



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 9, Issue 11, November 2020

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

ijirset@gmail.com

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Analysis of Blackspots in NH-173 Kadur Mudigere (KM) Road Chikmagaluru and Integration with QGIS Software

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ABSTRACT: A dark spot or a black spot incidents have traditionally been concentrated in road traffic control. It may have taken place on a number of reasons like a steep drop or corner, so the continuing circulation is covered up, a hidden cross roads on a quick street, bad or hidden warning signs on a transverse lane. The location on a road where more accidents happen is referred to as the black spot. The latest report shows that the maximum number of accidents or black spots occurred mainly on Kadur Mudigere street (KM road) NH-173 in the chikmagalur district.

The main purpose of this study is to determine the highest number of black spots incidents by obtaining data from government departments such as police stations. The ASI method is to define the black spot according to its number and also to identify the seriousness of the accident in that specific area. It has been found that the most of the accident black spots occurred due to speed of the vehicle, negligence of the driver and also due to the geometric condition of road. In order to reduce the black spot some remedial measures like road markings, sign board, humps, traffic signals, width of the pavement and other geometric improvement should be taken. It shall also discuss that the Geographical Information System Software (QGIS 3.14) is used for the mapping of the accidents at that particular location.

KEYWORDS: Accident Blackspots, Average Daily Traffic (ADT), Geographical Information System (QGIS), Heat map, Passenger Car Units (PCU).

I. INTRODUCTION

In the area of safety administration on the roads, a black spot accident or black spot is traditionally concentrated in road accidents. It could have taken place for a number of reasons, such as sharp descent or cornering a straight path, with incoming traffic concealed, a concealed junction on a fast road, bad or covert warning signage at an intersection. Those areas are commonly defined as 'high risk accident sites', although no widely accepted concept of black or black area has been given.

In India, 0.2 crashes per kilometre of length or road length must be considered as the highest 10 percent of sites with a proven higher collision rate than the other roads in an area, for road lengths. The identification of a back spot depends largely on the meanings used. In urban situations, a black spot can be a crossroads, a stretch of road or some other position that fits the description. The black spot of an urban road is considered as: There must be a history of at least three crashes of casualty for a road segment within 500 m or a cross road between them within 150 m of each year, which is three accidents in a stretch of 500 m or 500 metres each year. A black spot in an accident is a risky or high-risk area in which frequent accidents occur. The detection, examination and processing of black spots in road accidents is generally considered one of the most important methods of road accidents.

1.1 Geographic Information System

"A GIS is a system of hardware, software and procedures to facilitate the management, manipulation, analysis, modelling, representation and display of georeferenced data to solve complex problems regarding planning and management of resources".

In the last decade, spatial Information systems have become an important tool in the planning and management of urban and resources. Their ability to store, retrieve, analysis and model vast areas with enormous amounts of spatial data led to a wide variety of applications. Geographical Information Systems are now used for land use planning,

management of services, simulation of habitats, landscape evaluation and planning, planning for transport and infrastructure, market research, study of visual effect, management of facilities, tax assessments, real estate study and many other applications.

Benefits of GIS

In virtually every sector, the GIS benefits organisation of every scale. The economic and strategic importance of GIS is increasingly being recognised. GIS advantages are commonly divided into five fundamental categories:

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

1.2 SCOPE AND OBJECTIVE

1. The basic aim of the study is to identify accidental black spots on National Highway – 173 by considering the parameters responsible for occurrence of accidents.
2. To obtain incident reports from the police department with records available.
3. To assess different traffic and road accident-related factors.
4. To conduct black spots analysis with GIS.
5. Detailed analysis of the top positions and recommendations of future enhancements.
6. The objective of this research is to identify the engineering factors that may contribute to the cause of accident and to give the appropriate engineering solutions.

II. LITERATURE REVIEW

Hafeez & M. A. Kamal - The existence of black spots on highways is crucial to recognise and examine with the main causes of previous road accidents. The available accident data, particularly because of geometric conditions, traffic and vehicle speeds, can hardly be investigated and analysed. In this study it was found that the majority of black spot incidents took place because the driving of road users was fast and violent. The contribution of the geometric conditions to injuries is comparatively lower. Moreover, the majority of injuries occurred in the open day rather than in the evening. For the secure and smooth flow of traffic on city highways, invasions should be cleaned up inside the right of way and separate service routes for local traffic should be provided. Slight geometric changes can eliminate black spots by low costs remedies such as traffic markings, signs, signals, regulation, etc.

K. Brahimi and M.A. Madouche - This paper includes two methods of recognising hot spots. The Mascara Wilaya was selected as a study site in Algeria. The first approach is focused on the study of mobility of individuals and goods. This method makes a detailed study of the driver's risk factors and various vehicle types on the studied roads but fails to accurately identify the black spots that are interested in using the Geographical Information System (GIS) and spatial analysis. The second method includes the use of ArcGIS tool's Kernel Estimate approach to enhance analysis and to define high-risk areas to provide detailed planning solutions.

III. METHODOLOGY

A. STUDY AREA

Chikmagalur is one of the districts in the state of Karnataka, India. The area of study stretch is from Holy Cross Hospital to Cafe Coffee Day along KM (Kadur Mudigere) Road of NH-173. The analysis is around 6 km long. This stretch consists of a horizontal curve and a low visibility intersection. The distance is occupied with more vehicles and the traffic density has increased over the years. Owing to poor traffic control and over speed, fatal accidents are rising in recent years. The climatic condition of Chikmagalur is tropical. In winter, there is much less rainfall than in summer. The average temperature in this place is 22.0°C / 71.5°F. The rainfall here is around 1006 mm / 39.6 inch per year. This stretch is connected to other places by roadway. In the transport system the street network plays a crucial role in taluks such as Kadur, Aldur, etc. The following figure below shows about the selected stretch.

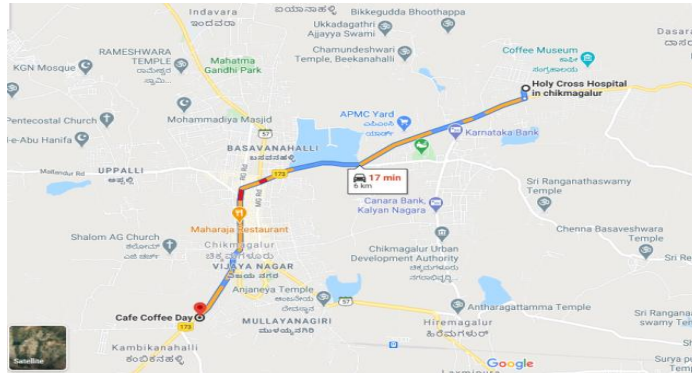


Fig-1: Selected Area of Study – National Highway-173 (KM Road)

B.DATA COLLECTION

Data from the Traffic Police Station for the last 3 years are collected from the accident data for NH-173 KM (Kadur Mudigere) road over an area of 6 km and a charts are prepared as shown. After viewing the data recorded by the police, the most fatal deaths have taken place in the places have been listed below.

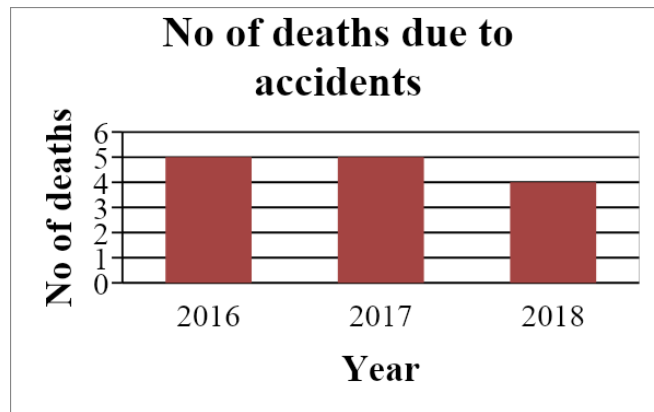


Chart-1: No. of deaths for a period of 2016-2018 of NH-173 KM Road, Chikmagalur

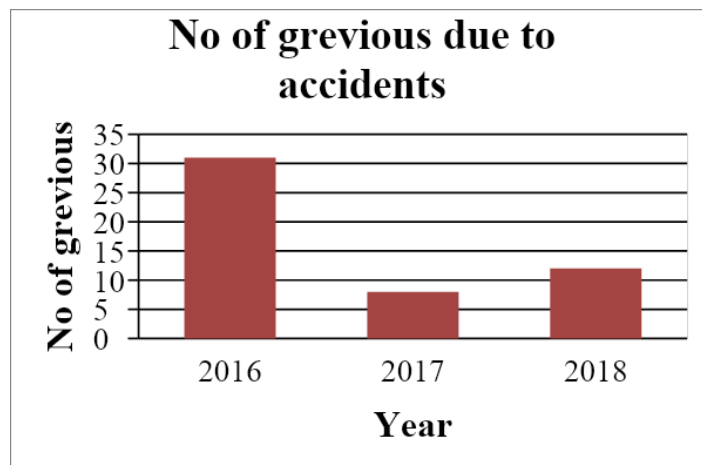


Chart-2: No. of greivous for a period of 2016-2018 of NH-173 KM Road, Chikmagalur

Sl. no	Location of accidents with landmark and road names	Total no of deaths			Total no of grievously injured persons only		
		2016	2017	2018	2016	2017	2018
1	SBI Bank Housing Board to Holy Cross Hospital	2	0	0	4	0	1
2	St. Joseph High School to APMC Yard	0	1	0	4	1	0
3	Dantramakki Lake to Agriculture Office	1	2	1	3	0	3
4	Life Line Tender Chicken to Dantramakki (East End)	0	0	0	4	2	0
5	Nagalakshimi Theatre to Shamnur Petrol Bunk	2	1	1	6	1	4
6	Mthayas Tower to Thogarihankle Circle	0	0	1	4	1	1
7	Bolarameshwar Temple to Annapurna Hospital	0	1	0	1	1	2
8	KSRTC Bus Depo to Café Coffee Day	0	0	1	5	2	1

Table-1: Accident Data

C.ROAD INVENTORY SURVEY

In order to quantify road geometric parameters such as road width, foot path width, median, shoulders, surface type, surface condition, edge obstruction, road markings, road signs, drainage facilities, and adjoining land use, a comprehensive inventory has been carried out on the whole identified locations. Once the black spots were figured out, the next step was to investigate further on these hot spots mainly road analysis. This was calculated by means of topographical maps from the complete station. This data was collected from the same police station.

Table-2: Road Inventory Data

Sl.no	Location	Starting from(Km)	Ending to (Km)	Pavement Width(m)	Shoulder Width(m)	Divider width(m)
1	SBI Bank Housing Board to Holy Cross Hospital	4.00	4.40	7.30	2.0	-
2	St Joseph High School to APMC Yard	3.50	3.75	6.20	1.5	-
3	Dantramakki Lake to Agriculture Office	2.50	2.75	6.40	1.4	-
4	Life Line Tender Chicken to Dantramakki (East End)	2.00	2.30	14.2	0.8	1.1
5	Nagalakshmi Theatre to Shamnur Petrol Bunk	2.00	2.30	17.2	1.2	0.9
6	Mthayas Tower to Thogarihankle Circle	3.00	3.25	17.5	1.4	-
7	Bolarameshwar Temple to Annapurna Hospital	3.50	4.75	7.40	1.0	-
8	KSRTC Bus Depo to Café Coffee Day	4.00	4.35	7.60	1.1	-

D.SPEED AND DELAY STUDY

The speed and delay research was performed on whole, black spots in the Chikmagalur district of NH-173 using a moving observer technique to find out the average speed of journey and traffic time. The minimum journey speed and the maximum journey speed observed on the selected stretch. Due to the electronic signal and pedestrian crossing the delay was observed at a maximum of 60 sec . Parked cars, sluggish cars, road crossings, bus stops, traffic signals, and pedestrian crossing are the main reasons for delays on the selected stretch. The table below shows the average speed of travel for the selected stretch.



Table-3: Average Journey Speed of Vehicles

Location	Average journey speed(Km/hr)	
	Without delay	With delay
SBI Bank Housing Board to Holy Cross Hospital	20.57	15.15
St Joseph High School to APMC Yard	29.98	22.5
Dantramakki Lake to Agriculture Office	20.07	17.38
Life Line Tender Chicken to Dantramakki (East End)	36.00	23.47
Nagalakshmi Theatre to Shamnur Petrol Bunk	21.03	10.25
Mthayas Tower to Thogarihankle Circle	26.66	18.46
Bolarameshwar Temple to Annapurna Hospital	21.6	16.2
KSRTC Bus Depo to Café Coffee Day	27.97	25.2

E.TRAFFIC VOLUME COUNT SURVEY

The Kadur Mudigere road segment was collected in the average daily traffic (ADT). Classified volume counts in the day’s top hour were collected by means of traffic data and shown in the table. This data becomes extremely crucial as it is very important to understand the total vehicles at the stretch during peak hours. Increase in vehicles mean increase in the risk of accidents. Passenger Car Unit (PCU) is a metric used for the calculation of road traffic. PCU primarily affects the traffic variables of a mode of transport (for instance, speed, density) in comparison to the individual vehicle. The PCUs of various loomtives was measured previously and these constants was readily available.

In addition to this speed studies, all black spots have been conducted. For the major classes of vehicles maximun and average speeds have been registered and shown in the table below. The local people were interviewed and their views were reported as regards recurrent accidents.

Table-4: Peak Hour Traffic Data

Type of vehicles	Timings				Total vehicles	PCU Constants	PCU/Hour
	Morning (10:30-11:30)		Evening (5:30-6:30)				
	Ups	Downs	Ups	Downs			
Cycles	7	4	1	2	14	0.50	7
Two Wheelers	508	598	405	467	1978	0.50	989
Three Wheelers	138	129	68	51	386	1.00	386
Cars	232	246	143	212	833	1.00	833



Buses	11	11	7	8	37	3.0	111
LCV	51	65	38	29	183	1.5	274
HCV	25	29	22	23	99	4.5	445
Bullock Carts	0	0	0	0	0	8.0	0
Others	0	0	0	0	0	--	0
Total Vehicles Per Hour	972	1082	684	792	3530	--	3045

F.SPOT SPEED STUDY

The quality and safety of the road network are calculated by speed. Vehicle speeds per unit of time are the speed by definition. The kilo-meter per hour (kph) or miles per hour(mph) is a standard unit of speed. In general, there are two speeds: the average time and the average space. Space-mean speed is the distance between a stretch of road and the average time of many vehicles over this particular segment. The average speed of many vehicles measured at a given place (spot speed) is the time-mean rate.

Table-6: Speed of Vehicles For Spot Speed Analysis

Type of vehicke	Two Wheelers	Three Wheelers	Cars	Buses	Trucks
Speed(Km/hr)	33.76	27.57	36.79	26.28	24.13

IV. ANALYSIS

Step-1: Open Application for QGIS as GIS application to create data

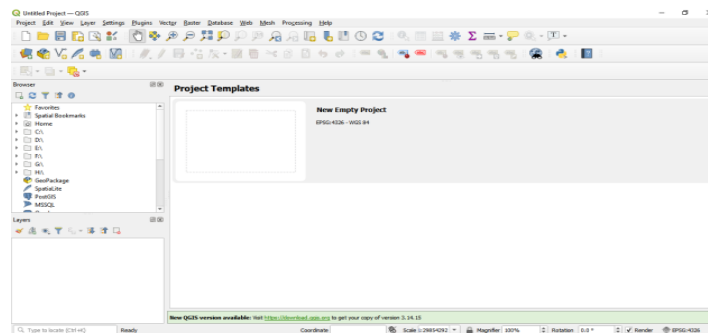


Fig-2: Open Application

Step-2: Get collected excel or csv file

SI No	Latitude	Longitude	SI No	Latitude	Longitude
1	13.33754	75.80453	31	13.3099	75.7694
2	13.33640	75.80138	32	13.30985	75.76935
3	13.33752	75.80451	33	75.76935	75.78697
4	13.33641	75.80139	34	13.32925	75.78699



5	13.32925	75.78698	35	13.32813	75.78522
6	13.33191	75.79138	36	13.32878	75.78637
7	13.32921	75.78695	37	13.32815	75.78525
8	13.33189	75.79136	38	13.32821	75.78531
9	13.32813	75.78523	39	13.32593	75.77478
10	13.32895	75.78644	40	13.32595	75.77478
11	13.32815	75.78525	41	13.31949	75.77212
12	13.32687	75.77668	42	13.31165	75.77028
13	13.32810	75.7852	43	13.3117	75.7703
14	13.32690	75.77672	44	13.3071	75.76751
15	13.32596	75.77481	45	13.30995	75.76945
16	13.32318	75.77209	46	13.34087	75.80377
17	13.32592	75.77479	47	13.3299	75.7817
18	13.3232	75.77211	48	13.3299	75.7817
19	13.32588	75.77473	49	13.32242	75.78658
20	13.32314	75.77205	50	13.3237	75.7721
21	13.32593	75.77478	51	13.3237	75.7721
22	13.32315	75.77206	52	13.3256	75.7742
23	13.31955	75.77218	53	13.3256	75.7742
24	13.3162	75.772	54	13.32231	75.774
25	13.31952	75.77215	55	13.8855	75.8417
26	13.31621	75.77201	56	13.32231	75.774
27	13.31338	75.77121	57	13.32231	75.774
28	13.30715	75.76755	58	13.32231	75.774
29	13.3099	75.7694	59	13.3075	75.7706
30	13.30712	75.76753			

Fig-3: Accident data in Excel File

Step-3: Create Shape file using above csv/excel file in QGIS

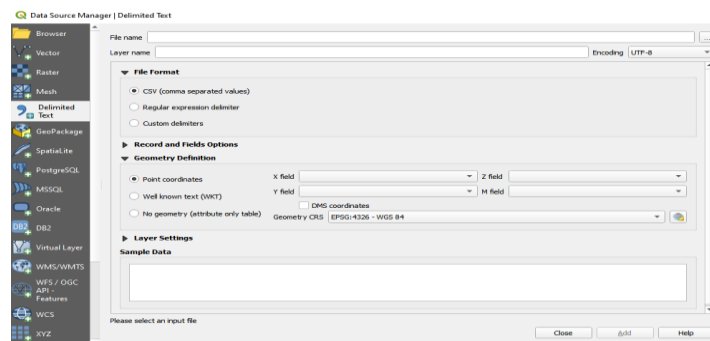


Fig-4: Create shape file in QGIS

Step-4: Select all options from tool csv to shape file

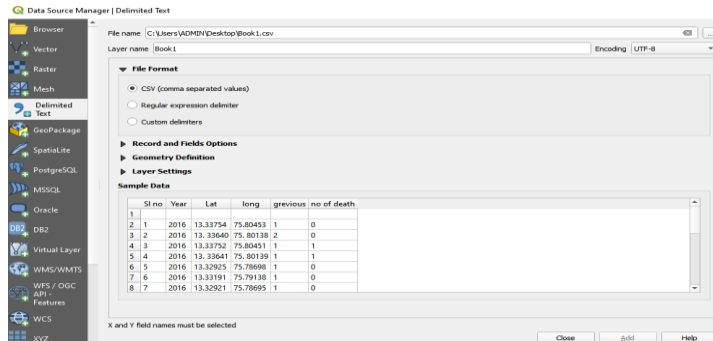


Fig-5: Select Tools CSV to Shape File

Step-5 : Select column name from options fields based on Latitude and longitude

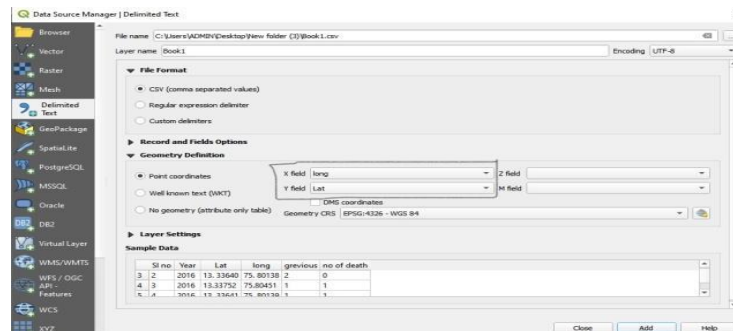


Fig-6: Column name from Option Fields based on Latitude and Longitude

Step-6: Click Add so it will create accident shape file and add to map

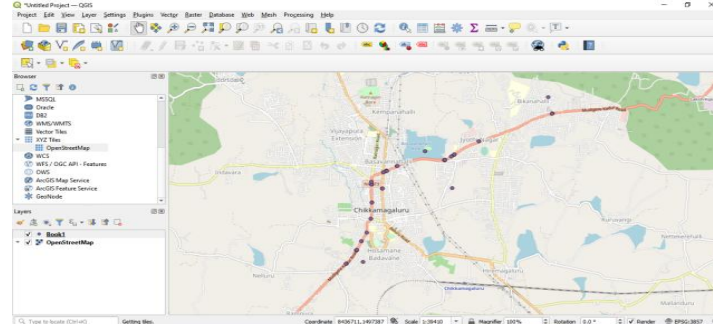


Fig-7: It Will Create Accident Shape File

Step-7: Click on the property and select heatmap in the symbology

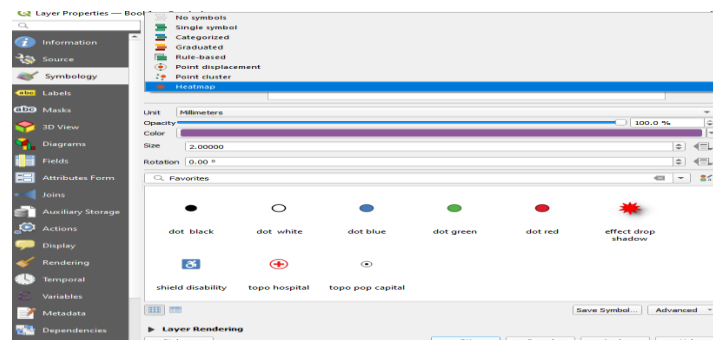


Fig-8: Select heatmap

Step-8: Select the colour red to identify the accident spot

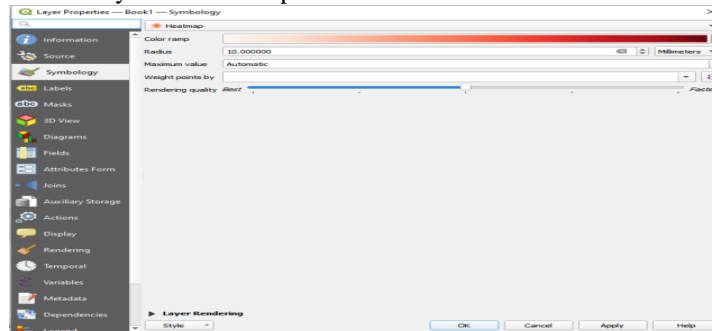


Fig-9: Select red colour

Step-9: Click Apply and select layer rendering

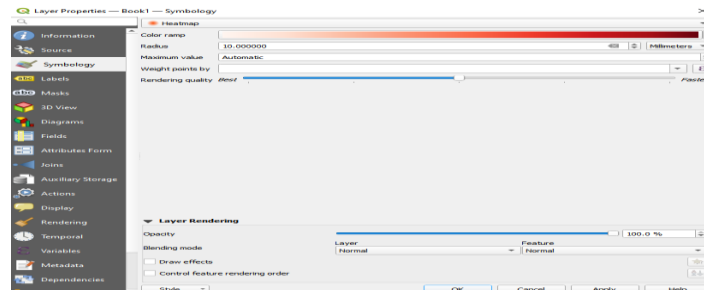


Fig-10: Selection of layer rendering

Step-10: Choose darken option in the layer rendering

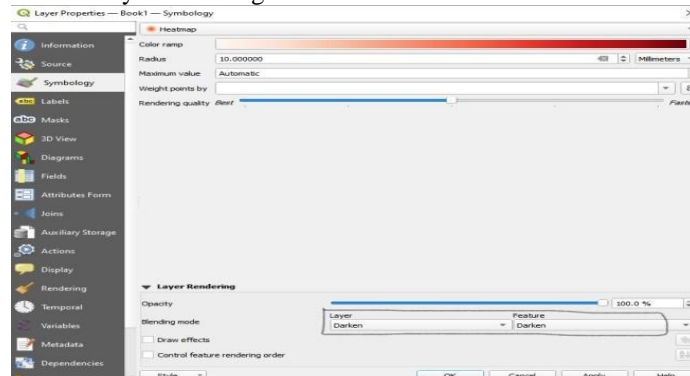


Fig-11: Dark option in the layer rendering

Step-11: Click Apply and Generate Hot Spot

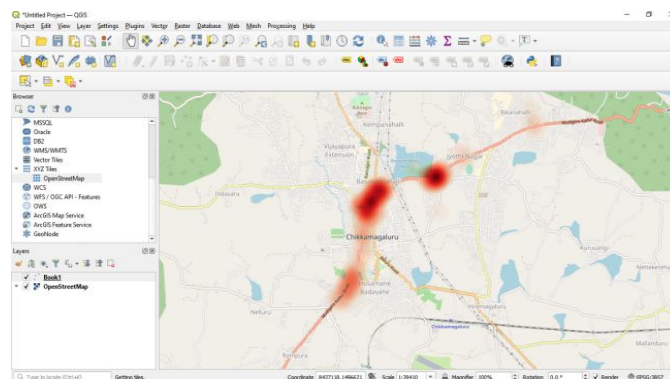


Fig-12: Generate Hot Spot

V. RESULTS AND DISCUSSIONS

The selected stretch that is NH-173 Katur Mudigere (KM) road was identified eight major accident black spots. The final result obtained from the analysis of GIS which indicates the accident black spots at different locations. The following below figure shows the black spots along the selected stretch.

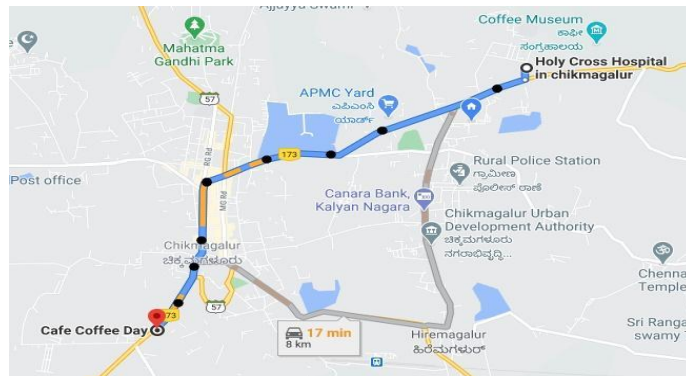


Fig-13: The black colour dots represent the identified black spots/hot spots along the selected stretch

A. REASONS FOR ACCIDENTS

1) SBI Bank Housing Board to Holy Cross Hospital

- There is no yellow bar in the middle of the road and also accident zone name plate.
- This is where the national road 173 is located and also this place consists of Housing Board bus stand, auto stand, commercial stores, many people meet in this place, the width of the road is short and also connected to many different roads.

2) ST Joseph High School to APMC Yard

- This place is school/college. There is no school zone name plate.
- There is no yellow bar in the middle of the road and also there is no white bar for the left and right side of the road.

3) Dantramakki Lake to Agriculture Office

- There is more traffic due to vehicles.
- There is no yellow bar in the middle of the road and also there is no white bar for the left and right side of the road.

4) Life Line Tender Chicken Shop to Dantramakki (East End)

- From the side of the Katri Maramma Temple towards Dantramakki lake, there is a fluctuating road.
- There was so much sand accumulating on the side of the road on the lake Two-wheelers are inconvenient for traffic.
- On the side of the road, the barricaded stones were left untouched. Iron crossbars are not installed for safety.

5) Nagalakshmi Theatre to Shamnur Petrol Bunk

- The reflector angles placed on the road are spoiled.
- There is no school/college instruction board.

6) Mthayas Tower to Thogarihankle Circle

- There is no yellow bar in the middle of the road and also there is no white bar for the left and right side of the road.
- On either side of the bus stop, there is no zebra crossing for the pedestrian to travel.

7) Bolarameshwar Temple to Annapurna Hospital

- There is no footpath in Annapurna Hospital.
- There is no yellow bar in the middle of the road and also there is no white bar for the left and right side of the road.

8) KSRTC Bus Depo to Cafe Coffee Day

- The road is narrow in the middle of the roads.
- The footpath space on the left and right side of the road is rained down.

B.SUGGESTIONS AND IMPROVEMENTS

1) SBI Bank Housing Board to Holy Cross Hospital

- Due to the curvature of the roads, the right and left side road should provide with information panel.
- Rumble strips should have to put to control fast traffic.

2) ST Joseph High School to APMC Yard

- Road Humps should be installed on the roads leading to the main road.
- Hazard marking should be done to cross the road safely for school children.

3) Dantramakki Lake to Agriculture Office

- Rumble strips should have to put to control fast traffic.
- Zebra crossing should be provide to cross the road near the circle.

4) Life Line Tender Chicken Shop to Dantramakki (East End)

- No parking instruction board should be provided near Katri Maramma Temple.
- Painting should be done on both sides of the road.

5) Nagalakshmi Theatre to Shamnur Petrol Bunk

- Pedestrian crossing should provide near the Nagalakshmi Theatre.
- Vehicle stop line should provide, because the presence of Hanumanthappa and NMC circle.

6) Mthayas Tower to Thogarihankle Circle

- Zebra crossing should provide for the pedestrians to cross the road.
- Near the Mthayas cross zebra crossing should be provided.

7) Bolarameshwar Temple to Annapurna Hospital

- Road end marking paint should provide on both sides.
- Speed limit instruction board should be provided.

8) KSRTC Bus Depo to Cafe Coffee Day IJ91111622

- Painting should be done on both sides of the road.
- Road Humps should be provided in the curvature of the road,

VI.CONCLUSIONS

1. The research attempt in the chosen stretches was to identify black spots in the accidents.
2. This paper has been found by accident black point on the NH-173 road Kadur Mudigere (KM) in chikmagalur for a distance of about 6 Km, based on the data collected in the last three years from the police station.
3. The accident severity index (ASI) method was calculated and used to find eight primary black spots accident top rankings.
4. The analysis was done by using Quantum Geographical Information System Software (QGIS.3.14) and the identified accident black spots were shown.
5. A survey was carried out of the road stock, traffic volume numeration, speed and delay to determine the principal cause of the accidents in the selected locations.
6. The significant causes of accidents include the high-speed lane, poor road geometry, limited vision and lack of traffic discipline.



7. The remedial measures like lane markings, pedestrian crossing, speed limit, good pavement maintenance, widening of the pavement etc. were suggested for all identified black spots.

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