International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 07 | July 2019 www.irjet.net p-ISSN: 2395-0072

IDENTIFICATION AND ANALYSIS OF BLACK SPOTS ALONG THE SELECTED ROAD STRETCHES OF BELAGAVI CITY

Pallavi Bhover[1], Rashmi. J. V[2], Nityanand Kudachimath[3]

[1] PG Student, Department of Civil Engineering, Jain College of Engineering, Belagavi, India
[2]Asst.Professor, Department of Civil Engineering, Jain College of Engineering, Belagavi, India
[3]Asst.Professor, Department of Civil Engineering, Jain College of Engineering, Belagavi, India

---

Abstract - *As the population is increases day by day the numbers of vehicles are also increasing. As the vehicles are increasing, number of accidents also increases. The accidents are due to human error or road parameters Road accidents cannot be totally prevented, but by using suitable traffic engineering safety plan and management measures, the accidents rate can be reduced. Black spots are the locations in a road where accidents are common or places in which road crashes results in fatal injuries. Therefore identification of accident prone location is considered as the first step in road safety measurements. In this study to identify the black spot and accidental prone location zone within Belagavi City, Accidental Severity Index method and to locate the black spots Arc GIS 10.1 software is used. For this study, the road accident data for the past three years 2015, 2016 and 2017 pertaining to Belagavi City is collected from South Traffic Police station, Belagavi. Road Safety Analysis was carried out in the identified black spots such as College road, Gogate Circle, Shri Atal Bihari Vajpayee Marg, Bemco Cross and Khadarawadi Cross. From the analysis I have identified accidental prone zone and black spot in the selected study stretch and some remedial measures are made to reduce future accidents and to improve the road transportation system.*

Key Words: *Black spots, Accidental Severity Index method, Arc GIS 10.1, Road safety measures*

1. INTRODUCTION

Roadways are the important factors for the economic and social development of the country and they are also acts as a back bone of that country. India has more population so it requires large amount of transportation services like air, land and water transportation. Among these transportation services road ways are more convenient compared to other services. So it is very necessary to increases and to maintain the road networks of our country. As per Ministry of Road Transport and Highway, in 2014 the number of accidents increased by 2.5 percent from 4,89,400 to 5,01,423 in 2015. So this analysis says that 1,374 accidents and 400 deaths are happens daily. This implicit that 17 persons becomes fatality of road accidents for every hour.[1] This causes an obstruction for the social development of that country. Traffic accidents are the major reason of death and injuries universal. The location in the road where the number of accidents repeatedly occurs is called as Black spots. These road accidents lead to the loss of life and property. So it is very important to identify the accident prone location to reduce the future accidents. This analysis may help in good scheduling and road safety policies. The black spots methods are made to find out the accidental prone location in a particular road stretch and reduce the accidental risk in that selected area by giving some remedial measures. Road accidents cannot be totally reduced, but by applying some suitable traffic engineering safety management measures, the accidents rate can be prevented. The black spots identification methods are highly depends on the primary data (road inventory survey, spot speed analysis, traffic volume count etc) and secondary data (accidental data from police station). Severity index method, Ranking method and GIS techniques are used to identify the accidental prone location. GIS (geographical information system) is a one of the powerful tool for managing the large quantity of heterogeneous data so it can be used to identify of hot spots and prioritize the hot spots on roads. It is a computer system for capturing, storing, querying, and analyzing the data. Some of the benefits of usage of GIS are[8]

- Cost saving and increased efficiency
- Better decision making
- Improved communication
- Better record keeping
- Managing geographically

1.1 Description of study stretch

Belagavi is an important educational centre of Karnataka State. Belagavi can boast of having three Universities namely: Visvesvaraya Technological University, Rani Channamma University and KLE Medical University. Belagavi has two

allopathic Medical Colleges, three Homoeopathic Medical Colleges, two Ayurvedic Medical Colleges, two Dental Colleges, seven Engineering Colleges and many other polytechnics, management, pharmacy, nursing, horticulture and other graduation colleges. Belagavi has airport and has regular flights connectivity to various states capitals such as Hydrabad, Bangalore etc. In road network, Belagavi lies on the Golden Quadrilateral National-Highway on the Mumbai-Chennai stretch. It is connected to Goa by NH-4A and it is also connected to Savantwadi in Maharashtra State and Bagalkot in Karnataka State by State Highway SH-20 and Belagavi city has selected as a Smart city. Belagavi city is a very important city of Karnataka State and projected as Second Capital of the state. Suvarna Soudha is constructed in Belagavi at a cost of Rs.450 Crores and four winter session of both the houses of state legislature are held in Belagavi. The city is situated on the sloping terrain viz; sloping South West to South East. The general ground level varies from 815 m Malmaruti Extension to 74m in old Belagavi. Belagavi city is situated nearly 2500 ft (762m) above the sea level. The city is located at 15°50'58.90" North, 74°29'51.63"East.

The study stretch is selected for the analysis is from CHENNAMMA CIRCLE to PEERANAWADI JUNCTION including both roads that is CONGRESS ROAD and SHRI ATAL BIHARI VAJPAYEE MARG. This stretch is chosen because traffic is more in this route due to presence of industries and various education institutions compared to other routes. The total distance of the selected road stretch is 11km.

The main objective is to study the various causes for road accidents by collecting accidental data and by conducting traffic studies such as road inventory survey, traffic volume count and spot speed analysis.

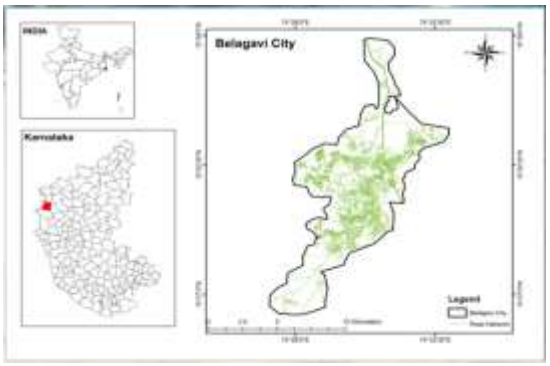

Fig -1: Belagavi Road Networks (Source: Google)

Fig -2: Selected study stretch (Source: Google earth)

2. OBJECTIVES AND SCOPE OF PRESENT STUDY

The main objectives of the project is to analyze the accidental scenario in the city and suggest the remedial measures for safe and efficient flow of traffic also,

1. Select the road stretch for the identification of the accidental prone locations. (i.e., The road stretch is selected for the study is from Channamma Circle to Peeranawadi Junction including both Congress Road and Shri Atal Bihari Vajpayee Marg.)
2. Study of accidental pattern in the identified black spot. (The collection of accidental data from the Traffic police station to study the various accident pattern in the identified black spots.)

3. To rank the accident prone location based on the Accidental Severity Index method. (The Accidental Severity Index method is used to rank the identified black spots.)
4. To identify the accidental zones by using GIS. (The collected primary data that is Traffic studies such as road inventory survey, traffic volume count and spot speed analysis and secondary data that is accidental data are used for the analysis of accidental zones in GIS.)

3. METHODOLOGY

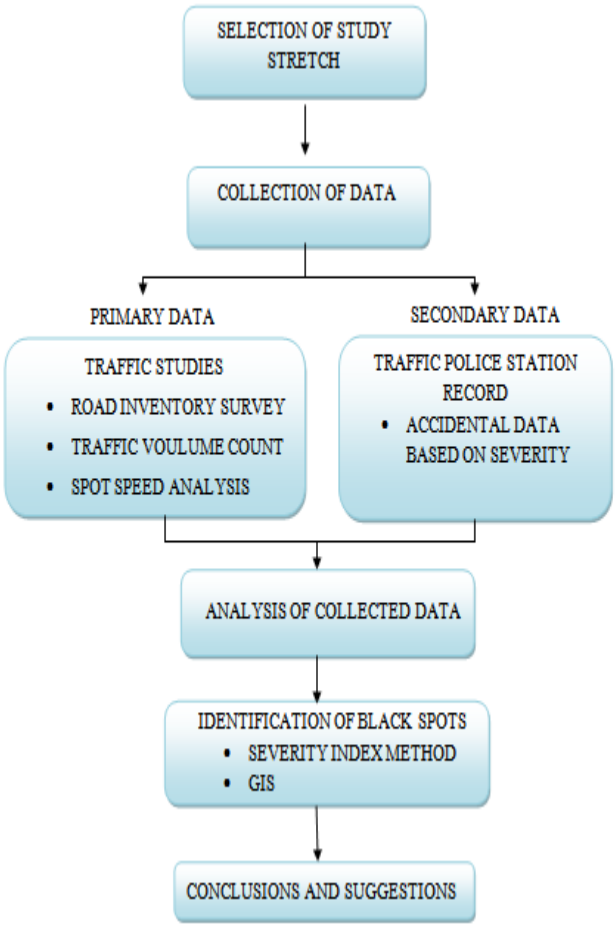

Fig -3: Procedure carried out for the Analysis

3.1 Primary data (traffic studies)

The following traffic studies were carried out

Road inventory survey

Traffic volume count
Spot speed study

3.1.1 Road inventory survey

Table -1: Geometric elements of the selected study stretch

Road stretch	Length of selected road(km)	Total no of lanes	Each lane width(km)	Shoulder width(km)	Footpath/Drainage(km)	Median width(km)
Peeranawadi to 3rd Gate	5.9	6	3.6	2.8	2.2	1.5
Congress Road uptoGogate Circle	2.5	4	3.5	0.5	2.2	1
From 3rd gate to goaves Circle	1.7	6	3.6	2.8	2.2	1.5
Goaves Circle to Railway Over Bridge	0.4	6	3.6	2.8	2.2	1.5
Length of Railway Over Bridge	0.4	4	3.4	0.3	1.5	7
From Gogate Circle to Fish Market	0.7	4	3.7	2.8	Absent	0.8
From Fish Market towards Bogarves Circle	0.7	4	3.7	0.5	2.2	0.8
From College Road uptoChennamma Circle	1.1	4	3.7	0.5	2.0	0.8

3.1.2 Traffic volume count

Traffic volume count gives the measure of how many vehicles passes through a particular point of location during the period of time. According to this study the time can be classified into peak hour and peak off hour. For any traffic infrastructure design and accidental studies the peak hour traffic volume count is essential. For this study Manual method is adopted. In this present study, Six hour manual volume counts were conducted at the junctions covering both morning and evening peak to analyze the existing turning movement pattern and to plan the required improvements at the junctions.
Traffic volume was conducted from morning 7.00 to 10.00 and evening 5.00 to 8.00 on one working day, one non working day and one semi working day. In this present study, Six hour manual volume counts were conducted at the junctions covering both morning and evening peak to analyze the existing turning movement pattern and to plan the required improvements at the junctions. The collected data is used for GIS analysis

The locations are as given below:

1. 3rd Railway Gate (three legged intersection)
2. Gogate Circle (four legged intersection)
3. Bogarves Circle (three legged intersection)
4. College Road

Table -2: Traffic volume count data

Location	Peak hour traffic volume (PCU)
3rd gate	64337.5
Gogate circle	65988
Bogarves junction	79035.5
College road	52587

3.1.3 Spot speed study

It is immediate speed of a vehicle at a specified spot. This study may be helpful for following purpose. The spot speed study was conducted at three different locations such as Khanapur Road, Near Gogate Circle and College Road at with 30 meter distance using stop watch method.

Procedure for Stopwatch spot speed study.

30 m length was selected of a desired location. The selected length should be plane without any humps. Record the time of the vehicles to passes the selected length. Here in this study 50 samples of vehicles are taken. Calculate vehicle speeds. General frequency distribution table and determine speed percentile and modal speed.

3.2 Secondary data collection

The secondary data which is known as accidental data of previous three years (2015-2017) where collected from Traffic police station South zone, Belagavi. The collected data includes the First Information Report (FIR) of the accidents that have occurred during period 2015-2017.By analyzing the given data the various accidental patterns were studied in selected stretch. They were implemented for the calculation of severity index method from which the ranks were given for the black spots in study stretch.

3.3 Accidental severity index method (ASI)

Accidental Severity Index method is used to identify the hotspot location in the road. This Severity Index value is based on the number of fatal accidents, number of serious accidents and the number of minor accidents. The ASI is defined as the dimensionless value indicating the hazardousness of a spot in the road.

Based on accidental data collected, the Accidental Severity Index (ASI) value is calculated. The accidental zone locations are prioritized according to the severity index method. The following equation is used for this method

$ASI=NfWf+NsWs+NmWm$[6] …….equation(1) (1)

Where, Nf=No. of deaths at the spot in last 3 years

Wf=Weight assigned to fatal accidents=6

Ns=No. of serious accidents at the spot in last 3 years

Ws=Weight assigned to serious accidents=3

Nm=No. of minor accidents at the spot in last 3 years

Wm=Weight assigned to minor accidents=1

3.4 Geographical information system (GIS)

A geographical information system (GIS) is a computer system used for capturing, querying, analyzing and displaying the geographical data. GIS represents a new paradigm for the organization of the information and the design of information system, the essential aspect of which is the use of concept of location as the basis of structuring of information system. This is a powerful tool for managing large amounts of heterogeneous data. A GIS can be effectively used to prioritize black spots on roads. The capability of GIS to link attributes data with spatial data facilities prioritization of accident occurrence on roads and the results can be displayed graphically which can be used for planning and decision making.[8]

To carry out the analysis some of the factors are considered as follows:[8]

- Lane width.
- Number of lanes in each direction.
- Approximate number of vehicles per day.
- Drainage facilities.
- Surface condition of the existing pavement.

- Frequently moving vehicle.
- Existence of shoulder, edge obstruction and median.

3.4.1 Procedure for GIS analysis:[8]

- Scan the map containing the desired road network and input that image to Arc view for digitizing.
- Digitize the road network with due considerations for separation of every link and assign id number to every link.
- Specify the attributes for every roadlink usingthe questionnaire provided.
- Export the road attribute table generated in dbase format so that it can be imported by Arc view.
- Join the road attribute table tothe digitizedroad map and prioritize the road network for accidents occurrence using total weights assigned to every link.
- Accident black spots on a given road network are ranked by result obtained from prioritization.

3.4.2 Prioritization

This prioritization involves assigning suitable weights to different factors so as to achieve a desired result. Here the some of the various factors, which tend to influence the occurrence of accidents on roads, are assigned weights on a scale of 0-10 in such a manner that the factors which tend to increase the probability of the accidents have lower weights.[8]

3.4.3 Software work[8]

- The selected roads maps are downloaded.
- By using GPS latitude and longitude values for selected points is found.
- The map image is input in ARCGIS.
- Geo-referencing is done with minimum of four points for one spot.
- Geo-referencing is done with all the sites in one map.
- Map image is digitized with shape file.
- In the attribute table, desired columns are entered with their values
- Analysis is done to rank the accidental prone location.

4. RESULTS AND DISCUSSIONS

4.1 Secondary data collection

Table -3: Type of accidents in selected study stretch of Belagavi

Year	Fatal	Non fatal	Total accidents
2015	11	76	87
2016	10	79	89
2017	15	43	58
TOTAL	**36**	**198**	**234**

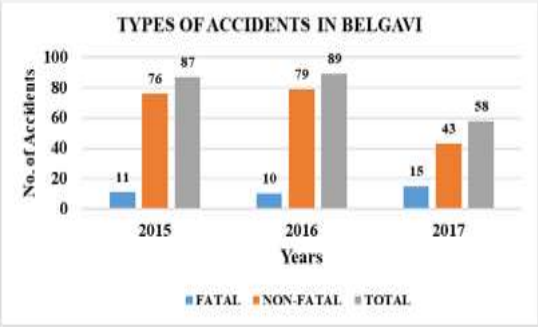

Fig -4: Types of accidents in selected study stretch of Belagavi

From the Fig 4, it is observed that the more number of accidents are occurred in the year of 2016 compared to 2015 and 2017.

Table -4: Classification of accidents during 2015 to 2017

Year	Minor injured	Major injured	Deaths	Total
2015	35	41	11	87
2016	47	32	10	89
2017	24	19	15	58
Total	**106**	**92**	**36**	**234**

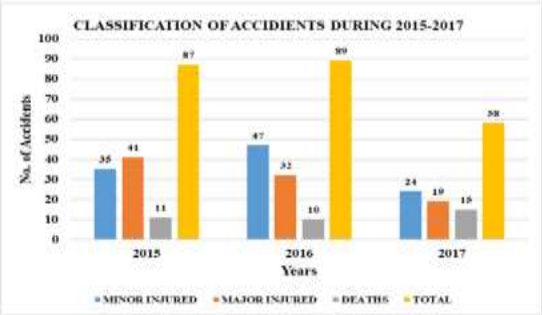

Fig -5: Classification of accidents during 2015-2017

From the Fig 5, it is observed that the more number of accidents are occurred in the year of 2016 that is 89 numbers including both fatal and non fatal accidents compared to the year of 2015 and 2017.

Table -6: Fatality distribution by age during 2015 to 2017

Year	<18 years	18-30 years	31-45 years	46-60 years	>60 years
2015	0	5	1	3	2
2016	2	4	0	4	0
2017	0	6	4	4	1
2015	0%	45.45%	9.09%	27.27%	18.18%
2016	20%	40%	0%	40%	0%
2017	0%	40%	26.66%	26.66%	6.66%

Table -7: Vehicles responsible for accidents

Year	2 wheeler	Car/Jeep/4 wheeler	Bus	Truck	Others	Total
2015	39	20	4	24	0	87
2016	28	32	4	24	0	89
2017	21	17	3	16	1	58
Total	**88**	**69**	**11**	**64**	**1**	**234**
Percentage	**37.77%**	**29.61%**	**4.72%**	**27.47%**	**0.43%**	**100%**

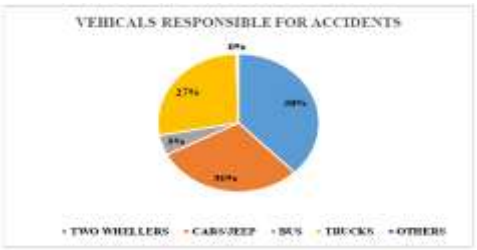

Fig -6: Vehicles responsible for accidents

From the Fig 6, it is observed that the more number accidents were caused from two wheelers and followed by four wheelers.

4.2 Accidental severity index method

The tables shown below will provide the information about accidental data and Accidental Severity Index which is used for ranking the black spots as said in methodology.

Table -8: Accidental data from 2015 to 2017

Location	2015			2016			2017		
	Death	Serious injury	Minor injury	Death	Serious injury	Minor injury	Death	Serious injury	Minor injury
College road	4	9	5	0	7	14	5	3	8
Gogate circle	2	4	7	2	5	7	1	4	2
Shri Atal Bihari Vajpayee Marg	0	9	7	0	5	3	3	4	2
Bemco cross	3	6	3	2	6	5	4	3	2
Khadarawadi cross	1	5	4	3	5	4	2	2	4
Congress road	1	8	9	3	4	14	0	3	6

Table -9: Accident severity index of given black spot locations

Location	2015	2016	2017	Severity index value
College Road	56	35	47	138
Gogate Circle	31	34	20	85
Shri Atal Bihari Vajpayee Marg	34	18	32	84
Bemco Cross	39	35	35	109
Khadarawadi Cross	25	37	22	84
Congress Road	39	44	15	98

For every location the equation (1) is applied and calculated. After obtaining the Accidental Severity Index value the black spot locations are ranked according to the severity index value. These locations are arranged in ascending order of severity index value as shown in the Table 9.

Table -10: Ranking of black spot

Black spot location	Rank
College Road	1
Bemco Cross	2
Congress Road	3
Gogate Circle	4
Shri Atal Bihari Vajpayee Marg	5
Khadarawadi Cross	5

From the Table 10, is observed that the College road has higher severity index value compared to other spots so it is ranked as 1st because more number of accidents are happened in this location during the period of 2015 to 2017. Then Bemco spot is in 2nd rank according to the severity index value. Congress Road and Gogate Circle these locations are ranked as 3rd and 4th respectively. Here the Shri Atal Bihari Vajpayee Marg and Khadarawadi Cross location has same Severity Index value so these two are ranked as 5th.

4.3 Geographical information system (GIS)

As per the results obtained using GIS, it is observed that Khanapur Road is a high accidental prone location compared to other zones. Also, it is observed that the results obtained from the Ranking method and GIS method is almost similar. Since the zone considered in GIS includes Shri Atal Bihari Vajpayee Marg, Bemco Cross and Khadarawadi Cross, in one stretch it is stated to be more accidental prone zone followed by College Road.

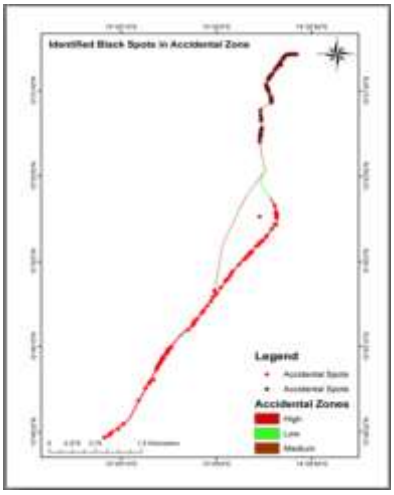

Fig -7: Accidental prone locations zone using GIS

5. CAUSES RELATED TO THE STUDY STRETCH

Fig -8: Unscientific road work

Fig -9: Signals are not in working condition

Fig -10: Congestion

Fig -11: Reduction in width of lane

6. TRAFFIC REGULATION

Regulations to control traffic at accidental prone locations.

Based on the analysis carried out by Accidental Severity Index method and GIS, the high accidental prone locations were found. In order to reduce the future accidents some of the road safety improvements are suggested below:

- Traffic signals should be made functional at Globe theater and Bogarvaes Circle.
- Pavement marking must be improved at Fish market.
- Zebra cross should be provided at Bogarves and Majagaon locations for safe crossing of the pedestrians.
- Speed limit should be controlled at Gogate Circle and College Road locations.
- Cameras must be installed from Shri Atal Bihari Vajpayee Marg to Peeranawadi junction.
- Providing the footpath facility by evacuating the road side vendors at Fish Market.
- Signal to be installed at Bemco Cross due to presence of heavy traffic.
- Local bus stop at Gogate Circle and Third Gate should be made at least 500m away from intersection to avoid traffic congestion.
- Road marking should be provided at Peeranawadi junction.
- Provide the speed limit sign boards on Khanapur Road.
- Over speeding and drunken driving led to accidents particularly during the night time at Khanapur Highway road stretch.
- Provide the shoulder at Fish market location.
- In some locations provide the parking so that vehicles cannot be stand on the side of the road which creates the problem for pedestrians and vehicles along the selected stretch.
- Over speeding of two wheelers between the age group of 18-30 years leads to accidents due to presence of various education institutions in Khanapur road stretch.
- Proper patch work of road should be made near Railway over bridge and at some location in Khanapur Road.
- Road surface condition should be improved near Fish market.

7. CONCLUSIONS

- The accidental data collected from department of traffic police Belagavi, indicated around 234 accidents in which 36 individuals were killed and 198 were injured between the years 2015-2017.
- By analyzing the accidental data it is clear that people of age group of 18-30 years have suffered more number of fatal accidents.
- The more numbers accidents occurred due to rash driving and negligence of traffic rules and it is observed that two wheelers are more involved in the accidents.
- From the 'Spot Speed Analysis', it is found that the vehicles are not moving within the designed speed limit at the Gogate Circle location. Hence do not satisfy the IRC standards. Precaution should be taken by setting regulations in order to control the speed.
- By using 'Accidental Severity Index' method the hotspot ranks are given in which College road has got more Severity Index value so it is ranked as First accidental prone location.
- By using Accidental Severity Index method the hotspot ranks are given in which Shri Atal Bihari Vajpayee Marg and Khadarwadi cross has got less Severity index value so it is ranked as Fifth or Last accidental prone location in a selected study stretch.
- When the analysis was carried by using GIS, the highly prone accidental location is given from Shri Atal Bihari Vajpayee Marg to Peeranwadi junction. And least accidental prone location is given to Congress road.

REFERENCES

[1]. Athira Mohan and Dr. V.S. Landge, "Identification of accident blackspots on national highway", International Journal of Civil Engineering and Technology (IJCIET) Volume 8, Issue 4, April 2017, pp.588-596.

[2[. Berhanu, G., (2004) "Models relating traffic safety with road environmental and traffic flows on arterial roads in Addis Ababa" Accidental Analysis and Prevention volume 36, pp 697-704.

[3]. Caliendo, C., Guida, M., Parisi A., (2007) "A crash-prediction model for multilane roads", Accident analysis and prevention, volume 39(4), pp 657-670

[4]. G. Mintsis, S. Basbas, P. Papaioannou, C. Taxiltaris, I. N. Tziavos (2002), "Application of GPS technology in the land transportation system" Elsevier, European Journal of operational Research, volume 152, pp 399-409. dio:10.1016/S0377-2217(03)00032-8

[5]. Ismail Bulent Gundogdu (2010), "Applying linear analysis methods to gis-supported procedures for preventing traffic accidents:case study of konya", Elsevier, safety Science Volume 48 pp 763-769.

[6]. M Mohammed Fayaz1, Mrudula S P[2], Sarah Jaison George[3], Sherin P Yoyak[4], Serin Sara Roy[5], "Black spot identification using accident severityindex method", International Journal Of Current Engineering And Scientific Research (Ijcesr), Volume-5, Issue-3, 2018. Pp.63-68.

[7]. Naidu.V.M., Venkat.L and P.I.Vamsi (2011), "Identification and analysis of black spots on NH5-vishakhapatnam", Golbal Journal Engineering and Applied Sciences-ISSN, Volume 1 2249-2231, pp104-108.

[8]. Reshma E.K, Sheikh Umar Sharif (2012), "Prioritization of accident black spots using GIS" International Journal Of Emerging Technology and Advanced Engineering, Volume 2 Issue 9,pp 117-122.

[9]. Rathinam, C., Nair, N., Gupta, A., Joshi, S., Bansal, S., (2007) "Self-reported motorcycle riding behavior among school children in India", Accident Analysis and Prevention, volume 39(2), pp 334-339

[10]. R.R.Sorate, R.P.Kulkarni, S.U.Bobade, M.S.Patil, A.M.Talathi, I.Y.Sayyad, S.V.Apte (2015), "Identification of accidental black spots on national highway 4 (new katraj tunnel to chandani chowk)", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 3, pp 61-67.

[11]. Snehal U Bobade, Jalindar R Patil, Raviraj R Sorate, "Identification of accidental black spot on national highways and expressways", International Journal of Research ion Advent Technology (E-ISSN:2321-9637), 13-14 February 2015.

[12]. Snehal Bobade-Sorate, Anuj U. Manerikar, Devika J. Buttepatil, Prem M. Rathod (2016), "Black spot analysis on national highway-4", International Journal of Engineering Research & Technology, Volume 5, Issue 03, pp 484-488.

[13]. Vivek and Rakesh Saini (2015), "Identification and improvements of accident black spots on N.H-3 district una, himachal pradesh-acase study", International Journal Of Core Engineering & Management, Volume 2, Issue 3, pp 155-177.

[14]. Vikram R.Shetty, Chathan Kumar Nt, Mithun (2017), "Accident black spot analysis in mangaluru", International Journal of Advanced Technology in Engineering and Science Vol. No.5, Issue No.01,pp 713-719.

[15]. Wen Cheng, Simon P. Washington (2005), "Experimental evaluation of hotspot identification methods", Elsevier, Accidental analysis & prevention, volume 37, pp 870-881.dio:10.1016/j.aap.2005.04.015.

BIOGRAPHIES

Ms. Pallavi Bhover (B.E in Civil Engineering M.Tech in Construction Technology) PG Student, Department of Civil Engineering, Jain College of Engineering, Belagavi, Karnataka, India

Ms.Rashmi J.V. (B.E in Civil Engineering M.Tech in Construction Technology) working as Assistant Professor in Department of Civil Engineering, Jain College of Engineering, Belagavi, Karnataka, India

Mr.Nityanand S. Kudachimath (B.E in Civil Engineering M.Tech in Highway Technology) working as Assistant Professor in Department of Civil Engineering, Jain College of Engineering, Belagavi, Karnataka, India