Identification of Accident Prone Stretches in urban Area a Case Study of Rajkot City

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Abstract— Road traffic accidents can be defined as "An accident that occurred on a road open to a public traffic; resulting in personal injury, damages to the property and loss of life in which at least one moving vehicle was involved." Thus, road traffic accident is collisions between vehicles, between vehicles and pedestrians, between vehicles and animals, or between vehicles and geographical or architectural obstacles. Accident prone location should be identified so the accident can be reduced with proper action on the sever locations. This study is of better relevance in this context for mitigating accident problems on city roads through systematic identification, analysis and measure of accident prone stretches. Based on Accident Severity Index(ASI) method the top most three accident prone stretches are identified.

Key words: Raod Accident, Accident Prone area

Year	Number of Accidents		Number of Persons		Accident Severity*
	Total	Fatal	Killed	Injured	
2003	4,06,726	73,589 (18.1)	85,998	435,122	21.1
2004	4,29,910	79,357 (18.5)	92,618	464,521	21.5
2005	4,39,255	83,491 (19.0)	94,968	465,282	21.6
2006	4,60,920	93,917 (20.4)	105,749	496,481	22.9
2007	4,79,216	1,01,161 (21.1)	114,444	513,340	23.9
2008	4,84,704	1,06,591 (22.0)	119,860	523,193	24.7
2009	4,86,384	1,10,993 (22.8)	125,660	515,458	25.8
2010	4,99,628	1,19,558 (23.9)	134,513	527,512	26.9
2011	4,97,686	1,21,618 (24.4)	1,42,485	5,11,394	28.6
2012	4,90,383	1,23,093 (25.1)	1,38,258	5,09,667	28.2
2013	4,86,476	1,22,589(25.2)	1,37,572	4,94,893	28.3
2014	4,89,400	1,25,828(25.7)	1,39,671	4,93,474	28.5

Source: Information supplied by States/UTs (Police Departments).
Figures within parentheses indicate share of fatal accidents to total accidents.
* Accident Severity : Number of persons killed per 100 accidents

Table 1: Road Accident Statistical Analysis – Morth 2014

I. INTRODUCTION

Accidents cannot be totally prevented but through scientific analysis and proper engineering measures their frequency and severity can be reduced. Therefore, traffic engineer has to carry out systematic accident studies to investigate the causes of accidents and to take preventive measures in terms of design and control. It is essential to analyze every individual accident and to maintain zone wise accident records. The statistical analysis of accidents carried out periodically at critical locations or road stretches or zones will help to arrive at suitable measures to decrease the accident rate effectively.

Traffic Accidents in the country have marginally increased by 1.3% during 2014 compared to 2013. 4,81,805 Traffic Accidents resulted in injuries to 4,81,739 persons and 1,69,107 deaths during 2014. India has a road network of over 48,65,394 kilometres+ as on 1st March, 2012. For the first time, an effort has been made by the Bureau to capture a comprehensive data on road accidents using the revised preformed. 'Road Accidents' cases in the country have increased by 1.8% during 2014 (4,50,898 cases) compared to 2013 (4,43,001 cases). The fatalities in road accidents have increased by 2.9% during 2014 as compared to 2013. During 2014, a total of 4,89,400 road accidents were reported by all States/Union Territories. Of these 25.7 per cent (1,25,828) were fatal accidents.

The number of persons killed in road accidents were 1,39,671 i.e. an average of one fatality per 3.5 accidents. The number of road accidents, road accident fatalities and persons injured in road accidents in India during 2003 to 2014

II. LITERATURE REVIEW

A. R.R. Sorate et. Al.(2015) "Identification of Accident Black Spots on National Highway 4 (New Katraj Tunnel to Chandani Chowk)

R.R.Sorate et. Al. analysed that The 34-km stretch of Mumbai-Bangalore highway in the Pune city limits has seen 110 fatal accidents in the last three years claiming 111 lives. Thus the primary aim of the project is to identify the accident black spots on National Highway-4 spanning 14.5Kms from New Katraj Tunnel to Chandani Chowk and to suggest remedial measures. Methodology adopted includes collecting the secondary data from respective authority, conducting physical survey (primary data) and analyzing them by method of ranking and severity index, accident density method, weighted severity index. Locations appearing in all the three methods were termed as black spots. Further corrective measures were suggested.

B. Pavan R Vyas Et. Al.(2015) "Identification Of Black Spots For Safe Commuting Using Weighted Severity Index And GIS"

Pavan R Vyas et. Al. studied the present state of traffic accident information on SH-85 from Tavarekere to Magadi Town in Karnataka State. In this study, the various factors, which tend to influence the occurrence of accidents on roads, are assigned weights on a scale of 1-10 in such a manner that the factor, which tends to increase the probability of the accidents are assigned lower weights. The entire stretch is segmented using dynamic segmentation tool in Arc GIS After the analysis, most of the hazardous locations were obtained in the map. The Weighted Severity Index (WSI) method was used to rank the probable-accident locations.

C. Gourav Goel & S.N. Sachdeva (2014) "Identification Of Accident Prone Locations Using Accident Severity Value On A Selected Stretch Of NH-1"

Gourav Goel & S.N. Sachdeva carried out study on road accident data of a selected stretch of NH-1 (Delhi-Ambala-Amritsar Road). A 50 km road stretch between RD 98 km to 148 km was selected and road accident data of four years (2007-2010) was collected. The 6-laning work of NH-1 is in progress during the selected period so the study considers the effect of widening project on road accidents also. The effect of 6-laning work on road accidents has been evaluated by dividing total number of accidents into two groups before construction and after construction work started. To identify the accident prone locations the total stretch was divided into smaller sections of 5 km each. Total accidents and accident severity value has been used to rank the accident prone locations. The stretch of the road 140-144 km is found to be the most accident prone followed by the stretch 98-104 km and the stretch 145-148 km. A field study has been conducted to compare the analysis with field results.

D. Gopala Raju Et. Al., (2012) "Identification of Black Spots And Junction Improvements in Visakhapatnam City"

Gopala Raju et. Al. studied causes of accidents are studied and suggested different remedial measures to reduce number of accidents. The present work intended in identifying various black spots (accident prone location) in Visakhapatnam city. Four locations have been identified as major accident prone areas namely, Gajuwaka junction, Venkojipalem junction, Spencers Junction and Hanumanthawaka junction. Most of the road accidents occur due to heavy vehicles and public utility vehicles like auto rickshaws and taxies. Accidents due to auto rickshaws may not be fatal but number of accidents is more, when compared to other mode of transportation.

III. DATA COLLECTION

For the present study accident data, vehicle registration data and other data of study area are required, which is a huge and laborious work. Global and national level data are obtained and from various journals and technical published papers. State level data are collected and compiled from State Traffic Branch. Vehicle registration data is collected from Regional Transport Office of study area. Population, land use pattern, physical features of various roads, map of study area etc are collected from municipal corporation office. The accident data of last five years will be collected from police stations for the research work.

Road accident statistics of Rajkot city from the year 2010 to 2015 is shown in Table 2. Accidents are classified in fatal accidents, grievous injury accidents, minor injury accidents and non injury accidents. In the year 2010 the total number of accidents was 1530 and in the year 2015 the total number of accidents was 1559. During these six years the population and vehicle ownership have increased but the number of total accidents and fatal accidents has remained approximately constant in the city. This may be because of improved quality of roads, introduction of new roads, increased width of roads, installation of traffic control devices at junctions, channelising island at intersection, introducing medians on roads and improvement in geometrics of roads of the city. This may also be due to increased traffic sense in the people and strictly implementation of traffic rules by traffic police of Rajkot city.

		Number of Accidents				Number of Persons	
Year	Fatal (F)	Grievous Injury (GI)	Minor Injury (MI)	Non Injury (NI)	Total	Killed	Injured
2010	92	120	1115	203	1530	96	1576
2011	108	110	1197	176	1591	111	1634
2012	113	119	1137	195	1564	122	1616
2013	106	109	1217	185	1617	110	1654
2014	114	129	1184	194	1621	119	1662
2015	106	133	1128	192	1559	121	1597
Total	639	720	6978	1145	9482	679	9739

Table 2: Accidents Classified According to the Year from 2010 to 2015

IV. DATA ANALYSIS

A. Accident Severity Index Method

Accident Severity Index (ASI) suggest average accident weightage points of a stretch per km per year. In this study, this method is employed for ranking the most severe stretches, as it involves all type of accidents with proper weightage. For computation of Accident Severity Index, the accidents are classified into four groups namely, fatal, grievous injury, minor injury and non-injury accidents. Weightage is assigned to categories based on relative cost of accidents. As Chakraborty et. al (1995) has given weightage points as follows:

Fatality = 6
Grievous Injury = 3
Minor Injury = 0.8
Non-Injury = 0.2

Using the above weightage points Accident Severity Index is calculated by the following formula:

$$I = \frac{n1w1 + n2w2 + n3w3 + n4w4}{5L}$$

Where
I= Accident Severity Index
L= Length of road
n_1, $n2$,$n3$,$n4$ = Number of fatal, grievous and minor injury and non injury accidents.
w_1, $w2$,$w3$,$w4$ = Corresponding weight age points for each kind of accidents.

Based on ASI ranking of the accident prone stretches are done. Higher the value more severe is the stretch. In Traffic police department fatal and total accidents details according to different stretch are available. Ranking of accident prone stretches is based on accident rate and accident severity index method is shown in Table 3. In this study, the top three most severe stretches are identified as below:

Sr. No.	Name of Stretches	Length (in Km)	(ASI)	Ranking of Stretches
1	Kalawad road	5.85	38.67	1
2	150 ft Ring Road (Madhapar Chok to Gondal Chawk)	10.7	34.21	2
3	Javahar road	1.07	33.05	3
4	Aamrapali Main Road	1.7	27.48	4
5	80 feet road	1.8	26.71	5
6	Palace road	0.89	26.25	6
7	Race course road	2.9	25.75	7
8	RamnathPara Main Road	1.4	25.29	8
9	Jilla garden road	1.17	25.16	9
10	Jamnagar road	4.65	24.98	10
11	Lakhajiraj road	0.95	24.00	11

Table 3: Accident Prone Stretches

Kalawad road – ASI 38.67
150 ft ring road– ASI 34.21
Javahar road – ASI 33.0
Kalawad Road

This is a fully divided road starting from Mahila college chowk, leading towards Kalawad village. The length of Kalawad Road is 5.85 kms. Effective carriageway width is 7.45-15.75 meters and right of way is 24.70-37.10 meters.

1) Problem Identification

Based on field survey of this road following problems are identified:

1) At KKV hall 150 feet Ring road meets to the Kalawad road. The surrounding area of Kalawad road at this junction is built-up with high rise buildings. So there is very heavy traffic volume congestion during peak hours on this road. Rotary intersection is provided at this junction but it is observed that rotary is locked-up very often.
2) At KKV hall large hoardings on both the side obstruct the visibility. This increases the reaction time of driver.
3) Absence of channelized Intersection at KKV hall junction and BAPS Swaminarayan temple junction leading to vehicular conflicts to the road users.
4) Encroachment on Both the side also make conflicts.
5) BAPS Swaminarayan temple junction is uncontrolled intersection on Kalawad road. The roads from this junction lead to Swaminarayan temple, Amin Marg , Mahila college chowk and Kotecha chowk on north, south, east and west sides respectively. During the religious festival season, high intensity of pedestrian movement across the Kalawad road towards Swaminarayan temple would take place. This is reason of traffic jammed condition.
6) No pedestrian facilities provided on Kalawad Road.
7) Traffic control devices are inadequate at Swaminarayan temple junction.
8) High on-street parking at Swaminarayan temple reduces the effective carriageway for amooth movement of traffic
9) In monsoon season, rain water spills over the road of under bridge of Mahila college chowk due to poor drainage facilities.
10) Road signage and markings are generally missing to warn the road users in advance at many places on this stretches.
11) There is high commercial vehicle movement on this road. So heavy vehicle conflicts are observed.
12) Irregular traffic signals at KKV hall junction.

Inadequate and Illegal Rickshaw parking is at KKV hall junction which affect the road users.

Fig. 1: Stretch of Kalawad Road

B. Javahar Road

This is a peripheral road in central area joining Hospital chowk and Trikon bag main CBD area of Rajkot city. It is partly divided and 1.07 kms. Long stretch. Its effective carriageway width is 11.00-16.90 meters and right of way is 15.90-28.50 meters. The road width 11.00 meters is observed at the undivided twoway section.

Problem Identification

From the field survey of this road, problems identified are enlisted below:

1) There are vehicular conflicts at Hospital chowk result in significant delay to road users at the rotary.
2) Foot path width is inadequate and inconsistent on either side of Hospital chowk
3) Near LalBahadur Shahstri stadium, vehicular and pedestrian conflicts exist at city bus control point.
4) Near Hospital chowk, Auto Rickshaw and chhakdas are parked very close to the intersection which is obstructing smooth traffic flow.
5) On-street parking at Trikon Baug to Jubeli Chawk obstructing on to the carriageway.
6) Several major institutions like school, bank, and shopping centre have very poor parking facilities in their own premises.
7) Jubeli Area is having a vegetable market so In evening periods there are more chances of conflicts.
8) RMTS Bus stand is on this road which affect adversely to the effectiveness of carriage way.

C. 150 Ft. Ring Road

150 Ft. ring road is four lane road with Exclusive bus lane for BRTS starting from Gondal Chokdi to Madhapar Chawk. Length of this Stretch is 10.7 km.

1) Problem Identifications

From field survey following problems are identified.

1) Absence of Road signal on almost Intersection of the road.
2) Raiya Circle meets with heavy traffic on morning and evening peak hours from four different way

Raiya Road , Aamrapali Road , 150 ft ring road respectively.

3) Very heavy traffic observed at KKV hall junction which also effect the traffic flow movement of 150 ft. ring road.
4) No Pedestrian walk way on throughout the road.
5) Heavy Vehicle movement make a conflicts in Traffic at intersection .
6) Auto rickshaw, Hawkers make a Congestion at Madhapar intersection on the stretch 150 ft. Ring Road.
7) No Channelized at Mavdi Intersection which is one of the most heavy traffic intersection.
8) BRTS route meets with regular traffic flow. On 10.7 km Stretch there are 18 Bus terminal for BRTS which may also Cause Traffic .
9) Some slots of the stretch are not assembled with foot path. This imposes the pedestrian to use carriageway.
10) Carriageway width available at Mavdi circle is inadequate due to heavy traffic, results into side swiping and rear end collision of vehicles.

Fig. 2: Signal Not Working at Raiya Circle and Traffic Congestion

V. CONCLUSION

The study presented in the paper has been conducted to identify the accident prone locations on the selected stretch and improvement suggested.

- There should be a provision of channelized Intersection to stream line traffic movement.
- Medians should be provided on all approaches of KKV hall junction and BAPS Swaminarayan temple junction for controlled directional traffic and to avoid crisscross movement on approaches of the stretches.
- Traffic signal system is proposed at BAPS Swaminarayan temple junction for safe movement of vehicular and pedestrian traffic and to optimize the intersection performance.
- Proper action should be taken against large hoardings. .
- Proper drainage facilities at under bridge of Mahila college chowk should be introduced
- Pedestrian facilities, foot path with guard rails in the intersection area should be provided on throughout the stretch.
- Frequent cleaning of foot path is required.
- Road signage and markings should be introduced at appropriate places.
- Encroachment should be restricted or shifted else where from the road.
- On-street parking should be controlled and it is required to make a compulsion to park the vehicle on the specified parking slots.
- Median openings to be provided with signal along minor streets.
- Foot path should be provided throughout the road.
- Proper traffic control devices like pavement markings and traffic sign and Signals should be provided at suitable locations.
- Haphazard on-street parking at Mavdi Circle road reduces the effective carriageway for movement of traffic.
- On-street parking should be controlled and it is required to make a compulsion to park the vehicle on the specified parking slots.
- There should be a provision of channelisers to stream line traffic movement.
- The electrical poles should be removed and to be made underground cable systems.

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