Identification and Improvements to geometrics of blackspots at West Bangalore

Supreeth R [#1], Nikhil T R [*2], Yateen Lokesh [#3]

[#] Postgraduate student,Department of Civil Engineering, M.S Ramaiah University of Applied Science, Bangalore, Karnataka, India

Abstract

Increase in the population day by day the numbers of vehicles are also increasing. As a fact of increase in the vehicles, number of accidents gradually increases. The accidents are occurred due to human error or road parameters. For sorting out the issues, road is preferable than human and vehicles. As a matter of fact, to control the issue, road is preferable than Human and vehicle. An accident black spot is a hazardous or high-risk location where a number of accidents repeatedly occur.

This paper deals with the identification of Blackspots and improvements to the specific locations in terms of geometrics of road. The procedure described is based on recorded accidents, data about accidents and traffic studies. Finally, the evaluation of the proposed remedies will be simulated using vissim and Sidra Intersection software. The ultimate scope of the project is to find out the root cause of the accidents and also to find the facts that can lead to corrective actions.

Keywords - Black Spots, Traffic studies, Accident analysis, Parking studies, Remedial measures, PTV Vissim, Sidra Intersection
.

I. INTRODUCTION

India is one of the countries having high rate of road accident and fatalities. National highways accounts for a substantial proportion of these accidents leading to huge economic losses and to irreparable loss of human lives. Therefore, it has been decided to make concerted efforts towards improvement of road safety (Dinesh Mohan, 2015) in general and on National Highways (Bombade, 2015) in particular.

The major cause for the disability, injury and death is due to the road accidents. The road accidents is caused due to the negligence from the government and lack of road and traffic planning since the major role is played by the transportation engineers for the better design and control of road system, it is mandatory to maintain low accident rate on road transportation an effective and reduction in accident rate measures need to be taken care by the transportation department

Bangalore (R, 2013) is the city comes in fourth position from the top 10 cities with the highest number of Road Crash Deaths (in India). In this, accident data's are used to identify black spots and traffic studies are used to find the improvements in geometrics of road. The accident data is obtained Traffic Management Centre, Bengaluru. The identified spots can be investigated with traffic parameter studies to identify the improvements.

II. METHODS TO IDENTIFY THE BLACK SPOT

Generally four methods are used to identify the Black spots

i. Weighted Severity Index (Hinsu, 2015)
ii. Using Geographic Information System
iii. Method of Ranking
iv. Based on accident recorded on Police Stations

A. Weighted Severity Index

$WSI = (41* K) + (4*GI) + (1*MI)$
Where, K is the number of person killed
GI is the number of grievous injury
MI is the number of minor injury
Locations having WSI above 40 are termed as accident black spots. This method can also use to rank the black spot for prioritization.
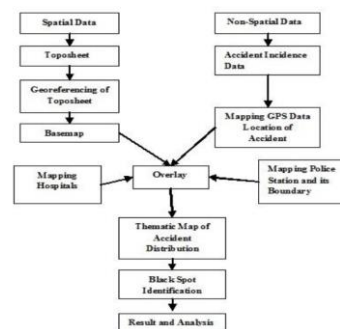
B. Using Geographic Information System

Fig 1:flow chart

C. Kernel Density Estimation

• Using **Arc GIS 10.2.2** (Liyamol, 2013)
• It is a Spatial analysis method
• Used to calculate the density of accidents with a search radius of 50m
• It divides the entire study area to a pre-determined number of cells and applies a circular neighbourhood around each crash
• Density Estimation measures cell densities in a raster by using a sample of known points
• Kernel function will cantering at a known point and tampering of to "0" over a defined window area

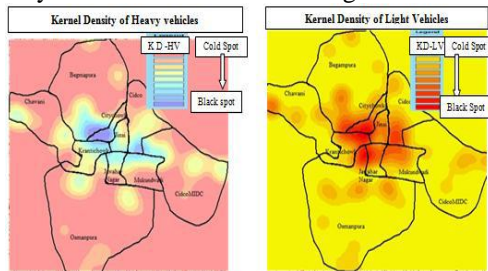- The black spot is detected in dark blue colour for heavy vehicles and dark red for light vehicles

Fig 2:Output using kernel density method

D. Point Density Estimation

- It calculates the density of point features around each output raster cell

- A neighbourhood is defined around each raster cell centre, and the number of points that fall within the neighbourhood is totalled and divided by the area of neighbourhood
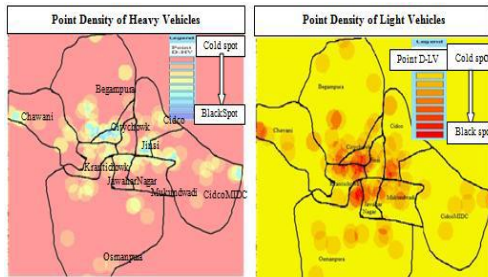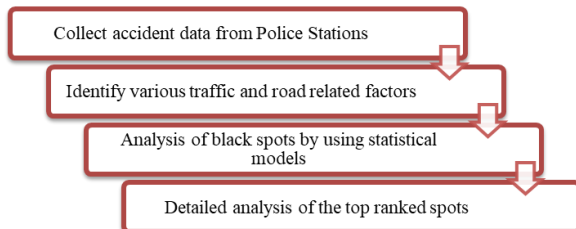

Fig 3:Output using point density method

E. Method of Ranking

F. Based On Accident Recorded On Police Stations

The accident data can be obtained from the Traffic management center

Collected data's are classified in to

- Location
- Fatal/ Grievous injury accident details of three consecutive years

From the classified data, five road accidents took place during the last three consecutive Calendar years involving fatalities/grievous injuries or Ten fatalities took place during the last three consecutive calendar years

III. IDENTIFICATION AND PRIORITIZATION OF BLACK SPOTS

All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified.

A. West Division)

The accident data's where obtained from Traffic Management Centre(TMC) for the past three consecutive years (2017,2018, 2019(up to march)), Five road accidents took place during the last three consecutive Calendar years involving fatalities/grievous injuries or Ten fatalities took place during the last three consecutive calendar years are considered to identify the black spot.

TABLE I
West Division: Summary of accidents

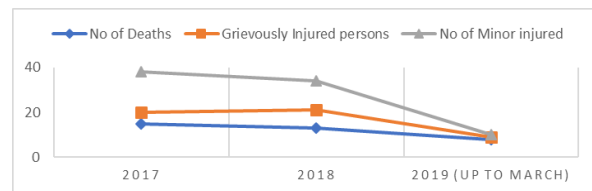| Year	2017	2018	2019 (up to March)	Total
No of Deaths	15	13	8	36
Grievously Injured persons	20	21	9	50
No of Minor injured	38	34	10	82

Fig 4:Summary of accident

B. Identification And Prioritization Of Black Spot Using Weighted Severity Index Method (WSI)

Prioritized locations and its WSI Values are listed below

TABLE II
Involvement of accidents In terms of location

NO	Location	No of person killed	No of grievous injury	No of minor injury	WSI
1	Magadi main road, Kottigepalya to Ashraya	9	12	23	393
2	H Cross Junction Towards Nvayuga Toll	8	11	23	412
3	Nice Road, Nagegowdanapalya	7	11	18	342
4	Chokkasandra junction towards S M Circle Junction	6	7	15	298
5	Nice Road, Near Purvankura	6	10	13	258

The identified black spots are classified according to WSI (weighted severity index) and top ranked Black spot can be considered for investigation.
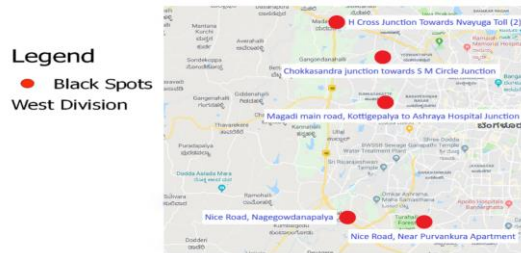

Fig 5:Black spot mapping using QGIS

C. INVESTIGATION ON BLACK SPOTS (USING TRAFFIC STUDIES)

1. Traffic Turning Movement Study
2. Traffic Volume Study
3. Spot Speed Studies
4. Speed and Delay Studies
5. Parking Studies
6. Existing Road Geometrics Study
7. Intersection Studies

1) Traffic Turning Movement Study

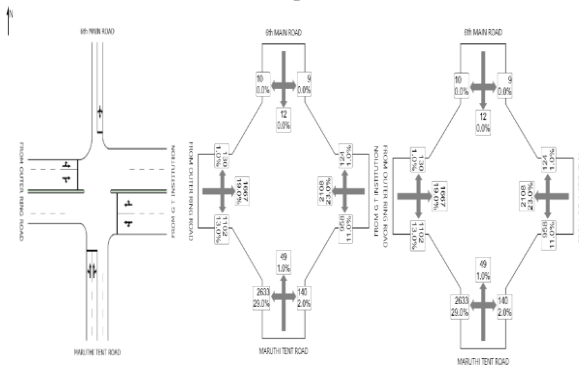Traffic volume study is carried out in both peak hour and non-peak hour.

Figure 6. Traffic turning movement Using Sidra intersection

In this intersection as per traffic turning movement survey conducted, the moving traffic was dense from outer ring road to magadi road and vaise versa at peak hours

2) Traffic Volume Study

Traffic volume study is carried out in both peak hour and non-peak hour. As per the IRC 86- 1983 the passenger car unit (PCU) value for different class of vehicles are Two wheeler= 0.5, Light Motor vehicle= 1, Heavy Motor Vehicle= 3.5.

TABLE III

Traffic volume study peak hour

Traffic Volume Study				PEAK
LANE	TW (PCU = 0.5)	LMV (PCU = 1)	HMV (PCU = 3.5)	PCU
From Outer Ring Road	623	852	324	2298
From G T Institution	1310	1204	473	3515
From 6th Main Road	69	20	10	90
From Maruthi Tent Road	1229	1037	367	2936
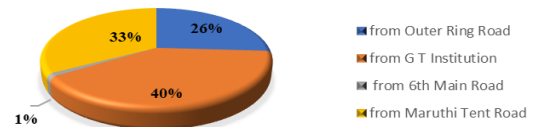
Figure 7. Traffic Volume Ashraya Hospital

TABLE IV

Traffic volume study nonpeak hour

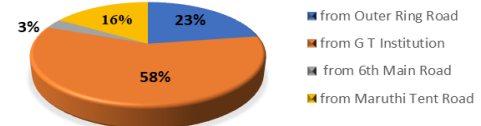| Traffic Volume Study				NON PEAK
LANE	TW (PCU = 0.5)	LMV (PCU = 1)	HMV (PCU = 3.5)	PCU
From Outer Ring Road	474	247	139	970.5
From G T Institution	1411	391	402	2504
From 6th Main Road	59	50	15	132
From Maruthi Tent Road	228	259	93	699

Figure 8. Traffic Volume Ashraya Hospital

The Traffic volume study where observed to be more during the peak time whereas during the nonpeak time the volume of the vehicle decrease

3) Spot Speed Studies

Spot speed is calculated using android software called as "speed gun". The average speeds of the vehicles in each direction are noted. And the spot speeds where observed to be less during the peak time whereas during the non-peak time the model average raised up to 25kmph

TABLE V

Spot speed study in the direction of GT institution

Direction of flow	Peak Time				Non-Peak Time			
From,	Modal Average (kmph)	15% (Lower Speed) (kmph)	85% (Upper Allowable Speed)(kmph)	98% (Design Speed) (kmph)	Modal Average (kmph)	15% (Lower Speed) (kmph)	85% (Upper Allowable Speed) (kmph)	98% (Design Speed) (kmph)
Outer ring road	15	05	25	45	25	5	30	55
G T Institution	15	05	27	35	25	9	28	35

4) Speed and Delay Studies – Floating Car Method

Floating car data (FCD), also known as floating cellular data, is a method to determine the traffic speed on the road network and the study helps to locate the points of congestion and insufficient road capacity.

| Sl no	Trip	Distance(km)	Running time(m)	Avg speed(kmph)
1	Ashraya to G T Institution	1.0	3.33	17.99
2	G T Institution to Ashraya	1.0	2.85	20.98
3	Vijaya bank to Outer ring road	1.4	6.39	13.14
4	Outer ring road to Vijaya bank	1.4	4.0	21.05

5) Parking Study – In and Out Survey

Parking is one of the major problems that is created by the increasing road traffic. It is an Impact of transport development. Studies conducted to collect the required information about the capacity and use of existing parking facilities.
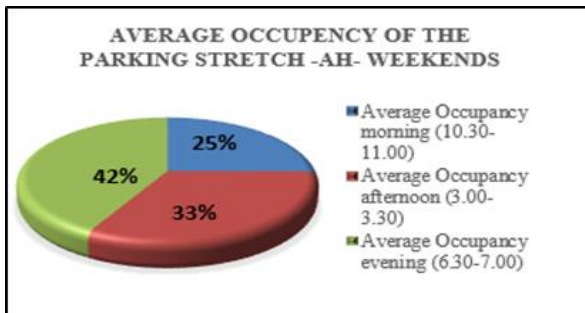
Parking studies are conducted on weekdays and weekend days for the following time interval

- Morning Survey-10:30am to 11:00am
- Afternoon Survey-3:00pm to 03:30pm
- Evening Survey-06:30pm to 07:00pm

Study area- Infront of Ashraya Hospital
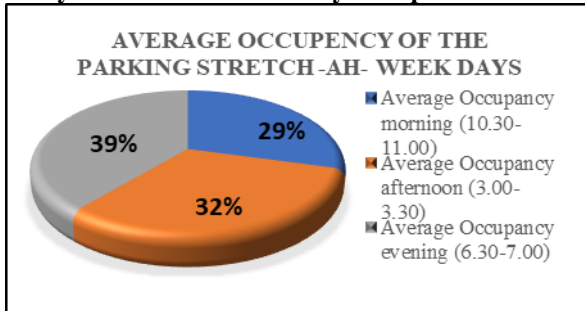
Average efficiency $= \dfrac{71.11+77.22+94.44}{3} = 80.926\%$

Average efficiency $= \dfrac{56.67+73.89+95.00}{3} = 75.185\%$

As per the survey conducted between weekdays and weekends it has been found that weekdays has more occupancy of the parking stretch

6) Study on Road Geometrics

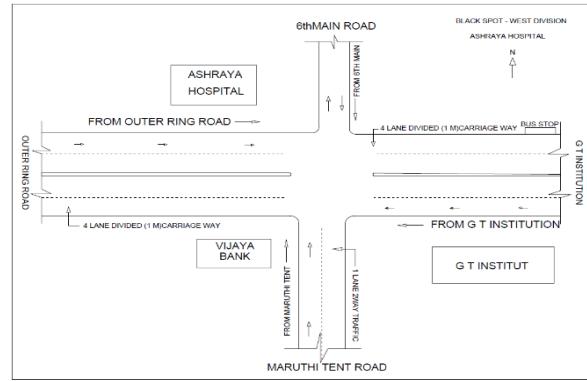The drawing which indicates the road geometrics of the Ashraya hospital junction

Figure 9. road geometrics of Ashraya Junction
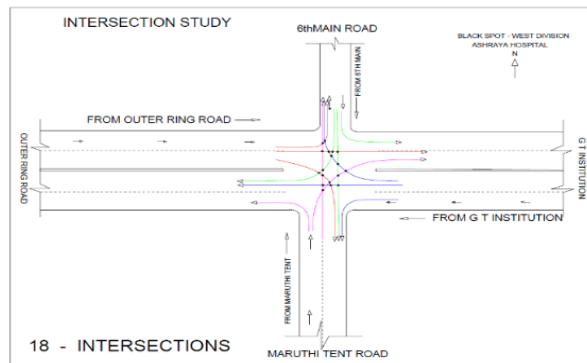
7) Intersection Study

Figure 10. Intersection Study- Ashraya Hospital

The major intersections that are expected to impact the operational efficiency of the study area are:
1. From Outer Ring Road
2. From Maruti Tent Road
3. From G T Institute
4. From 6th Main Road

From the analysis of the road geometrics and intersection study conducted on Ashraya hospital junction, 18 different type of conflicts have been observed .

8) Simulation using PTV VISSIM (Student)

- The existing as well as proposed improvements are validated using VISSIM software to verify the suggestion

Figure 11. Existing Condition Ashraya Hospital, West Division

9) Improvements in terms of Geometrics

- The identified black spots are investigated using traffic studies. The improvements in terms of geometrics for the corresponding spots are suggested as per the IRC guide lines. Existing conditions are cross checked with the regulations in IRC 86-1983 to identify the necessary improvement.
- As per IRC 86-1983 pcu/hr in 2 lane carriage way is 1500. For the spot (From GT institute, To GT institute and Maruti tent road), in peak hour, the value is far greater. An additional lane is required to avoid the congestion in present and future traffic.
- From GT institute – Four Lane Instead of Two Lane
- To GT institute – Three Lane Instead of Two Lane
- Maruti tent road – Three Lane Instead of Two Lane
- Parking in the road must be restricted
- Proper road signs and markings must be provided as per IRC.
- From the parking studies we can observe the average parking efficiency is less, therefore On-street parking must be avoided also it reduces the road capacity.
- Conversion of the junction to a Zero tolerance junction.
- Relocating of bus stop /shelters
- The place must be monitored by traffic department in respective interval to check the speed
- A warning sign of "Black spot" should be installed in the spot
- Installation of cat eyes and road reflectors will help to follow the lane
- HMV must be restricted to take U turn in intersection
- There are no proper pedestrian crossing facilities all over the route, which forces the pedestrian to cross the road in an uneven pattern. This increases conflict points and in turn giving rise to accident. So proper pedestrian crossing is much needed to avoid the accident

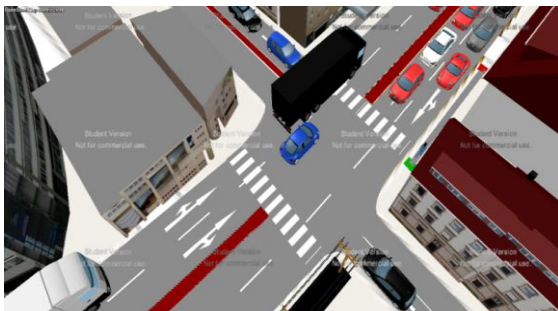### 10) Proposed Condition in Terms of Geometrics using PTV VISSIM (Student)

Figure 12. Proposed Condition, Ashraya Hospital, West Division

D. Results and Analysis

[1] The Black spots in the west division of Bangalore city was identified using traffic accident data. Later, the identified spots are prioritized by WSI method.

[2] Most of the prioritized black spots are concentrated nearer to the bus stop

[3] Five locations has been identified as major accident prone areas namely, Magadi main road, Kottigepalya to Ashraya Hospital Junction, H Cross Junction Towards Nvayuga Toll (2), Nice Road, Nagegowdanapalya, Chokkasandra junction towards S M Circle Junction, Nice Road, Near Purvankura Apartment junction. The Magadi main road, Kottigepalya to Ashraya Hospital Junction is highly densely built up area. As per the survey conducted, which is nearer to the outer ring road. Hence this junction has been prone with huge traffic inflow and outflow rates.

[4] From the studies it came to know that, most of the victims of accidents are pedestrians and major accidents are happening due to ignorance of driver

[5] Provision of skywalk/underpass to pedestrians, additional lane in case of congested volume, informatorily and warning boards aside of road, restriction of parking in the road side, provision of lighting system are major improvements proposed for the black spots

[6] PTV VISSIM (student) version was used for simulating the real and improved spots. The results proves the necessity of improvement in terms of geometrics

[7] Since the PTV VISSIM (student) version have less features, several improvements are not done for simulation

IV. CONCLUSIONS

[1] 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.

[2] A "Black spot" on the road is a spot where accidents have been historically concentrated. The number of accidents and the fatality of the accidents are severe at these spots.

[3] Identification and analysis of such spots will help us in identifying the cause of the accidents and to suggest suitable remedial measures.

[4] We have used the collected police data and FIR reports in identifying the locations of black spots.

[5] We have used the WSI (Weighted Severity Index) method to select the top locations of black spot.

[6] The above methodologies proved to be efficient in identifying, whereas the above studies helped in analysing the black spots.

[7] Implementation of the suggested remedial measures will increase the road safety.

[8] SIDRA INTERSECTION (student) version was used for the design of intersection in both real and improved spots. The results gives the improvements in terms of geometrics

[9] PTV VISSIM (student) version was used for simulating the real and improved spots. The results proves the necessity of improvement in terms of geometrics

[10] Since the PTV VISSIM (student) version have less features, several improvements are not done for simulate

REFERENCES

[1] Bombade, S. U,. Identification of accidental black spots on national Highways and Expressways. IJRAT. (2015).

[2] Dinesh Mohan, G. T,. Road safety in India. Transportation research & injury prevention programme, IIT Delhi,. (2015).

[3] Pothula sanyasi Naidu, Gundu Navya, Chukka Deepika, Mahesh Yamala, ,Capacity of Road with vechile Characteristics and Road Geometrics Interface Modelling, SSRG International Journal of Civil Engineering 2.10 (2015): 27-33.

[4] Liyamol, S. A,. Identification and analysis of accident black spot using geographic information system.International journal of innovative research in science, engineering and technology., (2013).

[5] nayak, S. c,. Accident analysis and development of crash prediction model for a mid sized city. National institute of technology Rourkela., (2014).

[6] R, N. T,. Identification of Black spots and improvements to junctions in Bangalore city. IJSR, (2013).