

MODELING ACCIDENT PREDICTION USING ROAD GEOMETRICS FROM ROAD SAFETY AUDIT

Ishan Ranadive¹ , Nikhil Pitale²

¹ Civil Engineering Department, G.H. Raison College of Engineering, Nagpur, (India)

² Assistant professor, Civil Engineering Department, G.H Raison College of Engineering Nagpur, (India)

ABSTRACT

Plying on the road is a multitasking activity that requires road users to manage their attention between various driving and non driving tasks. Inappropriate road geometrics or inappropriate design may lead to road crashes which increase chances of injury or death. To reduce this risk and to attain sustainable safety, road safety audit can play a pivotal role. Road safety audit comprises of independent assessment of design and various other parameters. This paper discusses the need for Road safety audit and the methodology involved.

Keywords: Road Safety Audit, Transportation System , Highway Geometrics

I INTRODUCTION

Transportation system has brought about a revolution in the contemporary economic and social relations. However as every coin has two sides, road accidents have become a matter of concern now-a-days. India being a low income, developing country is going through a phase of rapid and unplanned development. One of the major challenges that India has to face is that of road safety. India has the highest number of road traffic fatalities in the world. Hence for a better and safer system road safety audit is a necessity. Road safety audit is a formal procedure for independent assessment of the accident potential and likely safety performance of a specific design for a road or traffic scheme whether new construction or an alteration to an existing road. It is therefore necessary to give increasing attention to the operational characteristics of highway transportation and study the need for better geometric design, capacity, intersections, traffic regulations, signals, traffic signs, roadway markings, parking facilities and design of street lighting. The main idea of road safety is making the road transportation system for the users in the most efficient way without compromising the performance of the system. . Cause of accidents can be well understood with the help of proper auditing of road, which can provide clues to many factors of road accidents.

II NEED FOR STUDY

As per the National Crime Records Bureau (NCRB), in the year 2013 there were 4,43,001 road accidents resulting in the death of 1,37,423 people(alarming 15 deaths an hour) contributing to 36.4% share of Road

Accident Deaths in Un-natural Total Deaths. The “Savelifefoundation” estimates that road accidents are now the leading cause of death for Indians in the 15-40 age group and that these deaths shave off 2.5 percent of India’s annual GDP. 10% of the global accidents occur in India, in terms of absolute numbers more people die in road crashes in India than anywhere else in the world. Basic traffic rules on road like Lane Discipline, Overtaking, Speeding, Acceleration/Deceleration, U-Turns, Stopping/ Parking, Driver Signals, Night Driving, Mirrors, Tailgating etc are not adhered to by Indian road user

Road Safety is the product of a complex system that involves interactions among the vehicle, the environment and the road user. Advanced road and traffic engineering, traffic legislation, driver training, traffic enforcement and post crash management are the various ways to improve the system. Thus Road Safety Audit is the need of the hour as it paves a way for safe and superior traffic conditions in the years to come.

III OBJECTIVES OF THE STUDY

1. To minimize the number and severity of accidents that will occur on the new or modified road.
2. To identify any aspects of a highway design which gives rise to safety issues.
3. To suggest reforms in the design to enhance road safety issues.
4. To design a model based on auditing data for predicting accidents.

IV METHODOLOGY

4.1 Triggering the Audit

The National Highway Authority Of India (NHAI) will routinely mandate an RSA. However it can be done by Asian development bank or the designer itself. If there is competent staff within the organization, they themselves can undertake the audit. The designer might also float a tender and appoint a specialist consultant or an independent engineer for the same.

4.2 Procurement of the Project Details

The auditor must procure all necessary details of the project from the designer or the authority which is initiating the RSA. It must include the expediency report, designs and drawings.

4.3 Scrutiny of the Details

The auditor scrutinizes the project details and issues a pilot estimate of the safety concerns. Some preliminary talks with designers during the onset of meeting can help interpret reasons for particular design decisions and allow the auditor to explain his role and the audit process.

4.4 Pursuing the Audit

The auditor goes through the details using apt schedule. This is followed by site visit wherein he identifies the safety concerns and suggests their solutions. An official report is documented about the audit findings and forwarded to the designer or client. The auditor need not provide elaborate designs. However he should give precise instructions about what needs to be done. Some appropriate diagrams, sketches, and illustrative copies of

plans can be included in the report.

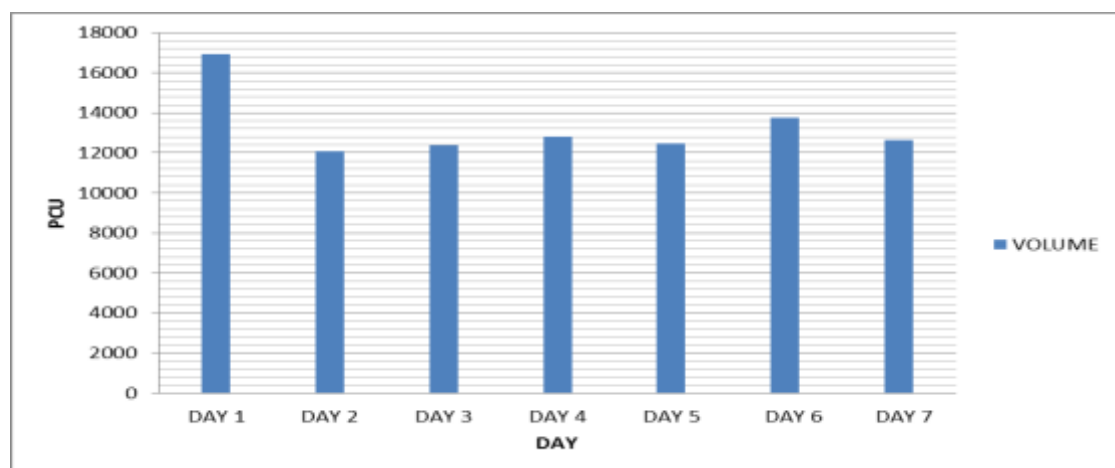
4.5 Finalization

After retrospection of the report , the auditor should understand the recommendations to apply and point out those that are tough to implement. After this the designer and auditor should meet to clarify all issues to both parties satisfaction. All unresolved issues are brought to the notice of the client and he takes the final decision pertaining to them. The designer then explains and registers any changes to the project and the audit is then complete. The recommendations made and agreed changes are rechecked at the commencement of the next stage of the RSA.

V DATA COLLECTION

Traffic data such as traffic volume count, geometric parameters of highway along with accident analysis data have been collected for the study. Project stretch is from Mahalgaon to Boregaon on NH 6.

Traffic Volume Count



Accident Data

Year	No. of accidents	Deaths	Injuries
2011	105	65	101
2012	65	64	89
2013	63	36	76
2014	59	40	73

VIEQUATIONS FOR MODELING

During data collection the number of accidents in a year were acquired from accident analysis data. These accidents depend upon various geometric parameters of the road. For this study we have considered lane width,

horizontal alignment and vertical alignment as the pivotal parameters which have a direct relation with number of accidents happening on the road. Hence we formulate the following equation.

$$A_1X_1 + A_2X_2 + A_3X_3 = D$$

Where

X_1 = horizontal alignment

X_2 = vertical alignment

X_3 = lane width

D = no. of accidents

A_1 , A_2 , A_3 are constants and their value is calculated using regression analysis.

As we have accident data available for last 4 years, we can generate 4 such equations. The horizontal alignment (X_1) is calculated as follows

$$X_1 = \frac{R_1 * L_1 + R_2 * L_2 + \dots + R_n * L_n}{L_1 + L_2 + \dots + L_n}$$

Where R = radius of curvature

L = Length of curve

The vertical alignment X_2 is given as

$$X_2 = \frac{K_1 * L_{c1} + K_2 * L_{c2} + \dots + K_n * L_{cn}}{L_{c1} + L_{c2} + \dots + L_{cn}}$$

Where k = rate of vertical curvature

L_c = length of curvature

The value of lane width was taken as per road conditions for a particular year. Now the 4 generated equations are

$$A_1 * 8 + A_2 * 7 + A_3 * 3.5 = 105$$

$$A_1 * 5 + A_2 * 4 + A_3 * 7.5 = 65$$

$$A_1 * 4 + A_2 * 3 + A_3 * 7.23 = 63$$

$$A_1 * 3 + A_2 * 5 + A_3 * 7.23 = 57$$

Now the above equations are analysed using regression analysis and the values for constants are found.

The equation below obtained after regression can be used to find out number of accidents if the geometric parameters are known

$$4.60X_1 - 0.69X_2 - 7.068X_3 + 97.77 = D$$

VII. CONCLUSION

The objective of the paper which was to correlate the road geometrics with road accidents has been fulfilled. Highway safety depends upon many factors of traffic conditions. Safety on the highways is also dependent on geometric design. As the relationships between highway safety and road geometric design elements are considered some relationships can be seen intuitively at a first approach. However, the important point is to determine the level of these relationships quantitatively. Although the relationships generally show the same tendency, their levels vary according to each country's characteristic conditions. Given India's current traffic scenario, Road safety audit is a necessity and not just an option. It is the responsibility of each and every individual to contribute in educating road users about correct practices for enabling a safe system for oneself and others.

VIII. REFERENCES

- [1] BAGI A S. et.al (2012) "Road Safety Audit", IOSR Journal of Mechanical and Civil Engineering (IOSRJMCE) ISSN : 2278-1684 Volume 1, Issue 6 (July-August 2012), PP 01-08.
- [2] Jain S S. et.al (2011) "Road Safety Audit For Four Lane National Highway", 3rd International Conference on Road Safety and Simulation, September 14-16, 2011, Indianapolis, USA.
- [3] Chandrasekran S. et.al (2004) "Safety Assessment Model And Metrics For Accidents In Road Transport System".
- [4] Jinhua Tan et.al (2008) "Rural Road Safety Audit In China".
- [5] Landge V. et.al (2013) "Identifying Accident Prone Spot on Rural Highways - A Case Study of National Highway NO.58", International Journal of Chemical, Environmental & Biological Sciences (IJCEBS) Volume 1, Issue 2 (2013) ISSN 2320 -4087.
- [6] Varkadi S. et.al (2013) "Road Safety Audit On A Major Freeway: Implementing Safety Improvements". Springerlink.com
- [7] Toledo Tomer (2006) "Driving Behaviour: Models and challenges" Transport Reviews (2006)