Economic Assessment of Flyover – A Case Study of Rajkot City

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Abstract— The term flyover had become a by word and elicited different reaction to common people. Some people showed indignation because they cannot foresee that by putting up this kind of structure may not ease the traffic congestion within an intersection but instead it complicates the traffic problem. This research study therefore, would be part of extensive studies that was undertaken to determine effects of flyover construction to the way of life of the motorists and commuters, and in general travelling public. In addition, this is to make them aware of the advantages and dis-advantages that it may bring to their everyday life of activity. To reduce traffic congestion at an at-grade intersection near a big city, one method is construction a flyover bridge at the old junction in two directions on one of the main roads. The flyover facilitates the traffic flow in the directions of the bridge, but the infrastructure cannot fully solve all of the problems especially on the secondary road. Under the bridge, although it relieves the traffic congestion at the intersection, traffic signal can be considered as one of the solution.

Key words: Flyover, Bridge

I. INTRODUCTION

Due to the unmanageable growth rate of vehicular traffic on roads travel is becoming chaotic, tiring, time consuming and unsafe. Mostly, traffic congestion and accidents are found at these junction as traffic from different directions converge. Same level of road meet at a point and form intersection due to the heterogeneous traffic especially in India the chances of accidents is more at intersection. To regulate and manage the traffic for achieving rapid movement flyover is one of the solution. It minimizes the risk of accident as head to head and tail to tail. Now a day's city is developing to mega and metro and as a result, flyover is a better solution for the traffic problem. Big mega cities are well planned and its transport system is also well - equipped while developing cities are not so well planned. That's the reason that if planning of small city is taken in to consideration it will create big problem [3]. It is found that in urban areas, the improvement of intersection at-grade is very limited. To avoid the traffic congestion in the congested cities, flyovers are planned at major congested area of the cities. Due to the lack of fund or ignorance about planning perspective, this planning are not to up to its approach. If the flyover are planned wrongly i.e. if the location of the flyover is not according to the requirement then it would create the same traffic problem but in some other location and that to also without any remedies.

The flyover is constructed on 150ft. ring road between Raiya telephone exchange and big bazar mall. In the selected flyover there is one major intersection which is signalized due to insufficient width of the road under the flyover traffic jamming problem occurring during the peak hour. It affect the vehicles who wants to move at the right side. Due to the flyover number of vehicles are diverted who wants to travel across the intersection. Flyover is helpful in both ways i.e. saving in total travel time and saving in fuel. In this paper to fulfill the objective i.e. assessing the flyover through the two method: (1) Benefit / cost ratio (B/C) Method (2) Net Present value (NPV) Method.

The objective of the paper is to analyses the traffic impact of such an independently designed flyover at 150 feet ring road of Rajkot city. The ring road is a 4 lane road which is divided by BRTS route. Flyover has 4 lane road, having width of 3.25m each.

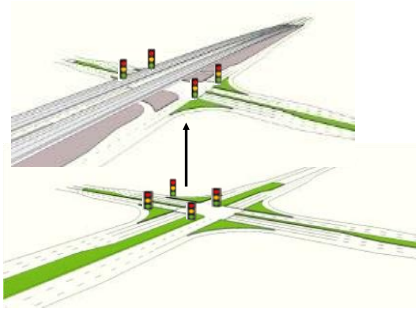

Fig. 1: Layout of an At-Grade Intersection Converted To a Flyover-Improved Intersection

II. NEED OF STUDY

According to the transportation professionals' concern the increase in urban traffic congestion has become a serious matter. In urban road networks, the intersections are very large and very close to each other. Due to which more traffic congestion is observed especially during peak hours. Researchers are making efforts for obtaining rational quantification of congestion and formulating appropriate measures for mitigation of congestion for urban roads, also efforts to improve the traffic operations at urban intersection are made. In fact, in urban areas evidencing exciting roads or the scope of improvement of intersection at-grade is very limited. So, due to the unavailability of land and to achieve fast and safe movement of vehicle at at-grade separator is one of the solution i.e. flyover.

Fig. 2: Flyover at Indira circle intersection

III. OBJECTIVES

- To assess the economic feasibility of the flyover at the intersection
- To study traffic and road safety issues at the flyover improved intersection

IV. METHODS OF ECONOMIC ESSESEMENT

Economic assessment is the process of systematic identification, measurement and assessment of the inputs and outcomes of two alternative activities, and the subsequent comparative analysis of that activities. The identification of the best course of action based on the evidence available is the main purpose of economic assessment.

Thus, different methods of economic evaluation are: (a) Benefit/Cost Analysis (b) Net Present Value [5]

A. Benefit/Cost Analysis:

The benefit-cost ratio (BCR), defined as the ratio of benefits to the total costs at the same point in time, is a profitability index based on discounted benefits per unit of discounted costs of a project. When the benefits are derived from the reduction of undesirable effects, it is also referred to as the savings-to-investment ratio (SIR). Its use also requires the choice of a planning horizon and a MARR. Since some savings may be interpreted as a negative cost to be deducted from the denominator or as a positive benefit to be added to the numerator of the ratio, the BCR or SIR is not an absolute numerical measure. However, if the ratio of the present value of benefit to the present value of cost exceeds one, the project is profitable irrespective of different interpretations of such benefits or costs.

The benefit-cost ratio method is more efficient or we can say more effective as compared to remaining two method. It gives accurate result. Often it is used in major public project. For the accurate result proper care has to be taken or else it will lead to misguiding results.

The benefit-cost ratio is defined as the ratio of the discounted benefits to the discounted cost at the same point in time.

It follows that the criterion for accepting an independent project on the basis of the benefit-cost ratio is whether or not the benefit-cost ratio is greater than one (B/C > 1).

B. Net Present Value:

Whenever an investment is made, the gain over a planning horizon is supposed to have a look so that the invested money are not wasted instead used for the invested purpose only. For this reason, a minimum attractive rate of return (MARR) is adopted and used for compounding the investment. It can also be used to discount the cash flow. In the net future value (NFV) the profit is separated according to the planning horizon based on the investing at the initial level as where at the MARR. The net present value of the estimated case flow for the project over the selected planning horizon is the discounted value of the present net present value. A positive value of net present value indicates that some net gain corresponding to the project cash flow.

Let BPVx be the present value of benefits of a project x and CPVx be the present value of costs of the project x. Then, for MARR = i over a planning horizon of n years,

$$BPV_x = \sum_{t=0}^{n} B_{t,x}(1+i)^{-t} = \sum_{t=0}^{n} B_{t,x}(P|F,i,t)$$

$$CPV_x = \sum_{t=0}^{n} C_{t,x}(1+i)^{-t} = \sum_{t=0}^{n} C_{t,x}(P|F,i,t)$$

Where the symbol (P|F, i,t) is a discount factor equal to (1+i)-t and reads as follows: "To find the present value P, given the future value F=1, discounted at an annual discount rate i over a period of t years." When the benefit or cost in year t is multiplied by this factor, the present value is obtained. Then, the net present value of the project x is calculated as:

$$NPV_x = BPV_x - CPV_x$$

or

$$NPV_x = \sum_{t=0}^{n} (B_{t,x} - C_{t,x})(P|F,i,t) = \sum_{t=0}^{n} A_{t,x}(P|F,i,t)$$

If there is no budget constraint, then all independent projects having net present values greater than or equal to zero are acceptable. That is, project x is acceptable as long as

$$NPV_x \geq 0$$

V. DATA COLLECTION AND DATA ANALYSIS

To find the total benefit from the flyover 3 type of survey has been carried out here

A. CVC – Classified Volume Count:

This survey is conducted to understand the traffic characteristics in term of average daily traffic, traffic composition, peak hour traffic and directional split at individual survey locations. This survey is carried out during working days for the 14 hours (7:00 to 21:00) due to the less traffic found on the selected flyover after the 21:00 the survey is not conducted

B. Delay Survey:

Intersection improvements result in speeding up traffic and reducing jamming. Speed and delay studies on the existing facility provide the basis for estimating the causative problems and benefits of the improved facility. The study is conveniently conducted by the "Moving Observer" method in the peak hour. It is helpful to find out total fuel that is wasted at the intersection in the ideal condition of the vehicle.

C. Occupancy Survey:

It is obtained by manual observation technique of how many occupants within a vehicle over the selected flyover.

Table 1:

Name of Intersection			
KKV hall	Hour	No of vehicles	Vehicles in PCU
Raiya Telephon	7:00 to 21:00	17310	11856

e Exchange to Big Bazar mall side			
Big Bazar mall to Raiya Telephone Exchange side	7:00 to 21:00	16782	11548

Source: Survey carried out on working day

Table 2: Occupancy Survey at Rajkot City – 150 Ft. Ring Road

TYPES OF VEHICLES	OCCUPANCY
2W	1.54
3W	2.64
4W	3.11
BUS	38.28
LCV	2.4

Source: Survey carried out on working day during peak hour

Delay survey is carried out on a signalized intersection my moving observer method, total number of vehicle are converted into vehicle hour. From the occupancy survey we can find the total number of delay in passengers per hour. In this study area the total delay in passenger per hour for an annum is 719128

As per the current price list of petroleum the total number of passenger hours converted into amount of rupees. Here in this study area 2W and car are considered as petrol vehicle while truck and LCV are considered as diesel and auto as CNG

Table 3: Fuel Saving at Intersection

Type of fuel	Liter/year	Rs./liter	Amount in Rs.
Petrol	2,68,636	57.41	1,54,22,431
Diesel	42,887	50.78	21,77,837
CNG	33,995	48.34	16,43,349
TOTAL FUEL SAVING			1,92,43,619

Source: http//:www.petroleum.nic.in

Table 4: Travel Time Saving at Intersection

Type of vehicle	Delay in passenger (hour/day)	Travel time saving for passenger hour (in rs.)	Travel time saving (rs./year)
TW	245637	32	7860384
3W	80942	-	-
4W	342815	62.5	21425937
BUS	48902	39.5	1931629
LCV	832	-	-
TOTAL			3,12,17,950

Source: IRC SP 030: 2009

So total benefits that are generating from the flyover is about 5.04 Cr. Per annum. The total cost of construction of flyover is 25.50 Cr. as per the DPR. So benefit to cost ratio as per the equation B/C is about 1.02 after 12 years of construction here traffic projection is considered as based on IRC SP 030 about the 8% minimum growth of vehicle while Net Present Value (NPV) is positive.

Equation of NPV,

$$NPV = (Bi - Ci)/ [(1 + i) \wedge n] \quad (IN CR.)$$

Where, Bi = sum of saving in travel time cost and saving in fuel cost for the i year

Ci = maintenance cost for the i year

Bi – Ci = Net Benefit

(Bi – Ci)/ [(1 + i) ^n] = Discounted benefit

VI. Conclusion

An at-grade intersection was upgraded with an installation of a flyover at a cost of about Rs. 25.50 Cr., to increase capacity of the intersection and reduce vehicle delay and long queue at the at-grade level, the flyover is one of the methods that supported traffic volume about 30,000 – 35,000 vehicle/day.

In terms of benefits at the intersection the vehicle delays were reduced by saving tin travel time and saving in fuel cost that is about Rs. 26 Cr. after 12 years. The results of study, however, show that traffic signalization for both the existing at-grade situation and flyover upgraded situation has been and is still controlled by fixed time control plans, here is still long queue and delay especially on the major road.

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