

# URBAN ROAD SAFETY AUDIT: TECHNIQUE AND CASE STUDY

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**ABSTRACT:** Road accidents are acting as a global threat. In year 2004, the World Health Organization recognized road accidents claiming 9<sup>th</sup> rank among top unnatural death causes. It was also projected that by year 2020 it will acquire 3<sup>rd</sup> rank. Since many years, many methods are in practice to reduce rate of road accidents by studying analysis of accident occurrence; such methods are also known as *reactive methods*. During 1980s, United Kingdom evolved a *pro-active Approach* to reduce road traffic accidents which today, is known as Road Safety Audit (RSA). Developed countries like United States, Australia, New Zealand, Austria etc adopted the technique of RSA and surprisingly obtained drastic reduction in road accident rates. It was reported in India, a total of 98,254 people died on roads through year 2005. As per agenda of the World Bank and the Asian Development Bank, it is mandatory to conduct a safety audit at various stages of all new road projects which are to be funded through these agencies. In India, Ministry of Surface Transport (MoST) has suggested a guideline to conduct RSA for the National Highways of India. The highway traffic is homogeneous in nature and, to some extent the rate of accident is possible to reduce by introducing traffic safety devices and awareness among users. In contrast, urban roads are of heterogeneous nature and show of a highly mixed traffic character. The safety of VRU thus become of prime importance as there is extensive volume of pedestrians and bicyclists. The paper discusses basics of RSA along with its need today for urban roads. A suggestive technique is also mentioned to perform a safety audit particularly Indian urban roads. Moreover, a RSA performance on existing road - “Gaurav Path” of Surat City is also mentioned.

## 1. INTRODUCTION

Road design, as carried out by road engineers, responds to some form of logic, ingrained in the '*road standards*' adopted by each country or road authority. The logics, however, have evolved in time, both through increased knowledge of the effects of road features on mobility, traffic flows and safety, and through changes in attitudes towards organisation of road traffic and use of transport modes. Thus, at a time when motorisation was beginning to grow sharply, road engineers and planners were mainly concerned with smooth traffic flows, but safety gradually became a major preoccupation when accidents and injuries were seen to multiply; moreover, the needs of non-motorised road users, which had been largely ignored until the recent years, are now being considered both because of a more realistic view of future road transport (pedestrians are no longer seen as a 'disappearing species') and for environmental reasons. As a consequence, road standards have evolved to take into account some safety issues among other constraints related to mobility and economics.

Effects of this process on the traffic environment have been multiple. In a single country, old and new designs for roads may be found, which reduces road 'readability' and raises wrong expectations from the road users. Newly designed roads, if properly planned and constructed, should normally be safer than the older ones, but unexpected safety problems may also arise,

especially when unplanned changes have occurred in traffic volumes and mix and in the road environment (urbanisation). On older roads, local remedial measures, even when used appropriately to correct site-related accident factors (*'black-spot treatment'*), may have broken the logic of road design and, by introducing some inconsistencies in road features, generated accident migration and new accident patterns.

The original objective of RSA process was geared towards the reduction of road casualties through the incorporation of a more *pro-active approach*. Traditional *black-spot* analysis is a *reactive measure* of addressing safety problems and can be considered “the end result of a failure on the part of the designers to recognize the full safety implications of their work” (Jordan and Barton, 1992). Despite adherence to prevailing standards, roads are still being built with problematic locations resulting in disproportionate rates of road collisions. Introducing RSA early in the design of major road is a cost-effective way of eliminating potential safety problems before roads are built. RSA help to ensure that the issues associated with road safety are specifically addressed and are given equal importance as the other factors in a design project. Traffic accidents can be reduced by proactively addressing road safety issues at the time the road is conceptualized, designed, constructed or in service.

## 2. RSA BASICS

To avoid misconceptions, it is necessary to identify tasks that are beyond the scope of a traditional RSA. The following items have often been a source of confusion.

### ***Road safety audits are not a project redesign.***

Deficiencies should only be identified by the audit team. It is not within an audit's mandate for a redesign or recommendation to be made to mitigate a deficiency. This responsibility will rest with the project owners or their design staff. Auditors may suggest exemplary measures, but it is not their responsibility to make specific recommendations nor to promote a particular solution. The primary task should be for auditors to 'describe the problem'.

### ***Road safety audits are not intended for high cost projects only.***

In fact, experience has shown that RSAs can be particularly effective for smaller projects where design teams have limited labour and resources. Larger projects often have enough individuals involved with the required expertise so that internal checks become either inherent or a structured part of the design process.

### ***Road safety audits are not informal checks or inspections.***

Informal reviews should be a part of the normal design process separate from the service an RSA provides.

### ***Road safety audits are not a means to select among alternative projects.***

It is inappropriate to rely on the products of an audit to choose among alternative projects/alignments or to solve public opinion conflicts concerning route location.

### ***Road safety audits should not be viewed as a check of standards compliance.***

Road safety goes well beyond adherence to a set of minimum design standards. An audit is meant to be a holistic and multi-disciplinary review of the safety level provided by a facility.

## 3. ROAD SAFETY AUDIT - DEFINED

In India, the Manual for Safety in Road Designs, MoST - India (TRL, CRRI) defines RSA as: "Road safety audit is a formal procedure for assessing accident potential and safety performance in the provision of new road schemes, the improvement and the rehabilitation of existing roads and in the maintenance of existing roads."

Road Safety Audit is a procedure to evaluate the accident potentiality and the performance of the road with respect to safety. Safety audit is derived on the principle of "Prevention is better than cure". A carefully thought out safety audit program can bring invaluable benefits by helping in the identification of possible hazards and in turn assist in evolving

appropriate corrective and cautionary measures to minimize the hazards.

In India, RSA has become now mandatory for all newly taken up projects on National Highways and all those road projects funded by the international funding agencies. The auditing done at various stages make it possible to eliminate any features either physical or design elements that can be contributing to unsafe operations.

### 3.1 HISTORY OF RSA

The RSA process was initiated when road safety engineers realised that they were carrying out accident remedial schemes on relatively new roads. Adopting the principle of "prevention is better than cure", it was decided to use some of the safety experience gained from the remedial work, and design safety into new road schemes. The UK 'Institution of Highways and Transportation' (IHT) Guidelines on Accident Investigation and Prevention produced during this time included a section on "safety checking", suggested as an accident prevention mechanism.

Since then, the important milestones in the development of Safety Audit have been:

**Table 1 MILESTONES OF RSA**

Year	Milestone
1980	Some UK local authorities start doing safety audits
1990	Standard and Advice Notes, UK
1990	IHT Guidelines, UK
1990s	Denmark, New Zealand introduces RSA procedures
1991	UK Department of Transport made RSA Mandatory for all National roads
1994	Austrroads released publication entitled. <i>Road Safety Audit</i>
1996	FHWA of USA evaluated RSA process in Australia and New Zealand
1998	FHWA of USA started RSA pilot project
1999	Dublin Corporation introduces formal safety audit procedures in Ireland
1999	South African Road Safety Manual Introduced RSA as part thereof
1999	RSA Guidelines developed by University of New Brunswick, Canada
2000	Irish RSA Standard introduced as part of National Road Authority
2004	WHO declared World Health Day Theme: 'Road Safety is No Accident'
2005	Manual for Safety in Road Design by CRRI, TRL for MoST

The RSA process was developed to target the improvement of the road environment as a method to improve road traffic safety. The RSA process focuses on the contribution of the road elements to accidents. By identifying the potential safety problems during the

early stages of a project, the design can be modified or changed at low cost, thus eliminating potential of accidents.

#### 4. URBAN ROAD SAFETY AUDIT (URSA)

The Ministry has focused primarily on safety concerns associated with individual highways in India. However, safety thrust can also be applied to a network of local streets and intersections within an urban or municipal area. Identifying the safety issues associated with municipal or urban roads is a relatively new concept in the field of safety audits. In fact, most road safety manuals currently available do not address this topic. A possible explanation of this lack of attention is that the URSA focus can be quite broad. Specifically, a URSA may be conducted on a section of road or a network of streets. Furthermore, URSA can also be performed on existing streets or roads developed for new housing subdivision or town planning schemes (safety planning approach). Despite its broad definition, the audit or urban roads should not be overlooked. The safety issue identified in an URSA are important for minimizing the potential for future accidents within the municipal or city limits.

#### 4.1 URSA: MECHANISM AT ULB LEVEL

This section presents an overview of the URSA process which may be performed professionally. This refers to the complete process, from the determination of road safety audit requirement to the completion meetings and implementation of recommendations of URSA report. Finally, the undertaking of URSA is addressed. Refer flow chart shown in Figure 4 details out the proposed process which may be employed for the URSA. In the entire audit process, coordination among involved concerned bodies plays an important role. Figure 1 explains participation of various agencies involved in conducting URSA.

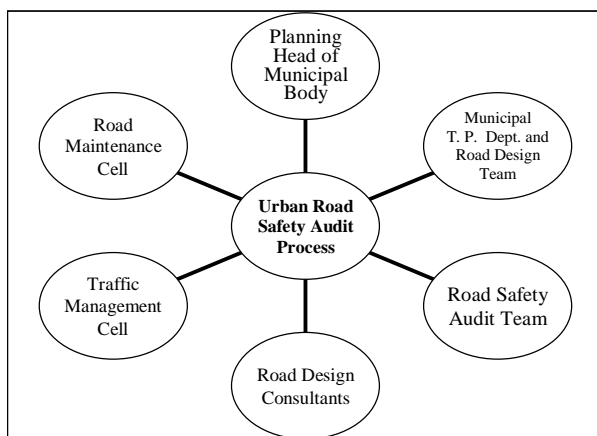


Figure 1 PARTICIPATION IN URSA PROCESS

There shall be a guideline released at ULB level for conducting URSA for specific area of authority, a similar practice as of General Development Control Regulations (GDCR) under. If done so, a professional

attitude towards road safety for the users can be achieved successfully.

#### 4.2 COMMISSIONING URSA

It may be the responsibility of the Municipal Project Manager within the local body to determine the requirement for URSA in accordance with the accident analysis and black-spot identification. The municipal project manager, through the road design brief, may instruct the design team to obtain a URSA.

As such URSA differs from the process and stages of RSA for a Highway scheme, RSA for urban roads can be performed in three stages which are enlisted below;

**STAGE: 1** - Conceptual design stage

**STAGE: 2** - Detailed design stage

**STAGE: 3** - Existing roads

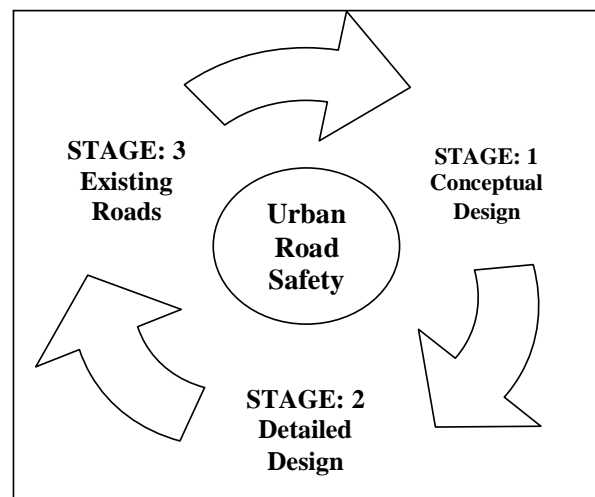


Figure 2 STAGES OF URSA

The URSA may be applied to all the future schemes of city roads. Prioritising category of arterial roads, the safety audit shall also be performed on sub-arterial and collector roads. Though speed of vehicle may be observed a little reduced yet all the roads shall be audited with safety point of view.

#### 4.3 URSA APPLICABILITY

Schemes that should be audited cover a wide range of types and sizes, on different classes of roads in urban areas. These may include:

- Major new road schemes;
- Major new rehabilitation schemes;
- Minor improvements;
- Traffic management schemes;
- Development schemes;
- Maintenance works; and
- Existing roads.

Although it would be desirable to subject all schemes to a safety audit, both financial and personnel resources will be limited and it may not be achievable.

It is therefore important for there to be a clear procedure for prioritizing schemes, which defines the type of schemes and the appropriate level of audits required.

**4.4 TIME SCALE FOR URSA**

The municipal project manager in consultation with municipal design team should allow an adequate time period within the overall project plan for the URSA to take place. Generally for minor road schemes, URSA may take up to 15 days and for larger schemes a preferred time period of 45 days shall be allowed to complete the audit. Time scale factor for URSA is majorly dependent on acquisition of secondary data; hence as earlier such data is made available also the URSA process may get completed well-timed.

**4.5 APPOINTING THE URSA TEAM**

The Design Team should in the first instance, attempt to obtain a URSA Team from Municipal body’s internal URSA Team. If this is not practicable, the design team should appoint an independent URSA Team.

It will be necessary for the Design Team to demonstrate that the URSA has been carried out in accordance with these procedures. In particular, they should demonstrate that the entire Road Safety Audit Team is completely independent from the Design Team and is comprised of at least four personnel with appropriate road safety training and experience and relevant Road Safety Audit experience.



**Figure 3 THE URSA TEAM**

**4.6 THE AUDIT BRIEF**

The design team is responsible for preparing and issuing the Audit Brief to the Audit Team. The Audit Brief needs careful preparation and must include sufficient information to enable an efficient audit to be undertaken. A copy of the brief shall be forwarded to the Municipal Project Manager for approval in advance of the audit. Any alteration to the brief should be documented along with their reasons by the Municipal Project Manager.

The design team should retain a copy of all information submitted to the URSA Team. If necessary, the Design Team and the Road Safety Audit Team can meet to discuss the audit brief.

**4.7 AUDIT MANAGEMENT**

The Municipal Project Manager and Design Team should liaise and ensure that the Audit process is initiated at the appropriate stages. The Design Team will need to demonstrate to Municipal Project Manager

that the URSA has been carried out in accordance with these procedures and by people who are independent of the scheme design.

**4.8 URSA REPORT**

A URSA Report should include an introductory statement setting out the Terms of Reference and listing the URSA Team members. The statement should describe when the URSA was carried out and refer to any plans and other documents checked by the Road Safety Audit Team. The report shall be submitted in two stages viz. *Draft Report* and *Final Report*.

The URSA Team members should record their comments on each scheme in a systematic way and use this as a basis for developing the *draft report*. This report should be produced to include a series of road safety problems and related recommendations for improvement. Following the production of this report, and if required, a meeting should be convened involving the Municipal Project Manager, Design Team and URSA Team.

Once the URSA Team has completed the Road Safety Audit, a copy of the *final report* should be sent to the Municipal Project Manager and to the Design Team. A paper copy of the final report, together with all the requested documentation and plans should be archived by the Road Safety Audit Team. The final report should not be amended after this stage.

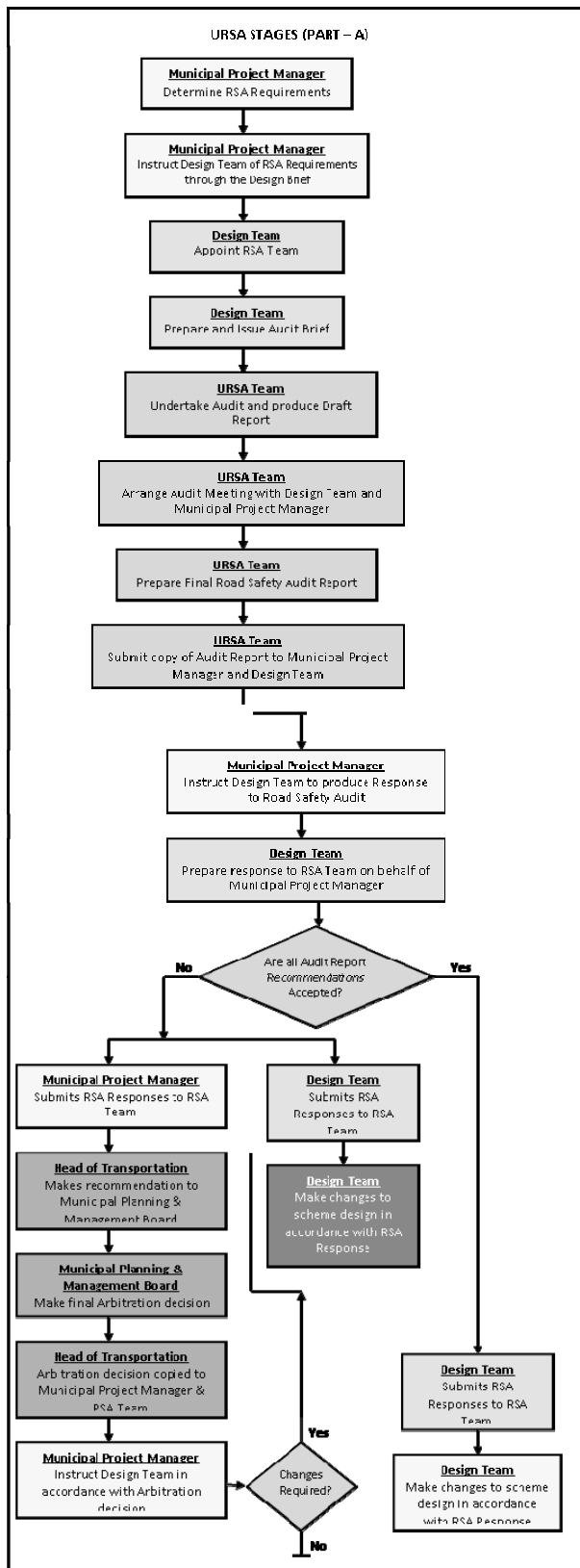
**4.9 EXCEPTION REPORT**

Where there are any recommended changes that are not agreed, the Municipal Project Manager should prepare an Exception Report listing all recommendations raised within the URSA Report that remain unresolved. The Exception Report should give reasons why recommendations from the URSA Report have not been adopted.

The Municipal Project Manager will require a response to the URSA from the Design Team. The Municipal Project Manager should instruct the Design Team to make those changes to the designs that are agreed as a result of the URSA Report. Where all of the URSA recommendations are accepted in full, these changes should be made to the scheme and documented. If the changes are substantial, the road scheme shall be re-submitted for URSA.

The Municipal Project Manager should forward a copy of the Exception Report to the Audit Team, and to the Head of Transportation Department.

The URSA Process is shown as a flow chart (See Figure 4) to simplify the stages to conduct an audit.



**Figure 4 FLOWCHART of URSA PROCESS**

#### 4.10 ARBITRATION

For those issues raised within the Exception Report, it will be necessary to seek arbitration in order to determine whether the outstanding URSA recommendations are to be adopted. In such instances,

the Head of Transportation department will make a recommendation to the Municipal Planning and Management Board, which will consider the issues involved and act as the final arbiter.

#### 4.11 CHECKLISTS FOR URSA

This section presents an overview of checklists for URSA. The section discusses the structure of checklists, as well as their uses.

There are two series of checklists under the URSA process. Both the checklists shall be applied to audit of Municipal Roads. There is a *master checklist* and a *detailed checklist*. The *master checklist* provides the Auditor with a general listing of the topics to be considered depending on the stage of design at the time of the audit. The *detailed checklists* elaborate on the topics contained in the master checklist. These lists provide exemplary issues / items to be considered – grouped by area of concern (e.g. alignment, intersections, road surface, visual aids, physical objects and others) while carrying out an audit. The *detailed checklist* contains two columns: one that displays the audit items, and other that provides key points to consider for each item when conducting the audit.

It is important to note that the checklists should serve only as a *guide* or *memory-aid* for the individual or the team conducting the safety audit. These are not all inclusive, nor shall it be used as a substitute for knowledge or experience. As such all the three stages of URSA are unique in nature, each require special attention for a variety of possible issues. For all the three stages of URSA, the checklists under both the heads are different and used as and when required.

The checklist includes general items like departure from standards, cross-sections, cross-sectional variations, drainage, landscaping, public utility/amenities, lay-bays, access to roads, provision for emergency vehicles, future widening, adjacent development; alignment criterion such as visibility, new and existing road interface, vertical alignment; provision for pedestrians, cyclists, signs, lighting, pavement marking, readability to drivers; pavement edge rounding, parking lots and on-street parking facilities. Also, many other decisive factors may also be covered under these checklists though the list does not prove to be exhaustive. All these items are checked for the schemes under audit to envisage the safety of road user. The findings may be reported and suggestive measures are evolved.

#### 5. CASE STUDY – “GAURAV PATH, SURAT”

Surat Municipal Corporation selected a segment on Surat-Dumas road to be developed as model road which has been named as “*Gaurav Path*”. Surat-Dumas road is located in the western part of the city. This road starts from Athwagate and reaches to Dumas which is a beach and recreational place for the city. Apart from this,

entire length of the road is under Surat municipal limits. Further, the road provides approach to many places of importance including many villages. A 2.6 Km stretch of Surat-Dumas road which is known as “*Gaurav Path*”; the road segment starts from Sargam Shopping Centre and ends up at Goverdhan Haveli which was the point of city-limits till July-2006. In between, the road provides approach to a few schools, S.V.N.I.T., Gardens, malls, public service buildings and facilities etc. Moreover, many residential complexes, commercial complexes, theatre, meeting places, hotels etc; are located on the road. The Surat-Dumas road is one of the major corridors from the west direction.

As per discussions with directives of Surat Municipal Corporation, it came to notice that people were using the road for recreation purpose previously, especially during weekends. All the traffic volume data show a drastic variation for the weekend traffic. As per them, there was no point justified to design the road taking into consideration the generation of traffic volume of weekends. Though the road was designed for 60 Mt of right of way and was including service lanes on both the parallel ends of the road.

There is no actual statistics available for Land-use structure. During the formal examination of the road, it was seen that the major portion of the road has been covered by buildings being used for commercial purpose. A number of Malls and shopping centres, podium towers with shops, hotels, theatre, private hospitals etc. are major among the road side development. Moreover, there are a few religious places also approaching the road. Three schools and a college are located on either side of the road segment. Public gardens and gathering halls were also traced on the road. And, there are a few residential buildings including bungalows, low-rise apartments and high-rise buildings as well approaching the road. Yet, major portion of the road is used for commercial activities. It is to note that there is no industrial establishment and storage house on the entire road. Surat Municipal Corporation has taken well care to restrict slums, as there was no slum pocket identified for the entire length of the road segment.

Surat-Dumas Road links various villages located at western part to the Surat city. In week days, generally traffic flow is less compared to weekend days as people rush to Dumas for recreational purpose. Moreover, people use service lanes and road width ends for picnic purpose during weekend days especially during evening hours. The road speed limit signed is 60 KMPH but very often the observed speed of vehicle higher than the posted one. This may be the prime cause of accident occurrence on this road. This road shares 2.5% of road accidents occurring in Surat city as per statistics of year 2006. Accident data as collected from Umra Police Station may be summarised as under.

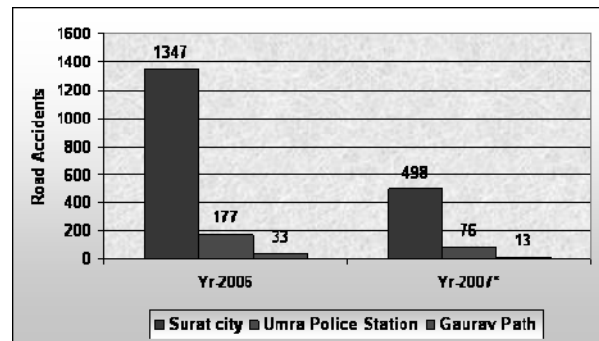
**Table 2 GAURAV PATH ROAD ACCIDENT DATA**

Type Year	Fatal	Grievous	Minor Injury	Total
2006	3 (9 %)	24 (72%)	6 (19%)	33
2007*	5 (38%)	5 (38%)	3 (24%)	13

\* indicates accident numbers up to May 2007 only

(Source: Compiled from records of Umra Police Station)

Surat-Dumas Road shares almost 19% of accidents occurring in limits of Umra police station i.e.; one fifth of the road accidents.



**Figure 5 ROAD ACCIDENT SHARE**

\* indicates accident numbers up to May 2007 only

(Source: Compiled from records of Umra Police Station)

It is to note that during year 2006, after commencement of road usage by people, more accidents begun to occur during night time. Share of accident at night was observed 58% and if the types of accidents are considered, night time driving leads to more grievous accidents. During discussions with police officials, it was commented by them that all the accidents which occur on road are not taken care of as a crime and many of such matters get resolved at the spot by the persons involved.

The entire road length is well covered with street light which are able to provide luminosity necessary for driving at night time, yet accidents are observed and the major cause might be the over speeding of vehicles.

The Surat-Dumas Road was opened for traffic in month of April 2006 and since then, accidents are occurring on this road. From the statistics mentioned in tables above, it is very well understood that the rate of accident occurrence is already considerably higher for five months of year 2005 when compared to a total of year 2006.

On the other hand, for entire length of road there is not a single point where any sort of zebra crossing or other road crossing facility for pedestrian is provided. With this fact, it can be said that the entire length is notably risky for accident occurrence involving vulnerable road users and vehicles moving with higher speeds. With a thorough examination of available

criminal records of Umra Police Station, a few accident prone locations were identified as shown in Table 3.

**Table 3 ACCIDENT PRONE LOCATIONS**

<b>Ichchhanath Intersection (Rotary)</b>					
Year \ Type	F	G	MI	Total	
2006	1	3	-	4	
2007*	1	1	-	2	

<b>Kargil Chowk (Rotary Intersection)</b>					
Year \ Type	F	G	MI	Total	
2006	1	5	2	8	
2007*	-	9	-	9	

<b>Vesu Patia (Near Big Bazaar)</b>					
Year \ Type	F	G	MI	Total	
2006	1	3	3	7	
2007*	-	1	-	1	

A URSA was performed based on above mentioned data. Also, available traffic volume data was referred prior to carry out the audit. The detailed design drawings were made available from the Surat Municipal Corporation. The URSA was performed comprising a comprehensive study using detailed drawings, numerous site visits and physical inspection during various hours i.e. day and night. The IRC codes were used as standard for reference and comparative suggestions.

URSA of Stage: 3 using checklists for 'Existing Roads' was performed on Gaurav Path. Initiating the examination of its location the basic study related to traffic volume, road accident occurrence rates and identification of accident prone locations etc. were performed.

After thorough study of road length, crucial issues were identified. After completion of the same, several field visits were conducted during day and night time at various hours. With the use of developed checklists, the road was examined and problematic locations were identified on map of the road design. After performance of audit, one would be able to comment that the road is well designed yet the design is lacking in many aspects as far as the road-user safety is concerned. At many locations, broken kerbs were found and observed to be unattended for repairing or maintenance.

Different categories of various checklists were applied and issues violating safety of road user was identified. Each such category had a suggestive elaborative list of possible issues. The location specific problems and a suggestive solution to each problem were provided with drawings and diagrams. More than a 100 locations were found to be prone to accidents in a

length of 2.4 Km stretch of the road. Recommendation to each specific problem was suggested with possible options if applicable. Negligence of road user safety is observed at large. Implementations of recommendations may safeguard the road users and bring the city roads a better tomorrow..!

## 6. CONCLUSION

RSA itself is proven to be a new approach in India to safeguard the highways and roads of national importance. At the same time, suggested URSA technique if implemented, it may show a drastic change in road accident scenario in urban centres of the country. It may happen that the suggestions and solutions provided in a URSA report prove to be a little costlier for the implementation. Well, the penny spent for the safety of road users has a lot more benefit which cannot be imagined as it directly relates with the human life. Awakening statistics and identified problems on Gaurav Path states that the urban roads which are well designed, yet these are disastrously lacking of safety aspects. A countrywide guideline for URSA shall be developed and implemented based on URSA technique discusses in the paper. Good urban roads are to facilitate the citizens and not a place to risk their lives.

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