

ROAD SAFETY AUDIT

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ABSTRACT

Road Accidents are increasing at a high rate all around the world day by day due to spectacular growth of the road transportation sector. Millions of people are injured and killed during years all over the world due to road accidents. Huge amount of socio- economic cost incurred due to accidents. Accidents rates are increasing despite of many preventive measures applied to improve road conditions and traffic laws. The serious economic loss caused by road accidents demand the attention of the society and call for the solution of the problem. A multi-disciplinary approach like Road safety Audit (RSA) measures are suggested for safety of road users like pedestrians, cyclists and vehicular users. The road safety audit process is best characterized as a proactive approach to road safety by addressing issues before accidents occur. This is a radically different approach to traditional black spot analyses used to identify problem areas based on frequency of accident occurrence. Road Safety Audit (RSA) is one of the safety measures employed for preventing or reducing road accidents an existing road or future road project to a formal examination. These are conducted by an independent, experienced multidisciplinary RSA team. RSA is an important tool for assessing accident potential of a specific design. Originally this RSA concept has first developed in the United Kingdom in the 1980s as part of Accident Investigation and Prevention techniques, they have evolved to the point where they are now an integral component of the road safety process. Analysis of major accident in the recent decades has concluded that driver's errors are the major concern for the occurrence of road accident. This Audit will focus on evaluating the benefits of the proposed actions that have emanated from deficiencies identified through the audit process.

Keyword: - RSA, Road signage, Intersection treatments etc....

1. INTRODUCTION

Rapid Rise in population along with increased and versatile land use patterns and increase in vehicle ownership have generated considerable traffic demand in the major cities in India. Road Traffic accidents have now become a great social concern in India and the situation is deteriorating. Millions of people were contused and killed throughout years everywhere the planet owing to road accidents. Vast quantity of socio-economic price incurred owing to accidents. Accidents rates square measure increasing despite of the many preventive measures applied to boost road conditions and traffic laws. Due to increase in vehicles and constant road breadth with ever-changing surroundings situation, the rates of accidents square measure increasing drastically. Road safety is that the main concern to cut back accidents. For road user safety, the analysis of accident is primary demand for road style.

Road safety Audit is a systematic, proactive and formal procedure for assessing accident potential and safety performance of latest or existing roads. It's a proper examination of a future traffic project, or Associate in Nursing existing road, within which Associate in nursing freelance and qualified team appearance at the project's crash potential and safety performance. RSAs may be viewed as a proactive affordable approach to boost safety. Road Safety Audits kind a very important role in diagnosis the protection of the road network, each as way as existing roads and upgrading comes on the road and transport network are involved.

RSA construct has 1st developed within the uk within the Nineteen Eighties as a part of Accident Investigation and hindrance techniques; they need evolved to the purpose wherever they're currently an integral part of the road safety method. RSA is AN economical, price effective and proactive approach to boost road safety. It's verified that RSA has the potential to save lots of lives. The RSA was originated in nice United Kingdom and is well developed in countries like kingdom, USA, Australia, New Sjaelland, Denmark, Canada, Malaya and Singapore. It's at variable

stages of implementation in developing nations like India, South Africa, Thailand and East Pakistan. RSA seems to be a perfect tool for rising road safety in India, as basic and correct information on accidents have nevertheless to be collected. Road safety Audit (RSA) may be a best and rising tool for improvement of road safety and therefore the assessing accident potential in developed and developing countries. The enlargement of the route infrastructure, particularly in major metropolitan areas, has not unbroken pace with the increasing traffic demand. Such imbalance in provide associate degreed demand is inflicting an unprecedented level of safety challenges vs. Recent years have witnessed a rise in motorization, infrastructure enlargement and increasing quality of individuals in India and in cities. This variation is probably going to continue within the returning years. Everyone if given a selection would love to be in the biggest vehicles as they typically own the road virtually. Individuals might be shocked to grasp that almost 95000 individuals get killed on Indian Roads on yearly basis, or nearly 260 individuals obtaining killed on routine. Road accidents currently leads the list of accidental deaths in India far more than the other like by drowning, fire, rail or air mishaps etc. Driving or riding a vehicle in India is by giant turning into a dangerous expertise and Indian roads like those of alternative Asian countries are getting virtual death traps. There's forever a personality's tendency to underreport undesirable facts. In our country it's the amount of accidents which regularly fails to induce registered. Decease attributable to its complexness cannot be neglected and therefore typically gets registered. Specialists have researched and indicated that a quantitative relation of 1:15:70 for road accident deaths, injuries requiring hospital treatment, and minor injuries is happening. Therefore it indicates that nearly eight million individuals "Directly-influenced" by accidents. A road safety audit is generally a formalized method whereby a report is submitted to the look team and/or consumer listing safety deficiencies. The audit report shouldn't contain suggested remedial measures though exemplary solutions could also be known. The look team, United Nations agency remains accountable for all style choices, should provide the audit team a documented response addressing all safety recommendations.

1.1 Safety audit stages and study points

As per IRC: SP: 88-2010 the safety audits are conducted in various stages in India.

Feasibility-stage audit measure conducted within the early coming up with and project development. These audits valuate choices like route locations, layouts, treatments, interchange locations and sort access management, impacts on the prevailing road network, and alternative options.

Preliminary Stage generally spoken as "Draft style," general style standards ar evaluated. Horizontal and vertical alignment, intersection and interchange kind and layout, sight distances, lane and shoulder widths, super elevation, and provisions for pedestrians and bicyclists are a number of the factors thought of at this stage. Any effects on safety ensuing from deviation from standards are noted at now.

A detailed design-stage audit reviews the final geometric design features, traffic signals, signing and marking plans, lighting plans, landscaping, intersection and interchange details, provisions for special users (older pedestrians, the disabled and bicyclists), drainage, guide rails, and other roadside objects. Detailed Stage also may involve a review of the plan for traffic control and management during construction.

Pre-opening is a final check, prior to opening, to ensure that the safety concerns of all road users have been addressed and that hazardous conditions have been eliminated. Pre-opening stage audit should include both day and night checks, evaluations in wet and dry weather, and driving, riding, and walking, if appropriate. A major focus of Pre-opening is to note variations from the original plans that may have been constructed.

Post construction stage involves recognition that the use of a roadway may change over time. Post construction stage audits may be performed on a road section newly opened to traffic to evaluate its performance or it can be used to identify safety deficiencies on existing roads. Intersections, roadway segments, and roadside features are some of the elements that may be examined in an audit of an existing roadway.

1.2 Benefits of Road Safety Audit

The assessment of benefit is subjective; however, there is evidence that some of the accidents generated by new road schemes are susceptible to low cost remedial measures. Such measures could have been added to the scheme at various stages throughout the design and construction process. More importantly other accidents associated with layout and level features cannot be influenced, other than by major reconstruction of junctions and structures, but could have been changed at negligible cost at the planning and design stages to provide greater safety audit system at all stages in planning, design and construction

2. LITERATURE REVIEW

On a national level, the primary RSA pointers were created in 2003 by Central Road analysis Institute (CRR) underneath Ministry of Shipping, Road Transport & Highways (MOSRTH) sponsored analysis study. These were once more revised by CRR in 2009. This can be being adopted by Indian Roads Congress (IRC) in 2010 as Manual for Road Safety Audit IRC-SP-88, 2010. The RSA manual ready by CRR in 2010 contains these main topics: Introduction; a proof of road safety audit; stages of road safety audits; road safety audit process; salient options and principles for safer road designs; specific parameters to be thought-about within the gift day traffic state of affairs in India; covering issues of safety for non-motorized traffic and issues of safety of High Speed Corridors, Safety Audit method for Rural Roads; checklists; and parts of an honest RSA and live of its success. A suggestion is additionally given on the procedure to begin RSA in a company.

Eugene M. Wilson and Martin E.Lipski had conducted safety Audits on Urban streets to provide an overview of the Audit Process in audit was conducted at a recently constructed local intersection in Memphis, Tennessee. They have conducted audit to describe the applicability of road safety audits in evaluating safety deficiencies on existing urban roads and streets. They have found some deficiencies like absence of Guard rails, stop bars and stop signs.

Sophia Vardakas, Fanis Papadimitriou and PantelisKopeliashad conducted an Audit on a major freeway for implementing safety measures. The safety team has identified some potential hazardous in the freeway and found reasons for causing accidents. Based on the Audit report and the visual examination they have suggested preventive measures for reducing the potential hazards in the freeway.

Muzharsayed and sumedh Mhaske have performed as GIS based road safety audit on National Highway 17 for a stretch of 3 km from Panvel to Indapur in Maharashtra using the GIS tools "Gram++" to differentiate different sites of a road segment having higher accident frequency with sites having low accident frequency which should be potentially improved in a cost effective manner. They have done this audit to reduce the risk of accident and to minimize the severity and to increase the awareness about safe design practices among all those involved in planning, design, construction and maintenances of roads.

3. METHODOLOGY

One of the advantages of the RSA method is that the cooperative interaction created by the members of the audit team. The information and knowledge of the team as a full square measure bigger than the total of those attributes as unconditional within the individual members, therefore the method edges from being conducted by a team. Whereas 3 members during a team is also adequate for a few project varieties, the amount might not be ample for larger, additional complicated comes or those requiring specific experience.

All of the observations achieved throughout the audit area unit recorded on the security audit checklists and forms ready in an exceedingly special format as illustrated on the following paragraphs. Below are a unit samples of some options to be determined throughout the sphere survey.

3.1 Identify project or existing road to be audited

The objective of this step is to spot the prevailing road to be audited and to line parameters for the RSA. There are a unit several reasons that a road or intersection may be audited and that they may include: road sections wherever there are a unit general safety considerations, sections with high crash levels, high traffic volumes, geometric road and associated style problems, sections scheduled for overlay comes and college zones that have dangerous aspects related to them. Once a road or intersection is chosen, parameters got to be set which will outline for the shopper what work are going to be accomplished.

3.2 Select an RSA Team

The consumer or project owner ought to choose the RSA team leader and along they must choose the remaining people which will get on the RSA team. The RSA team ought to possess a group of skills which will make sure the most crucial aspects of the project are self-addressed. The RSA team might embrace people like an expert in traffic engineering, design, maintenance, and safety engineering, likewise as experience in pedestrians and bicyclists, young and older pedestrians, older drivers, native information, human factors, enforcement, project scoping and representatives from native and federal governments. The perfect RSA team is that the smallest team that brings all of the mandatory information and knowledge to the method.

3.3 Review of Project Data and Conduct a Field Reviews

This is the foremost vital step within the RSA method and therefore the field reviews ought to see the project a minimum of 2 totally different times of day. Typically the team can practice the section along and note something which will have an effect on the security of the road. Standards and policies will be a beginning purpose however compliance with standards will not be necessarily result in a safer roadway.

3.4 Conduct Audit Analysis and Prepare Report of Findings

This step the RSA team can terminate the RSA findings and develop suggestion in mitigating them. In addition the audit team ought to establish however they want to judge risk from bound options and the way to range the suggestions given. This report clearly states the factors inflicting the accidents and deficiencies within the stretch.

3.5 Prepare Formal Response

This is the requirement of the project owner to explain what RSA recommendations are going to be implemented and what are not going to be. Some considerations can be:

- Is the RSA report finding within the scope of the project?
- Would the suggestion made in the RSA report address the safety issue?
- Will the suggestion made in the RSA report lead to mobility, environmental problems?
- What would be the cost associated with implementing the suggestions?
- Are there more cost-effective alternatives that would be equally effective?

3.6 Corrective measure

This step is to implement the protection recommendations found within the RSA report and to make sure the RSA method was a learning expertise. The project owner can have to be compelled to guarantee that the agreements delineate in the response report are completed as delineate and within the timeframe documented.

4. ROAD SAFETY STRATEGY

Road accidents in Bharat are high to heterogeneous traffic conditions. The large growth in population, motorized vehicles and therefore the movement of all sorts of vehicles on identical road in Bharat cause congestion, delays, inadequate parking and safety issues which ends in accidents. Thousands of lives square measure lost and several individuals square measure livid in Bharat in road accidents within the past years. So as to scale back these road accidents Road Safety Audits (RSA) are enforced by National road Authority of Bharat (NHAI) on existing and on projected new road comes. There has been a 5.52 %increase within the variety of road accidents cases across Telangana in keeping with National Crime Records Bureau (NCRB) 2015 information. This puts the State at the tenth position in terms of road accidents, recording twenty one, 252 accident cases being registered in 2015.

The data shows that 50% of road accidents and 30% of deaths have occurred in urban areas. The traffic accident information recording a section of NCRBs Accidents and Suicides in India, 2015 discharged in Gregorian calendar month 2016. Of the 21,252 accident cases within the state, 9,002 occurred on the National and State Highways. This slim margin alone resulted in three, 727 deaths of the 110 instances of deaths across the state that year. The rise within the variety of road accident cases and echo the national trend. There has been a rise of 3.1 % and 5.1% for road accident cases and deaths within the country as per the 2015 report. Two-wheelers contributed to the utmost variety of fatalities within the country, contributing 29.3% of the full variety of deaths. This was followed by 9.4% from deaths thanks to trucks, 12.4% thanks to cars and 8.3% of deaths thanks to buses. Hyderabad ranks tenth among cities with high variety of road accident cases and deaths within the country.

S.No	District	No of Accidents					No of Persons	
		Fatal	Grievous injury	Minor injury	Non-injury	Total Accidents	Killed	Injured
1	Adilabad	354	58	903	260	1575	379	1476
2	Karimnagar	543	136	826	92	1597	618	1815
3	Warangal City	248	113	503	105	969	262	989
4	Warangal Rural	295	56	423	48	822	323	1029
5	Khammam	425	57	974	110	1566	475	2252
6	Nizamabad	500	37	808	182	1527	541	1702
7	Medak	806	46	981	123	1956	919	2309
8	Mahabubnagar	885	35	930	111	1961	957	2039
9	Nalgonda	726	373	941	106	2146	795	2910
10	Rangareddy	226	5	172	12	415	242	422
11	Cyberabad	1125	214	2381	234	3954	1165	3631
12	Hyderabad	369	484	1587	217	2657	371	2382
Total		6502	1614	11429	1600	21145	7047	22956

Fig -1: District wise accidents for Telangana (2015)

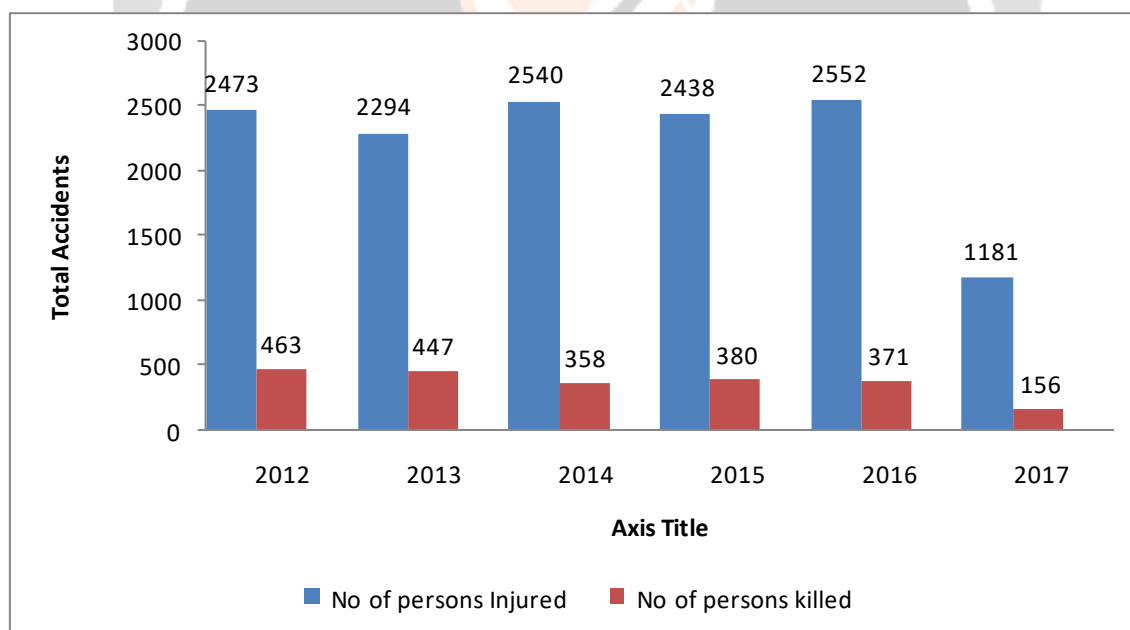


Fig -2: Total Hyderabad Accident record (Up to June 2017)

Road safety audit has the greatest potential for improving safety when it is applied to a road or traffic design before the project is built. It can be conducted on any design proposal, which involves changes to the ways road users will interact, either with each other or with their physical environment. Purpose of the audit is to look at the accident potential and safety performance of the proposal. It is a formal process using a defined procedure and not an informal check. To be effective, it must be conducted by persons who have appropriate expertise, experience and training and who are independent of the design team.

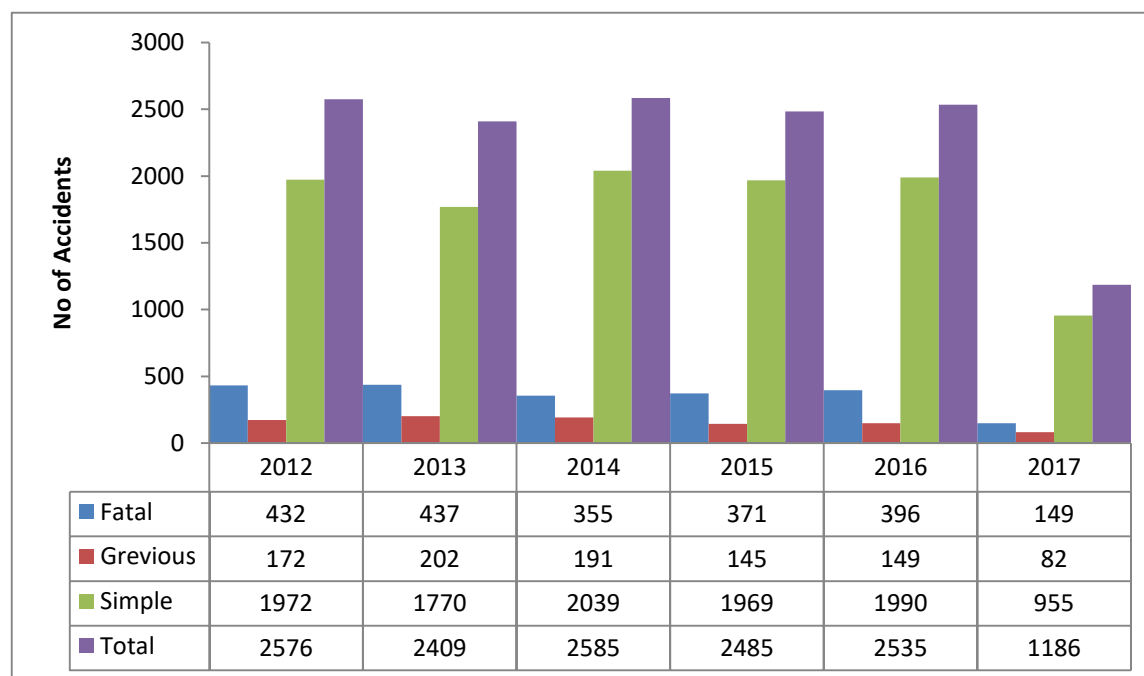


Fig -3: Total Hyderabad Accident record (Up to June 2017)

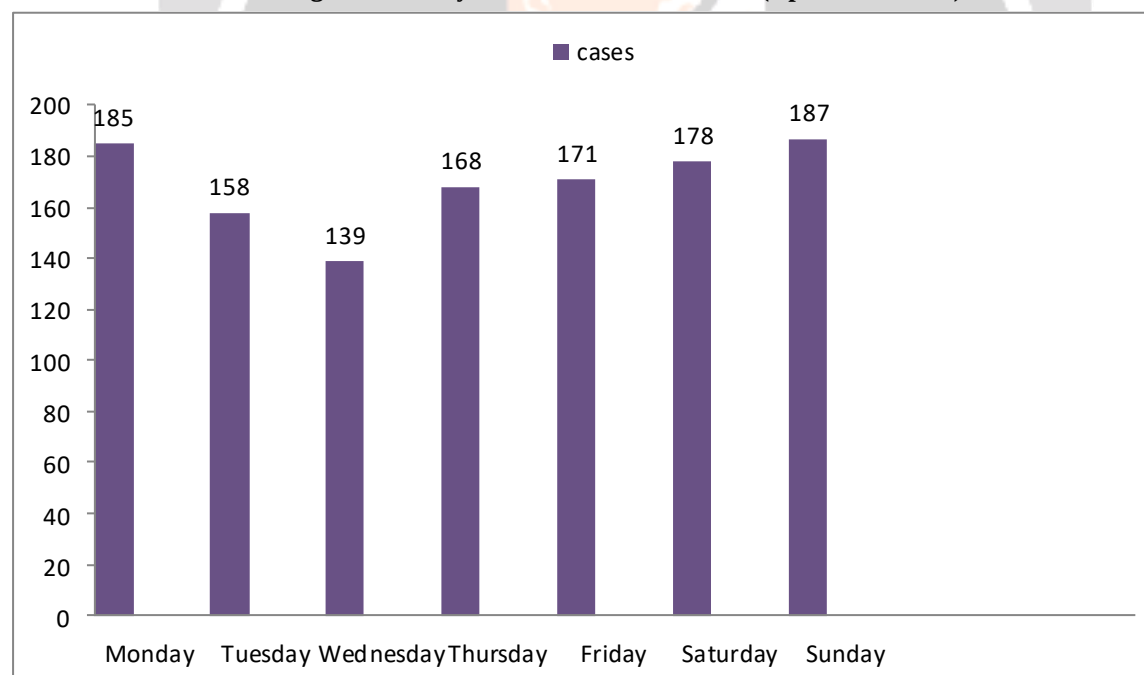


Fig -4: Day wise Hyderabad accident Record

The rate of accidents within the stretch is a lot of due heterogeneous and mixed traffic conditions. The yearly accident rate within the stretch has been increasing. The traffic within the stretch is high as a result of mixed land use pattern and therefore the average yearly accident rate within the stretch is concerning 100%. The accidents during this stretch are caused as a result of numerous reasons. The accidents caused by human negligence within the stretch are increasing drastically. So as to scale back these accidents and to extend the security concern within the stretch a post-construction road safety audit is conducted.

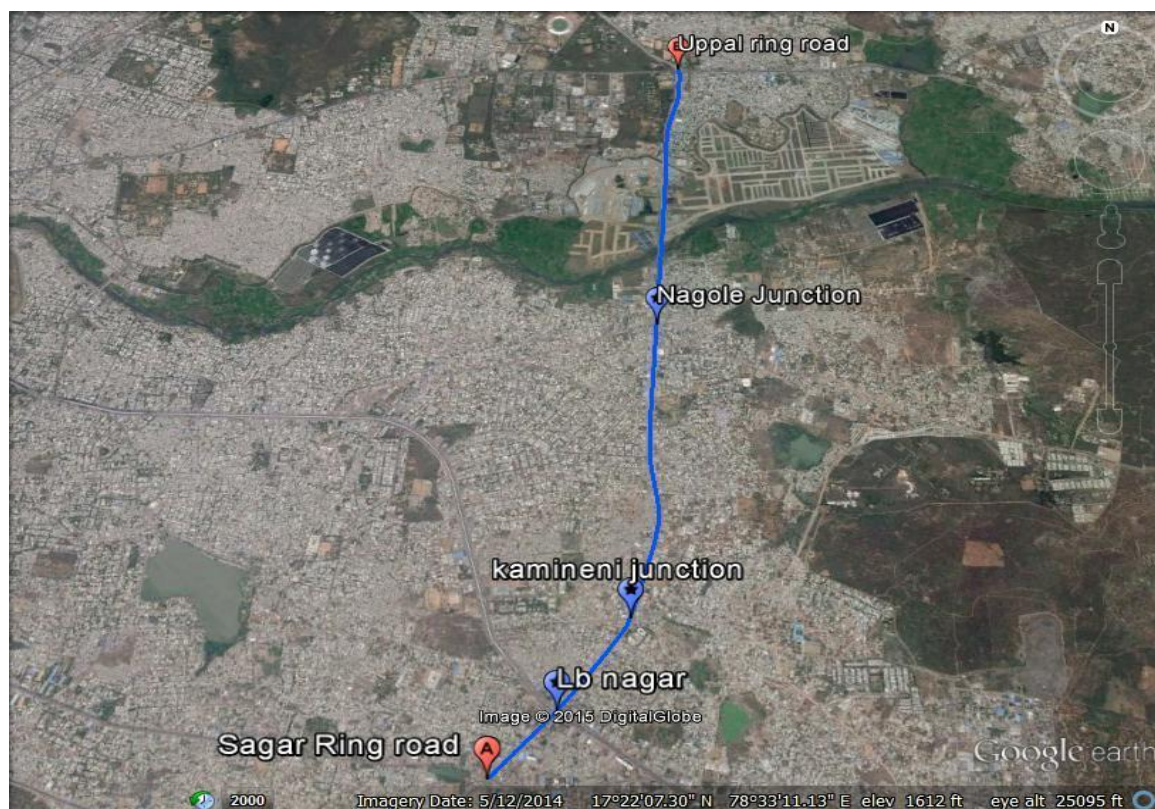


Fig -5: Stretch selected for Audit (Source: Google maps)

Road accident data were collected from two police stations in the stretch i.e. from LB Nagar and Uppal police station under various sections of IPC 338,337,304a. The data is analyzed into various following categories. Yearly classification of accident data gives the number of accidents recorded in a year. This data helps in finding various factors like:

- Factors causing accidents
- Black spots (Concentration of Accidents)
- Deficiencies in the stretch

The data from fig 6 represents the accidents in the stretch from the year 2013-2017 July. There is an increase in the rate of accidents for the year 2013 and decreased from the year 2014-2017 July. The decrease in the rate of accidents from a couple of years in the stretch is mainly due to the installation of traffic signals and road signs. Monthly classification of Accident data gives information regarding the accidents caused due to environmental and climatic changes. These data is very useful in determining the factors causing accidents due to change in environment and climate.

Collision type	Fatal	Serious	Simple
Head on collision	12	8	8
Read-End collision	30	30	150
Hit Pedestrians	26	8	146
Hit Fixed objects	20	10	160
Hit pedal cyclists	8	9	31
Right – angle collision	7	6	14

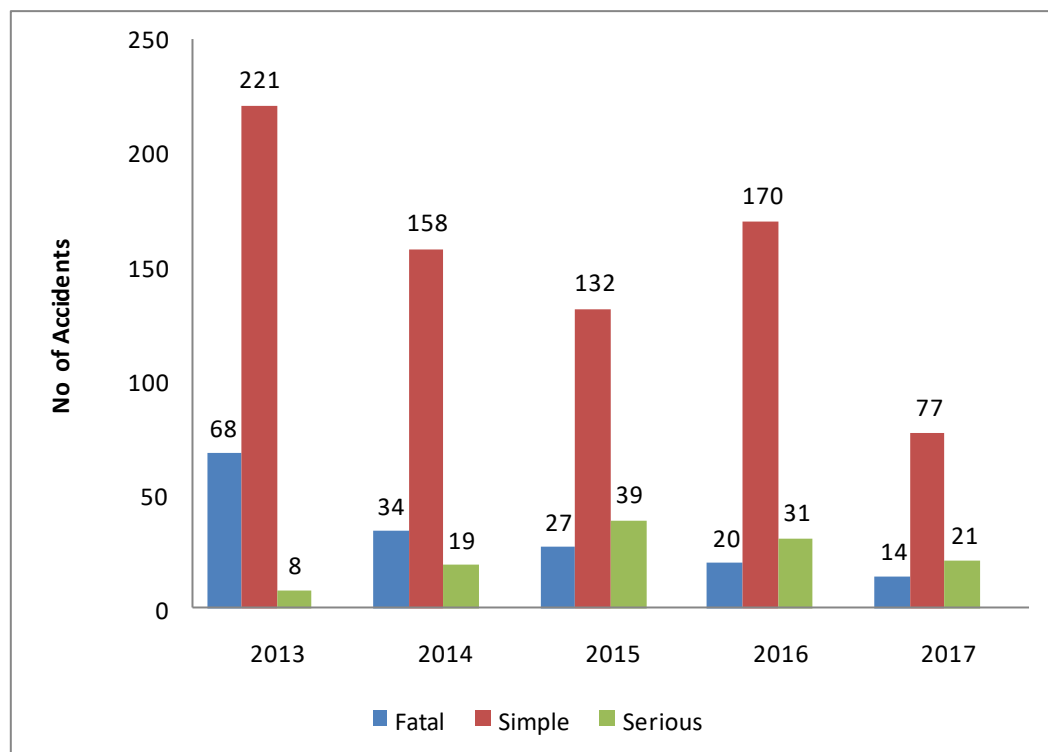


Fig -6: Stretch selected for Audit (Source: Google maps)

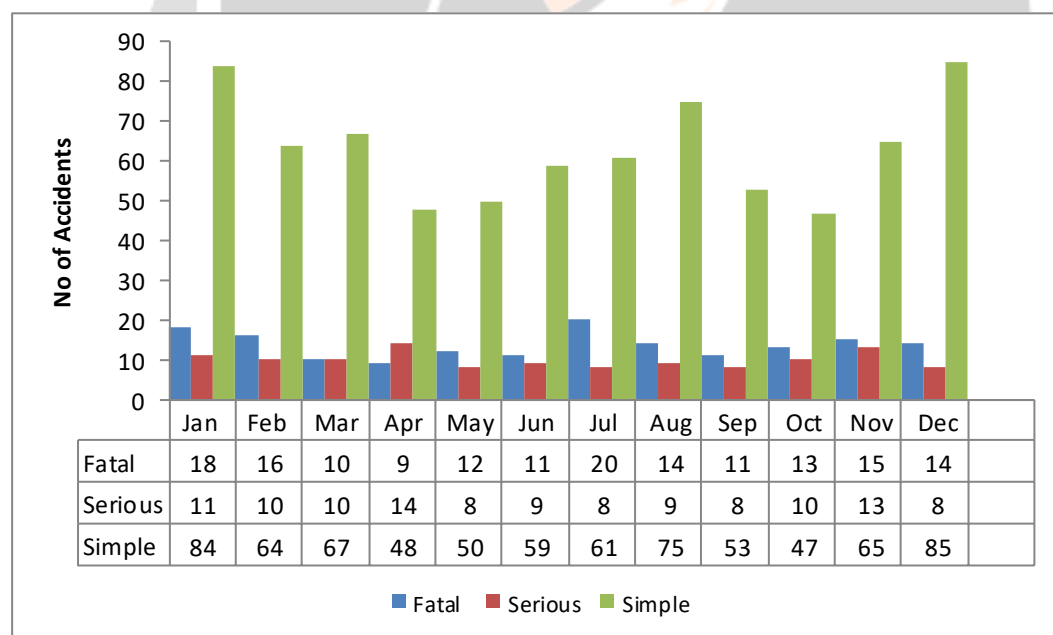


Fig -6: Month wise accidents report of the stretch

Cause of Accident	No. of accidents	% of Accidents
Negligence and rash driving	676	65
Mechanical failure of Vehicles	26	2.53
Pedestrians	31	3.0
Drunk & drive	186	18.0
Animal on roads	11	1.0
Others	109	10.47

Fig -7: Cause of Accidents

4.1 Observations

In both Directions (Up and Down)	
Sl. No.	Hazard Name
1	Unevenness in Pavement profile
2	Faded sign Boards
3	Pedestrian faults
4	Insufficient curb height
5	Absence of Pavement markings
6	Raised pavement markers/Reflectors
7	Useless/misleading sign boards
8	Unauthorized movement of vehicles at medians
9	Missing signs
10	Improperly designed bus-bays
11	Absence of Channelizers at junctions
12	Lane Designation
13	Absence of Kilometer and Hectometer stones

Fig -8: Cause of Accidents

4.2 Typical Hazards

Most of the signs are set at inappropriate locations and aren't in accordance with the quality. The sign has been virtually lined by trees within the medians and it's too short that cannot allow drivers to visualize it before reaching the sign. It had been additionally discovered that each one the markings on either side of the route are utterly tired to the extent that drivers cannot even see any indication. As a result of that drivers use the road with no marking condition in that may contribute to high range of accidents on the route.



Fig -9: Improper Sign Boards

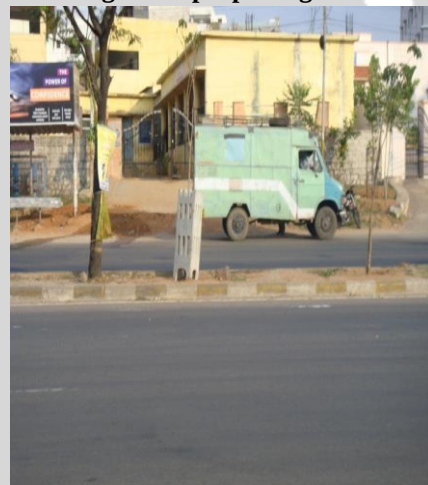


Fig -10: Absence of pedestrian crossing

5. PROPOSAL OF COUNTERMEASURES

At many locations on the road inspected, there are many signs confusing drivers on what decision to be taken and in some locations, the signs were either worn-out or completely missing. To reduce the confusions on the route the following improvements or countermeasures should be considered:

- ☐ Warn signs should be renewed near Kamineni Bus stops.
- ☐ Warning signs should be installed at required sections of the route approaching area of intersections,
- ☐ Existing markings which cause confusion on the route should be removed
- ☐ The markings should be renewed by repainting and widening centerlines and edge lines
- ☐ Markings/signs should be placed where missing.
- ☐ No honking sign boards should be installed at required sections (i.e. near schools and hospitals) in the stretch.

The DWT provides cues to visually impaired persons of changes or transitions in walking surfaces such as curb ramps where the sidewalk meets the street or on transit platforms; the DWT improves safety for sighted persons too. These DWT are to be installed at junctions for the safety of pedestrians.

A pedestrian crossing or crosswalk is a place designated for pedestrians to cross a road. Crosswalks are designed to keep pedestrians together where they can be seen by motorists, and where they can cross most safely across the flow of vehicular traffic

Marked pedestrian crossings are often found at intersections, but may also be at other points on busy roads that would otherwise be too unsafe to cross without assistance due to vehicle numbers, speed or road widths. They are also commonly installed where large numbers of pedestrians are attempting to cross (such as in shopping areas) or where vulnerable road users (such as school children) regularly cross. Pedestrian crossings are to be installed at various junctions in the stretch. The present markings are invisible. Detectable Warning tiles (DWT) are to be installed at the either ends of pavement.

Construction and maintenance activities often result in increased road safety risks, reduced traffic capacities, delays, and loss of access to abutting properties and developments. To ensure acceptable levels of safety and traffic service, effective management of traffic through work zones is essential.

Road safety Education occupies an important place in the prevention of accidents. School children who are particularly liable to accidents, can easily be imparted the necessary training in the schools about the rules of the road and related safety aspects.

Delineation on highway is used to assist drivers make navigation and control decisions. Adequate delineation allows the driver to keep the vehicle within the traffic lane, and plan the immediate forward driving task. Delineation should be consistent and continuous. Delineation is likely to become even more important as the driving population ages. Older drivers have reduced visual capabilities and rely to a greater extent on correct delineation of the road ahead.

Obstruction approach marking, stop lines, Route direction marking, Intersection Approach marking and object markings are to be marked according to guideline of IRC: 35-1997.

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