Feasibility of Flyover at Kalol Railway Crossing

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***Abstract*- Flyover construction on kalol railway crossing will be economically viable or not was determined. All over the world railway crossing are made for the efficient movement of man and vehicles with safety as a main consideration. Kalol city in Gandhinagar district of Gujarat (India) has only one existing manned railway crossing. This railway crossing has single working railway line and a levelled intersection connecting arsodiya village and kalol (east) to the rest of kalol and state highway 41. This rail road crossing is located in the highly populated area of kalol which is next to the kalol railway station on one side and sintex industry (plastic industry) on other side. This congested area leads to traffic problems at railway crossing. Study aims to select the best alternative among the other alternative to avoid the congestion on railroad intersection, by the means of traffic volume count survey, responder survey, delay survey and economic analysis. This survey helps to determine the future steps to be undertaken to solve transportation problems at kalol. By the means of different survey and adopting standard codes economic analysis is done for the kalol railway crossing. Study suggests best alternatives among other alternatives to improve transportation facility for kalol railway crossing.**

Index Terms- Delay Survey, Economic Evaluation, Passenger Car Unit (PCU), Railway Crossing, Responder Survey, Traffic Volume Count (TVC).

I. INTRODUCTION

Economy of any country depends mainly on transportation facilities. Good transportation facilities provide a fundamental requirement for society to achieve a better quality of life style. In this 21st century transportation play a vital role, transportation need to be efficient, fast, user friendly and should not show dangerous impact to environment and its flora and fauna. Transportation has helped movement of mankind and its requirement to set a civilization from the ancient times. Roads or highway are one form of the means of transporting men and material from one place to another place. Transportation is the critical underpinning upon which the industrial and technological complex of the nation is based. At rail crossing traffic congestion problem may causes more delay time and fuel consumption is more due to frequently stoppage of vehicle. Thus alternative must be provide to reduce traffic problems at intersection and rail crossing. To overcome this problem, signal design or over-bridge or under-pass is possible alternative.

II. STUDY AREA

Kalol city is a taluka in gandhinagar district of Gujarat state. City is having population of about 1,33,737 (2011),it has density of 5300/sq.km. City is largest in terms of area as compared to other taluka of gandhinagar. City is well connected by national and state highways, broad-gauge railways and bus station. The city transportation is mainly dependent on roadway system. Vehicle growth has been rapid. The network is expressing heavy traffic congestion, noise pollution and air pollution.

Kalol is divided into four major areas: Kalol East, Kalol center, Kalol West, New Panchvati. Kalol east and rest of kalol is separated by railway line of national importance running between middle of the city. In East side there are industries like Sintex (Plastic Industry) Bharat Vijay Mill (Textile Industry) among others and also includes residential area.

At Kalol 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 is formed on both side of road. Below arrow shoes study area

III. METHODOLOGY

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

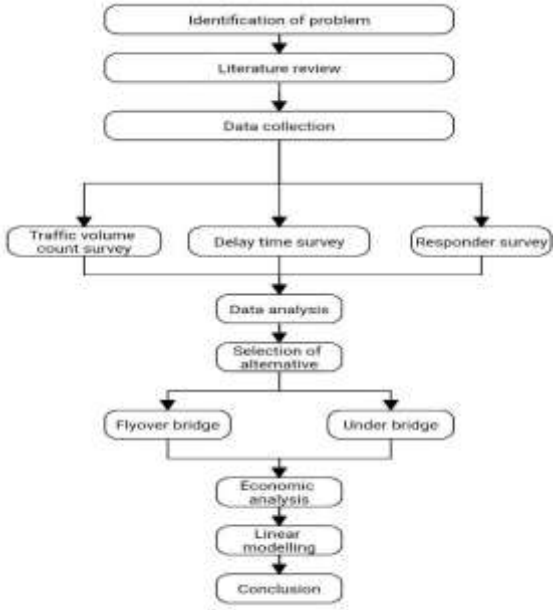


FIGURE 2. Methodology Flow Chart

IV. DATA COLLECTION

A. TRAFFIC VOLUME COUNT (TVC)

Traffic volume count for peak hours (three hours) in morning and evening for both the side of railway crossing was collected manually. Traffic volume count for each 15 Minutes interval from 7 AM to 10 AM in morning and 5 PM to 8 PM in evening was collected for three days, which is 10/09/2018 (Monday), 11/09/2018 (Tuesday) and 12/09/2018 (Wednesday).

VEHICLE CLASS	EQUIVALENT FACTOR
CYCLE (N.M.V),BIKE (2W)	0.5
THREE WHEELER (3W), CAR (4W)	1
LIGHT COMMERCIAL VEHICLE (L.C.V)	1.5
HEAVY COMMERCIAL VEHICLE (H.C.V)	3

On the basis of below chart from IRC 106, PCU (passenger car unit) were calculated from the collected traffic volume count.

TABLE 1. PCU FACTORS

Below data shows combined PCU of morning and evening peak hours on Monday.

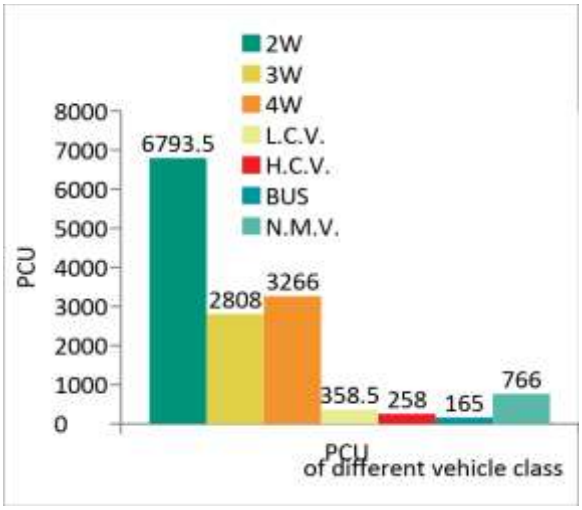


FIGURE 3. PCU ON MONDAY

Below data shows combined PCU of fmorning and evening peak hours on Tuesday.

VEHICLE	DELAY PER VEHICLE (MINUTES)
2W	7.25
3W	10.22
CAR	16.02
L.C.V/H.C.V	16.38
BUS	9.22
NMV	8.48

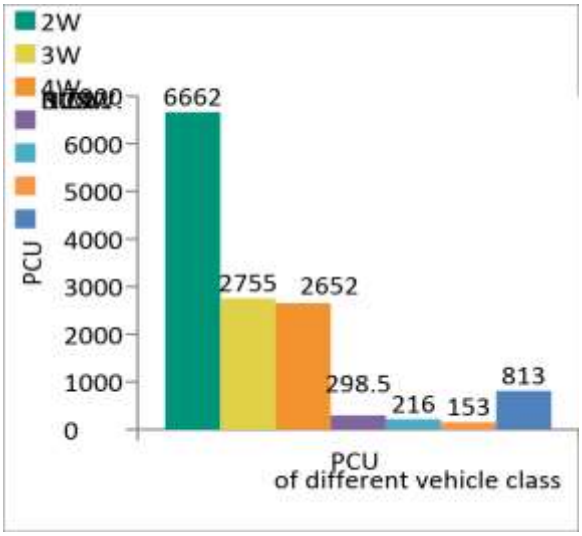


FIGURE 4. PCU ON TUESDAY

Below data shows combined PCU of morning and evening peak hours on wednessday.

TYPE OF VEHICLE	OCCUPANCY
2W	1.5
3W	2.4
CAR	4.8
L.C.V/H.C.V	1.4
BUS	43
NMV	1

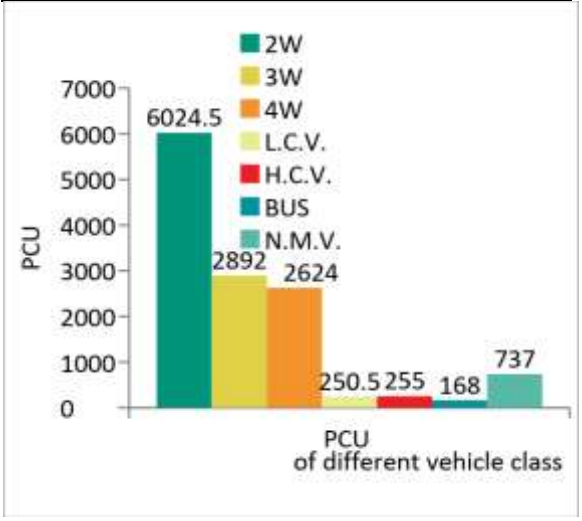


FIGURE 5. PCU ON WEDNESSDAY

B. DELAY SURVEY

At kalol railway crossing there are at least 29 trains passing through kalol railway crossing in 24 hrs. Delay in time due to gate closer of the railway crossing was noticed. It was found that 11 trains passed from railway crossing in morning and evening peak hour on 10/09/2018. Which resulted in 1 hr 28 min. of waiting time due to gate closer in peak hours of a day.

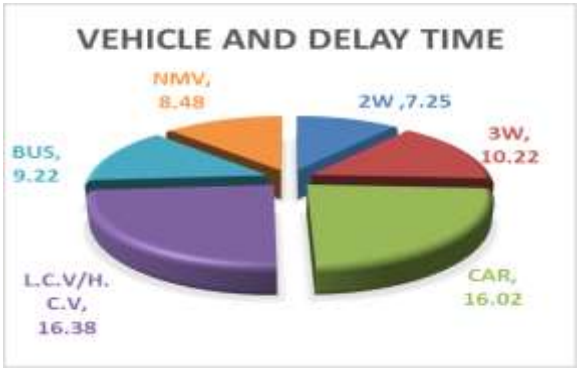


FIGURE 6. VEHILE DELAY TIME.

TABLE 2. VEHICLE DELAY

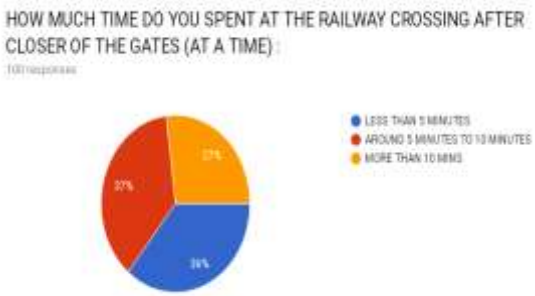
C. Vehicle occupancy

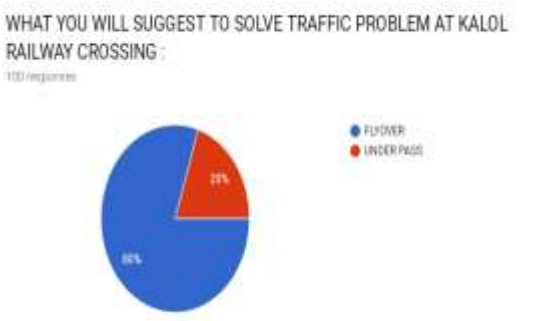
This survey determines the occupancy of passengers in each vehicle. This survey establishes the traffic volume in terms of number of persons by different types of vehicle crossing at a given point. The analysis of vehicle occupancy survey data and junction delay survey data provide valuable inputs in economic analysis of the project.

TABLE 3. VEHICLE OCCUPANCY

D. RESPONDER SURVEY

A Responder survey was conducted by the means of google form. Google form is an online survey platform for collecting data. Google form was





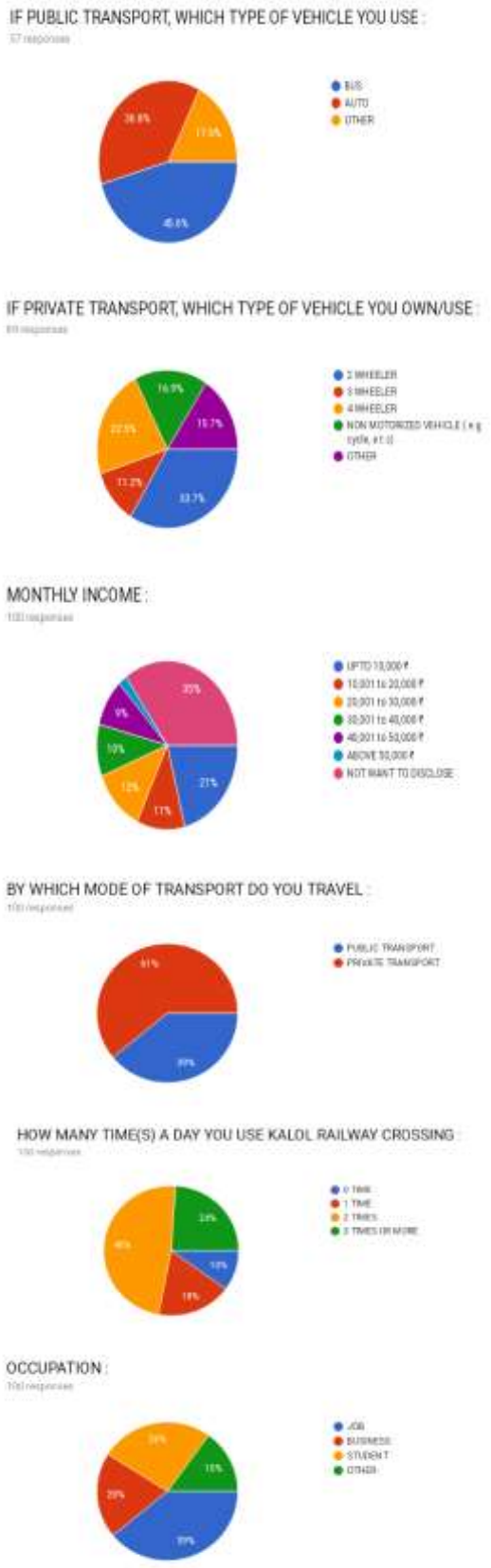


FIGURE 7. RESPONDER SURVEY

V. ECONOMIC ANALYSIS

As per Kalol Nagarpalika estimated cost of flyover is 40cr. It is approximate assume that construction period is 2 years. The equal distribution of fund is assumed during construction period, 1). Year 1, 50% of initial cost 2). Year 2, 50% of initial cost. Maintenance cost of flyover bridge is 28,00,000 per year. With the help of above cost value economic evaluation is carried out.

A. NUMBER OF VEHICLES TO BE BENIFITED

TYPE OF VEHICLES	KALOL EAST TO KALOL CENTRE (VEHICLES)	KALOL CENTRE TO KALOL EAST (VEHICLES)	TOTAL
2W	845	1407	2252
3W	172	180	352
CAR	207	171	378
LCV	13	11	24
HCV	6	2	8
BUS	4	2	6
NMV	94	99	193
TOTAL	1341	1872	3213

TABLE 4. VEHICLES TO BE BENIFITED

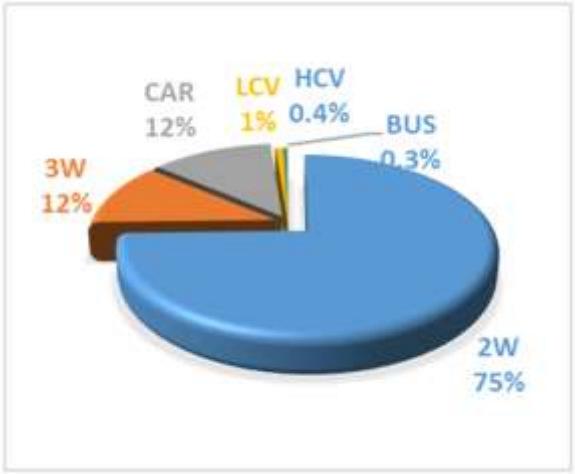


FIGURE 8.PERCENTAGE OF DELAY VEHICLE

B. SAVING IN TIME (HOUR/DAY)

TYPE OF VEHICLE	NO. OF VEHICLES	SAVING IN VEHICLES HOURS.
2W	2252	272
3W	352	60
CAR	378	101
LCV	24	6.5
HCV	8	2.2

BUS	6	1
NMV	193	27

TABLE 5. SAVING IN TIME

C. SAVING IN TIME PER YEAR

TYPE	DELAY(HRS)	PASSANGER OCCUPANCY	DELAY (HOURS / DAY)	DELAY (PER HOURS/YEAR)
2W	272	1.5	408	148920
3W	60	2.4	144	52560
CAR	101	4.8	485	177025
LCV	6.5	1.4	9	3285
HCV	2.2	1.4	3	1095
BUS	1	43	43	15695
NMV	27	27	27	9855

TABLE 6. TRAVEL TIME SAVING IN PASSANGER PER HOUR/YEAR

D. Travel time saving in Rs/year.

It was estimated by multiplying saving in vehicle time in hr/day with Travel time saving in Rs./passenger-hr.

TYPE OF VEHICLES	PEAK HOUR DELAY HOURS/YEAR	TRAVEL TIME SAVING IN RS/PASSANGER HOUR	TOTAL TIME SAVING IN RS/YEAR
2W	893520	67.48	60294729
3W	315360	10.23	3226132
CAR	1062150	34.81	36973441
LCV	19710	10.23	201633
BUS	94170	10.23	963359
TOTAL			10,16,59,294

TABLE 7. Total saving in RS/YEAR (Source: DMRC 1996 study)

E. FUEL CONSUMPTION

TYPE OF VEHICLE	IDEA FUEL CONSUMPTION
2W	0.34
3W	0.42
CAR	0.54
LCV	0.69
HCV	0.89
BUS	0.86

TABLE 8. IDEAL FUEL CONSUMPTION

TYPE OF VEHICLE	PETROL	DIESEL	CNG
2W	100%	0%	0%
3W	0%	7%	93%
CAR	36%	23%	41%
LCV/HCV/BUS	0%	93%	7%

TYPE OF VEHICLE	SAVING OF PETROL(LITRES)	SAVING OF DIESEL(LITRES)	SAVING OF CNG(KG)
2W	92.48	0	0
3W	0	1.7	23.43
CAR	19.63	12.54	22.36
LCV	0	4.71	0.31
HCV	0	1.82	0.13
BUS	0	0.79	0.06
TOTAL	112.11	21.56	46.29

TABLE 9. PROPOSITION OF VEHICLE AS PER FUEL USAGE

F. Money saving

It is calculated by multiplying the price of fuel with fuel saving during 1 day in litre or kg. Current fuel price (January 2019)

FUEL	PRICE	MONEY SAVING/DAY	MONEY SAVING/ YEAR
PETROL	68.03	7626	2783490
DIESEL	67.73	1460	532900
CNG	54.7	2532	925275
TOTAL RS			42,41,665

TABLE 10. FUEL CONSUMPTION

G. TOTAL SAVING

SR.NO	SAVING	RS
1	Travel Time Savings	101659294
2	Fuel Saving	4241665
TOTAL		10,59,00,959

TABLE 11. SAVINGS

VI. ECONOMIC EVALUATION

A. NPV Calculation

The stream of costs/benefits associated with the project over an extended period of time is calculated and discounted at selected discounted rate to give the present value. Benefits are treated as positive and cost as negative and the summation give the Net Present Value (NPV). Any project with positive NPV is treated as acceptable and negative NPV is not acceptable. The NPV is algebraically expressed as:

$$NPV = \frac{(B0-C0) + (B1-C1) + (B2-C2) + \ldots\ldots\ldots (Bn-Cn)}{(1+i)1 \quad (1+i)2 \quad (1+i)n}$$

Year	Bi (crores)	Ci (crores)	Bi-Ci (crores)	Bi-Ci (1+i)n (Crore)
2019	-	-	-20.0	-20.0
2020	-	-	-20.0	-20.0
2021	10.59	0.28	10.31	8.52
2022	11.65	0.28	11.37	8.54
2023	12.81	0.28	12.53	8.56
2024	14.09	0.28	13.81	8.58
2025	15.50	0.28	15.22	8.59
2026	17.05	0.28	16.77	8.61
2027	18.76	0.28	18.48	8.62
2028	20.66	0.28	20.38	8.64
NPV@10%				68.66
Total cost of construction				40.00
Net NPV				28.66

TABLE 12. NPV CALCULATION

Bi = Saving in travel time cost + Saving in fuel cost + saving in accident cost for the ith year Ci = Maintenance Cost for ith year

Bi - Ci = Net Benefits

Bi - Ci/(1+i)n = Discounted benefits

Now, as per NPV calculation, Cost of construction = RS. 40 crore

NPV = (+ RS. 68.66 – RS. 40) crore = (RS. 28.66) crore

Hence the NPV is positive, the project is economically justified.

B. B/C Ratio Calculation

There are a number of variations of this method, but a simple procedure is to discount all costs and benefits to their present worth and calculate the ratio of the benefits to costs. Negative flows are considered as costs whereas positive flows as benefits. Thus the savings in the transport costs are considered as benefits. If the B/C ratio is more than one, the project is worth undertaking.

Year	Bi (crores)	Ci (crores)	Bi-Ci (crores)
2021	10.59	0.28	10.31
2022	11.65	0.28	11.37
2023	12.81	0.28	12.53
2024	14.09	0.28	13.81
2025	15.50	0.28	15.22
2026	17.05	0.28	16.77
2027	18.76	0.28	18.48
2028	20.66	0.28	20.38
TOTAL			118.87

TABLE 16. B/C RATIO CALCULATION

Cost of the project is 40 crore.

Net benefits cost is 118.87 crore.

Benefits /cost ratio 118.87/40 = 2.97

B/C ratio is more than 1. So the project is justified.

VII. LINEAR MODEL

VEHICLE	DELAYED VEHICLES	TIME SAVINGS.
2 W	2252	272
3W	352	60
CAR	378	101
L.C.V	24	6.5
H.C.V	8	2.2
BUS	6	1
N.M.V	193	27

TABLE 17. LINEAR MODEL INPUT

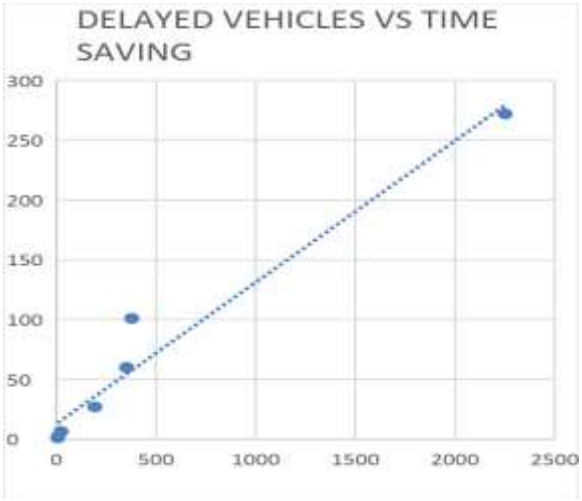


FIGURE 9. GRAPH SHOWING R SQUARE NEAR TO 1.0

XII. CONCLUSION

Research shows collection of data and various analysis to check feasibility of fly over at kalol railway crossing. Traffic volume count for peak hours in morning and evening for both the side of railway crossing was collected manually for three days. PCU observed by traffic volume count study were 14415, 13549 and 12951 on 10,11,12 September 2018 respectively. Delay time survey suggest that around 88 minutes of gate closer in peak hours is there. Economic evaluation for fly over was carried out. It was estimated that by constructing fly over, Total saving in travel time and fuel will be of Rs. 10,16,59,294. As per cost of construction and maintenance cost of fly over in kalol, This estimation were made (A).NPV of Rs. 28.66 crore was observed, which is positive, the project was

economically justified. (B).Benefits /cost ratio of 2.97 was observed, Here B/C ratio is more than 1. So the project was economically justified. It was found that underpass is not a beneficial alternative for kalol railway crossing as there is limited space for the underpass construction. While considering fly over as an alternative, it emerges out as an economically beneficial alternative by economic evaluation.
Thus, fly over construction will play a good role in city transportation over kalol railway crossing.

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