

Road Safety Audit of A Urban Highway in Chandigarh at Post Construction Stage

Gurusewak Singh¹ and Dr. Umesh Sharma²

¹P.G. Student, Department of Civil Engineering, Punjab Engineering College
(Deemed to be University, Chandigarh, India)

²Professor, Department of Civil Engineering, Punjab Engineering College
(Deemed to be University), Chandigarh, India

E-mail: ¹gurri2593@gmail.com, ²umesh1651@gmail.com

Abstract—The incessant rise in the number of road fatalities and accidents has become a major concern in most parts of the world, with over 1.2 million deaths every year due to road crashes. In India, the number of registered vehicles has grown at a compound Annual Growth Rate (CAGR) of 11.07 percent from the year 1981 to 2014. This has further resulted in the increase of accident rate in the country which is about 10 % of the total road fatalities all over the world. According to the statistics of the year 2013, the reported road fatalities were 1.37 million which caused a loss of 3% of the country's GDP (Gross Domestic Product). Globally, many countries have recognized the severity of this problem and have undertaken various programs so as to reduce the causes and impact of accidents. Moreover, in more than 100 countries, 2011-2020 is planned to be a "Decade of Action for Road Safety", with a goal to prevent 5 million road accident deaths globally. The main aim of such programs is to reduce or eliminate the possible causes of road accidents. There are multiple factors which are responsible for the occurrence of a road accident, which includes weather conditions, behavior of road users and improper or faulty geometric design of the pavement. Thus, in order to reduce the causes or impact of accidents, there is a need to first identify the nature and behavior of accident to facilitate safety for the road users. Road Safety Audit (RSA) appears to be an ideal tool for this task. It is a process which studies the potential causes that are responsible for accidents, by conducting and gathering the relevant data through site inspection thereby improving the safety performance of the road. The present study aims to evaluate the safety parameters of a V2 road in Chandigarh by conducting a comprehensive Road Safety Audit (RSA) and suggests suitable preventive measures and improvements to be undertaken so as to reduce the extent and impact of the number of accidents.

Keywords: - Accidents, Parameters, Road Safety Audit (RSA).

1. INTRODUCTION

The efficiency of road networks in transportation system plays a vital role in the economic development of the country. According to statistics of 2014, USA has the largest road network worldwide, with India sharing the second position. The road transportation system occupies a dominant position in India as compared to other modes of transportation. The growing urbanization and population has further hiked the

urban travel demand in the country. This increase in the road users and number of vehicles has affected the rate of accidents throughout the country which is about 10 % of the total road fatalities all over the world (Gopalakrishnan, 2012). The global accident report by World Health Organization (WHO), indicate that the total number of deaths from road accidents has increased to 1.25 million in a year and the highest accident fatality rates are reported in the developing countries. According to the Ministry of Road Transport and Highways (MORT&H) in 2016, the country has recorded 0.45 million accidents, leading to 0.15 million deaths that is about 413 people died everyday in total 1317 road accidents. The severity of the accidents measured by persons killed per 100 accidents was recorded as 31.4 in 2016 as compared to 29.1 in 2015. In order to reduce these accident figures, every year, the country spends huge amount of resources to reconstruct and improve the road network. Also, many countries have started analyzing the road safety problems by ranking the dangerous sites and treating the roads, which are high on priority list. Globally, as a leader in road safety, International Road Federation (IRF) presented a methodology to reduce traffic injury risks by inspecting and auditing the various road parameters affecting accidents. Road Safety Audit is a formal methodology for independent appraisal of the accident potential and likely safety execution of a particular outline for a road or traffic plan - whether new development or a change to a current road. The procedure emphasis is laid on improving safety for road users. Road Safety Audit can either be carried to evaluate the safety of an existing road or an infrastructure or to spot the safety parameters of a proposed road network during the planning, design and implementation stages of the project. Often, the safety considerations are unseen during the planning of transport projects, later on proved to have high socio - economic costs. For example - death of an earning member of a household would impact his/her family in many different ways.

In 1980's the Road Safety Audit procedure started in United Kingdom and then was adopted by Australia and New Zealand

in 1990's (Peter Lougheed, 2016). In Denmark road safety audit is mandatory for all National roads. Road Safety Audits are commonly used in the United Kingdom and Australia, and are coming into wider use in the United States. These are necessary requirement for all highway road advance Schemes in the United Kingdom. The road safety condition in India is worsening when we compare it with other developed countries. The death rate per vehicle in India as compare to other countries like Japan, Sweden, Australia, United Kingdom, United States of America, Norway, Brazil, Mexico and Malaysia is 10 to 20 times higher.

Road Safety Audits differ from conventional traffic safety studies in two ways. Road Safety Audits are often pro-active investigations, rather than reactive investigations of sites with histories of complaints or pitiable safety performance of the road. Its investigation team is independent of the staff which is responsible for designing the project or maintains the road. A key feature of a Road Safety Audit is the use of a team of professionals with different expertise. The team includes highway safety engineers, highway maintenance personnel, and enforcement of law. Additional specialties are also added to the team as needed. The team members can have their own objective point of view because they are not involved in the maintenance and designing part. Furthermore, the authorities and engineers are now taking actions with a target of 50% reduction in the fatalities and 40% reduction in injuries by 2020 with the effective implementation of road safety audit. It gives a benefit cost ratio of 9:1, when we compare the Road Safety Audit with other traditional safety guidelines. The main differences between road safety guidelines and the new Road Safety Audit procedure are listed in the table below:

Table 1: Comparison between the Road Safety Audit and Traditionally Road Safety guidelines

Road Safety Audit	Traditional Road Safety Guidelines
<ul style="list-style-type: none"> It is performed by a team, which is independent of the project. 	<ul style="list-style-type: none"> Road safety review team is not independent of the designing team.
<ul style="list-style-type: none"> It is performed by multi expertise team. 	<ul style="list-style-type: none"> It is performed with the help of design and/or safety expertise.
<ul style="list-style-type: none"> It recognizes all the potential problems which affect the road users. 	<ul style="list-style-type: none"> It concentrates more on the motorized traffic on the road.
<ul style="list-style-type: none"> It accounts the capabilities and limitations of the road users, which are the important elements of the Road Safety Audit. 	<ul style="list-style-type: none"> It considers the human factors responsible.
<ul style="list-style-type: none"> A formal report is prepared. 	<ul style="list-style-type: none"> It does not generate a formal report.
<ul style="list-style-type: none"> Review is also done after the submission of report. 	<ul style="list-style-type: none"> No review of the report is done.

2. STUDY AREA

Chandigarh is the capital of North Indian states Punjab and Haryana. The geographical area of the city is 114 square Kms, out of which the total road length is 1536 Km. The master plan of Chandigarh as designed by Le Corbusier consist of 7 different types of roads known as 7Vs. These seven roads for the traffic circulation in the city are listed in the table 2. This integrated system of seven roads was designed to avoid any interruption in the traffic circulation within the city. However, over the last 10 years, the vehicular traffic has increased drastically which has further resulted in a remarkable increase in the accidents statistics in the city. Apart from this, there are other reasons such as inefficiency in geometric design, missing road markings etc, which have also contributed in the increase of accidents. Thus, there is a need to identify and analyze the possible causes of occurrence of the accidents.

Table 2: Types of roads in Chandigarh

Type of Roads	Functions
V1 Roads	These are the fast moving roads which connect Chandigarh to the other cities like Roopnagar, Ambala, and Panchkula.
V2 Roads	These are the arterial roads and which further connects with the V3 roads of the city.
V3 Roads	These are fast vehicular sector dividing roads. These roads does not have sidewalks, therefore does not have paths of direct access.
V4 Roads	These are meant for slow traffic, which gives access to the daily life services like shops, market, etc.
V5 Roads	These roads originate from V4's and circulate in the sector.
V6 Roads	These roads provide access to houses.
V7 Roads	These roads include foot paths and cycle tracks.

The area selected for the study includes a V2 category road of the city also known as the Madhya Marg having a total road length of 8.5 km. According to the accident data provided by the concerned authorities Madhya Marg was witnessed with the maximum number of accidents in 2014. The road stretch was divided into 4 sections and detailed investigation was done on each section to find the possible reasons for the occurrence of accidents.

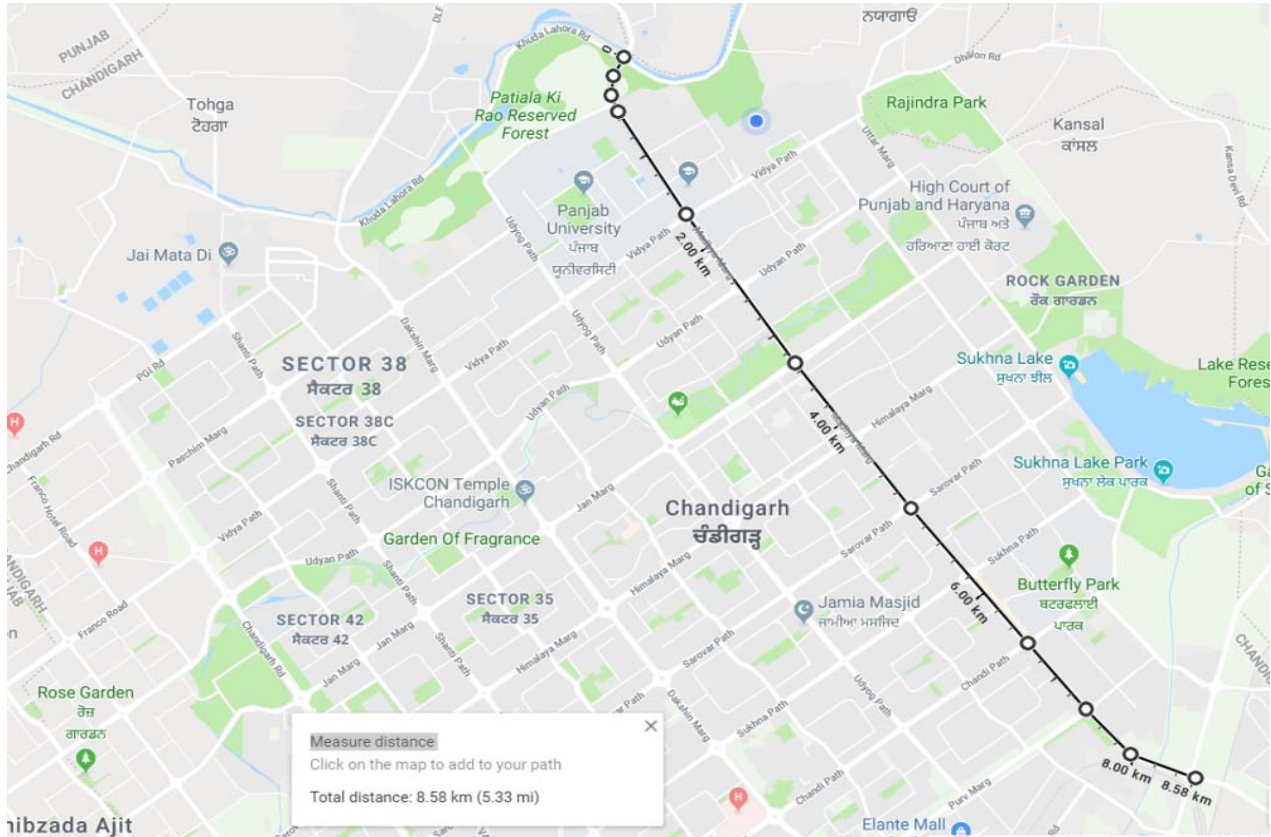


Fig. 1: Road selected for the study (8.5 km Madhya Marg)

3. METHODOLOGY

A Road Safety Audit (RSA) is a proven methodology for ensuring that various safety deficiencies and designs are reviewed at appropriate stage in a cost-effective way. Road Safety Audit includes some typical steps in the process.

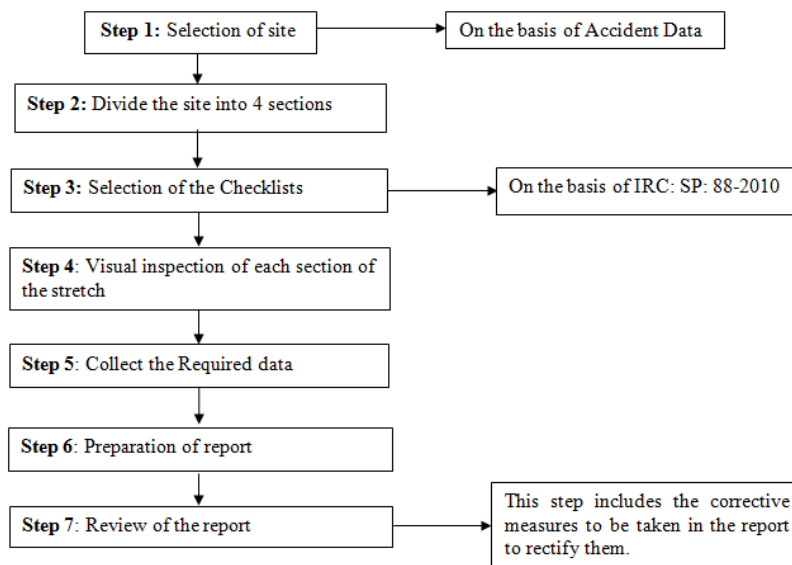


Fig. 2: Steps involved in the Road Safety Audit Methodology

Step 3.1: The first step in RSA is selection of site, which was done on the basis of accident data. The road network is made of different types of road carrying junctions and rotaries between them. The accident data including the information about the location, time and date of the accidents was collected for a period of 3 years from the concerned department (Table 3).

Table 3: Km wise distribution of accidents on Madhya Marg during 2014-2016

Distance	Accident	Injured person	Fatalities	Person Killed	Total	Percentage
0-2.4 km (Stretch 1)	02	06	00	00	08	7.62
2.4-4km (Stretch 2)	03	02	06	06	17	16.2
4-5.6km (Stretch 3)	02	02	00	00	04	3.8
5.6-8.48km (Stretch 4)	16	30	14	16	76	72.3
Grand Total					105	

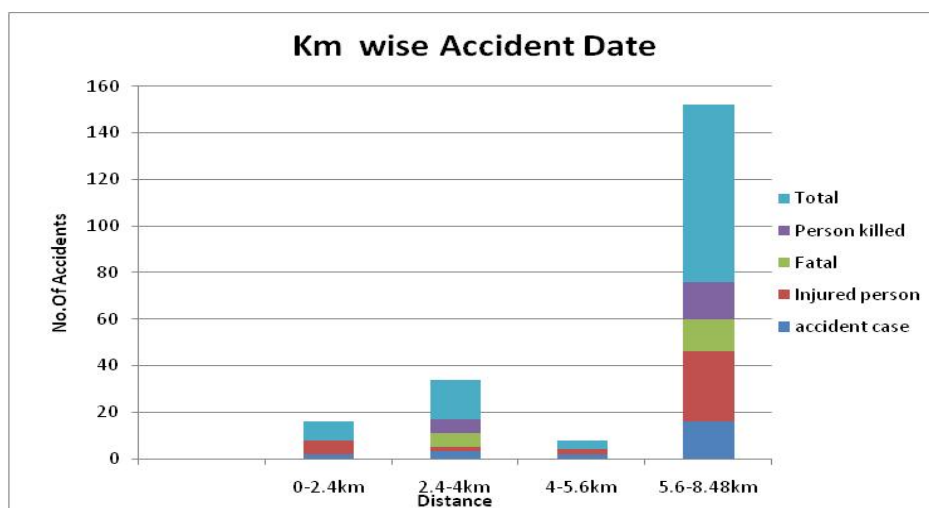


Fig. 3: km wise accidents from 2014 to 2016

Step 3.2: The selected road is divided into four sections to concentrate more on accident prone areas.

Step 3.3: From each section, data is collected with the help of different checklists. There are various checklists which are adopted for carrying out Road Safety Audit for different stages of the project with the help of IRC: SP: 88-2010. Checklist helps to inspect the geometric aspects and taking care of the signs and markings also. These checklists describe the problems and situations that can affect the road safety of selected types of project and the audit stage.

Step 3.4: After the selection of checklist, thorough inspection of the site was carried out, which includes the major and the minor defects responsible for the road crashes.




Step 3.5: The defects are noted by manually inspecting and on the basis of which data is collected which helps in the making of report. Collected data represented the portion of road which has maximum number of accident in the study and which is more prone to accidents.

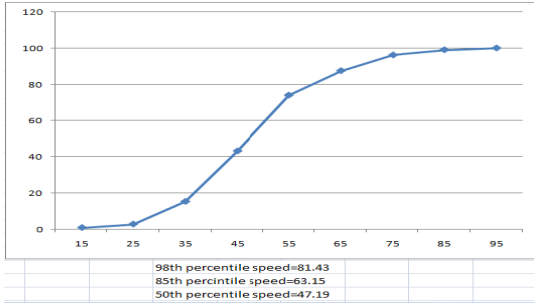

Step 3.6: Reports are prepared with the help of collected data. Report recognized and prioritized the issues of safety. Suggestions on the basis of identified safety issues, degree of safety risks can be reduced. With concise and precise brevity, the Road Safety Audit results are summarized in a formal report.

Step 3.7: Review of the report helps to unify the findings into the site when appropriate. Various corrective measures in the report are taken and rectified.

4. RESULTS

Table 4: Data collection and analysis

Aspect to be studied	Is it appropriate?	Remarks
Do plantations obscure visibility or the view of signs?	Yes	Some of the plantations were found to be improperly placed and were obstructing the view of road sign. 
Are the surface and carriageway markings in good condition?	No	Markings were found to be absent at some places these should be corrected as soon as possible as it helps to guide the user to be in a proper lane. 
Do the road users park in the ways that could constitute hazards?	Yes	For currently peak hour volume at some places parking of vehicles on carriageway leads to congestion problem leads to time delays. 

<p>Are the prevailing speed levels within Desirable limits?</p>	<p>Yes</p>	<p>85th percentile speed comes out to be 63 where the speed limit set for the road is 60 kmph therefore speed limits are desirable.</p> 
<p>Are all the locations free of construction equipment and any signing or temporary traffic control devices that are no longer required?</p>	<p>No</p>	<p>No cautionary signs have been provided, the road is still under construction at many points, there is debris that needs to be cleared off and at certain points, and temporary signs need to be installed.</p> 

5. CONCLUSION

A thorough inspection of selected road (Madhya Marg) was carried out using checklist 7 (Planning), checklist 8 (Alignment) and checklist 9 (Cross Section) as per IRC: SP: 88-2010. The keen observations from the investigation specify that, maximum number of accidents was found in stretch 4 that is from sector 26 to Kalagram lights. Although, there is no definite trend in accidents found throughout the years and it is difficult to explain a particular trend of accidents according to the given accident data. However, the stretch requires improvement in the geometric elements and pavement remarking. Carriageway markings and shoulder width plays a significant role in the movement of traffic on roads, as it helps to guide the user to be in a proper lane. Markings were found to be absent at some places and these should be corrected as soon as possible also it was observed that the width of the median is not adequate. Some of the plantations were found to be improperly placed and were obstructing the view of the road signs. Further, the spot speed studies as per IRC 106 were conducted and the 85th percentile speed was found to be 63 kmph which was same as the speed limit set for the road. Although, the present designed speed limits are desirable but there is need to take care, as it was expected to increase in the traffic volume.

REFERENCES

- (1) Bagi ,Arun S & Kumar, Dheeraj N, ‘Road Safety Audit’ , *IOSR journal of machanical and civil engineering(IOSRJMCE)* 2278-1684 Volume 1, Issue 6 (July-August 2012), PP 008
- (2)Jain,S.S,Singh,P.K.&Dr.Parida,M, ‘Road Safety Audit For FourLaneHighways’,*3rdInternational Conference on Road Safety and Simulation*, September 14-16, 2011, Indianapolis, USA
- (3) Deshpande,pawan, ‘Road Safety and Accident Prevention:A Review, *International Journal of Advanced Engineering Technology* E-ISSN 0976-3945
- (4) Rahoof, Abdul &,Singh, Bipin Kumar, ‘Road Safety and Road Safety Audit in India: A Review *International Journal For Technological Research In Engineering*, Volume 4, Issue 7, March-2017
- (5) K, Vignesh Kumar & Vijay, P., ‘Study on Road Safety Improvement in India *IJRET: International Journal of Research in Engineering and Technology*, ISSN: 2319-1163 | pISSN: 2321-7308
- (6) Federal Highway Administration. (2014). Road safety audit. [Online] Available: <http://safety.fhwa.dot.gov/rsa/> (October 15, 2014).
- (7)FHWA Road safety audit guidelines https://safety.fhwa.dot.gov/rsa/guidelines/documents/FHWA_SA_06_06.pdf
- (8)Kareem, A., ‘A review of the Global Menace of road accidents with special reference to Malaysia-A Social perspective, ‘*The Malaysian journal of Medical Science*’2003 Jul; 10(2): 31–39.

- (9) Gopalakrishnan S. A Public Health Perspective of Road Traffic Accidents. J.Family Medicine and Primary Care, 2012. Vol 1, Issue 2.
- (10) Peter Lougheed, Eric Hildebrand, Canadian Journal of Civil Engineering, 2016. Road Safety Audits and major P-3 freeway projects: estimating the reduction in collision frequencies. 43 (11), 977 - 985