International Journal of Research in Engineering, Science and Management
Volume-1, Issue-11, November-2018
www.ijresm.com | ISSN (Online): 2581-5792

Economic Evaluation of Fly-Over Bridge: A Case Study of Swami Vivekananda Over-Bridge, Rajkot

Shivabhai M. Gohil[1], M. R. Bhatt[2]
[1]*Student, Department of Civil Engineering, Atmiya Institute of Technology and Science, Rajkot, India*
[2]*Professor, Department of Civil Engineering, Atmiya Institute of Technology and Science, Rajkot, India*

***Abstract*: Rapid urbanization and industrialization have caused an unprecedented growth of vehicles in the world. The urban traffic congestion has a global phenomenon. Due to fast growing vehicular traffic, old planned cities become congested road links, intersection become saturated, busy and supply service is above its capacity. Therefore, it requires effective controls to regulate the traffic and optimize congestion and Delay of the traffic at the intersection. This problem can be eliminated by providing Flyover Bridge at railway and highway intersection in my case. This research is mainly focused on Economic evaluation of Flyover Bridge at highly congested intersection. This research is consider the traffic survey like classified volume count survey, speed and delay survey and also collect the data like accident data, population and vehicle growth data of study area. Economic evaluation will be carried out for the Vivekananda over bridge, Rajkot. From this research it revealed that for better & efficient transportation infrastructure in urban area at highly congested intersection should gave the facilities if Flyover Bridge may be satisfy the needs .It is not important but necessary to understand the development impact of the proposed project and evaluate a appropriate strategy for implementation of its financial availability, Economic Evaluation is require.**

***Keywords*: fly over bridge, Economic evaluation**

1. Introduction

The flyover-bridge intersection is an intersection that has a special bridge constructed over an at-grade intersection to allow for the free flow in two directions on one of the main road and reduce the traffic congestion in both of these directions.

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.

A flyover is a bridge constructed along an intersecting highway over an at-grade intersection. It allows two – direction traffic to flow at free flow speed on the bridge. The flyover is one of the methods for solving traffic problems at at-grade junctions on highways including capacity, congestion, long delay and queue length. Traffic signalization at the improved intersection still uses the same fixed time control plans, even after the installation of a flyover over the intersection.

Due to fluctuation of vehicle population in the city it is not possible to stop traffic and it is very difficult to provide extra land as per traffic demand. At the intersection traffic jam problem may causes delay time and fuel consumption due to frequently stoppage of vehicles at different intersection. Many conflict points at intersections the rate of accident will be increase. Due to fast growing vehicular traffic, cities become congested and road. links, intersection become saturated, busy and supply service is above its capacity. Therefore, it requires effective controls to regulate the traffic and optimize delay and congestion of the traffic at the intersection. Space sharing intersection e.g. rotaries and pre timed signals are widely used to control the intersections. Space sharing intersections are intended to give equal priority and permit continuous movement of all intersecting vehicle flows. For higher traffic volumes, space sharing intersections such as rotary is not preferable due to increase in congestion and overall intersection delay and conflicts. In pre timed signal, green times for the phases remain constant for the particular period of the day, although demand fluctuates during that period. This problem can be eliminated by providing flyover at intersection. The flyover construction need very massive amount of investment and it also effect the economy of the country so before construction we have to check feasibility of the flyover so that we can come to know that from this project we can achieving our desire goal or not, and it will overcome the transportation problem and beneficial in future or not.

Bridge structure has been evolving throughout the history, and it will continue in the future, at may be rapidly rate. The driving force to use the bridge is due to advancement in the construction technique of bridge from engineering aspect.

Bridge helps in reduce the congestion, accidents rate, and also time saving for the road user. It is to mention that safety and asthenic will also continue to play major role.

Flyover is a bridge, road, railway or other similar structure that crosses over another road or railway. In flyover super structure are piers or columns of different span without any wing walls. It allows two directions traffic to flow at free speed on the bridge. The flyover is one of the methods for solving traffic problems at grade junction on highway including capacity, congestion, long delay and queue length. Traffic signalization at upgraded intersection often uses the same fixed time control plans, even after installation of flyover at intersection. Maintenance cost of flyover is generally less in case of cyclone and earthquake. Flyover is design for urban area where there is lots of congestion occurs at any intersection point or any road network. At intersection due to heavy and non-uniform traffic people have to suffer delay, congestion, and loss of fuel. To solve out such type of problems there is two way or solution:

1. Flyover
2. Underpass

This research work tries to evaluate flyover performance of Swami Vivekananda over bridge at Gondal Road, near swami Narayan gurukul in terms of reduction in traffic as well as economic benefits. For this research work variety of surveys were carried out at the over bridge like delay survey, spot speed survey and classified volume survey. From the analysis of primary and secondary data, impact of flyover on traffic condition and the economic benefits generated by the flyover is calculated. Calculation is carried in terms of decrease in accident and saving in fuel consumption due to the flyover construction.

2. Objectives of the study

- To study traffic and road safety issues at the fly over.
- To assess the economic evaluation of the flyover.
- To give suitable suggestion for improve intersection.

3. Scope of the study

1. To collect classified volume count data by manually during 1day period , delay, occupancy survey are carried out during peak hour and speed survey on the fly over .
2. Delay time saving are carried by no. of affected vehicle calculate.
3. To collect the data of actual fuel consumption and travel time on the flyover.
4. Total saving due to the fuel and delay time are calculated. Saving due to the delay time saving are briefly calculated.
5. To carry out analysis for checking viability of the project by net present value (NPV) method..

4. Literature review

N. D. Chhatbar, Pa. Shinkar, “Economic Assessment of Flyoer – A case study of Rajkot city”

In these papers the author has research in extensive studies that was undertaken to determine effects of fly over construction to the way of life of the motorists and commuters and general travelling public. Use various methods like benefit/cost ratio and net Present value (NPV) method are used for economic assessment.

And conclude that in terms of rupee an installation of flyover at a cost and vehicle delay time in terms of cost are calculated and assess the fly over bridge.

Parthkumar K. Patel, Arvind M. Jain. “Before And After Study Of An Over –Bridge –A Case Study Of IIM-An Intersection.”

In these paper the author has works on the briefly study on the IIM-A cross road (andhajan mandal cross road) before and after the construction of the over bridge. And check the present ground condition. Evaluate the over bridge performance and impact on traffic condition.

Various surveys are carried out and finally conclude that the total number of vehicle benefitted by an over bridge, average Delay time and saving in travel time and fuel consumption. These saving are calculated in terms of rupee. Calculate that the bridge is appropriate and its yearly benefits are 24.5% and it is more than assumed direction 22.5%.

T. Patel, K. Dave, Feasibility Study and Rapid Construction of Flyover at Sahakari Zin Intersection on NH-8, Himmatnagar.

In these paper the author have check the feasibility of rapid construction of Fly over at sahakari Zin Intersection on NH-8, himmatnagar. Observed that the number of accident occur due to high speed of vehicle ,traffic delay, risk of pedestrian life, lack of proper facility like symbol, signals and markings. Fly over suggest for the traffic flow at this intersection and during the construction of flyover minimize traffic delay by the road safety audit and using the rapid construction of the fly over at intersection.

Conclude the final that the fly over bridge will carry the future traffic safely next 30 year. Construction of flyover is an accelerated by the prefabricated bridge element. Minimise the accident by construct flyover and smooth traffic flow in both direction. And in himmatnagar number of ceramics so it can ceramic waste use in construction to minimise the pollution.

A. V. Arjun, L. Venkat, V. M. Naidu, “Economic Feasibility and Efficient Project Scheduling of Fly-Over in Visakhapatnam (India)

In this paper the author have mainly carried out the economic feasibility of a fly over in Visakhapatnam (India) between maddilapalem and satyam junction is carried out. The benefits acquired and construction cost of the flyover, feasibility study has been done. The flyover construction scheduling is carried out through different stages of construction. And a database was

prepared for construction manager to decide between economy and duration of the project.

Finally conclude that the peak hour traffic at maddilapallem junction toward NAD at various times is calculated in PCU. And studied the benefit and cost and concluded that the construction of a 4-lane fly over is thoroughly feasible between maddilapalem and satyam junction. By decreasing or increasing in number of casting beds for spine and cantilever segments, the duration of the construction is varied.

5. Selection of study area

Fig. 1. Google map of study area

Rajkot is situated in the middle of the peninsular Saurashtra in central plains of Gujarat State of Western India at a height of 138 m above mean sea level. Rajkot is located 245km from Gandhinagar, the state capital, at the centre of Saurashtra peninsula in the central plains of Gujarat State, located in western India at a height of 138m above mean sea level, and located on the banks of the Aji River and Nyari River. It lies between latitude 20.18 N and longitude 70.51 E. Rajkot is the biggest city in terms of population in the Saurashtra-Kutch region, bustling with commercial activity, spurred by new global economic and industrial. Rajkot is a head quarter of Rajkot District and the city is connected with other parts of the country by Rail, Air and Roads. There are mainly two railway stations, one at Junction Plot area and another at Bhaktinager area. Also there are major roads and NH-8A links Kandla, NH-8B links Porbandar and state capital Gandhinagar. Then, State highways connect Rajkot to other important towns of the region like Jamnagar, Surendranagar, Porbandar, Junagadh, Veraval, Bhavnagar, Amreli, Bhuj, Kandla, Ahmedabad, Baroda etc.

- The fly-over bridge is situated at gondal road behind Swami Narayan Gurukul, Rajkot.
- It is constructed in T-shape at P.D.Malaviya college to makkam chawk and mavdi road are meet at mid-way on to the over bridge.

Table 1
Equivalency factor for various vehicle in PCU

S. No.	Vehicle Class	Equivalency factor (PCU)
1	Two wheeler, scooter	0.22
2	Three wheeler	0.9
3	Car	1
4	LCV	2.38
5	BUS	4.6
6	HCV	3.9
7	Cycle	0.42

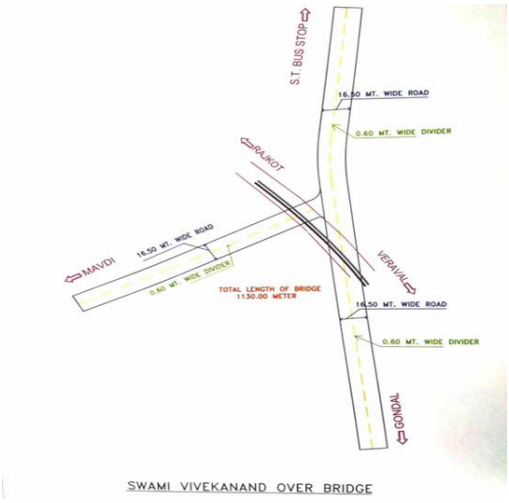

Fig. 2. Swami Vivekananda over bridge

6. Data collection and analysis

One day survey is carried out in a working day of 15th jan 2018 for the 17 hours i.e. 6:30am to 11:30 pm at swami vivekanand over bridge, Gondal road, Rajkot. From the below table it is observed that total total no. of vehicle i.e. 1) towards mavdi road is 35139, 2) towards PDM college are 41367 ,3) towards Makkam chawk are 28706 vehicle moving . From the Table 2, it is observed that 2W and 3W composition are more in selected study area due to the surrounding residential area.

Table 2
Classified Volume Count Survey at swami Vivekananda over bridge

Direction	Towards Makkam chawk		Towards PDM college		Towards Mavdi road	
	In Vehicle	In PCU	In Vehicle	In PCU	In Vehicle	In PCU
2W	25044	5509.68	36808	8097.76	30917	6801.74
3W	1866	1679.4	2150	1935	2051	1845.9
4W(car)	1180	1180	1577	1577	1482	1482
LCV	393	935.34	440	1047.2	477	1135.26
BUS	101	464.6	161	740.6	129	593.4
HCV	24	93.6	21	81.9	27	105.3
BICYCLE	98	41.36	210	88.2	96	40.32
Total	28706	9903.98	41367	13567.66	35179	12003.9

After the construction of ROB the vehicles designated from Gondal were diverted from other route.

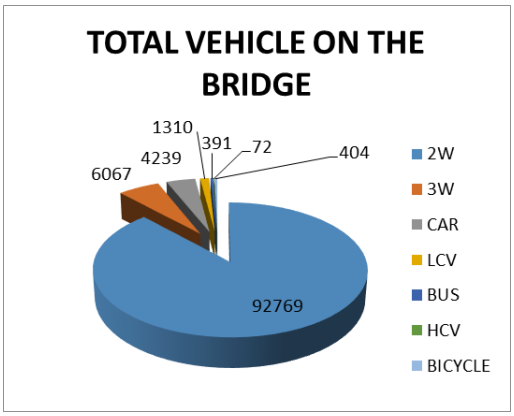

Fig. 3. Total vehicle on the bridge

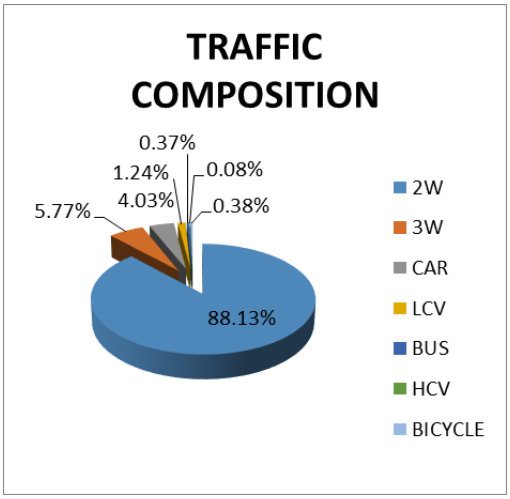

Fig. 4. Traffic composition

Table 3
Type of vehicle and Occupancy

Type of vehicle	Occupancy
2W	1.486
3W	2.85
CAR	2.06
LCV	1.46
BUS	31.41

From the Fig. 5, and Table 5, we can say that for the 2W, 3W, 4W, LCV, BUS, HCV, BICYCLE the total savings in delay time is 2.83, 46.11, 60.84, 208.92, 375.77, 150.64, and 156.91 sec respectively.

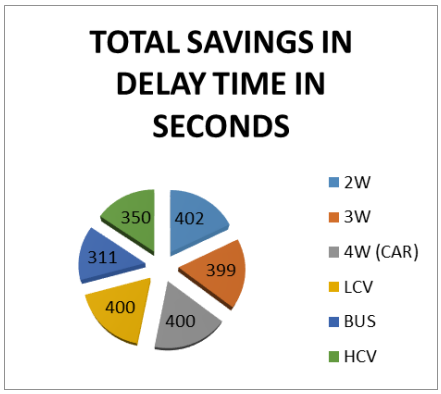

Fig. 5. Total savings in delay time in seconds

Table 4
Total delayed vehicle during gate closure if ROB not present

	Towards Mavdi road	Towards Makkam chawk	Towards PDM college	Total
2W	4738	4003	5625	14366
3W	328	302	363	993
CAR	241	197	243	681
LCV	96	74	81	251
BUS	25	23	26	74
HCV	6	2	3	11
BICYCLE	21	4	28	53
TOTAL	5455	4605	6369	16429

Table 5
Travel Time savings in Rs. /Passenger Hr.

Type of vehicle	Total savings in delay time in seconds
2W	402
3W	399
4W (CAR)	400
LCV	400
BUS	311
HCV	350

Table 7
Total delay saving in Rs.

Type of vehicle	Occupancy	Person monthly income	Person hourly income	Value of vehicle in Rs. Per hour
2W	1.486	15034	62.6	93.1
3W	2.85	12336	51.4	146.5
4W (CAR)	2.06	45733	190.6	392.5
LCV				27.6
BUS	31.41	15330	63.9	2006.3
HCV				116.3

Table 6
Travel Time savings in Rs. /Passenger Hr.

Type of vehicle	No. of affected vehicle	Total delay time saving in vehicle hours per day	Delay saving in passenger hour per day	Delay saving in passenger hour per year	Round about delay savings in passenger hour per year
2W	14366	1604.2	2383.84	870101.6	870102
3W	993	110.05	313.64	114478.6	114479
4W(CAR)	681	75.66	155.85	56885.25	56885
LCV	251	27.88	40.7	14855.5	14856
BUS	74	6.39	200.71	73259.15	73259
HCV	11	1.069	33.57	12253.05	12253

Table 8
Total delay saving in Rs.

Type of vehicle	Total delay savings in passenger hour per year	Value of vehicle in Rs. Per hour	Total delay savings in Rs. Per year
2W	870102	93.1	81006459
3W	114479	146.5	16771115
4W (CAR)	56885	392.5	22327461
LCV	14856	27.6	410012
BUS	73259	2006.3	146979833
HCV	12253	116.3	1424662
Total		Rs. 26,89,19,541	

Table 9
Fuel rate as on 13-07-2018

Fuel	**Fuel rate (As on 13/07/2018)**
Petrol	75.78
Diesel	73.06
CNG	49.75

Table 10
Ideal fuel consumption for various vehicle

Type of vehicle	Ideal fuel consumption (lit/hr.)
2w	0.34
3w	0.42
4w(car)	0.54
LCV	0.69
BUS	0.86
HCV	0.89
BICYCLE	0

(PCRA STUDY 1996)

Table 11
Fuel composition of various vehicle

Type of vehicle	Diesel	Petrol	CNG
Car	29%	39%	32%
3W	15%	2%	83%
LCV	95%	1%	4%
2W	0%	100%	0%
HCV	100%	0%	0%

Table 12
Fuel saving in litre

Type of vehicle	Total time saving in hr. in one day	Total fuel saving in one day in litre
2W	1604.2	545.43
3W	110.05	46.22
4W (car)	75.66	40.86
LCV	27.88	19.24
BUS	6.39	5.5
HCV	1.069	0.96

Table 13
Fuel composition

Type of vehicle	Diesel	Petrol	CNG
2W	0%	100%	0%
3W	15%	2%	83%
4W(CAR)	29%	39%	32%
LCV	95%	1%	4%
BUS	100%	0%	0%
HCV	100%	0%	0%

To find out ideal fuel consumption for the particular type of vehicle PCRA value is adopted for that group of vehicle. The list of ideal fuel consumption for the each type of vehicle is shown in Table 8. Here total number of delayed vehicle is considered and that number of vehicle is multiplied by the particular ideal fuel consumption to find out the total loss of fuel of delayed vehicle.

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

Table 14
Fuel saving composition in litre in one day

Type of vehicle	Total fuel saving in one day in litre	Diesel	Petrol	CNG
2w	545.43	0	545.43	0
3w	46.22	6.93	0.93	38.36
4w(car)	40.86	11.85	15.94	13.08
LCV	19.24	18.28	0.19	0.77
BUS	5.5	5.5	0	0
HCV	0.96	0.96	0	0

Table 15
Fuel saving composition in Rs. in one day

Type of vehicle	Diesel	Petrol	CNG	Total
2w	0	41332.68	0	41332.68
3w	506.305	70.475	1808.91	2385.69
4w(car)	865.761	1207.933	650.73	2724.424
LCV	1335.53	14.398	38.3	1388.228
BUS	401.83	0	0	401.83
HCV	47.76	0	0	47.76

Table 16
Fuel saving in Rs. in one year

Type of vehicle	Saving in one day in Rs.	Saving in one year in Rs.
2w	41332.68	15086428
3w	2385.69	870777
4w(car)	2724.424	994415
LCV	1388.228	506703
BUS	401.83	146668
HCV	47.76	17432
TOTAL Fuel saving		**Rs.1,76,22,432**

Table 17
Total saving in one year in Rs.

S. No.	Savings	Total amount saving in one year
1	Due to delay time saving	26,89,19,541
2	Due to fuel saving	1,76,22,432
	Total	Rs. 28, 65, 41, 973

7. Calculation by method of economic evaluation

A. Net Present Value (NPV) method

As per the SP030 we can say that in the peak hours the traffic growth will be 7.5% of the total traffic. Rate of interest is taken 6.23% for this method and 7.5% traffic growth are considered to find out total benefit from the flyover. Here in a study area ROB is constructed in year 2012 so benefit from 2012 to 2015 are added of the calculated benefits.

Table 18
NPV Value calculation

Year	Bi in Cr.	Ci in Cr.	(Bi - Ci) In Cr. (Net Benefit)	Correct ((Bi- Ci)/(1+i)^n)) In Cr.(Discounted Benefit)
2012	Initial investment		58.44	-58.44
2013	11.57	0.0020	11.57	10.76300087
2014	15.65	0.0022	15.65	13.54489615
2015	19.94	0.0024	19.93	16.04592846
2016	23.90	0.0026	23.90	17.89380914
2017	26.97	0.0028	26.97	18.78410418
2018	**28.65**	0.0030	28.65	18.56214888
2019	30.43	0.0033	30.43	18.34281537
2020	34.35	0.0035	34.34	19.25545067
2021	41.17	0.0038	41.17	21.47291561
2022	52.43	0.0042	52.43	25.4376669
				180.1027362
				-58.44
			TOTAL NPV	**121.66**

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

Total Construction cost: 58.44 Cr.
NPV = 180.102 -58.44 =121.66 Cr.

8. Conclusion

- Total number of vehicles benefitted by a Rail over bridge is 16429.
- Average Delay time saving per vehicle Passing from three direction is 377 sec.
- Due to Rail over bridge construction saving in travel time cost Rs. 26,89,19,541 per year.
- Saving in Fuel consumption cost Rs. 1,76,22,432 per Year.
- If rail over bridge constructed total benefit is Rs. 28,65,41,973 Rs. .
- By adopting NPV method It is observed that in the selected ROB value is NPV = 180.102 -58.44 =121.66 Cr positive. Then this rail over bridge is economicaly justified.

References

[1] A.V. Arjun, Dr. L.V. Venkat, V.M. Naidu. Economic Feasibility and Efficient project scheduling of Fly-over in Visakhapatnam (India), IJERT,vol.2, Issue 3,March -2013,
[2] Dipti Ranjan Mohapatra. An Economic Analysis of Improvement of road Infrastructure: A case study. European academic research,vol.2, Issue 11,February 2015, ISSN : 2286-4822
[3] Heather Jones, Filipe Moura , Tiago Domingos . Transport infrastructure project evaluation using cost-benefit analysis. Science Direct, Elsevier, Procedia–social and behavioral Science 111(2014)400-409, EWGT2013-16th Meeting of the EURO Working Group on Transportation.
[4] Milan Valuch, Martin Pitonak. Economic analysis of bridges project rehabilitation, Science Direct, Elsevier , Procedia Engineering 111 (2015)828- 833,XXIV R-S-P seminar ,Theoretical Foundation of civil Engineering (24RSP) (TFoCE 2015)
[5] Narabodee Salatoom, Pichai taneerananon. An Evaluation of fly over - Improved Intersection: A case study of Airport Intersection.
[6] Nihal D. Chhatbar, Praful A. Shinkar. Economic assessment of fly over – A case study of Rajkot city. IJSRD, vol.4, Issue 01, 2016.
[7] Pravin Hadiyal, Arvind M. Jain, Assessment of fly over in terms of saving in Travel time and fuel consumption – A case study of Ellis bridge inter section. IJSRD, vol.4,issue 03,2016.
[8] Panchal Chetan, Mauni Modi, Hardik Sukhadiya. A Study for feasibility of flyover bridge at intersection on ring road in metrocity: A case study of Vrundavan intersection,Vadodara . International Journal of advance research in engineering, science & Technology. vol. 4, Issue 2, February -2017.
[9] Parthkumar K. Patel, Arvind M. Jain. Before and after study of an Over Bridge – A case Study of IIM-A Intersection. IJSRD, vol. 3 Issue 03, 2015.
[10] Tarun Patel, Krupa Dave. Feasibility Study and Rapid Construction of Flyover at Sahakari Zin Intersection on NH-8,Himmatngar ,IJERT, vol.4 Issue 04,April -2015.
[11] HCM (2010) Highway Capacity Manual - Vol 3: Inerrupted Flow. Washington, D.C., TRB, National Research Council.
[12] IRC- SP 30
[13] IRC 106(2017)
[14] The economic evaluation of projects; Research gate
[15] IRC-106-1990, “Guidelines for capacity of urban roads in plain areas.”
[16] IRC-SP-41-1994, “Guidelines for the design of At-Grade intersection in Rural &Urban Areas.”
[17] www.rmc.gov.in