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IDENTIFICATION ANALYSIS AND IMPROVEMENT OF ACCIDENT BLACK SPOTS ONNH-563

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ABSTRACT:

Population is increasing, vehicles are increasing, accidents are increasing. Reasons for the accidents might be a human error or poorly constructed roads or environmental factors. Road safety has recently become a major concern in most developing countries because the fatality rate is more in developing countries as compared to developed countries. India is the third longest road network in the world with almost 4million kilometers consisting of National Highway (NH), State Highways (SH), Major District Roads (MDR) and Other District Roads (ODR).

A black spot is a location on the road where traffic accidents occur more frequently. The identification of sites (black spots) that are more dangerous from accident point of view can help in better scheduling road safety policies. The type of black spots that may include are, obstacles such as trees, poles, deficient geometry, sharp curves, mix traffic etc., The study includes collection of secondary accident data and prioritizing the accident-prone locations by using Weighted Severity Index (WSI) method. WSI method follows a system of assigning scores based on the number and severity of accidents in that particular locationin the last few years.

This report lays importance on accident studies on the National Highway 563 in the DistrictMahabubabad, State of Telangana, India. So, the main aim of this study is therefore, to identify the major accident black spots on National Highway 563 and improvement in it.

KEYWORDS: Black Spots, Weighted Severity Index

INTRODUCTION

These days most of the life loss is occurring due to road accidents. According to Global road safety scenario, injuries and deaths occurring in the world are 50million and 1.3million respectively. The devastating human misery and the economic loss incurred by the road accidents demand the attention for the study of traffic engineering and to overcome the loss occurred by these accidents. Safety of road users and their vehicles is the primary motive of Traffic engineers and analysis of accidents is required to know which factors lead to accidents and how to improve those areas. From the accident statistics, we analyze it as a combination of an Engineering problem, Education problem and Enforcement problem. A traffic engineer must analyze these statistics and come up with innovative ways to reduce accidents through better planning, design and maintenance of the roads. The location in a road where traffic accidents often occur is called as a “Black Spot.” Identification and analysis of these black spots are regarded as one of the most effective approaches in the prevention of road accidents.

METHODOLOGY

The task is to identify where accidents are happening and investigate them to determine the factors involved so that appropriate and effective remedial measures can be applied. Taking actual accidents as the starting point is of fundamental importance, because it is not possible to reliably identify and analyze hazardous locations from the look of the road alone. The available Road Traffic Crash (RTC) data from traffic police provide a reasonable starting point. Road accidents happen in many forms and in many locations. It is neither feasible nor useful to analyze each individual crash in detail. The key is to try and identify locationswhere an above average number of RTCs are occurring, as these are potentially worthwhile sites for investigation and treatment. Road safety specialists recognize four main approaches to the task of treating roads with bad RTC records:

1. Single site: treatment of individual sites (e.g., junctions, bends, or short (300-500m) lengths of road) at which accidents are clustered (these sites are sometimes called "accident clusters" or "accident blackspots")
2. Route action: safety treatments applied to the whole length of a road whichhas a bad overall accident record •
3. Mass action: application of standard treatments to locations having common accident features (e.g., provision of central refuges at pedestrian crossings on wide roads) •
4. Area action: safety treatments applied throughout an area (often a section oftown) which has a bad overall accident record (e.g., traffic management and traffic calming measures undertaken throughout a housing area).

STUDY AREA-MARIPEDA TOWN

- **Identification of blackspots** is the procedure to locate those spots in the roadnetwork that are particularly dangerous, that is, the black spots.
- **Diagnosis** is the process to study what are the problems, the accident contributing factors and the deficiencies for each of the identified black spots.
- **Finding countermeasures** implies a methodical analysis to design suitable countermeasures for each black spot, based on actual problems and deficiencies.
- **Estimating effects** is the process to estimate the safety

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effects (and if necessary, also other effects) and costs of suitable countermeasures.

- **Prioritizing** implies finding the best action plan (or investment program), according to some defined criteria, and based on estimated effects and costs as well as budget restrictions.
- **Implementation** is the actual realization of the prioritized measures included in the action plan (or investment program).
- Follow-up and evaluation are the last and very important step, which aim is to assess the actual results (effects and costs).

Crash data collection and identification of black spots

Crash Data Collection The use of data has underpinned the development of successful programs and strategies in countries which have managed to reduce their road safety problems. An understanding of the magnitude of the economic, medical and social impacts has generally been the motivation for many countries to start investing significantly in road safety programs. Reliable information on crashes helps guide counter-strategies and ensures treatments are as targeted and effective as possible. Almost all the States in India need to improve the quality and availability of crash data before some of the approaches described in this manual can be used. For this reason, the following sections outline the importance of data and ways in which data can be improved. 3.1.1 Importance of Data Crash data are essential for:

- Assessing and communicating the scale of the road crash problem, and making the case for in- creased investment in road safety
- Identifying the most important road safety issues that need to be tackled as a priority
- Making a business case for road safety engineering treatments at a location, route or area
- Targeting treatments at the 'real' issues
- Monitoring road safety performance
- Evaluating the impact of individual measures, whole schemes and strategies ∟ Determining what works, and what does not work A variety of sources of crash data are used to support the development and monitoring of road safety programs internationally. The poor quality and availability of the range of crash and injury data in remains a major impediment to obtaining significant and measured improvements in road safety levels in many States in India.

3.3 Crash Data:

Police crash report information is the main source of data used for road safety engineering analyze. It should be noted that increasingly concessionaires/PPPs are being made responsible for safety on the routes they operate and may also be required to collect similarcrash data. In all the States in India, police collect information on crashes that occur acrossthe road network, this is generally a statutory requirement when injury crashes occur. Data collection by the police is undertaken in a wide range of ways from State to State. It is important to understand that it is not done primarily to collect information which can be used by road safety stakeholders to develop countermeasure schemes and policies. It is mainly collected for legal purpose; the information is used in court cases as evidence where

persons are fined or charged in relation to crashes. The information may also be required as part of the insurance claim procedure to allocate blame.

Process of recording information about a traffic crash in a typical police station includes the following steps:

The information received in the police department may be in written form or oral description. Head constable in the police station records details of all crime cases in the main register or Register No. 4. Register No.4 has pre-defined 21 columns in which the necessary details related to crime are entered to keep the records of each crime. Some police stations maintain all data records in the register as well as in computer. Preliminary investigations may find no occurrence of criminal offence. In such cases no further action is taken by the police. However, if there is evidence of cognizable offence then FIR is registered U/S 154. The format of each FIR is standard and same for all kinds of crime/accidents which are generally registered. Many police stations have started recordingthis in a computerized database. All the information related to the crime/accident includingfatalities is reported to circle office (CO) with a FIR copy to get update and action requiredon the investigation. A copy of FIR is also sent to District Head Quarter. A formal communication through phone call or message is send to SSP office where all informationrelated to accident and fatalities are entered and recorded in Daily Dairy/Register by policeofficials present in the SSP office.

Sl No.	ITEM	DETAILS RECORDED
1.	General Description	Date, day, time, name of the police station
2.	Victim	Name, gender, action at the time of crash,
3.	Road user at fault(accused)	Name, gender, action at the time of crash
4.	Witness statements	Description of the incident includingdescription of the location with few landmarks
5.	IPC No.	IPC no. under which the case is registered
6.	Injury details	Fatal/non-fatal/hospitalization

TABLE:INFORMATION RECORDED IN FIR

COMMENTS:

Based on these various inputs and further discussions within the

H-1 committee, the sub group designed and formulated revised A-1 and A-4 forms. The new form is mainly designed to record various facts related to an accident covering the general identification details, road features where accident occurred along with important details related to vehicle, victims and property damage involved in a particular accident, while at the same time keeping the data entry / recording process simple and less time consuming. Additionally, the A-1 form has been designed to be 'Optical Character Readable (OCR)' which can further reduce the time taken for manually entering the data into a computerized system. Similarly, A-4 form has been designed to obtain analysis tables important from macro perspective. The form A-4 is totally based on the information collected/reported in form A-1.

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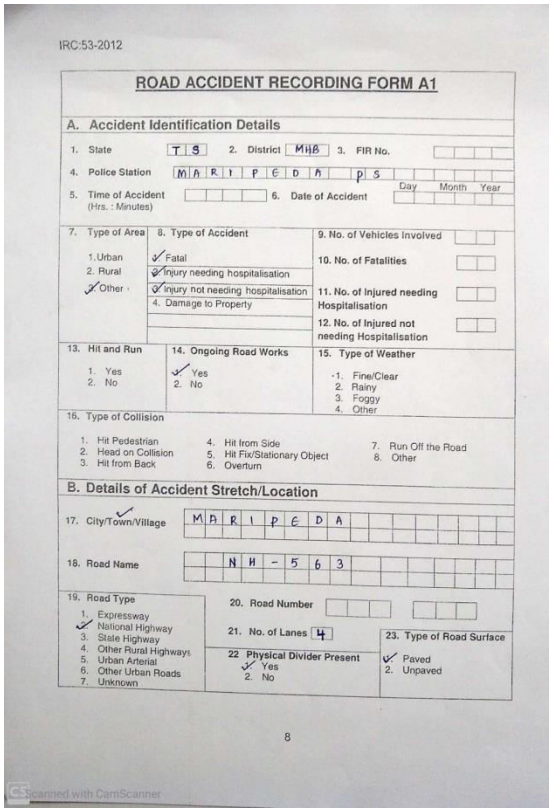

IRC:53-2012

ROAD ACCIDENT RECORDING FORM A1

A. Accident Identification Details

1. State: TS 2. District: MHB 3. FIR No.
4. Police Station: MARIPEDA PS
5. Time of Accident (Hrs. : Minutes) 6. Date of Accident: Day Month Year
7. Type of Area: 1. Urban 2. Rural ✓Other
8. Type of Accident: ✓Fatal; ✓Injury needing hospitalisation; ✓Injury not needing hospitalisation; 4. Damage to Property
9. No. of Vehicles Involved
10. No. of Fatalities
11. No. of Injured needing Hospitalisation
12. No. of Injured not needing Hospitalisation
13. Hit and Run: 1. Yes 2. No
14. Ongoing Road Works: ✓Yes 2. No
15. Type of Weather: 1. Fine/Clear 2. Rainy 3. Foggy 4. Other
16. Type of Collision: 1. Hit Pedestrian 2. Head on Collision 3. Hit from Back 4. Hit from Side 5. Hit Fix/Stationary Object 6. Overturn 7. Run Off the Road 8. Other

B. Details of Accident Stretch/Location

17. City/Town/Village: ✓ MARIPEDA
18. Road Name: NH-563
19. Road Type: 1. Expressway ✓National Highway 3. State Highway 4. Other Rural Highways 5. Urban Arterial 6. Other Urban Roads 7. Unknown
20. Road Number
21. No. of Lanes: 4
22. Physical Divider Present: ✓Yes 2. No
23. Type of Road Surface: ✓Paved 2. Unpaved

8

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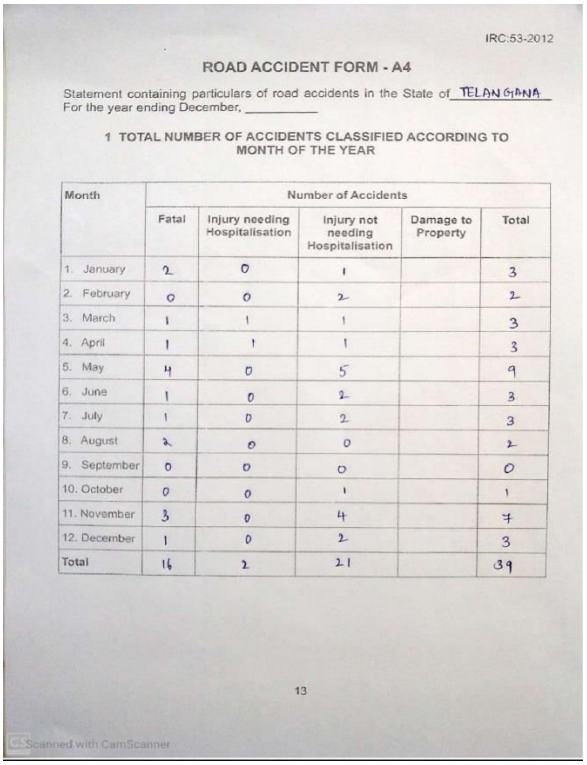
FIG: A1 FORM



IRC:53-2012

ROAD ACCIDENT FORM - A4

Statement containing particulars of road accidents in the State of TELANGANA
For the year ending December, _____

1 TOTAL NUMBER OF ACCIDENTS CLASSIFIED ACCORDING TO MONTH OF THE YEAR

Month	Number of Accidents				
	Fatal	Injury needing Hospitalisation	Injury not needing Hospitalisation	Damage to Property	Total
1. January	2	0	1		3
2. February	0	0	2		2
3. March	1	1	1		3
4. April	1	1	1		3
5. May	4	0	5		9
6. June	1	0	2		3
7. July	1	0	2		3
8. August	2	0	0		2
9. September	0	0	0		0
10. October	0	0	1		1
11. November	3	0	4		7
12. December	1	0	2		3
Total	16	2	21		39

13

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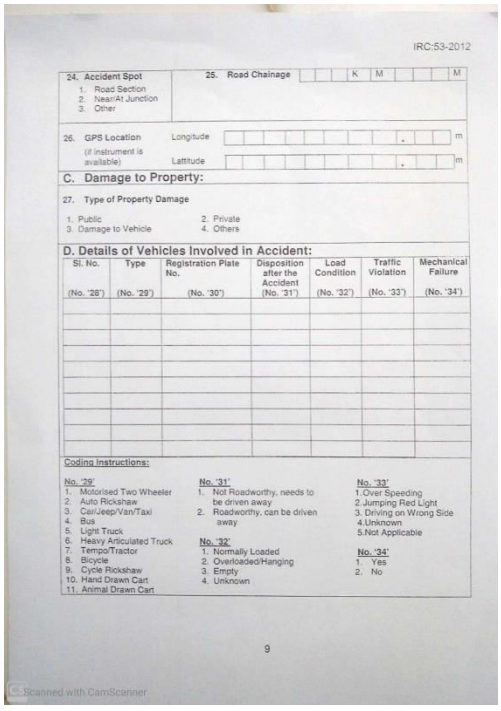
FIG: A4 FORM



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24. Accident Spot: 1. Road Section 2. Near/At Junction 3. Other
25. Road Chainage: K M
26. GPS Location (if instrument is available): Longitude m; Lattitude m

C. Damage to Property:

27. Type of Property Damage: 1. Public 2. Private 3. Damage to Vehicle 4. Others

D. Details of Vehicles Involved in Accident:

Sl. No. (No. '28')	Type (No. '29')	Registration Plate No. (No. '30')	Disposition after the Accident (No. '31')	Load Condition (No. '32')	Traffic Violation (No. '33')	Mechanical Failure (No. '34')

Coding Instructions:

No. '29': 1. Motorised Two Wheeler 2. Auto Rickshaw 3. Car/Jeep/Van/Taxi 4. Bus 5. Light Truck 6. Heavy Articulated Truck 7. Tempo/Tractor 8. Bicycle 9. Cycle Rickshaw 10. Hand Drawn Cart 11. Animal Drawn Cart

No. '31': 1. Not Roadworthy, needs to be driven away 2. Roadworthy, can be driven away

No. '32': 1. Normally Loaded 2. Overloaded/Hanging 3. Empty 4. Unknown

No. '33': 1. Over Speeding 2. Jumping Red Light 3. Driving on Wrong Side 4. Unknown 5. Not Applicable

No. '34': 1. Yes 2. No

9

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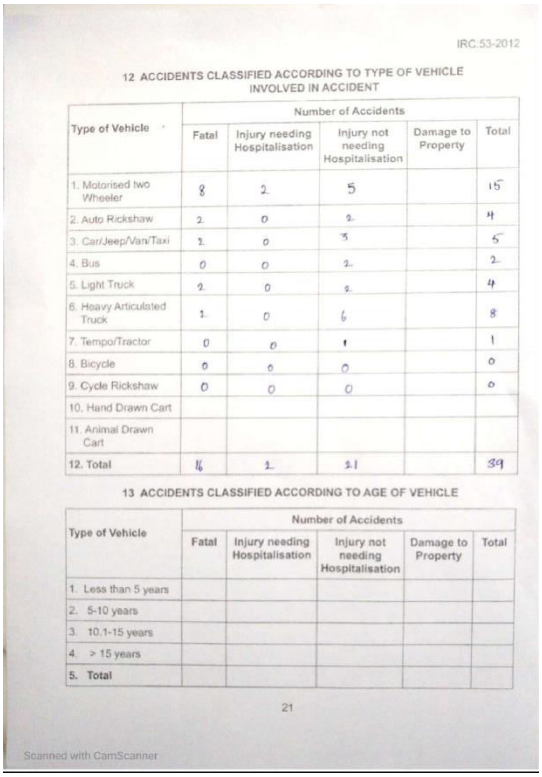
FIG: A1 FORM



IRC:53-2012

12 ACCIDENTS CLASSIFIED ACCORDING TO TYPE OF VEHICLE INVOLVED IN ACCIDENT

Type of Vehicle	Number of Accidents				
	Fatal	Injury needing Hospitalisation	Injury not needing Hospitalisation	Damage to Property	Total
1. Motorised two Wheeler	8	2	5		15
2. Auto Rickshaw	2	0	2		4
3. Car/Jeep/Van/Taxi	2	0	3		5
4. Bus	0	0	2		2
5. Light Truck	2	0	2		4
6. Heavy Articulated Truck	1	0	6		8
7. Tempo/Tractor	0	0	1		1
8. Bicycle	0	0	0		0
9. Cycle Rickshaw	0	0	0		0
10. Hand Drawn Cart					
11. Animal Drawn Cart					
12. Total	16	2	21		39

13 ACCIDENTS CLASSIFIED ACCORDING TO AGE OF VEHICLE

Type of Vehicle	Number of Accidents				
	Fatal	Injury needing Hospitalisation	Injury not needing Hospitalisation	Damage to Property	Total
1. Less than 5 years					
2. 5-10 years					
3. 10.1-15 years					
4. > 15 years					
5. Total					

21

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FIG: A4 FORM

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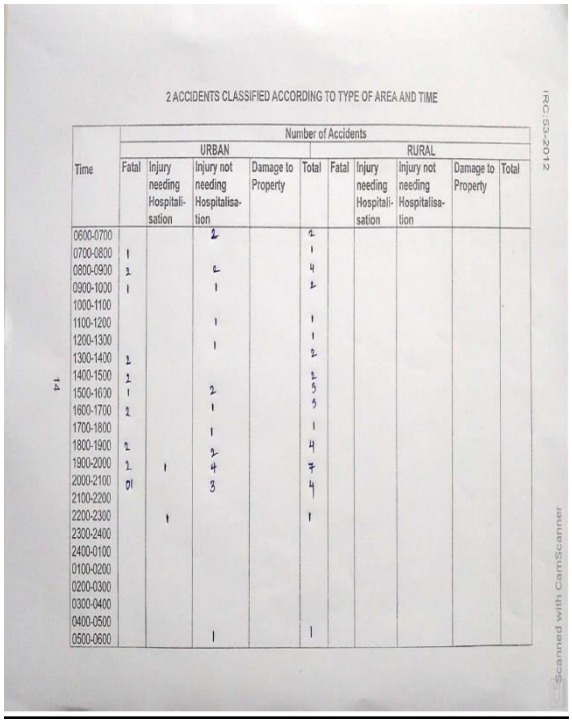

2 ACCIDENTS CLASSIFIED ACCORDING TO TYPE OF AREA AND TIME

Time	Number of Accidents									
	URBAN					RURAL				
	Fatal	Injury needing Hospitalisation	Injury not needing Hospitalisation	Damage to Property	Total	Fatal	Injury needing Hospitalisation	Injury not needing Hospitalisation	Damage to Property	Total
0600-0700			2		2					
0700-0800	1				1					
0800-0900	1		2		4					
0900-1000	1		1		2					
1000-1100										
1100-1200			1		1					
1200-1300			1		1					
1300-1400	1				2					
1400-1500	1				1					
1500-1600	1		2		3					
1600-1700	1		1		2					
1700-1800			1		1					
1800-1900	1		3		4					
1900-2000	1	1	4		7					
2000-2100	01		3		4					
2100-2200										
2200-2300		1			1					
2300-2400										
2400-0100										
0100-0200										
0200-0300										
0300-0400										
0400-0500										
0500-0600			1		1					

FIG: A4 FORM

Collection Of Accident Data

3years (2018-2020) of accident data has been collected from the nearby police station in Maripeda city, Mahabubabad District and the data has been summarized in the below tabular format.

Table 2; Accident Data

Year	Fatal	Grievous injuries	Minor injuries	No. Of Accidents
2018	16	2	21	39
2019	17	4	15	36
2020	14	5	13	32
Total	47	11	49	107

5.1 Accident Severity Index:

The accident data for the years (2018-2020) has been collected from the nearby police station. Police enter the accident data in A1 forms, which is basically a data collection of the basic details involved in the accident like the type of accident, number of persons involved in the accident, number of casualties occurred, date and time of the accident occurred, and type of vehicle involved etc.,

This data collected through the A1 forms have been analysed and have been classified as fatal, grievous, minor.

FATAL – No. of fatalities occurred

GRIEVOUS – Casualties that require high medication

MINOR – Casualties that doesn't require medication

This data will be further classified into when they happened. For example,

- Into seasons – to analyse in which season accidents most often occur.
- Into months in a year – to analyse in which month accidents most often occur.
- Into days in a week – to analyse on what day accidents most often occur
- Into age group of drivers – to analyse which age group of people are most often encountered with accidents.
- Into hours in a day – to analyse at what time accidents most often occur.
- Into type of vehicle – to analyse which vehicle most often encounters accidents.

4: STATISTICAL ANALYSIS OF ACCIDENT

Identification and analysis of these black spots are regarded as one of the most effective approaches in the prevention of road accidents. Qualitative and quantitative analysis of accidents can provide the information for the cause of accidents and this analysis helps to identify the black spots. Chi-square test is one of the best statistical analyses in the interpretation of accident data and is used on the accident data to know the accident black spots.

CHI-SQUARE TEST

A chi-squared test, also written as χ^2 test, is a statistical hypothesis test that is valid to perform when the test statistic is chi-squared distributed under the null hypothesis. This testis used to determine whether there is a statistically significant difference between the expected and the observed frequencies in one or more categories.

IDENTIFICATION OF ACCIDENT BLACK SPOTS

- Accident severity index
- Accident density method
- Weighted severity index (WSI)

The Accident Severity Index (ASI) was calculated using the information gathered. The blackspots were prioritized based on the severity of the site, and road safety analysis was conducted in the hotspots that were discovered. The idea behind this strategy is that a location's number of fatal or injury accidents is given more weight than property damage- only events.

The Accident Severity Index (ASI) is a one-dimensional statistic that indicates how dangerous an area is. The following equation was used to solve the problem

ASI = (NfWf) + (NsWs) + (NmWm)

Where,

N_f =No. of fatal accidents at the spot in the last 3 years

W_f=Weight assigned to fatal accidentN_S=No. of serious

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accidents at the spot in the last 3 yearsW_S=Weight assigned to serious accident
N_m=No. of minor accidents at the spot in the last 3 years
W_m=Weight assigned to minor accident

Accident Density Method

The number of accidents per unit length for a piece of highway is used to determine accident density. High accident locations are defined as sections having more than a preset number of accidents.
Average no. of accidents = (Total no. of accidents) / 29

Weighted Severity Index(WSI)

The accident black spots were discovered using the Weighted Severity Index Method (WSI), which assigns scores based on the quantity and severity of accidents in a given place during the previous three years.

Weighted Severity Index, **(WSI) = (41 x K) + (4 x GI) + (1 x MI)**

Where, K is the number of persons killed.

GI is the number of grievous injuries.MI is the number of minor injuries.
A fatal accident is given 10.25 times more importance in the WSI formula than a grievousinjury (4 << 41), and minor accidents are given a unit coefficient. (1 << 41). This is an empirical relation showing how fatal accidents, grievous injuries and minor injuries are compared with one-another.

Improvements of a Accident Black Spots

Figure 8: Intersection of Mahabubabad X-Roads

Causes of accidents:

- Centre line and pavement edge markings are not provided in the pavement.
- Absence of road curves.
- Left turn, Right turn, ascending gradient signs are not installed.
- Restricted sight distance.

Improvements:

1. Need to install warning signs.
   - By installing warning signs, we can warn the driver about what lies aheadon the road.
2. Installation of road curves.
   - Curves are provided to get easy turning in roads.
3. Speed limit at Blackspot approaches.
   - Drivers can aware danger is ahead so that they will reduce the speed andcontrol the vehicle.
4. Remove obstacles.
   - Obstacles is one of the reasons for traffic congestion, by removing them thevehicles can move free and safe.
5. Install break away feature to light poles, signposts.
   - Breakaway feature is designed to break off and fly over a vehicle that strikesthe pole, minimizing danger to the vehicle's occupants.

6.2 Black Spot 2:

Figure 9:

Causes of accidents:

1. Large turning volumes of buses and other vehicles.
2. Inadequate protection for pedestrians.
3. Inadequate signals.
4. Pedestrians walking on road way.

Improvements:

1. Create left/right turn lanes.
   - By creating left/right turn lanes and turning sign posters drivers can understand there is a turn ahead and they drive carefully, which reduces thenumber of accidents while taking the turn.
2. Add pedestrian refuge islands.
   - Pedestrian island is a small section of pavement in the middle of the road where pedestrian can take rest after crossing a busy half road. Which helps in crossing the busy roads safely.
3. Install pedestrian signals.
   - Without pedestrian signals it might cause confusion between pedestrians and drivers which leads to the accidents.
4. Install side-walks.

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➢ Side-walks/walkways which helps pedestrians to walk safely besides the roads

Figure 10: Maripeda bus

Causes of accidents:

1. Fixed object collision.
2. Roadway design inadequate for traffic conditions.
3. Poor delineation.
4. Objects near travelling way.

Improvements:

Figure 15:

Figure 13:

1. Remove obstacles near road way.
➢ As it is a main junction in the town, the density of traffic flow is high so the obstacles on the road makes the road narrower which results in traffic congestion and leads to accidents.
2. Improve/install pavement markings.
➢ Pavement markings are the margins on the road where vehicles allow to travel inside the markings in normal conditions. As it is a junction without these pavement lines there is no restrictions for the vehicles and vehicles without control leads to an accident.
3. Install barrier curbing.
➢ Curbs help to control water runoff and, in conjunction with the crown in the roadway, direct rainwater to the side of the street where will not impede traffic.

Causes of accidents:

1. Roadway design inadequate for traffic conditions.
2. Side-walk too close to travelled way.
3. Improperly located drive way.
4. School crossing area.

Improvements:

1. Urgency to lay a new pavement.
➢ Due to the poor condition of roads, there is a high chance of grievous andfatal accidents. So, there is necessary to lay new pavement.
2. Move side-walk laterally away from highway.
➢ In this section of road, the side-walk is very close to highway, they shouldbe laid far from highway and they should be guarded with hand rail.
3. Regulate minimum spacing of drive ways.
➢ The recommended spacing between private driveways necessary to preserveboth safety and traffic flow.
4. Using school crossing guards.
➢ The primary responsibility of an adult school crossing guard is to helpchildren safely cross the street as they walk or bicycle to and from school.

6.5 Black Spot 5: Khammam Road

Causes of accidents:

1. All fatal accidents are due to lorries, trucks, tractors etc.,
2. Dust problem due to loose soil.
3. Road way design inadequate for traffic conditions.
4. High approach speed.

Improvements:

1. Re-surfacing of the pavement.
➢ Due to the movement of heavy load vehicles the road got damaged and makes difficult for

two-wheeler vehicles to travel on dusty and damaged road, there by accidents occurs at night time. So, there is necessary to lay new pavement.

2. Install/improve signing or marking of pedestrian crosswalks.

➢ Pavement markings are the margins on the road where vehicles allow to travel inside the markings in normal conditions. As it is a junction without these pavement lines there is no restrictions for the vehicles and vehicles without control leads to an accident.

3. Install advanced route/street signs.

7.1 Summary

➢ In this section of road small streets are directly connected to the roads, so drivers on highway may not able to see the vehicles coming from streets. Necessary Installation of street signs on the highway and speed-breakers in the streets to prevent the collisions of vehicles.

4. Prohibition of over loaded vehicles and reducing speed-limit.

➢ As mentioned in the first point of improvements, due to this heavy load vehicles the road is getting damaged easily and also reckless behavior of heavy load truck drivers results in a greater number of fatalities.

Figure 16:

Causes of accidents:

1. Parking of vehicles at the road side.

7.2 Conclusion

2. Wash out of road markings like center line, pavement edge lines.

3. Road side vendors selling on the pavement.

Figure 18:

Improvements:

1. Prohibiting the vehicles to park on road side.

➢ Parking of vehicles by the roadside disturb the flow of vehicles on the roads this results in traffic congestion, sometimes people who is crossing beside this parking vehicles may not be noticeable by the drivers.

2. Need to provide road markings.

➢ As it is a busy road there should be proper markings on the road (zebra crossing, etc.,)

➢ Prohibiting the vendors to sell on the roads.As it is highway vehicles move with certain speed, when the vendors sell on the road, gathers the crowd and any minor mistakes of people or drivers results in accidents.

SUMMARY AND CONCLUTION

Our study was conducted to identify the black spots of the most important and deadliest road in Maripeda. Thus, indicators and indices known in the literature were adopted to analyze the accident data for the 3 years 2018-2020. The data set studied consists of 107 accidents distributed over 6 locations on the 5km stretch of the study area.

The Statistical analysis methods serves to analyze the number of victims related to accidents, taking into account 3 types of accidents: Fatal, Grievous, Minor

Afterwards, the WSI method was used to identify black spots and classify them into three groups according to the severity level. The results of our analysis led to the identification of 6 black spots over a 5km stretch with a high level of WSI observed at the Khammam Road.

The proposed method for calculating WSI has shown its effectiveness in identifying black spots in rural areas. Also, the analysis of the black spot classification results demonstrated the reliability of the proposed approach. This work can be used by road safety specialists to consider improvements to the road sections studied by prioritizing the deadliest points.

In addition, the method proposed in this study may be the basis for further research on improving road safety. In this context, we urge future researchers to adopt our approach in the analysis of the number of victims by dividing the types of deaths and injuries. These details are very significant in describing the fatality of accidents.

From our study it can be concluded that the weighted severity index value is calculated only after the occurrence of accidents. So, this method is helpful in identifying accident black spots only. Weighted Severity Index value helps in finding the factors causing accidents. So, severity index method can be used for prioritization of accident black spots to carryout rectification works. This also helps to find the nature of rectification works to be carried out on each accident black spot locations.

From our study we also concluded that,

- Accident severity and seasons in a year are independent.
- Accident severity and months in a year are independent.
- Accident severity and days in a week are independent.
- Accident severity and age group of drivers are independent.
- Accident severity and hours in a day are independent.
- Accident severity and type of vehicle are independent.

- Occurrence of accidents are not uniformly distributed in months in a year, hours ina day, age-group of drivers.

- Occurrence of accidents are uniformly distributed in seasons in a year.

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