Road Safety Audit of Accident Prone Locations in Bhopal City

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ABSTRACT

A Road Safety Audit (RSA) is a formal safety performance examination of an existing or future road or intersection by an independent audit team which considers the safety of all road users, qualitatively estimates and reports on road safety issues and opportunities for safety improvement.

The objective of the research was to conduct the Road Safety Audit (RSA) of accident prone zones of Bhopal city as per the guidelines of IRC SP 88:2010, "Manual on Road Safety Audit", and to suggest remedial measures for prevention of accidents at accident prone locations. This research has provided necessary suggestions and recommendations which will act as a guideline for road network planners and the authorities concerned with accident mitigation measures.

Keywords: Road Safety Audit, Accident Prone Locations, Accident Mitigation Measures

Introduction

Today road traffic injuries are one of the leading causes of deaths, disabilities and hospitalizations with severe socio-economic costs across the world. Rapid increase in vehicle ownership in India and specially in Madhya Pradesh State Capital Bhopal during the past 3 decades has placed considerable pressure on the road networks, their traffic and control devices, and on users of road facilities. Not only the number of accidents are increasing but also the number of people killed and injured in traffic crashes are also been steadily increasing. Thus, there is a need for the review of the causes of accidents by which deficiencies in road network could be found out and remedial measures could be suggested based on the outcomes of the Road Safety Audit (RSA).

Objectives

The various objectives of our project are as follows:

1) To review the relevant literature related to Road Safety Audit (RSA) in India and Abroad.

2) To conduct the Road Safety Audit (RSA) of accident prone zones in Bhopal city.

3) To suggest remedial measures for prevention of accidents at accident prone locations of Bhopal city.

Need of study

It has been estimated that about 1.7 million persons are killed and more than 15 million are injured every year in road accidents throughout the world. Almost 11% of the world's reported fatalities are due to road traffic accidents. The magnitude of road accidents and fatalities in India is alarming. This is evident from the fact that every hour there are about 56 accidents (about one accident every minute). Similarly, every hour more than 14 deaths occur due to road accidents i.e. one death in every 4 minutes.

Figure-1 shows the wide variation among cities in road accident parameters in terms of accidents per lakh of population (ranging from 19 in Kolkata to 205 in Bhopal),

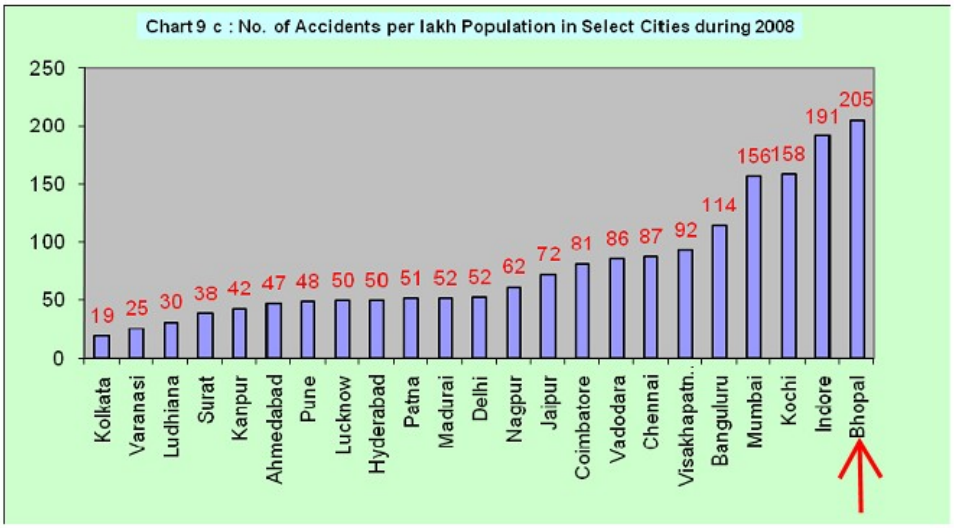

Figure-1 Number of Accidents per Lakh Population During 2008

(Source: - "Road accidents in India 2008", transport research wing, MORTH, India)

The numbers of accidents in Bhopal city are increasing consistently over the last few years as shown in the table given below.

Table-1 Road Accident Data of Bhopal City

S. No.	Year	Total No. of Accidents	Fatalities	Casualties
1	2005	2651	208	2571
2	2006	3409	184	2537
3	2007	3448	254	3163
4	2008	3554	279	3305
5	2009	3719	272	3152
6	2010	3653	270	2990
7	2011	3459	299	2970

(Source: Traffic Police, Bhopal)

The study of above data reflects the alarming accident rate in Bhopal. Hence it is imperative to assess the magnitude and dimensions of road accidents by conducting a proper methodological road safety audit in order to assess the roads from the point of view of safety of the road users, address the problems and provide the required necessary solutions, suggestions and recommendations in order to make the roads more safer and user friendly.

Literature Review and Case Studies

Manual on Road Safety Audit, IRC: SP: 88 – 2010, Road Safety Audit is a formal procedure for assessing accident potential and safety performance in the provision of new road schemes and schemes for the improvement and maintenance of existing roads. Specific aims of RSA are:

1. To minimize the risk of accidents
2. To recognize the importance of safety in highway design to meet the needs and perceptions of all types of road users.
3. To reduce long term costs of project facility, bearing in mind that unsafe designs may be expensive.
4. To increase awareness about safe design practices among all those involved in the planning, design, construction and maintenance of roads.

Asian Development Bank, Manila (June 2003), The RSA is a systematic procedure that brings traffic safety knowledge into the road planning and design process to prevent traffic crashes. The RSA is a formal systematic road safety assessment or "checking" of a road or a road scheme. The RSA can be applied to all kinds of road projects—new road construction as well as rehabilitation of existing roads. The potential benefits are:

(i) savings in time and cost by changing project details at the planning and design stage;

(ii) reductions in the number of accidents and the consequent savings in road accident-related costs; and

(iii) reductions in possible litigation costs

Case Study: - 1 Illinois Department of Transportation:

RSA of Clear Lake Avenue and Dirksen Parkway

Project: Improvements to roadways and intersections in a commercial area adjacent to an interchange

Project Background: Clear Lake Avenue connects the I-72/I-55 interchange east of Springfield, Illinois, with downtown Springfield. Dirksen Parkway intersects Clear Lake Avenue just west of the interchange. The key findings and suggestions of the RSA are:-

Selected Safety Issue	Suggestions
The new signalized hill street will be 650 feet from Clear lake and Dirksen Parkway.	• Co-ordination of adjacent signals • Signing and signal junctions
Realigned hill street can be expected to accommodate commercial driveways located on back to back horizontal curves	• Raised medians to restrict left turning • Inclusion of service Roads
Queued, turning and parking vehicles at clear lake avenue and the south service road may interfere	• Restricted turning movements • Relocation of service road intersection
Opportunities for interim improvements	• Improved pedestrian facility • Improved signals at raised medians

Case Study: - 2 Yellowstone National Park: RSA of Old faithful Area

Project: Replacement of existing interchange with new access

Project Background**:** The Old Faithful area is a popular destination within the Park. Peak visitor months accommodate an average daily traffic volume of about 6,000 vehicles**.**

The focus of the RSA was the existing Old Faithful Road between the Old Faithful interchange and the geyser site, including the geyser parking area. The key findings and suggestions of the RSA are summarized in Table

Selected Safety Issue	Suggestions
Issues with 2B	
• Driver unfamiliarity	• Signing
• Traffic volume spikes	• Appropriate design vehicle
• Downhill approach	• Anti-skid pavement
Issues with 8/8A	
• Short weaving segments	• Grade separated ramps
• Limited sight distance	• Control of roadside vegetation
Pedestrian Conflict	• Parking Restrictions
• In Parking areas	• Raised crosswalks
• At cross walk	• Lighting

RSA and its Methodology

A Road Safety Audit (RSA) is a formal safety performance examination of an existing or future road or intersection by an independent audit team. RSA is a proactive, low-cost approach to improve safety. RSA helps to develop a number of solutions incorporating measures that were not originally included in the projects.

The typical methodology of RSA adopted is as follows:

Step-I Review of literature
Step-II Collection of accident data and its study
Step-III Identification of road-in-service to be audited
Step-IV Performing field observations under various conditions.
Step-V Preparation of formal questionnaire and interviewing various road users
Step-VI Conduct audit analysis and prepare report of findings

Study Area

This work is mainly into two study areas:
1. Hoshangabad Road, (Regional research laboratory to Misrod)
2. Raisen Road, (Jinsi trisection to Bhanpura over-bridge via Piplani)

RSA-1 Hoshangabad Road

Project: - Road Safety Audit of Hoshangabad road from Regional Research Laboratory to Misrod.

Project Environment: Sub-urban Project
Design Stage: Preliminary (40 to 80%)
RSA Stage(s): Under construction Stage.
Name of Road: Hoshangabad Road
Number of Lanes: 6 Lanes, 2 Way Road
Type of Road: National Highway 12 (Jaipur –Jabalpur)
Length of Study Area: 6.2 km

Project Background: The road is in under-construction stage under Jawaharlal Nehru National Urban Renewal mission (Jnnurm) scheme. The road connects important industrial area "Mandideep" to the city and recently a number of malls, residential areas and educational institutes have been developed along the way. During last few months the construction of Bus Rapid Transit System (BRTS) on the road has resulted in number of accidents and consequent fatalities. The key findings and suggestions of the RSA are summarized in Table: 2

Table: 2 SUMMARY OF SELECTED SAFETY ISSUES AND SUGGESTIONS

S. No.	Selected Safety Issue(As per IRC: SP 88, 2010)	Suggestions	Remarks

1.	No Advance information regarding approaching construction zone	• Approach transition zone should be provided • Advance warning signs should be installed at-least 50 m before the hazardous location.	Refer appendix, fig.2,IRC:SP 55-2001 and IRC 67-2001
2.	Inappropriate location of bus-stops and inadequate clearance from traffic lanes	• Bus-stops should at least 75m away from junction influence area • Bus-bays should be provided.	Refer IRC: 86
3.	No Street Lighting hindering night time visibility	• Adequate street lighting of sufficient intensity should be provided. • Additional lighting (such as halogens) should be provided at work zones	Refer appendix figure 3
4.	No buffer zone(width between work zone and moving traffic) is provided	• Longitudinal buffer of 1.5m and • Lateral buffer of 0.5m should be provided	Refer IRC:SP 55-2001
5.	No provision of marked lanes for safe and clear guidance of traffic	• Provide White lines of 15cm width at places where there is no median • Provide Broken single white lines of width 10cm and length 3m to divide	Refer appendix figure 3 and IRC:35-1997

		carriage way	
6.	Inadequate traffic control devices	• Reflectors, Delineators, Cat eyes • Traffic sign boards are required	-
7.	No provision for pedestrians and non-motorized traffic	• Foot-over bridges • Zebra crossing should be provided	Refer appendix, fig.5
8.	No personal protective equipments provided to workers	• Helmets, hand gloves, reflective jackets etc. must be provided to workers	Refer appendix, fig 4 and IRC:SP 55-2001
9.	Lack of speed reducing measures at work zones	• Speed Limit sign boards • Speed brakers	-
10.	Uncontrolled access points	• Speed brakers should be provided at minor roads • Wherever possible access should be minimised	-

RSA-2

Project: - Road Safety Audit of Raisen road from Jinsi to Bhanpura over-bridge via Piplani.

Project Environment: Urban
Project Design Stage: Preliminary (40 to 80%)
RSA Stage(s): Existing Stage.
Name of Road: Raisen Road

Number of Lanes: 4 Lanes, 2 Way Road
Type of Road: National Highway 86 (Kanpur-Dewas)
Length of Study Are: 13.2 km

Project Background: The road connects old Bhopal city with Govindpura industrial area and Ayodhya by-pass. It is a densely populated area having high volume of mixed traffic. The Ayodhya Bypass has recorded the most number of accidents over the last few years. The key findings and suggestions of the RSA are summarized in Table: 3

Table: 3 SUMMARY OF SELECTED SAFETY ISSUES AND SUGGESTIONS

S. No.	Selected Safety Issue(As per IRC: SP 88, 2010)	Suggestions	Remarks
1.	Poor surface and carriage way markings	• Provide necessary markings such as edge marking, centre line marking, object marking etc.	Refer IRC: 35-1997
2.	Inadequate street lighting	• Adequate number of street lights should be provided • High mast lights should be provided at junctions	-
3.	Inappropriate width of medians and markings	• Minimise median openings. • Medians should be marked with alternate white and black strips with retro-reflective paint	IRC:35-1997
4.	General layout of junction does not caters safety for all road users	• a rotary is required at Ayodhya junction and ITI intersection	Refer appendix, fig.6 and

	(ITI Trisection, Ayodhya Junction)		IRC: 86-1
5.	Presence of petrol pumps at junctions	• Relocate the petrol pumps	Refer "manual for safety in road design"
6.	No satisfactory provision for parking	• Proper off street parking should be there • Prohibit on-street parking	Refer appendix, fig.7
7.	Activities beside road to distract drivers	• Remove Hoardings distracting the concentration of drivers • Create hawkers point	Refer IRC:SP-88-2010
8.	Improper location of bus-stops	• Bus-stops should at least 75m away from junction influence area • Provide proper bus-bays	Refer IRC: 86
9.	Poor condition of traffic signs	• Traffic signs should be of proper standards	Refer IRC:35-1997
11.	No adequate provision for pedestrians at hazardous places	• Provide foot over bridges, pedestrian signal and subways at hazardous places	Refer appendix, fig.8
12.	Cyclist are forced to ride on main carriage way	• Separate lane of 2.0m should be provided or • Service road of minimum	Refer IRC: 86

		5.5m should be provided	
13.	Non-functioning traffic signals	• Install new signals with proper synchronisation • Mount over-head signals	Refer appendix, fig.9

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Appendix

Figure-2 No advance warning signs

Figure-3 No Street lighting and markings

Figure-4 Workers with no protective equipments

Figure-5 Cyclists forced to move on main carriageway

Figure-6 Conflicting Situation due to improper layout of ITI intersection

Figure-7 Haphazard on-street parking

Figure-8 Pedestrians crossing in unsafe Environment

Figure-9 Non-functioning traffic signals

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