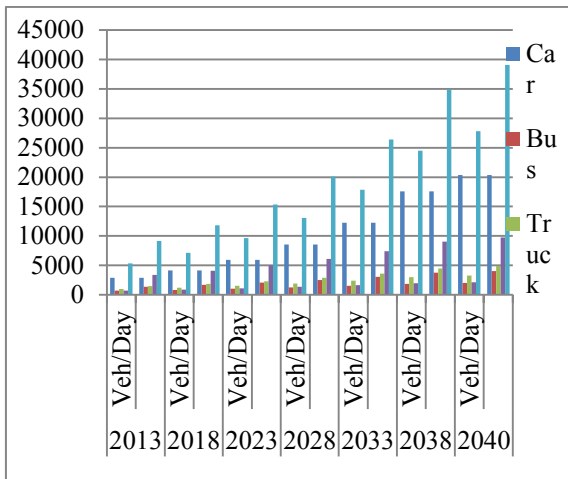


Fig .2 : Yearly Traffic variation in AADT at Kathpur

Sr. no	Project Activities	Estimated Cost (Rs.)
1	Site clearance	15570107
2	Earthwork	728235560
3	Sub base and base courses	926276470
4	Bituminous works	2517184915
5	Bridge, flyovers, underpasses, RoB, Pedestrian subway, footbridge, etc	2495561548
6	Drainage and Protection Work	714757586
7	Traffic sign, Markings and Road appurtenances	720576959
8	Maintenance, Repair and rehabilitation	842967485
9	Environmental Management	48293119
Project Cost (Rs.)		9009423748
Escalation 25% ; (Total project Cost) Rs.		1801884750
Total Project Cost		10811308458
Concession period in days		9855
Per day cost to be collected		1097037.899

Table. 4: estimated cost of project

(Source: Feasibility for 6-laning of NH-8 from Udaipur Ahmedabad in the State of Rajasthan)

vehicle characteristics			
	Length in m	Width in m	Weight (self wt+ load capacity)
car	3.66	1.5	1.4
Truck	9.2	2.4	9.7
bus	9.2	2.4	16
MAV	18.5	2.5	55

Table. 5: Vehicle Characteristics

	Lin m	W in m	Weight	occupancy	saving in travel time	Total
car	1.98	6.00	0.25	1.07	0.58	9.88
LCV	4.97	9.60	1.76	0.44	10.04	26.8

bus	4.97	9.60	2.91	10	12.22	39.7
MAV	10	10	10	0.44	12.78	43.2

Table. 6: weight age awarded vehicle characteristics

The weight ages awarded to each vehicle characteristic on a 10-point scale are as in Table-6. Percent weight age for each vehicle type:

$$\begin{aligned} \text{Car} &= 1/12 \times 100 = 8.33\% \\ \text{LCV} &= 2.5/12 \times 100 = 33.33\% \\ \text{Truck or bus} &= 4.0/12 \times 100 = 20.83\% \\ \text{MAV} &= 4.5/12 \times 100 = 35.7\% \end{aligned}$$

The toll fee per trip for each vehicle type may be assumed as:

$$\begin{aligned} \text{Car} &= x_1 \\ \text{LCV} &= x_2 \\ \text{Truck or bus} &= x_3 \\ \text{MAV} &= x_4 \end{aligned}$$

The total revenue collected per day must be equal to per day cost of project so that the total estimated cost of the project is recovered in the stipulated concession period.

$$2886X_1 + 455X_2 + 1009X_3 + 706X_4 = 563419.5634$$

Suppose X_1, X_2, X_3 and X_4 is X

$$2886x(8.33\%/100) + 455x(33.33\%/100) + 1009x(20.83\%/100) + 706x(35.7\%/100) = 563419.5634$$

$$X = 636.97 \dots$$

Put $X = 636.97$ in

$$\text{Car} = X_1 = 1/12 \times 100 = (8.33/100) \times 636.97 = 53.05 \text{Rs}$$

$$\text{LCV} = X_2 = 2.5/12 \times 100 = (33.33/100) \times 636.97 = 212.30 \text{Rs}$$

$$\text{Truck or bus} = X_3 = 4.0/12 \times 100 = (20.83/100) \times 636.97 = 132.68 \text{Rs}$$

$$\text{MAV} = X_4 = 4.5/12 \times 100 = (35.7/100) \times 636.97 = 227.39 \text{Rs}$$

$$\text{Car} = X_1 = 53.05$$

$$\text{LCV} = X_2 = 212.30$$

$$\text{Truck or bus} = X_3 = 132.68$$

$$\text{MAV} = X_4 = 227.3$$

V. CONCLUSION

- 1) Economic evaluation of a proposed BOT facility is essential for the assessment of technical as well as economic feasibility of the project.
- 2) The estimation of vehicle operating cost and saving in travel time due to provision of a new facility must be undertaken carefully so that the toll fees for each vehicle type and toll collection period can be fixed accordingly.
- 3) With assumed parameters and computation methodology the Rounded off toll collection amount for car comes out to be Rs 53, for bus Rs 212, for truck Rs 132 and for multi-axle vehicle (MAV) as Rs 227.
- 4) The car and multi axle truck vehicle are more than other category of the vehicle on the study area.

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