

# Before and After Study of an Over Bridge – A Case Study of IIM-A Intersection

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*Abstract*— Ahmedabad is the seventh largest metropolitan and fifth largest city in India. Ahmedabad is known as financial hub of Gujarat. Many people arrive here in search of job or to settle, which increase congestion in the city. There are numerous places in Ahmedabad which are suffering from the congestion problem. Among them IIM-A cross road (Andhjan Mandal cross road) is the study area of the present research work, at which over bridge is constructed in order to reduce traffic congestion. As user benefit is prior concern in any transport project, project should fulfill its requirement. To check present ground condition, evaluation is carrying out. This paper tries to evaluate over bridge performance and impact on traffic condition.

**Key words:** Traffic Congestion, User Benefit, Economic Evaluation, Travel Time Saving, Over Bridge Performance

## I. INTRODUCTION

It has been observed that, since past few decades, due to increase in income and in the absence of insufficient, fast and reliable public transport system more and more people are shifting to personal vehicles in most of the cities, which results in massive growth of automobile population around the world. It is observed that every year vehicle population increases in haphazard manner. To cope up with this situation, it is very difficult to provide extra land as per the demand. One needs to provide alternate arrangement to reduce or to stop traffic congestion. For this purpose, signal design at intersection or an over bridge or under pass structure at this location, is possible alternate. Over bridge or under pass type structures are provided after proper prior studies. But sometimes it may be possible that at the end of project user might not be able to get fruitful result.

This research work tries to evaluate over bridge performance at the IIM-A intersection in context to traffic congestion reduction as well as economic benefits. For this purpose variety of surveys were carried out at intersection like CVC survey, stopped delay survey and spot speed calculation survey. From the analysis of data, impact of an OB on traffic condition and economic benefit generated by presence an OB is calculated. Calculation is also carried out based on the assumption that if over bridge was provided parallel to 132 feet ring, what would be its effect on traffic flow condition and how much economical advantage would be generated.

## II. PROBLEM DEFINITION

There was a mammoth problem of traffic congestion at IIM intersection. Flyover at IIM intersection (Andhjan mandal) is provided in transverse direction of 132 feet ring road connecting Panjrapole to Vastrapur to reduce delay at IIM

junction. Reduction in delay due to over bridge construction was thought. But it seems that traffic is not reducing as per assumptions. This leads to the evaluation based on finance as well as traffic engineering perspective, whether IIM over bridge fulfill its presumptions or not.

## III. OBJECTIVE OF STUDY

As IIM-A over bridge is already constructed and it is in use by the road users, it is necessary to justify its application at this location. To evaluate and understand the above project, following objective related to the study is listed as bellow.

- To calculate user travel time saving and fuel consumption saving due to construction of an over bridge.

## IV. SCOPE OF STUDY

Traffic characteristics of area like IIM, Shivranjani, Vastrapur and Polytechnic leads to very high congestion at IIM-A intersection in the past before over bridge design. Study of this project mainly focus on intersection at IIM-A over bridge in order to carry out economic assessment. In order to assess the field situation, field surveys like classified volume count survey, spot speed survey and delay survey will be carried out.

## V. SELECTION OF THE STUDY AREA

The Panjrapole-IIM-A-Vastrapur stretch is a key artery in Ahmedabad's road network. This flyover is running perpendicular to 132 feet ring road. Every day, during office hours, this stretch becomes a major traffic bottleneck. The BRTS corridor simply adds to the woes. According to a traffic survey, IIM-A crossroads get extremely congested with traffic, to cop up with this traffic over bridge was provided.

The IIM flyover is the only flyover that at right angles to the other three bridges between Sola, AEC crossroads and Shivranjani. All these are parallel to the Ring Road. What is even more dangerous is that vehicles, which tend to zoom down flyovers, could then face the possibility of traffic accidents at the bottleneck of Vastrapur village. As one descends the flyover one will have to hit the brakes as one will immediately hit the bottleneck. This area has space for only two lanes moving to and fro, while the flyover along and side lanes will bring three lanes of traffic in one direction.

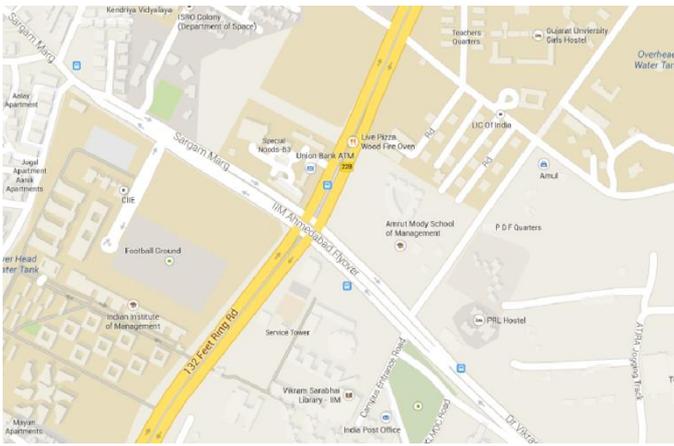


Fig. 1: Goggle image of study are

The bridge measure 520 meters in length and 13.5 meters wide. The area under the bridge measures around 1,340 sq. meters. AMC is planning to develop this area for recreational purposes. The auditorium will have a center stage, waiting area, information room, mini conference hall and other state of the art facilities.

### VI. ECONOMIC ANALYSIS

The Traffic volume at IIM-A intersection was continuously increasing day by day. Also there was tremendous accident hazard during peak hour due to the heavy traffic in the area. To overcome this problem over bridge is constructed. In view of the above an attempt has been made to evaluate the cost and benefits in terms of fuel consumption, travel time saving by an over bridge construction. Analysis of collected data converts user travel time saving and fuel consumption into monetary terms. This has been done based on the volume count and simultaneous delay survey carried out during total survey time of 3.5 hours. There are two alternatives for evaluating performance of IIM-A over bridge. One alternative is to compare it with the past condition and another alternative is to judge the effect on travel time and fuel consumption saving if the over bridge was constructed parallel to 132 feet ring road.

#### A. Analysis of data results

The vehicle hours computed is converted into passenger-hours based on vehicle occupancy. (Table 1)

Type of Vehicle	Occupancy
TW	1.6
3W	2.4
Car	1.8
LCV	1.2
Bus	52

Table 1: Vehicle Occupancy Table

Idle fuel consumption of the delayed vehicles is analyzed by taking the total delay in vehicle hours of each vehicle group multiplied by corresponding PCRA Idle fuel consumption coefficients. Idle fuel consumption coefficients of vehicles are as follows. (Table 2)

Type of Vehicle	Idle fuel consumption litre/hour
TW	0.34

3W	0.42
Car	0.54
LCV	0.69
Bus/Truck	0.86

(Source: PCRA Study 1996)  
Table 2: Idle fuel Consumption

From the analysis of classified volume count survey data one can see that the vehicle share percentage of different vehicles varies greatly and these vehicles run on diverse kind of fuel (Petrol, Diesel and CNG). Even vehicles of same category use dissimilar type of fuel. Proportion of vehicles according to fuel usage is given below. (Table 3)

Type of Vehicle	Diesel	Petrol	CNG
Car	29%	39%	32%
3w	15%	2%	83%
Bus, Truck, LCV	95%	1%	4%
TW	0%	100%	0%

Table 3: Proportion of vehicles according to fuel usage

With the help of data shown in above tables, one can carry out economic analysis for both alternatives.

#### B. Comparing present situation with past condition

Before an over bridge construction vehicles had to stop at intersection. Existence of an over bridge helps vehicles to eliminate junction which are moving from Panjrapole to Vastrapur and vice versa, which leads to saving in user travel time. Calculation of saving in delay per vehicle per cycle is shown in table below. (Table 4)

Direction	Morning	Evening
From Panjrapole	101	95
From Vastrapur	96	100
Average delay = 98 seconds		

Table 4: Delay during total survey time (in seconds) on Panjrapole – Vastrapur stretch

The computation of the passenger-hours lost in the form of delay for each type of vehicle is calculated and given in the following table. This computation is done for the peak hour and then converted into appropriate unit. As per study of CEPT, proportion of peak hour traffic is 10.16% of 1 day traffic volume at IIM-A intersection. (Table 5)

Vehicle Type	No. of vehicles passing during peak hour	No. of vehicles benefitted by an OB construction during 1 day
TW	2974	26298
3W	481	4252
Car	1416	12517
LCV	35	309
Bus/Truck	21	213
Cycle	84	185
<b>Total</b>	<b>5011</b>	<b>43774</b>

Table 5: Total No. of vehicles passing through an intersection on Panjrapole - Vastrapur stretch Per Day if OB is not present

By multiplying saving in delay with total number of vehicles benefitted by an over bridge construction vehicle hour savings per day could be found out. (Table 6)

Vehicle Type	No. of Vehicles	Savings in vehicle time in seconds	Savings in vehicle time in hours/ day
TW	26298	2577204	716
3W	4252	416696	116
Car	12517	1226666	341
LCV	309	30282	8
Bus/Truck	213	20874	6

Table 6: Savings in vehicle time in hours/ day

And by multiplying savings in vehicle time in hours/day with vehicle occupancy, savings in vehicle time in passenger hours/day could be found out. (Table 7)

Vehicle Type	Savings in vehicle time in hours/day	Passenger Occupancy	Savings in vehicle time in Passenger hours/day
TW	716	1.6	1146
3W	116	2.4	278
Car	341	1.8	614
LCV	8	1.2	10
Bus/Truck	6	52	312

Table 7: Savings in vehicle time in passenger hours/day

Finally by multiplying savings in vehicle time in passenger hours/ day with travel time saving in Rs. / Passenger – hour, calculation of travel time saving in Rs. / year is carried out. (Table 9)

The following average occupancy value is adopted for different modes keeping in view the type of land use in the study are. (Table 8)

Type of Vehicle	Travel Time Saving in Rs./ Passenger - hour
TW	Rs. 67.48
3W	Rs. 10.23
Car	Rs. 34.81
Bus	Rs. 10.23

(Source: DMRC 1996 study)

Table 8: Travel Time Saving in Rupees

Veh. type	Savings in vehicle time in Passenger hours/day	Travel Time Saving in Rs./ Passenger - hour	Travel Time Saving in Rs. / day	Travel Time Saving in Rs. / year
TW	1146	67.48	77332	28226209
3W	278	10.23	2844	1038038
Car	614	34.81	21373	7801269
LCV	10	10.23	102	37340

Bus/ Truck	312	10.23	3192	1164992
<b>Total</b>				<b>3,82,67,848</b>

Table 9: Travel time saving in Rs. / Year

To find out money saving due to fuel consumption saving, first of all vehicles benefitted by an over bridge construction is to be found out. Then from idle fuel consumption litre / hour and delay time saving, fuel consumption saving is calculated. Fuel saving is then divided with respect to vehicle fuel usage type and multiplied by respective fuel price. (Table 10), (Table 11)

Veh. Type	No. of Veh. benefitted by an OB constr. in 1 day	Fuel saving during 1 day in litres	Saving in Petrol (litre)	Saving in Diesel (litre)	Saving in CNG (kg)
TW	26298	243	243	0	0
3W	4252	49	1	7	41
Car	12517	184	72	53	59
LCV	309	6	0	6	0
Bus / HCV	213	5	0	5	0

Table 10: Fuel saving in 1 year

Vehicle Type	Money saving in 1 day as per respective fuel price	Money saving in Rs. in 1 year
TW	16164	5899860
3W	2369	864685
Car	10471	3821915
LCV	331	120815
Bus / Truck	276	100740
<b>Total</b>		<b>1,08,08,015</b>

Table 11: Saving of money during 1year through fuel consumption saving

Summation of fuel consumption saving and travel time saving in rupees indicates total money saving during 1 year. (Table 12)

Sr. No.	Saving	Amount in Rs.
1	Travel Time Savings	3,82,67,848
2	Fuel Savings	1,08,08,015
	<b>Total</b>	<b>4,90,75,863 Rs.</b>

Table 12: Total money saving in year in existing condition C. Estimation of benefits if over bridge would be parallel to 132 feet ring road (Alternate – 2 assumed scenario)

This is an assumption as well as second alternative of economic analysis. If an over bridge would have been constructed parallel to 132 feet ring road (Shivranjani – Helmet circle stretch) then vehicles going from Shivranjani to Helmet circle do not have to stop and vice versa. Economic analysis is carried out as per previous calculation.

Calculation of delay time saving for the vehicles which are travelling from Shivranjani – Helmet circle stretch and vice versa is shown below. (Table 13)

Direction	Delay during total survey time (in seconds)	
	Morning	Evening
From Shivranjani	83	82
From Helmet Circle	82	82
<b>Avg. delay per vehicle = 82 Seconds</b>		

Table 13: Delay during total survey time (in minutes) on Shivranjani – Helmet circle stretch

It is assumed that proportion of peak hour traffic is 10.16% of 1 day traffic volume at IIM-A intersection, as per study of CEPT. (Table 14)

Vehicle Type	No. of vehicles passing during evening peak hour	No. of vehicles passing during 1 day
TW	4508	39851
3W	360	3182
Car	1374	12146
LCV	54	477
Bus/Truck	102	902
<b>Total</b>	<b>6976</b>	<b>61668</b>

Table 14: Total No. Vehicles get benefitted by an OB if it was provided on Shivranjani – Helmet circle stretch

By multiplying saving in delay with total number of vehicles benefitted by an over bridge construction vehicle hour savings per day is found out. (Table 15)

And by multiplying savings in vehicle time in hours/day with vehicle occupancy, savings in vehicle time in passenger hours/ day is found out (Table 16)

Veh. Type	No. of Vehicles	Savings in vehicle time in seconds	Savings in vehicle time in hours/ day
TW	39851	3267782	908
3W	3182	260924	72
Car	12146	995972	277
LCV	477	39114	11
Bus/Truck	902	73964	21

Table 15: Savings in vehicle time in hours/ day

Veh. Type	Savings in vehicle time in hours/day	Passenger Occupancy	Savings in vehicle time in Passenger hours/day
TW	908	1.6	1453
3W	72	2.4	173
Car	277	1.8	499
LCV	11	1.2	13

Bus/Truck	21	52	1092
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Table 16: Savings in vehicle time in passenger hours/day

Finally by multiplying savings in vehicle time in passenger hours/ day with travel time saving in Rs. / Passenger – hour, calculation of travel time saving in Rs. / year is carried out. (Table 17)

Veh. type	Savings in vehicle time in Passenger hours/day	Travel Time Saving in Rs./ Passenger - hour	Travel Time Saving in Rs. / day	Travel Time Saving in Rs. / year
TW	1453	67.48	98048	35787520
3W	173	10.23	1770	645973
Car	499	34.81	17370	6340119
LCV	13	10.23	133	48541
Bus/Truck	1092	10.23	11171	4077473
<b>Total</b>				<b>4,68,99,788</b>

Table 17: Travel time saving in Rs./ Year

To find out money saving due to fuel consumption saving, all vehicles which are benefitted by an over bridge construction is to be found out. Then from idle fuel consumption litre / hour and delay time saving, fuel consumption saving is calculated. Fuel saving is then divided with respect to vehicle fuel usage type and multiplied by respective fuel price (as on date 14/05/2015). (Table 18), (Table 19)

Veh. Type	No. of Veh. benefitted by an OB constr. in 1 day	Fuel saving during 1 day in litres	Saving in Petrol (litre)	Saving in Diesel (litre)	Saving in CNG (kg)
TW	39851	908	908	0	0
3W	3182	72	2	11	59
Car	12146	277	108	80	89
LCV	477	11	0	11	0
Bus	902	21	0	20	1

Table 18: Fuel saving in 1 year

Vehicle Type	Money saving in 1 day as per respective fuel price	Money saving in Rs. in 1 year
TW	60400	22046058
3W	3498	1276828
Car	15759	5751856
LCV	607	221508
Bus / Truck	1150	419805
<b>Total</b>		<b>2,97,16,055</b>

Table 19: Saving of money during 1 year through fuel consumption saving

Summation of fuel consumption saving and travel time saving in rupees indicates total money saving during 1 year. (Table 20)

Sr. No.	Saving	Amount in Rs.
1	Travel Time Savings	<b>4,68,99,788</b>
2	Fuel Savings	<b>2,97,16,055</b>
	<b>Total</b>	<b>7,66,15,843 Rs.</b>

Table 20: Total money saving in year in existing condition

From the data supplied by AMC, the cost of the ROB construction was 20 crores in March 2013 while at present the savings as per the alternative 1 comes out to be 4,90,75,863 Rs., which comes out to be about 24.5% of construction cost of ROB. For the second alternative, parallel to 132 feet ring road the savings as per the present data comes out to be 7,66,15,843 Rs., which is far more than the alternative 1 and it is also an effective solution for the intersection into the above case study. In this case construction cost would be 34 crores (source: HCP feasibility report, September 2012) and saving would be about 22.5% of construction cost of ROB. So as per ROR concern, 1st alternative is good option.

## VII. CONCLUSION

Following are the important observations from the surveys, study and analysis.

- Total number of vehicles benefitted by an over bridge construction in one day are 43774.
- Average delay time saving per vehicle passing from Vastrapur to Panjrapole and vice versa is 98 seconds.
- Due to over bridge construction saving in travel time cost Rs. 3,82,67,848 per year.
- Saving in fuel consumption cost Rs. 1,08,08,015 per year.
- If over bridge was constructed parallel to 132 feet ring road instead of perpendicular direction, total saving of money during one year would be Rs.7,66,15,843.
- If OB was provided parallel to 132 feet ring road (Shivranjani – Helmet Circle Stretch), than it would be more beneficial as yearly advantage on this stretch compare to existing OB is Rs. 2,75,39,980 (Rs.7,66,15,843 - Rs. 4,90,75,863) more.
- Number of vehicles that would be pass in one day if OB would be parallel to 132 feet road are 61668, which are more than the number of vehicles which are passing on Panjrapole – Vastrapur stretch (43774).
- As per ROR concern existing direction of an over bridge is appropriate as its yearly benefits (24.5%) is more than assumed direction (22.5%)

## ACKNOWLEDGEMENT

I would like to express my sincere gratitude to **Prof. Dr. A. M. Jain** for initial spark and subsequent valuable guidance in my research work. His teaching has helped me in formatting the strategy and methodology for my research paper work. His prolonged contact with me during the

formulation of my report helped to achieve the required result in a pragmatic and presentable manner.

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