Impact Factor (SJIF): 3.632

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 3, Issue 4, April-2016

Justification of Rail-Over-Bridge with Economic Evaluation a Case Study of "Vastrapur Rail Crossing at Vejalpur"

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Abstract— Developing country like India, an adequate and efficient transportation system is necessary for economic growth. Success of a city mainly depends on effective delivery of urban services of which efficient transportation system can identify as the key elements. Traffic congestion is major problem for smooth flow of vehicles in city transportation network. With increasing in number of vehicles due to increasing of population in the city it may increasing delay time and create traffic jam problem at intersection of road and rail cross. Road traffic has been growing with very rapid rate i.e. 8% per annum (as per IRC), hence the traffic intensity and volume on the road is high.

Ahmedabad is a seventh largest metropolitan city in India. There are a number of places in Ahmedabad which suffering from the heavy traffic congestion. Among them vastrapur rail crossing which located at vejalpur is study area of the present research work, at which over bridge should be advisable due to heavy traffic congestion. From the research work it show that there is fixed delay foe 1 hr and 40 minutes in 24 hr. due to gate closing. The number of vehicles passing through the crossing is 33180 vehicle/day. The number of vehicle delay time is 36600 minutes per day. From the analysis it conclude that the total travel time saving and fuel saving is 2,10,73,549 and 70,52,000 per year due to construction of flyover at particular location. From the data collection and data analysis different methods like Net Present Value (NPV), Benefit-Cost ratio (B/C), Internal Rate of Return (IRR) and Sensitive analysis are used for economic evaluation.

Keywords-component: transportation system, traffic congestion, rail over bridge, Economic Evaluation

I. INTRODUCTION

An efficient transportation network is necessary for healthy economy of the country. Good transportation is a fundamental requirement for society to achieve a better quality of life. To meet the demand of 21st century, transportation links need to be efficient, fast, people friendly and sensitive to the environment.

Transportation is the critical underpinning upon which the industrial and technological complex of the nation is based. Transportation is the life-line of any Transportation plays a very important role in economical and social development of the country. Fixed facilities are the physical components of the system that are fixed in space and constitute the network link (e.g., roadway, segment, railway track, and pipes) and nodes (e.g., intersectionscountry. Because of all walks of life without transportation the progress or development of any country is impossible., interchange, transit terminal, harbour, and airport) of transportation system.

It observed that from past few decades due to increasing in income and due to insufficient public transportation system more people are shifting to personal vehicle in most cities, which result in increasing in growth of personal vehicle in the city and result in traffic congestion problem in the city. It show that every year number of vehicle increasing with high rate. In the city it is not possible to stop traffic and it is very difficult to provide extra land as per traffic demand.

Level Crossings are provided for vehicles, pedestrians and animals to cross over railway lines. They exist in countries all over the world and in many different types. Level crossings are definitely impediment to free flow of traffic on approach roads. Due to traffic hold up and road accidents, level crossings are still identified as being a weak point in transportation infrastructure. This constitutes a difficult problem to be solved by Rail Authorities and Department. Indeed, Railways cannot control the actions of road vehicle drivers and pedestrians at level crossings. To minimize the risk of train striking the road users at crossings, some of the level crossing is manned while others are unmanned.

At intersection and rail crossing traffic jam problem may causes more delay time and fuel consumption due to frequently stoppage of vehicle. Thus alternative must be providing to reduce traffic congestion at intersection and rail crossing. To overcome this problem, signal design or over-bridge or under-pass is possible alternative. Over-bridge and Under-pass are costly structure as compare to signal design. Thus Over-bridge or Under-pass type of structure provide at particular location after proper prior studies.

II. STUDY AREA

Vejalpur is a neighbourhood in the New West Zone of the metropolitan city of Ahmedabad in the Indian state of Gujarat.

Vejalpur (Gujarat) is geographically located at latitude (23.006145 degrees) 23°00'22.1" North of the Equator and longitude (72.516488 degrees) 72°30'59.4" East of the Prime Meridian on the Map of the world.

As of 2001 India census, Vejalpur had a population of 113,304. Males constitute 52% of the population and females 48%. Vejalpur has an average literacy rate of 80%, higher than the national average of 59.5%: male literacy is 84%, and female literacy is 77%. In Vejalpur, 11% of the population is under 6 years of age.

Vejalpur is declared as independent assembly constituency. Vejalpur, Jodhpur and Sarkhej are the three ward of vejalpur assembly.

Figure 1. Location of Vastrapur Railway crossing

III. IDENTIFYING THE STUDY PROBLEM

At satellite-Butbhavani road (vejalpur) and vastrapur railway intersection the provided level crossing is closed by gate on road whenever train is passing as per schedule. Due to heavy traffic the long queue formed at both side of road. At an intersection no. of time in day, especially during peak hour in morning and evening as accumulated traffic is heavy on both side of road which causes delay Due to this-

- Increase in fuel consumption
- Increase in travel time,
- Increase in air and
- Noise pollution.
- Congestion affects mental power and efficiency of users.

Figure 2. Traffic Congestion on Vastrapur Rail Crossing

IV. METHODOLOGY

It is required to frame the methodology to be followed before starting the actual research work. For the justification of flyover study, data works as raw material for analysis, planner and design maker. Without qualitative and detail data, scientific analysis becomes difficult.

To achieve the objectives a methodology is framed. Complete flowchart of each activity showing various stages involved is shown in fig. For this work study area is to identified for collecting data. Main stretches of the study area identify the problems, such as delay in travel time, loss of fuel consumption, air pollution, noise pollution. Traffic data are collected from location and is used for analysis purpose. Economic evaluation is carried out for the traffic data to find travel time saving and fuel saving.

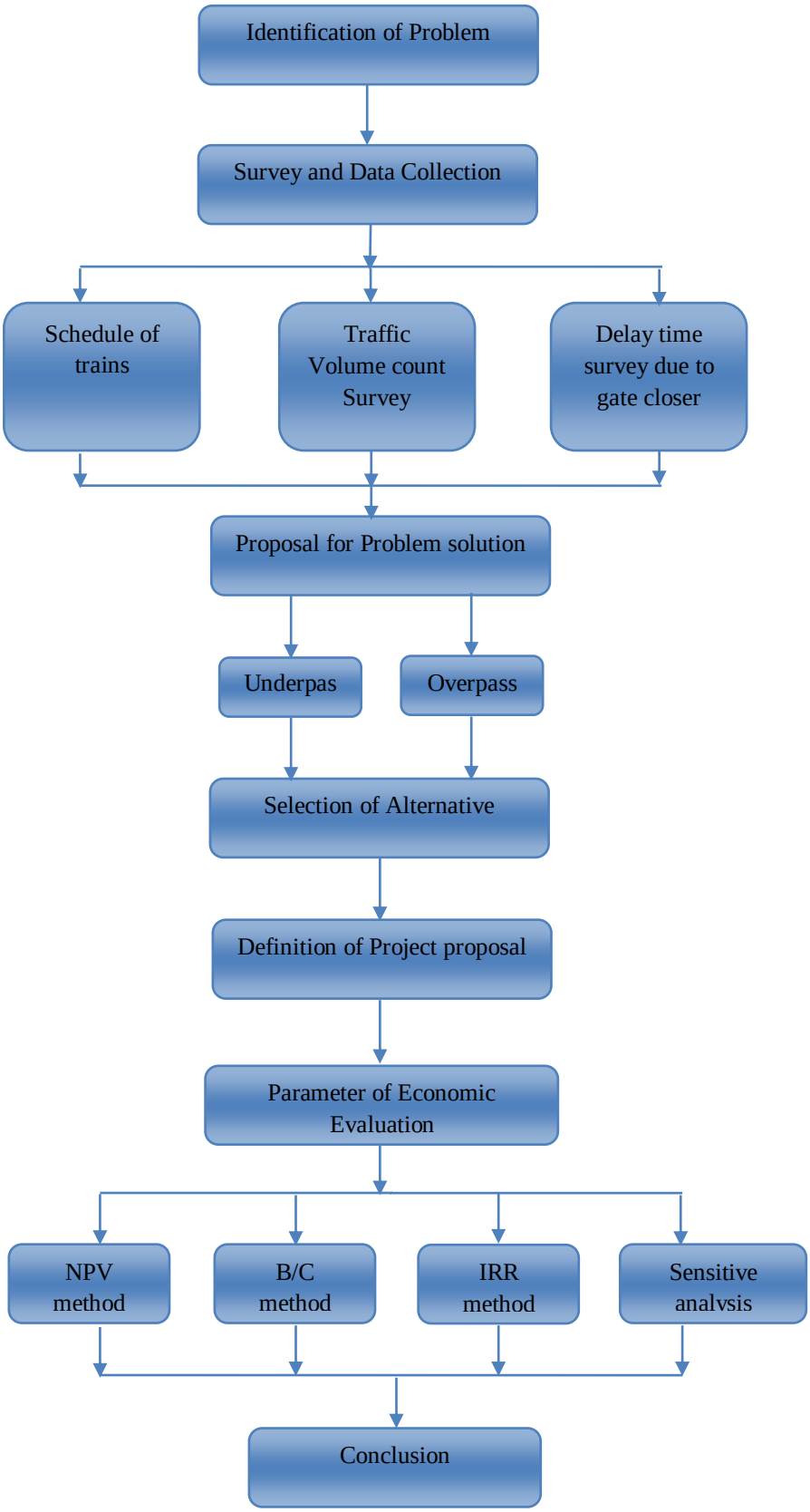

Figure 3. Methodology Flow Chart

V. DATA COLLECTION

It is necessary to collect relevant data for carrying out the study. The various traffic surveys conducted are

1. Traffic Classification and Volume
2. Pedestrians Volume
3. Frequency and duration of Gate closure of level crossing gate
4. Traffic delay Survey

Table 1 Volume Count Survey

Direction	Satellite to Butbhavani		Butbhavani to Satellite	
	(In vehicle)	(In PCU)	(In vehicle)	(In PCU)
2-Wheelers	10568	5284	10694	5347
3-Wheelers	3055	3055	2612	2612
Car/Jeep	2095	2095	1827	1827
Bus	105	315	97	291
Trucks/LCV	79	237	73	219
Cycles	1052	526	923	462
Total	**16954**	**11512**	**16226**	**10758**

On one day the survey is carried out for 15 hours from 7.00 a.m. to 9.00 p.m. at vastrapur crossing. From above table it can be observed that at vastrapur crossing from Satellite to Butbhavani side 16954 vehicles are moving and from Butbhavani to Satellite side 16226 vehicles are moving.

A. Frequency and Duration of Gate Closure

From the study there are 9 number trains passing through this line. The gate closed per day was observed around 100 minute due to shutting operation of trains. This crossing is closed during peak hour six times which create inconvenience to road users. The gate closer table is given below:

Table 2 Gate Closure Details

Time		Total Minutes	Type of Train	No. Of Train
From	To			
7.20	7.25	5	Passenger Train	1
8.09	8.15	6	Passenger Train	1
9.02	9.10	8	Passenger Train	1
9.23	9.29	5	Passenger Train	1
10.16	10.22	6	Goods Train	1
16.10	16.15	5	Passenger Train	1
17.48	17.54	6	Passenger Train	1
18.19	18.25	6	Passenger Train	1
20.19	20.24	5	Passenger Train	1
Total		52		9

B. Vehicle affected by gate closure

From the study, it can be observed that total of 4151 vehicles affected in both the direction due to gate closure per day for the 52 sec around 25% of the total traffic volume.

Table 3 Vehicle affected by

Direction	Satellite to Butbhavani	Butbhavani to Satellite	Total
	(In vehicle)	(In vehicle)	
2-Wheelers	1419	1433	**2852**
3-Wheelers	266	245	**511**
Car/Jeep	205	190	**395**

Direction	Satellite to Butbhavani	Butbhavani to Satellite	Total
	(In vehicle)	(In vehicle)	
Bus	13	11	**24**
Trucks/LCV	11	10	**21**
Cycles	182	166	**348**
Total	**2096**	**2055**	**4151**

C. Delay Vehicle per minute

From below fig we can say that for two wheelers, three wheelers, car, bus, LCV and cycle the delay time is 7.46, 11.09, 15.83, 16.73, 9.23, 8.22, minutes.

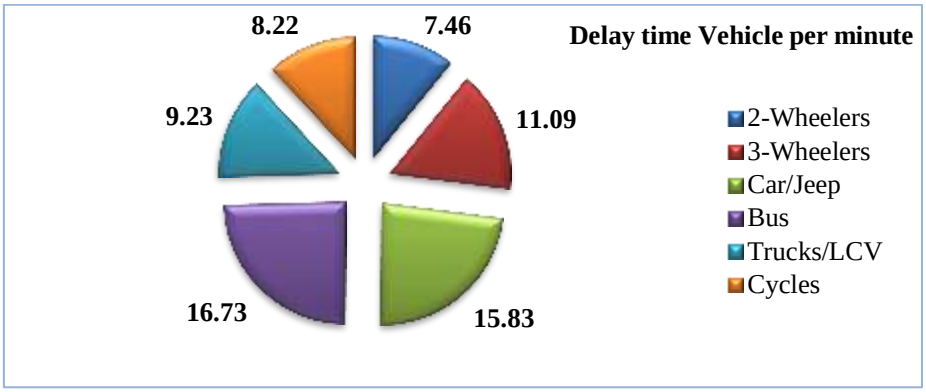

Figure 4. Delay time vehicle per minute

VI. ECONOMIC ANALYSIS

The data collected through field survey at identified crossing were computerized and analyzed primarily in view the following.

- To assess the total average delay to traffic which is further used for compiling the ideal fuel usage quantification
- To assess the total traffic and vehicles composition during peak hours.

The vehicle hours is converted into passenger-hours based on vehicle occupancy. The following average occupancy values are adopted for different mode keeping in view the type of land use in study is.

Table 4 Vehicle Occupancy

Type of Vehicle	Occupancy
2-Wheelers	1.8
3-Wheelers	2.4
Car/Jeep	2.0
Bus	64
Trucks/LCV	1.4

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 peak hour.

Table 5 Total Passenger hours at Vastrapur Railway Crossing

Type of Vehicle	No. of Vehicles Delayed	Delay in Vehicle Hours	Delay in Passenger-hours per day	Delay in Passenger-hours per year
2-Wheelers	2852	354	638	232819
3-Wheelers	511	94	227	82738
Car/Jeep	395	104	208	76076
Bus	24	7	428	156325
Trucks/LCV	21	3	5	1651
Cycles	348	48	48	17402
				5,67,011.09

Ideal fuel consumption of the delayed vehicles is analyzed by taking the total delay in vehicles group multiplied by corresponding PCRA ideal fuel consumption coefficient. Ideal fuel consumption coefficient of vehicles is as follows.

Table 6 Ideal fuel consumption

Type of Vehicle	Ideal Fuel Consumption (Lt/Hr.)
2-Wheelers	0.34
3-Wheelers	0.42
Car/Jeep	0.54
Bus	0.86
Trucks/LCV	0.89

(Source: PCRA study 1996)[10]

Based on traffic analysis and delay characteristics at the selected crossing, it has been worked out that on average daily 92000 litters of petrol and 11000 litters of diesel are estimated to be wasted due to idling of vehicles.(Source PCRA study 1996)

Table 7 Total Fuel Consumption, Costs and Emissions of Delayed Vehicles at Study Corridor

Fuel	Litters/Year	Rs/Litter	Amount in Rupees
Petrol	98000	64	6272000
Diesel	15000	52	780000
Total			**70,52,000**

The Vehicle-hours computed are converted into passenger-hours based on vehicle occupancy. The following average occupancy value is adopted for different modes keeping in view the type of land in the study are

Table 8 Travel Time Saving in Rupees

Type of Vehicle	Travel time saving in Rupees/passenger-hr
2-Wheelers	₹ 67.81
3-Wheelers	₹ 34.93
Car/Jeep	₹ 10.31
Bus	₹ 10.31

A. Evaluation of Travel-Time Saving

These value are used for evaluating the travel time saving for vehicles at vastrapur crossing.

Table 9 Travel Time Saving at Vastrapur Crossing

Type of Vehicle	Delay in Passenger-hours per year	Travel time saving in Rupees/passenger-hr	Travel Time Saving, Rs. Per year
2-Wheelers	232819	₹ 67.81	₹ 157,87,456.39
3-Wheelers	82738	₹ 34.93	₹ 28,90,038.34
Car/Jeep	76076	₹ 10.31	₹ 7,84,343.56
Bus	156325	₹ 10.31	₹ 16,11,710.75
Trucks/LCV	1651	-	-
Cycles	17402	-	-
	5,67,011.09		**₹ 210,73,549.04**

From the above table we can conclude that with the construction of over bridge we can achieve following benefits in terms of rupees.

Table 10 Benefit after construction of ROB

No.	Saving	Amount in Rs.
1	Travel time saving	₹ 210,73,549
2	Fuel saving	₹ 70,52,000
Total		**₹ 281,25,549**

B. Construction Cost of ROB

As from the present municipal bridge construction we can assume total bridge construction cost. Approximately total bridge construction cost is 25 cr. It is approximate assume that construction period is 2 years. The equal distribution of fund is assumed during the construction period,

1) Year 1, 50% of initial capital cost
2) Year 2, 50% of initial capital cost
3) Maintenance cost of ROB is 28,00,000 per year. With the help of above cost value we will go for economic evaluation. For economic evaluation we go for following methods.

C. Calculation for Various Method of Economic Evaluation

With help of above data economic evaluation of rail over bridge at selected study area can be done by various method of it and get a results of different method as per below table.

Table 11 Results of Economic Evaluations by different methods

NPV Value	B/C Ratio	IRR Value
10.93 Cr	1.42	16.2%

VII. CONCLUSION

Following conclusion are made from the above study-

1. Total number of vehicles affected due to gate closure duration of 1 hr and 40 minutes was found to be 4151. The number of vehicles passing through the crossing is 33180 vehicles/day and 22270 PCU/day.

2. In the Economic analysis
- NPV value is 10.93 cr., which is positive. Hence project is justified.
- B/C value is 1.44, which is greater than 1. Hence project is justified.
- IRR is 16.2 %, which is more than 15%. Hence project is justified.
- Sensitive analysis is carried out to check following possible consequences

Table 12 Sensitive Analysis

Assumption	B/C Value	Check
Benefits reduced by 15%	1.22	>1
Cost increased by 15%	1.25	>1
Both Benefits reduced by 15%, Cost increased by 15%	1.06	>1

3. By implementation of the ROB project following benefits are proposed.
- Saving in travel time cost is ₹ 210,73,549 per year
- Saving in fuel is ₹ 70, 52,000 per year.
- Saving in vehicle ideating cost.
- The accident hazards at level crossing is eliminated
- Increase in convenience and comfort of passengers.
- Increase in value of properties and land adjacent nearer to the bridge.
- Increasing in safety.
- Increasing in aesthetic of the city.
- Increasing in the speed of various vehicles.

I. ACKNOWLEDGEMENT

The author would like to express their sincere thanks to family and freinds for their unbelievable amount of help.

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