Road Safety Audit on Existing Road

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Abstract- *Road Safety Audit (RSA) is a formal method for assessing coincidence potential and safety performance of recent and current roads. RSA is a good, value effective and proactive technique to enhance road safety.It is proved that RSA has the capacity to store lives. FIR Data have to be gathered from the involved police stations at the identified stretches and do the twist of fate evaluation then identify the block spot region. Visit the block spot area give the recommendation for the relevant statement as a street safety auditor to the patron. The observe targets to assess Road Safety Audit of a segment of 4-lane or six National Highway (NH)/SH- and could cognizance on comparing the advantages of the proposed actions that have emanated from deficiencies identified thru the audit technique.After engaging in RSA, its miles discovered that vehicles are parked on toll road which reduces the effective width of carriageway and developing visitors risks to high velocity moving traffics.The most Vulnerable Road User (VRU) i.e. Pedestrians and cyclists' centers close to habitation are lacking and desires to be facilitated on priority.*

Keywords- *Accident Analysis, Black spot, ASI, Road Safety Audit Operation Maintenance Road, Chennai-Tada NH-5.*

I. INTRODUCTION

What is Road Safety Audit?

A road protection audit (RSA) is a formal manner for assessing accident capacity and protection performance examination of an existing or future street or intersection by way of an impartial, multidisciplinary group. It qualitatively estimates and reviews on ability road protection problems and identifies opportunities for enhancements in protection for all avenue customers. However, its systematic software can also ensure that a developing attention approximately accurate road safety concepts is carried out throughout in dual carriageway making plans, layout, construction and upkeep organisation. The predominant purpose of road protection audit is to ensure that all new street schemes perform as properly as achievable. This method that safety must be taken into consideration in the course of the whole cycle of design, production and pre-starting of any assignment facility and also for the duration of operation & renovation of the dual carriageway.

Why Road Safety Audit?

Road safety audit need to determine tasks on the idea of avenue consumer knowledge, attributes and abilities, day/night and wet and dry street situations. Safety audit is most effective a take a look at of safety elements and an auditor may also imply street safety issues inherent in designs that comply with our avenue requirements. This is because of the fact that our road requirements are an expression of a socio-monetary balance among road protection, accessibility, surroundings and economic system.The intention of avenue safety audit is to make certain that every one new street projects - and important working and preservation activities on present roads - are assessed from the point of view of road protection, so that any parameters of the task which are fallacious from the point of view of street safety are corrected in time.

II. SCOPE

The most important scope of street protection audit is to be make sure that each one new road schemes function as safely as achievable.

- To reduce the risk of injuries
- To reduce the Fatal & Severity
- To recoginse the significance of safety in motorway layout to meet the wishes and perceptions of all varieties of street customers.
- To reduce the lengthy-term expenses of an assignment facility bearing in thoughts that hazardous designs can be high-priced or even impossible to correct at a later level.
- To growth consciousness about safe design practices among all those involved within the planning, design, creation and Maintenance of roads.
- Road Accident Analysis of Projects Roads of Past 3 Years based on First Information Report (FIRs)

III. PROJECT DESCRIPTION

In order to provide better level of service to the vehicular traffic, it has been decided to augment the capacity from existing Four lane to Six lane the Chennai Tada Section

National Highway NH 5 from KM. 11.000 to KM. 54.400 in the State of Tami Nadu. The project corridor Chennai - Tada section of NH-5 starts from Chennai and traverses through Puzhal, Red Hills, Padiayanallur, Karanodai, Thatchur, Kavarappettai, Gummidipoondi and Elavoor all lying in Thiruvallur District and ends at the state border before Tada in Andhra Pradesh. The project corridor traverses mainly through build-up and industrial area up-to Padiayanallur, beyond which the road passes through agricultural land. There are 29 major and minor inter sections along the project corridor. There are 7 major bridges and 6 minor bridges along the Project corridor.

IV. STAGES OF ROAD SAFETY AUDIT

Safety Audit can be implemented on (a) new roads and (b) existing roads. On new roads, safety audit will lead to warding off building accident-inclined conditions and on present roads, audit will lead to improved roads from the safety point of view. It needs to be realized that protection audits are a vital price, and not a further expense.

a) New Construction
During Feasibility Study - Stage one Audit
During Preliminary Design - Stage two Audit
Completion of Detailed Design - Stage three Audit
During Construction - Stage four Audit
Completion of Construction (Pre-opening) - Stage five Audit

b) Existing Roads

On Existing Roads (Monitoring) - Stage 6 Audit

A. Audit of Existing Roadway Sections

Existing road additionally may be audited to assess their accident potential. It offers a systematic manner of being proactive in reducing the destiny chance of injuries. Audits of present roads involve a comparable method to that for brand spanking new road tasks. Accident statistics may be a vital a part of the statistics to be assessed, but they have to be supplemented by way of informed decisions about the potential for different types of injuries. The goal is to perceive any present protection deficiencies of design, format and road fixtures, which are not consistent with the street's characteristic and use. There need to be consistency of standards such that the street person's notion of nearby conditions assists safe conduct.

B. Background information

The client should arrange to provide all of the important records and documents in a usable shape for the audit group. This should not be left to the audit crew to do. Information will encompass task reports, layout details, information, drawings, etc. It can be essential to collect extra information, such as traffic volumes, vehicular speed, and so on. This have to be taken into consideration early enough to keep away from delays to the street protection audit system. As a minimal, the audit crew is to be provided with the subsequent documents.

C. Commencement meetings

Holding an assembly between client, designer and auditor, presents the opportunity to explain to the audit crew the work's reason, any issues specific to the mission and any specific problems that have been skilled in reaching planning, design or production objectives. The audit team will no longer be able to look into the website online below all traffic or weather conditions, so if specific conditions are essential, the auditors ought to be cautioned. The audit team's task is to pick out and document any street protection problem and pointers.

D. First information reports from police stations

First Information Reports (FIR) must be collected from the involved police stations on the recognized stretches. After getting the FIR records, database is to be created for evaluation of day-wise, month-wise, year wise, km-sensible distribution of injuries. This would help in figuring out the locations experiencing higher twist of fate frequency.

V. CASE STUDY

A. *Data Collection and Formatting*

The accident data which were collected and reported for the Project stretch i.e. Chennai to Tada section of NH-05. Accident Data was collected for the period January 2013 to December 2013. The data thus obtained was formatted as per IRC's current format of Accident Data Collection as shown in below Table 3.1.as per IRC:53-2012 The data thus collected will be analyzed as a whole to provide a Comprehensive Accident analysis Report.

B. *Crash Analysis*

The main purpose of crash analysis is to improve safety for the road users by identifying crash patterns, mitigating crash severity, analyzing the causes for the accidents and to recommend suitable safety measures to eliminate accidents and to provide a safe, comfortable journey within a reasonable time.

Key steps to a Crash Analysis Study:

1. Review Crash Data considering the sections as a whole
2. Identify the High Crash Locations
3. Quantify the main crash trend(s) for the Location
4. Determine the source of problem(s)
5. Evaluate types of improvements to address the crash problem(s)

C. *Review of Crash Data Considering the Project Stretch*

Prevalence Crash Data is useful in evaluating the contribution of different factors to traffic safety issues. Prevalence is simply the proportion of accidents involving a particular factor, such as night time driving, head on collision, rear end collision, right turn collision, etc. Counter measures aimed at a factor involved in large number of accidents have greater potential benefits than those aimed at something that occurs rarely. For the analysis the following information will be used:

1. Crash Severity
2. Crash Type
3. Date of Occurrence
4. Day of Occurrence
5. Time of Occurrence
6. Location of Occurrence
7. Road condition at the Accident spot
8. Weather condition at the time of Accident
9. Cause of the Accident

D. *Methodology for Identification of Black Spots*

Identify the main crash location or Black Spot Study Black Spot-There is no international standard of Black Spots or hazardous road sections. From a theoretical point of view, an accident Black Spot should be defined as follows (Elvik 2007, Sorensen and Elvik 2007)

"The location where the expected number of accidents are higher than at other similar locations as a result of local risk factors".

The definition of Black spot should be based on the local expected number of accidents instead of the recorded number of accidents. Comparison should be made with expected number of accidents at some other similar locations in order to identify the locations with inadequate design.

Based on the above theory, the following are the steps to identify the Black spot Locations for the subject section:

Steps for Identifying Hazardous Locations & Computing Accident Severity Index

Hazardous locations are the spots where minimum of 1 fatal or 1 grievously injured accident has taken place

The accidents will be grouped into 4 main types based on their Severity. The Four Types are:

1.Fatal Accidents 2. Grievous Injury 3. Minor-Injury 4 Non-Injury

Based on the above parameter of minimum1 fatal or 1 grievously injured accident the hazardous location/s will be identified.

For each location identified as above Accident Severity Index (ASI) will be calculated by assigning 7 points for each Fatal Accident and 3 points for each Grievously Injured Accident and then summing up the total points based on the total number of such accidents.

$$\text{Accident Severity Index (ASI)} = (Wtf \times Nf) + (Wtg \times Ng)$$

Where

Wtf = Points assigned to each Fatal Accident (7 points have been assigned to each Fatal accident)

Wtg= Points assigned to each Grievously Injured Accident (3 points have been assigned to each Grievously injured accident)

Nf = Number of Fatal Accidents reported at the location over the period for which the accident data has been collected (Min Last 3 Years)

Ng = Number of Grievously Injured Accidents reported at the location over the period for which the accident data has been collected. (Min Last 3 Years)

Average Severity Index /Average Severity for the subject stretch will then be calculated by the formula ∑ ASI/n. Where n is the number of hazardous locations identified above.

The Standard deviation of the ASI from the mean or average ASI will be calculated by the formula √∑ (ASI-Avg(ASI)2 /n
The Threshold Severity value is then established by the formula Average Severity +1.5 Standard deviation.

Locations having ASI more than the Threshold Severity Value will be considered as a Black Spot.

E. Findings of Accident Analysis

Major Phases of Accident Data Analysis

The Steps of the data analysis are shown in the following sections in Tabular as well as graphical forms.

The major steps are classified under the Following headings:

1. 1.Accidents Classified according to the Nature of the Accident
2. Accidents Classified according to the Year
3. Accidents Classified according to the Month of the year
4. Accidents Classified according to the Day of the week
5. Accidents classified according to Time
6. Accidents classified according to Cause of the Accident
7. Accidents classified according to Road Condition
8. Accidents classified according to Intersection type and Control.
9. Accidents classified according to Severity

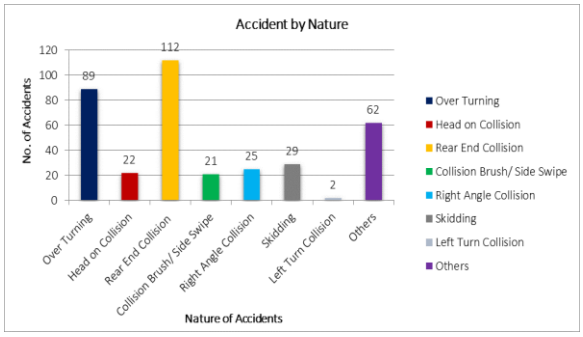

Chart -1 Nature of Accident

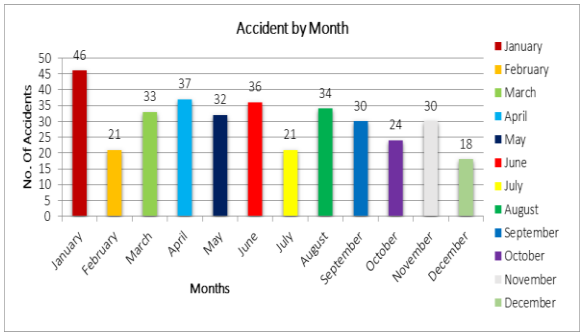

Chart -2 Accident by Month

ACCIDENT SUMMARY BY NATURE		
Nature of Accidents	**Accidents**	
	Number	**%**
Over Turning	89	24.6
Head on Collision	22	6.1
Rear End Collision	112	30.9
Collision Brush/ Side Swipe	21	5.8
Right Angle Collision	25	6.9
Skidding	29	8.0
Left Turn Collision	2	0.6
Others	62	17.1
Total Accidents	**362**	**100**

ACCIDENT SUMMARY BY SEVERITY		
Severity	**Accidents**	
	Number	**%**
Fatal	25	6.9
Grievous Injury	122	33.7
Minor Injury	110	30.4
Non-Injury	105	29.0
Total Accidents	**362**	**100**

ACCIDENT SUMMARY BY WEEK DAY		
Day	**Accidents**	
	Number	**%**
Sunday	53	14.6
Monday	48	13.3
Tuesday	59	16.3
Wednesday	43	11.9
Thursday	67	18.5
Friday	43	11.9
Saturday	49	13.5
Total Accidents	**362**	**100**

ACCIDENT SUMMARY BY MONTHS		
Months	**Accidents**	
	Number	**%**
January	46	12.7
February	21	5.8
March	33	9.1
April	37	10.2
May	32	8.8
June	36	9.9
July	21	5.8
August	34	9.4
September	30	8.3
October	24	6.6
November	30	8.3
December	18	5.0
Total Accidents	**362**	100.0

ACCIDENT SUMMARY BY TIME		
Time of Day	**Accidents**	
Hours	**Number**	**%**
0	21	5.8
1	6	1.7
2	2	0.6
3	15	4.1
4	7	1.9
5	7	1.9
6	9	2.5
7	20	5.5
8	20	5.5
9	16	4.4
10	17	4.7
11	17	4.7
12	26	7.2
13	14	3.9
14	16	4.4
15	17	4.7
16	21	5.8

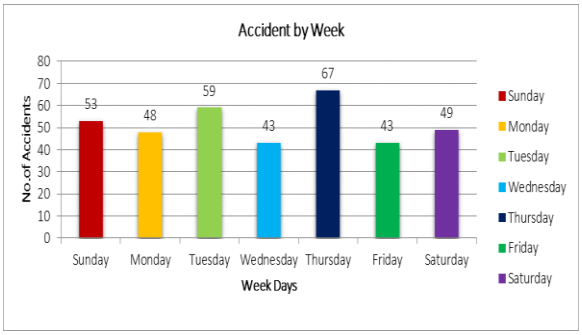

Chart -3 Accident by Week Days

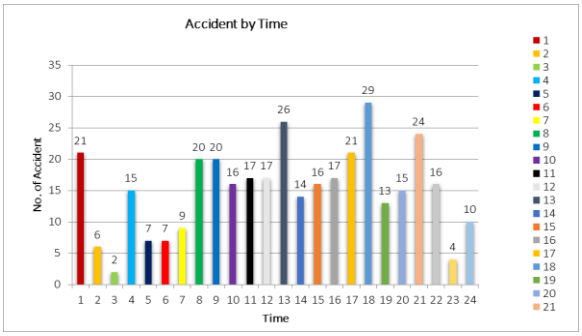

Chart -4 Accident by Time

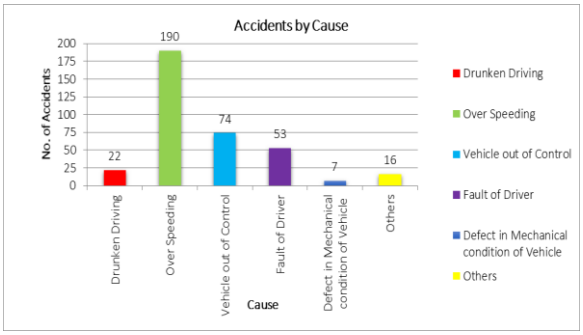

Chart -5 Accident by Cause

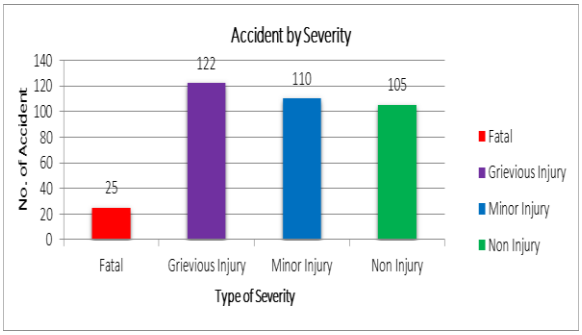

Chart -6 Accident by Severity

F. Summary of Findings:

1. Three Hundred and Sixty-Two (362 Accidents) has occurred in the project corridor between Chennai to Tada (CH 11.000 to CH 54.400) during the period January 2013 to December 2013.

2. 25 No's or 6.9 % of total accidents are Fatal Accidents, 122 No's or 33.7% of total accidents are Grievous Injury Accidents, 110 No's or 30.4 % of total accidents are Minor Injury Accidents and 105 No's or 29.1% of total accidents are Non-Injury Accidents.
3. 30.9 % of total accidents or 112 Nos have occurred due to Rear End Collision, 24.6% of total accidents or 89 Nos have occurred due to Over Turning, 17.1% of the total accidents or 62 Nos have occurred due to Other (Different vehicle and Pedestrians were involved), 8.0% of total accidents or 29 Nos have occurred due to Skidding, 6.9% of total accidents or 25 Nos have occurred due to Right Angle Collision, 6,0% of total accidents or 22 Nos have occurred due to Head on Collision, 5.8% of total accidents or 21 Nos have occurred due to Collision Brush/Side Swipe and 0.6% of total accidents or 2 Nos have occurred due to Left Angle Collision.
4. 12.7% of total accidents or 46 Nos have occurred in January, 10.2% of total accidents or 37 Nos have occurred in April, 9.9% of total accidents or 36 Nos have occurred in June, 9.4% of total accidents or 34 Nos have occurred in August, 9.1% of total accidents or 33 Nos have occurred in March, 8.8% of total accidents or 32 Nos have occurred in May, 8.3% of total accidents or 30 Nos each have occurred in September & November respectively. 6.6% of total accidents or 24 Nos have occurred in October, 5.8% of total accidents or 21 Nos each have occurred in February & July respectively and 5.0% of total accidents or 18 Nos have occurred in December.
5. 67 Accidents or 18.5% of total accidents on Thursday and followed by of 59 Accident or 16.3% of total accidents on Tuesday, 53 Accidents or 14.6% of total accident on Sunday, 49 Accidents or 13.5% of total accidents on Saturday, 48 Accidents or 13.3% of total accidents on Monday and with the lowest of 43 Accidents or 11.9% of total accidents each on Wednesday & Friday respectively.
6. Accidents has been occurred during all hours of the day with a Maximum of 29 no's Accidents or 8.0% of the total accidents taking place during 18.00Hrs, 26 no's Accidents or 7.2% of the total accidents taking place during 13.00Hrs, 24 no's Accidents or 6.6% of the total accidents taking place during 21.00Hrs, 21 no's Accidents or 5.8% of the total accidents each taking place during 1.00Hrs & 17.00Hrs respectively, 20 no's Accidents or 5.5% of the total accidents each taking place during 8.00Hrs & 9.00Hrs respectively, 16 no's Accidents or 4.4% of the total accidents each taking place during 10.00Hrs, 15.00Hrs & 22.00Hrs respectively, 15 no's Accidents or 4.1% of the total accidents each taking place during 4.00Hrs & 20.00Hrs respectively, 14 no's Accidents or 3.9% of the total accidents taking place during 14.00Hrs, 13 no's Accidents or 3.6% of the total accidents taking place during 19.00Hrs, 10 no's Accidents or 2.8% of the total accidents taking place during 24.00Hrs, 9 no's Accidents or 2.5% of the total accidents taking place during 7.00Hrs, 7 no's Accidents or 1.9% of the total accidents each taking place during 5.00Hrs & 6.00Hrs respectively, 6 no's Accidents or 1.7% of the total accidents taking place during 2.00Hrs, 4 no's Accidents or 1.1% of the total accidents taking place during 23.00Hrs and 2 no's Accidents or 0.6% of the total accidents taking place during 3.00Hrs.
7. 190 Accidents or 52.5% of the total accidents has occurred due to Over Speeding, 74 Accidents or 20.4% of the total accidents has occurred due to Vehicle out of Control, 53 Accidents or 14.6% of the total accidents has occurred due to Fault of Driver of motor vehicle, 22 Accidents or 6.1% of the total accidents has occurred due to Drunken Driving, 16 Accidents or 4.4% of the total accidents has occurred due to Others and 7 Accidents or 1.9% of the total accidents has occurred due to Defect in mechanical condition of Vehicle.
8. About 308 Accidents or 85.1% of the total accidents has been taken place at Away from Intersection, 30 Accidents or 8.3% of the total accidents has been taken place at T-Junctions, 9 Accidents or 2.5% of the total accidents has been taken place at Four Arm Junction, 8 Accidents or 2.2% of the total accidents has been taken place at Y-Junction, 6 Accidents or 1.7% of the total accidents has been taken place at Roundabout Junction, 1 Accident or 0.3% of the total accidents has been taken place at Manned Rail Crossing.
9. Pedestrians involved in Accidents:
   Pedestrians were involved in 32 accidents, of which 7 are Fatal Accidents and 25 are Grievous Accidents.
10. Two Wheelers involved in Accidents:
    Two wheelers were involved in 168 Accidents, of which 10 No's of accidents are Fatal, 81 No's of accidents are Grievous, 69 No's of accidents are Minor Injury and 8 No's of accidents are Non-Injury.
11. Trucks and Tractor involved in Accidents:
    Trucks were involved in 116 Accidents of the total accidents, of which 14 Accidents are Fatal Accidents, 24 Accidents are Grievous Accidents, 25 Accidents are Minor Injury and 53 Accidents are Non-Injury.

Corridor has to be monitored constantly at regular intervals to regulate and control the movement of Truck Traffic. The above findings help us to understand the basic causes for the accidents in the Project Stretch. Various factors are involved in the Highways like Road Users, Vehicles, Animals, Weather condition, Road Condition, Road Design and Road Signage which may have a direct or indirect impact on the accidents.

VI. IDENTIFICATION OF BLACK SPOT LOCATION

A. Identifying Hazardous Locations

The accidents are classified as Fatal Accidents, Grievous Injury Accidents, Minor Injury Accidents and Non-Injury Accidents. Chainage where a minimum of One Fatal or One Grievous Injury Accident has taken place is defined as Hazardous location. Ninety-Six (96) locations have been identified as Hazardous Location in this stretch and are listed in the Table given below:

B. Black Spot Locations:

In the following 7 locations the ACCIDENT SEVERITY INDEX (ASI) is more than the Threshold Severity Value; hence these have been classified as BLACK SPOTS.

Sl No.	Hazardous Location	Side	Total No. of Accidents	Fatal	Grievous	Wt. Fatal	Wt. Grievous	(ASI)	Standard Deviation
1	16.600	RHS	4	2	2	14	6	20	2.16
2	22.600	LHS	3	1	2	7	6	13	0.57
3	22.700	RHS	4	1	3	7	9	16	1.13
4	26.800	LHS	3	2	1	14	3	17	1.36
5	27.750	RHS	3	1	2	7	6	13	0.57
6	35.400	RHS	3	2	1	14	3	17	1.36
7	42.000	LHS	2	2	0	14	0	14	0.74

C. General observations:

- No advance warning sign boards about the merging of Service road with the MCW
- No barricade over the median in this portion. Pedestrians are crossing at this location.
- Poor visibility and insufficient turning radius for vehicles coming from minor road. No advance sign board about minor Intersection. Bus stop located close to the intersection. Vehicles are also coming in the wrong direction to cross the road. School is located on the opposite side.
- Heavy Pedestrian movement no provision for Pedestrian crossing.
- Lack of Traffic Control Devices
- Minor intersection. More than1.0 mts level difference between MCW and minor Road.
- Poor visibility for the vehicles coming from the Service Road of the flyover.
- No Hazard marker.
- No regulation at the intersection.
- No Stop Line nor Halt and Go Sign Board on the side road.

VII. CONCLUSION

This Report provide you the detailed procedure of Road safety Audit and Road Accident Analysis in the existing Road.

The Project work was a study and Analysis to find out the black spots in Chennai-Tada Section. The Accident Severity Index (ASI) Empirical Bayesian Methods was used to identify the accident Hazard locations. Based on the analysis, the following recommendation to make change the identified as vulnerable accident-prone area and Road Site safety at all the Blackspots The following general recommendation made by the Any government (Central / State government) to reduce the no of fatality and Accident Severities.

- All most all the accidents have occurred in the Straight stretches of the Road, where the drivers are tempted to go at high speed. Hence necessary sign boards have to be provided to regulate the speed and the same should be enforced. Provide rumble strips, groove pavement etc., to regulate the speed at intersections / median openings as majority of accidents have occurred due to Drivers negligence.
- Since pedestrians were involved in accidents it is recommended that barricades may be provided over the median at places of activities to regulate the movement of pedestrians.
- Pedestrian crossings with all traffic control measure to be provided at places where there are activities on both sides of the road.
- Stop line to be provided on the minor roads with Halt & Go sign board.
- Install flashing beacons 50m ahead of median opening / at grade junctions.
- Hazard markers to be placed.
- Improve pavement marking.

- Random Check to be done to avoid Drunken Driving
- Install retro-reflective signs and road markings.
- Unathorised median openings to be closed.

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