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A Statistical Data Analysis of Road Traffic Accidents in Jaipur City

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Abstract - The statistical analysis of accident is conceded out periodically at grave locations or road stretch which will help to arrive at suitable measures to effectively decrease accident rates. It is the measure (or estimates) of the number and severity of accident. These statistics reports are to be maintained zone-wise. Accident prone stretches of various roads may be assessed by finding the accident density per meter of the road. The places of accidents are marked on the map and the points of their clustering (BLACK SPOT) are determined. With the help of statistical study of accident occurrence at a particular road or location or zone of study for a long period of time it is realizable to predict with logical accuracy the probability of accident occurrence per day or relative safety of different classes of road user in that location. The interpretation of the statistical data is very important to provide insight to the problem.

The dilemma of accident is a very acute in highway transportation due to compound flow model of vehicular traffic, presence of miscellaneous traffic along with pedestrians. Traffic accident leads to loss of life and property. Thus the traffic engineers have to undertake a big responsibility of providing safe traffic schedule to the road users and ensure their security. Road accidents cannot be totally prevented but by suitable traffic engineering and management the accident rate can be reduced to a certain amount. For this cause organized study of traffic accidents are required to be carried out. Globalization has impacted many developing countries across the world. India is one such country, which benefited the most. Increased, economic activity raised the utilization levels of the people across the country. This created scope for increase in travel and transportation accidents in Jaipur city. India is undergoing major economic and demographic evolution together with increasing urbanization and motorization. Among the top ten causes of death in the country, Road Traffic Accident was the tenth cause two decades back, but with the increasing urban expanse and lifestyle changes. Jaipur has 3.32 million populations and over this population 1.9 million vehicles registered which is include 609 total vehicles per 1000. As the report released by the ministry of road transport and highways revealed that Jaipur had a share of 4.1% in total accidents in the country, in which 10,510 people lost their lives.

This study is related to road accident study of Jaipur city, behaviour of accident, accident statics and finding the flaws in road construction and safety aspects.

Index Terms—Black Spot, Globalization, Prone stretches, Severity.

I. INTRODUCTION

The process of rapid and unplanned urbanization has resulted in an unprecedented revolution in the growth of motor vehicles world-wide. The alarming increase in morbidity and mortality owing to road traffic incidents (RTI) over the past few decades is a matter of great concern globally. At present motor vehicle accidents rank ninth in order of disease burden and are projected to be ranked third in the year 2020. India accounts for more than 200,000 deaths because of road accidents, according to the Global Road Safety Report, 2015 released on Monday by the World Health Organization (WHO). This is 46% more than the national statistics released by the National Crime Records Bureau (NCRB) in July. Jaipur, a 290 year old city is the state capital of Rajasthan. It lies on the arravali hills, 431 meters (1414ft) above sea level, over an area of 484.64 sq.km. Jaipur is now a Metropolitan area, is the tenth major city in India, with a population of above 3 million. Unlike other Indian metros it continues to attract considerable migrant population due to its strategic geographical location, multilingual and cosmopolitan culture, tremendous growth potential and investment.

The existing road network in the city is inadequate. Functionally the road do not have any hierarchy as every individual road changes its characteristics after a short distance. At present 5.84% of the total developed area is belong to roads which is much below the desired level. Moreover, the vehicular population growth is quite high with just registered motor vehicles in 4.2million to 12.4 million vehicles on 31 ,march 2015 , an increase of around 3 fold in span of 10 years.

Most of roads in jaipur city are heavily encroached by parked vehicle, hawker and by the person of road side business. This thing result not only increase in the traffic volume but also in the traffic accident and make our life at risk. This paper was an attempt to analyze the road accidents in jaipur using annual data from 2005 to 2015.

II. Requirements

Data of road accidents were collected in two steps. In the initial stage, data on road accidents of Jaipur city were collected from three Police Stations (East zone police station near Gandhi circle , West zone police station Bani park ,South zone police station Ajmeri gate) in the city for three years. The data included Accident Date, Accident Time, Location of the Accident, Collision Type, Number of Vehicles Involved, Number of Deaths, Injury, Cost of Property Damage, Details of Driver and some more information about how accident occurred. It was found that more than thousand accidents occurred in Jaipur in last year.

After analyzing the accident data, the road intersection and mid-block having maximum frequency of accident is identified. Also for determine the present status of accident and traffic pattern we are taking data by self examining at the places.

Traffic police , Jaipur, categorized accident hotspot in four different zones and each zone covers major accident prone area of Jaipur. Each zone consist of minimum of six accident prone areas.

Four major zones are-

- South Zone
- East Zone
- West Zone
- North Zone

Places Of Accident Analysis:

1. Nri Circle
2. Trivani Tiraha
3. B2 Bye Pass

SOUTH ZONE

1	200 Feet Bypass Circle.
2	Badarwas Tiraha Gopalpura Road.
3	Dwarkadas Park Circle.
4	Government Hostle Circle.
5	Jyoti Nagar Thana Moad Sahkar Marg.
6	Dhuleshwer Garden Circle.

FIG 1. South zone for accident hotspot in Jaipur (Coutsey-http://jaipurtrafficpolice.rajasthan.gov.in/AccidentHotspots.aspx)

EAST ZONE

1	B-2 Bypass Circle
2	Goushala Tonk Road
3	Front Road of India gate Tonk Road
4	In Front of Saras Parlour
5	Trimurti Circle
6	In Front of M.N.I.T Gate
7	Bajaj Nagar

FIG 2. East zone for accident hotspot in Jaipur (Coutsey-http://jaipurtrafficpolice.rajasthan.gov.in/AccidentHotspots.aspx)

WEST ZONE

1	Panipetch Tiraha
2	Dahar Ka Balaji
3	Khetan Circle
4	Alka Tiraha
5	Road No. 14 Sikar Road
6	Jodla Power House
7	In Front of Hyper City Jhotwarw Pulia
8	Kanta Choraha
9	Road No. 5 Cut Express Highway
10	Dhabas Pulia Express Highway
11	Gandhi Path Queen's Road

FIG 3. West zone for accident hotspot in Jaipur (Coutsey-http://jaipurtrafficpolice.rajasthan.gov.in/AccidentHotspots.aspx)

NORTH ZONE

1	Road Towards Nahargarh and Jaigarh
2	ICICI Bank Circle Vidhyadhar Nagar
3	In Front of Vidhyadhar Nagar Stadium
4	Galta Gate Circle
5	Meena Petrol Pump Cut Dehli Road
6	RAC Cut Dehli Road
7	Idgah Pada Mandi Dehli Road
8	Dhobi Ghat
9	Ram Garh Moad
10	Bandh ki Ghati
11	Kanak Ghati
12	Manbagh
13	Sarva Moad

FIG 4. North zone for accident hotspot in Jaipur (Coutsey-http://jaipurtrafficpolice.rajasthan.gov.in/AccidentHotspots.aspx)

Black Spots in the State of Rajasthan

S. No.	Name of the District	Location of accidents including chainage (km to km)	NH No.	No. of fatalities during 2011	No. of fatalities during 2012	No. of fatalities during 2013	Reasons for frequent accidents	Nature of treatment required at the spot/stretches
1	Vishwakarma Jaipur West	Road No. 1, 5, 6, 9, 12, 14 Vishwakarma Area	11	15	9	9	BRTS cut, heavy traffic, over speeding and careless driving.	construct Pedestrian footpath on every cut of BRTS and to create awareness about traffic rules
2	Chomu Jaipur West	Jaitpura	11	3	6	2	Industrial area and no speed limit.	Fix speed limit, install signage, construct speed breakers and provide parking lights.
3	Bagru Jaipur West	Thikriya More	8	5	1	2	New construction of Vatika city and movement of Labourers and movement of heavy vehicles through Thikaria village to avoid toll tax.	provide traffic lights
4	Bagru Jaipur West	Bhakrota	8	9	8	26	Heavily Populated area and traffic movement at crossing.	need of bridge
5	T.P. Nagar Jaitpur East	Ghat ki Guni Agra Road	11	4	5	4	Roads are steeply sloped and curved and there are no street lights.	provide street lights, install caution boards and speed breakers in accident prone areas
6	Kanauta Jaipur East	Mali ki Kothi Bagrana	11	9	11	7	Damage of railing near Highway and no railing in some area and densely populated area on both sides of the road. Main reason is stopping of heavy vehicles on main Highway.	Repair of Damage railing behind Highway and construct railing in some area where it is necessary . It is good to construct bridge on densely populated area on both sides of the road.
7	Bajaj Nagar Jaipur East	Tonk Pulia and nearby	12	1	2	3		
8	Chaksu Jaipur South	Chaksu	12	41	5	33	Heavy traffic	Need for Four lanes on State Highways
9	Shivdaspura Jaipur South	Shivdaspura	12	19	5	4	Construction of four lane in progress.	Completion of construction work will mitigate the problem.
10	Shyamnagar Jaipur South	Shalimar Bagh to Ajmer road crossing	8	6	2	2	Heavy traffic and cuts at many places in the divider of road.	Widening of road and closure of unnecessary cuts on road divider.
11	Shahapura Jaipur Rural	Bhakhru	8	13	5	4	Cuts on NHW, crossing points and curved roads	Close cuts on NHW and install caution boards on crossing and turning points. To coordinate with NHAI to improve accident prone areas.
12	Pragpura Jaipur Rural	Bus Stand Pawta	8	9	3	3	Heavily populated area	Close cuts on NHW and install caution boards on crossing and turning points.

Fig.5 Source:- http://morth-roadsafety.nic.in

III. DATA COLLECTION

DATA OF ACCIDENT OF B2 BYE PASS				
S.NO.	YEAR	FATAL	GRIEVOUS	MINOR
1	2006	19	77	84
2	2007	29	94	81
3	2008	21	57	73
4	2009	15	62	61
5	2010	16	59	43
6	2011	8	54	75
7	2012	17	39	61
8	2013	13	64	67
9	2014	16	75	91
10	2015	18	89	117

Table 1: (Data of accident of B2 Bye pass)

DATA OF ACCIDENT OF NRI JUNCTION				
S.NO.	YEAR	FATAL	GRIEVOUS	MINOR
1	2006	11	28	38
2	2007	17	22	44
3	2008	13	27	48
4	2009	19	29	56
5	2010	9	31	48
6	2011	11	39	45
7	2012	12	33	59
8	2013	11	39	51
9	2014	10	35	61
10	2015	27	48	68

Table 2: (Data of accident of NRI Junction)

DATA OF ACCIDENT OF TRIVANI CHORAH				
S.NO.	YEAR	FATAL	GRIEVOUS	MINOR
1	2006	9	21	34
2	2007	11	26	33
3	2008	8	31	41
4	2009	13	30	46
5	2010	7	19	34
6	2011	12	23	20
7	2012	15	27	39
8	2013	9	26	42
9	2014	10	31	44
10	2015	19	40	59

Table 3: (Data of accident of Triveni Tiraha)

IV. FORMULA AND METHOD

1. Accident rate per kilometer

$$R = (A/L)$$

R= total accident rate per km for one year

A= total number of accident occurring in one year

L=length of control section in kms

2. Accident rate based on population

$$R = (B*100000)/P$$

R= death rate per 100,000 population

B= population of area

P= total number of traffic death in one year

B2 BYE PASS					
S.NO	YEAR	TOTAL ACCIDENT	LENGTH OF ROAD	ACCIDENT RATE PER KM	DEATH RATE BASED ON POPULATION PER LAKH
1	2006	180	5	36	370
2	2007	204	5	40.8	326
3	2008	151	5	30.2	441
4	2009	138	5	27.2	482
5	2010	118	5	23.6	564
6	2011	137	5	27.4	486
7	2012	117	5	23.4	569
8	2013	144	5	28.8	462
9	2014	182	5	36.4	366
10	2015	224	5	44.8	297

Table 4

NRI JUNCTION					
S.NO	YEAR	TOTAL ACCIDENT	LENGTH OF ROAD	ACCIDENT RATE PER KM	DEATH RATE BASED ON POPULATION PER LAKH
1	2006	77	6	12.84	865
2	2007	83	6	13.83	802
3	2008	88	6	14.67	757
4	2009	104	6	17.3	640
5	2010	88	6	14.67	757
6	2011	95	6	15.83	701
7	2012	104	6	17.34	640
8	2013	101	6	16.83	659
9	2014	106	6	17.67	628
10	2015	143	6	23.84	640

Table 5

TRIVENI NAGAR					
S.NO	YEAR	TOTAL ACCIDENT	LENGTH OF ROAD	ACCIDENT RATE PER KM	DEATH RATE BASED ON POPULATION PER LAKH
1	2006	64	6.5	9.85	1041
2	2007	70	6.5	10.76	951
3	2008	80	6.5	12.3	832
4	2009	89	6.5	13.69	748
5	2010	60	6.5	9.23	1010
6	2011	55	6.5	8.46	1211
7	2012	81	6.5	12.46	822
8	2013	77	6.5	11.84	865
9	2014	85	6.5	13.07	783
10	2015	118	6.5	18.15	564

Table 6

Accident Severity rate:

The accident severity rate measure the seriousness of accident and the availability of medical facilities in the city. Fig..... shows the accident severity rate of Jaipur which show the number of death per 100 accidents are relatively high in the city. Moreover high level of accident severity index may also be a result of poor data collection and its reporting process.

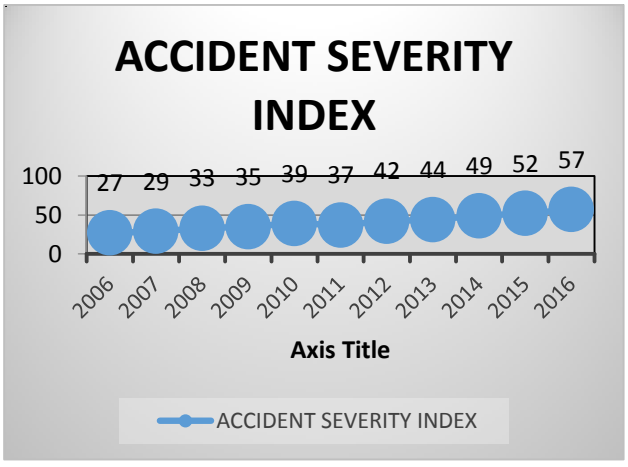


Fig 6 (Accident severity rate

V.CONCLUSION:-

1. NRI JUNCTION

1. Fig 7 (NRI JUNCTION)

So, there is right angle intersection of the two road, Road 1 has 8 lane with a total width of 28 meter and Road 2 has 6 lane with a total width of 21 meter , traffic volume by manual count for road 1 is 1375 and 943 PCU/hour on the two approaches of road 1and 690 and 470 PCU/hour on the two approaches of road 2. Now, from this data we will design the signal.

DESIGN:-

Width of road 1 is 28 meter with 8 lane with 4 lane in each direction.

Width of road 2 is 21 meter with 6 lane with 3 lane in each direction.

Approach volume of road 1 = 1375 & 943 PCU/hour

&, Approach volume of road 2 = 690 & 470 PCU/hour

Pedestrian walking speed is 1.2 m/sec (as per IRC Guideline)

Design traffic of road 1 = higher of two approaches volume per lane

= (1375/4)

= 345 PCU/hour

Design traffic of road 2 = higher of two approaches volume per lane

= (690/3)

= 230 PCU/hour.

Step 1: PEDESTRAIN CROSSING TIME

Pedestrian green time for road 1 = (28/1.2) + 7 (7 sec. is initial walk time as per IRC guideline)

= 30 sec.

Pedestrian green time for road 2 = (21/1.2) + 7

= 24.5 sec.

Step 2: MINIMUM GREEN TIME FOR TRAFFIC

Minimum green time for vehicles on road 2, G_2 = 30 sec.

Minimum green time for vehicles on road 1, G_1 = 30*(345/230)

= 45 sec.

Step 3: REVISED GREEN TIME FOR TRAFFIC SIGNALS

Adding 2 sec. each towards clearance amber and 2 sec , inter-green period for each phase,

Total cycle time required = (2+30+2) + (2+45+2)

= 83 second.

Signal cycle time may be conveniently set in multiplies of five second and so the cycle time is

85 second.

The extra time 85-83 = 2 second, may be appointed for green time of road 1 and 2 in 1 second each.

Therefore adopt, $G_{1=}$ (45+1) = 46 sec.

$G_{2=}$ (30+1) = 31 sec.

Step 4: CHECK FOR CLEARING THE VEHICLES ARRIVED DURING GREEN PHASE

Vehicles arrivals per lane per cycle on road 1 = (1375/85)

= 16.17

PCU/cycle.

Minimum green time required per cycle to clear vehicles on road 1 = 6+ (16.17-1)*2

= 36 second

(less than 46 seconds therefore OK)

Vehicles arrivals per lane per cycle on road 2 = (690/85)

= 8.12

PCU/cycle.

Minimum green time required per cycle to clear vehicles on road 1 = 6+ (8.12-1)*2

= 20.2 second

(less than 31 seconds therefore OK)

So green time period

Step 5: CHECK FOR OPTIMUM SIGNAL CYCLE BY WEBSTER'S EQUATION

Lost time per cycle = (amber time + inner-green time + time lost for initial delay of first vehicle)

For two phases = (2+2+4)*2 = 16 sec.

Saturation flow for road -1 of width 14m = 525*14 =7350 PCU/hr.

Saturation flow for road -2 of width 10.5m = 525*10.5 =5513/PCU/hr.

Y_1= (1375/7350) = 0.187

Y_2= (690/5513) = 0.125

$Y=Y_1 + Y_2$

=0.187+0.125

=0.312

Optimum signal cycle time, C_0 = (1.5L+5) / (1-Y)

= ((1.5*16) +5) / (1-0.312)

= 42.15 sec.

Therefore the cycle time of 85 sec designed earlier is acceptable.

The detail of the signal timing are given below,

ROAD	GREEN PHASE, G SEC	AMBER TIME ,Y SEC	RED PHASE, R SEC	CYCLE TIME, C SEC
ROAD 1	46	2	35+2	85
ROAD 2	31	2	50+2	85

2. B2 BYE PASS

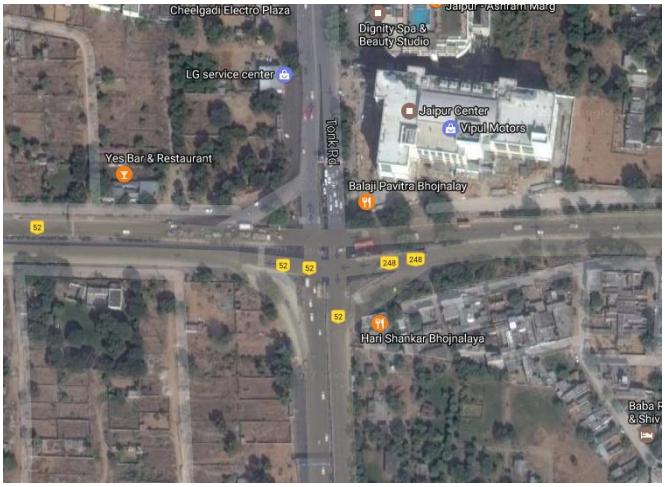
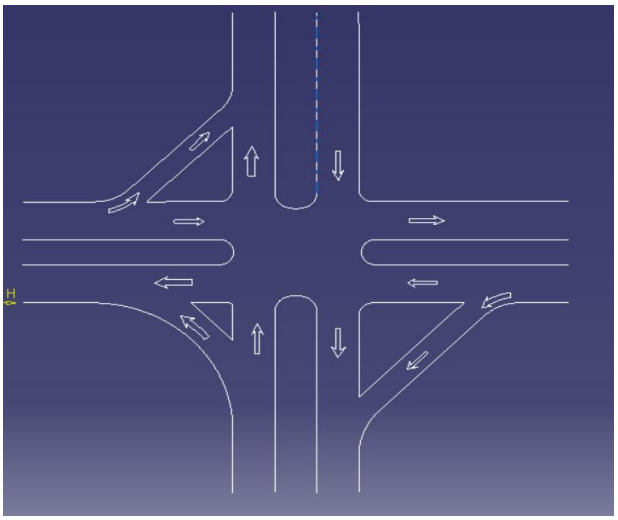


Fig.8 (B2 BYE PASS)

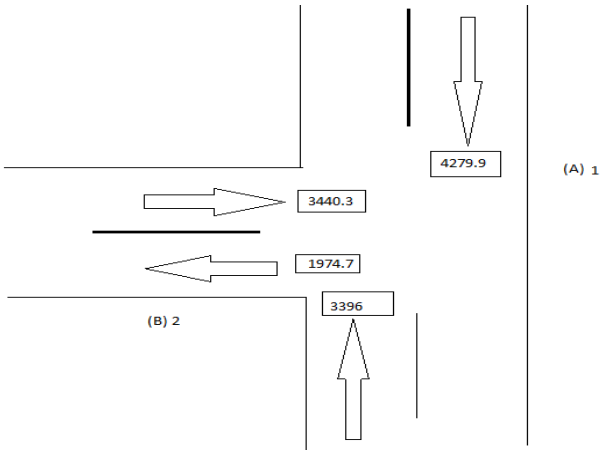
3. TRIVENI NAGAR TIRAH

Fig.9 (TRIVENI NAGAR TIRAH)



As the diagram show the traffic flow condition on the B2 bye pass so mainly the accident are happening on B2 bye pass occur in night time due to the rush driving of trucks. Also the reason behind the accidents is that the road to mansarovar is having the divider but there is no obstruction so the glazing of the vehicle head light is falling on opposite side person and leads to accident.

So for decreasing the rate of accident here we have to apply proper arrangement in the dividends and also there is provocations of cameras so any one who does not follow the rule should be punished. There should be speed breakers so that the that speed leads down and make a decrement in the accident rate.



SIGNAL DESIGN

For road 1,

Volume of approaching intersection during design hour is 4280 and 3396 PCU/ hr

For road 2,

Volume of approaching intersection during design hour is 3440 and 1975 PCU/ hr

Design traffic for road 1 = maximum of two approach volume / lane

= 4280/2= 2140 PCU/hr

Design traffic for road 2 = 3396/2= 1698 PCU/hr

i) Pedestrian green time for road 1

= (22.65/1.2)+7= 25.87 sec

Pedestrian green time for road 2= (17.53/1.2)+7 = 21.60 sec

Green time for vehicle for road 1

G2=25.87 sec= 26 sec

ii) Green time for road 1

G1= (2140/1698)*26 = 32.76 sec

iii) Adding 2 sec each towards clearance amber and 2 sec intergreen for each phase

Total cycle length required= (2+25.87+2)+(2+32.76+2)

= 66.63 sec

Signal cycle time may be set in multiples of five sec and so cycle time = 70 sec

Extra 3.4 sec may be apportioned to gren time of 1 and 2 as 2sec and 1.4 sec respectively

G1= 32.8+2= 34.8 sec= 35 sec

G2= 25.9+1.4= 27.3 sec= 28 sec

iv) Lost time per cycle= (amber time+ intergreen time+ time lost for initial delay of first vehicle)

for two passes

= (2+2+4)*2=16 sec

Saturation flow for road 1 =525*22=11567.56

Saturation flow for road 2= 33*525= 17551.02

Y1= 4280/11567.56= 0.37

Y2= 3440/17551.02= 0.194

Y= Y1+ Y2 = .37+ .0194= 0.57

Optimum cycle length

Co= (1.5L+5)/(1-Y)

=(1.5*16+5)/(1-0.57)

Co= 68 sec

Therefore , take 70 seconds

Also, there is reduction of the edge curb at the cut because of the sharp edge the peoples cannot get in formation about the vehicles come from another direction there are temporary structure so they get easily demolished and the reduction in accident should occurred easily.

VI. Appendix

The data Required primary data are collected from the office of Superintendent of police (Traffic) of each zone of Jaipur. This study is based on the data collected from 4 police station of accidental records of various zone and some data by manual counts. The accident record are situated at 4 different places in the Jaipur city. There are the main headquarter of traffic police at Sanganeri gate Jaipur which is mainly responsible for investigation of traffic accident and help us to get the data from various places. There are approx 62 Police station in Jaipur but from the beginning accident related data are collected from only 4 police stations. This drill is still widespread.

VII. ACKNOWLEDGMENT

My heart pulsates with the thrill for tendering gratitude to those persons who helped me in completion of the project.

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