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 such a 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 arraval 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


III. DATA COLLECTION

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

<table>
<thead>
<tr>
<th>S.NO</th>
<th>YEAR</th>
<th>FATAL</th>
<th>GRIEVES</th>
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Table 4: (Data of accident of Triveni Tiraha)

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<th>S.NO</th>
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<th>LENGTH OF ROAD</th>
<th>ACCIDENT RATE PER KM</th>
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Table 3: (Data of accident of Triveni Tiraha)

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Accident Severity rate:
The accident severity rate measure the seriousness of accident and the availability of medical facilities in the city. Fig. 6 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.

<table>
<thead>
<tr>
<th>S.NO</th>
<th>YEAR</th>
<th>TOTAL ACCIDENT</th>
<th>LENGTH OF ROAD</th>
<th>ACCIDENT RATE PER KM</th>
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Table 5

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</tbody>
</table>

Table 6

V. CONCLUSION:

1. 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 1 and 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

\[ = \frac{1375}{4} \]

= 345 PCU/hour

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

\[ = \frac{690}{3} \]

= 230 PCU/hour.

![Fig 6 (Accident severity rate)](image)
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, \(G_1 = 30 \times (345/230)\)
= 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 multiples 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 = \((1375/7350)\)
= 16.17

Minimum green time required per cycle to clear vehicles on road 1 = \(6 + (8.12-1)\times 2\)
= 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 = \((2+2+4)\times 2 = 16\) sec.
Saturation flow for road -1 of width 14m = \(525\times 14 = 7350\) PCU/hr.
Saturation flow for road -2 of width 10.5m = \(525\times 10.5 = 5513\) PCU/hr.
\(Y_1 = (1375/7350) = 0.187\)
\(Y_2 = (690/5513) = 0.125\)
\(Y = Y_1 + Y_2\)
= 0.312
Optimum signal cycle time, \(C_0 = (1.5L+5) / (1-Y)\)
= \(((1.5 \times 16) +5) / (1-0.312)\)
= 42.15 sec.

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

The detail of the signal timing are given below,

<table>
<thead>
<tr>
<th>ROAD</th>
<th>GREEN PHASE, G SEC</th>
<th>AMBER TIME, Y SEC</th>
<th>RED PHASE, R SEC</th>
<th>CYCLE TIME, C SEC</th>
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</thead>
<tbody>
<tr>
<td>ROAD 1</td>
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<td>35+2</td>
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<tr>
<td>ROAD 2</td>
<td>31</td>
<td>2</td>
<td>50+2</td>
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</table>
2. **B2 BYE PASS**

As the diagram shows, the traffic flow condition on the B2 bypass generally results in accidents occurring at night due to rush driving of trucks. The reason behind the accidents is that the road to Mansarovar has a divider but there is no obstruction, so the glazing of the vehicle headlight falls on the opposite side, leading to accidents.

So, for decreasing the rate of accidents, we must apply proper arrangement in the divider, and there should be provocations of cameras so that anyone who does not follow the rules should be punished. Speed breakers should be installed so that the speed is reduced, leading to a decrease in the accident rate.

3. **TRIVENI NAGAR TIRAH**

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

\[ = \frac{4280}{2} = 2140 \text{ PCU/hr} \]

Design traffic for road 2 = 3396/2 = 1698 PCU/hr
i) Pedestrian green time for road 1

\[ = \frac{22.65}{1.2} + 7 = 25.87 \text{ sec} \]

Pedestrian green time for road 2 = \( \frac{17.53}{1.2} + 7 = 21.60 \text{ sec} \)

Green time for vehicle for road 1

\[ G_2 = 25.87 \text{ sec} = 26 \text{ sec} \]

ii) Green time for road 1

\[ G_1 = \left( \frac{2140}{1698} \right) \times 26 = 32.76 \text{ sec} \]

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

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

\[ = 66.63 \text{ sec} \]

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 green time of 1 and 2 as 2 sec and 1.4 sec respectively

\[ G_1 = 32.8 + 2 = 34.8 \text{ sec} = 35 \text{ sec} \]

\[ G_2 = 25.9 + 1.4 = 27.3 \text{ sec} = 28 \text{ sec} \]

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

\[ = (2 + 2 + 4)^2 \times 2 = 16 \text{ sec} \]

Saturation flow for road 1 = 525 \times 22 = 11567.56

Saturation flow for road 2 = 33 \times 525 = 17551.02

\[ Y_1 = \frac{4280}{11567.56} = 0.37 \]

\[ Y_2 = \frac{3440}{17551.02} = 0.194 \]

\[ Y = Y_1 + Y_2 = 0.37 + 0.194 = 0.57 \]

Optimum cycle length

\[ C_0 = \frac{1.5L + 5}{1 - Y} \]

\[ = \frac{1.5 \times 16 + 5}{1 - 0.57} \]

\[ C_0 = 68 \text{ sec} \]

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 Sanganer 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.

The most pleasant point of presenting a thesis is the opportunity to thank who have contributed to it. Unfortunately, the list of expressions of thank no matter how extensive is always incomplete and inadequate. Indeed this page of acknowledgement shall never be able to touch the horizon of generosity of those who tendered their help to me. I extend my deep sense of gratitude and indebtedness to my guide Mr. Nandeshwar Lata (Asst. Prof.) Department of Civil Engineering, Jagannath University, Jaipur, for their kind attitude, invaluable guidance, keen interest, immense help, inspiration and encouragement which helped me carrying out my present work.

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Lastly, I thank all those who are involved directly or indirectly in completion of the present project work.
VIII. References


