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ROAD SAFETY AUDIT OF STATE HIGHWAY- 27

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Abstract: ***Road Safety Audit (RSA) is a formal examination of proposed or existing roads and road related areas from the perspective of all road users with the intention of identifying road safety deficiencies and areas of risk that could lead to road crashes. Road Safety Audit (RSA) is formal and independent safety performance review of a road transportation projects by an experienced team of safety specialists, addressing the safety of all road users. Road Safety Audit helps in reducing the number and severity of crashes. It also helps reduce costs by identifying safety issues and correcting them before projects are built. This State Highway 27 originates from Jhalawar (Rajasthan) passes through Ujjain (Madhya Pradesh) and ends at Malkapur Maharashtra and covers the length of 387 km approx.***

The State Highway-27 was two –lane highway but with the requirement of time it was converted into Six-lane Highway. The section which comes under the research is Indore-Ujjain Highway from Luvkush Square to Shri Vaishnav Vidhyapeeth Vishwavidhyalaya Indore, Madhya Pradesh. This national highway is maintained and operated by National Highway Authority of India (NHAI) and Madhya Pradesh Road Development Corporation (MPRDC). The identification of the critical section has been taken place on it. The study will be identifying the defects of the roads and will give the better idea about the defects .In this study the crashes reduction factor and crash modification factor will be found to know the actual condition of the section.

Keywords: Road Safety Audit, Crash Reduction Factor, Crash Modification Factor

I. INTRODUCTION:

Road crash scenario on the Indian roads continues to account for the highest fatalities in the world.
A total of 4,64,910 road accidents have been reported by States and Union Territories (UTs) in the calendar year 2017 claiming 1,47,913 lives and causing injuries to 4,70,975 persons. These figures translate, on an average, into 1274 accidents and 405 deaths every day or 53 accidents and 17 deaths every hour in the country. According to data published by Ministry of Road Transport and Highways (MoRT&H) Government of India, the state of Madhya Pradesh recorded the maximum number of road deaths (53,399) and it continues to occupy the dubious distinction of being in top 3 road crash prone states in the country (MoRT&H Statistics 2017). The share percentage of Madhya Pradesh is 11.5 % of accidents in India. The situation is well recognized by all state governments and individual states are embarking upon road safety audit of their road network.
Road Safety Audit (RSA) is a formal examination of proposed or existing roads and road related areas from the perspective of all road users with the intention of identifying road safety deficiencies and areas of risk that could lead to road crashes. State Highway No.27 **(shown in Fig. 1)** is a Six lane divided Highway connecting Jhalawar in Rajasthan, Ujjain in Madhya Pradesh and Malkapur in Maharashtra , the two major residential cum industrial/commercial township developments located on this road in Madhya Pradesh. Since this section gives the rapid growth to the state which is important. But, the focus of the study is Indore-Ujjain Highway-Luv Kush Sqaure to Shri Vaishnav Vidhyapeeth Vishvavidhyalaya Indore, Madhya Pradesh This Paper presents the outcome of the study on change in traffic accident scenario on the State Highway.

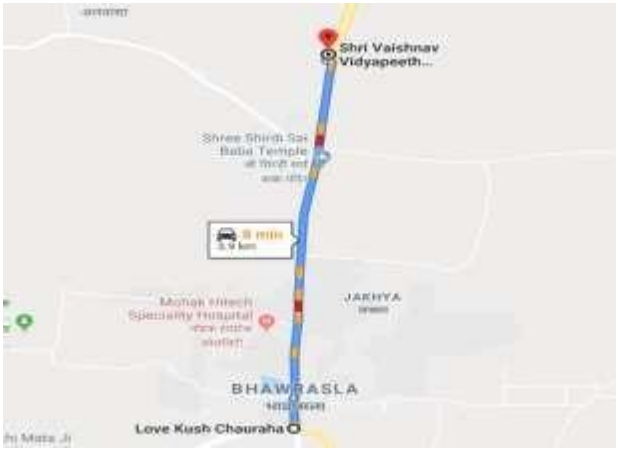


Fig 1: Location map of proposed area under study

II. DATA COLLECTION:

The accident data collected of the selected highway from respective police stations. The accident data collected for a period of four years from 2014 to 2017 of Madhya Pradesh .The accident should be reported to police authorities who would take legal actions especially in more serious accidents involving injuries, casualties or severe damage to property. The data has been collected from Banganga Police Station of the section from Luvkush Square to Shri Vaishnav Vidhyapeeth Vidhyalaya from 2015 to 2019 this section is consisting of the Universities , Colleges, Toll Plazas etc. on it.

Fig.2 Number of Road Crahes In Madhya Pradesh State

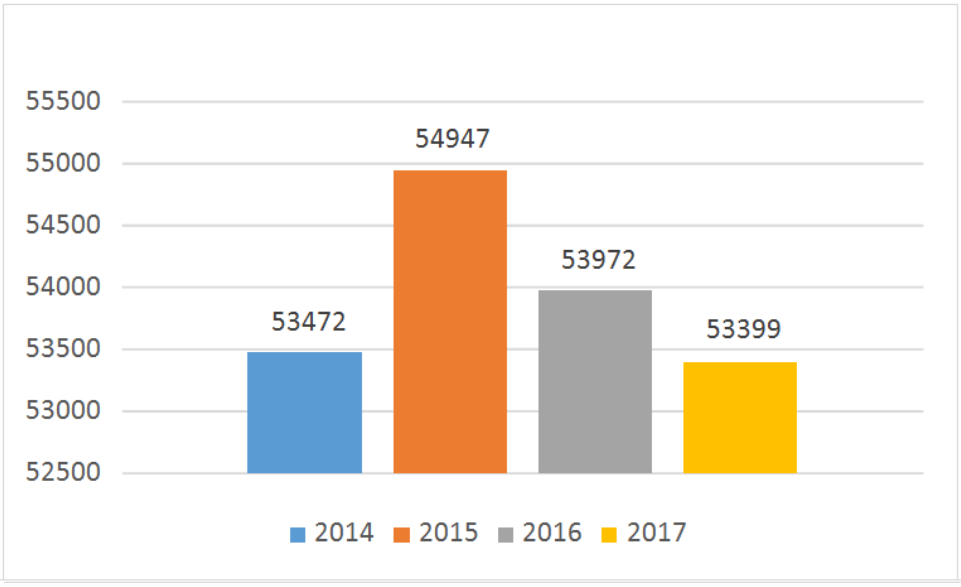
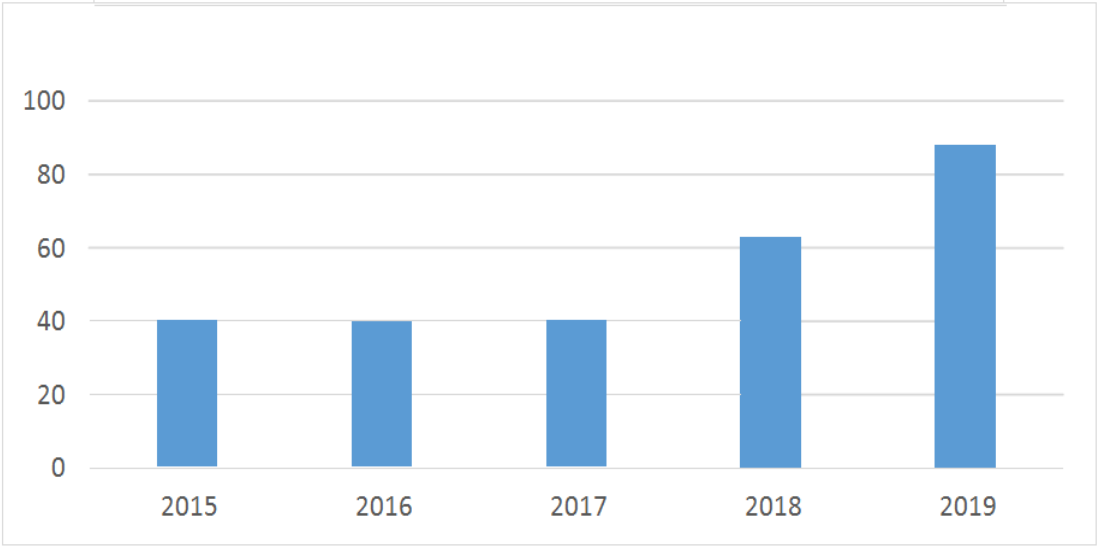


Fig. 3 No. of Accidents on this section from 2015-2019 up to date



Note: In above table data available is of 2019 and remaining data has been predicted by multiplying three times as in the year 2019 is 8 Month remained.

III. PROFILE OF ROAD SAFTY AUDIT IMPLIMENTATION SCENARIO:

Several safety associated recommendations were implemented on the study corridor conforming to the RSA recommendations. Some of the typical scenarios has been briefed below:

3.1 Implementation of Safety Recommendation: RSA was conducted as per the procedure given in IRC:88-2010. Some of the observations made are given below:

(a) In the below Image you can see the Luvkush Square is the one of the busiest square of Indore. This Square is the main Junction of the Ujjain road. As you can see this square is Un-channelized Square and not having proper facilities on it which is very dangerous for the road user. On this square no signatory boards are situated on it for proper guidance to the road user.

Fig 4. Condition of Luvkush Square

(b) In the below picture this is Aurbindo Hospital Square which is the semi-government hospital and the group of colleges too. On this square you can see that this Non-signalized Section and near to this Square the small-scale business are also in the working condition and acquiring the space of which is for the road user. The Information Signatory are present in well manner. On this section the near to the state highway the population of area is high according to the area and no bus lay are constructed so the congestion is been created on it.

Fig 5. Condition of Aurbindo Hospital Square

(c) This is the picture of Bhawarsala Square which is Un-Signalized Square. On the left side the road subsidiaries which connects to Bhawarsala Village. This Bhawarsala Village is consisting of the Sand mines in it. On this Square the Petrol Pump is situated and the in 5 Km radius no any other petrol pump is situated so it makes this petrol pump precious for vehicular user.

Fig 6. Condition of Bhawarsala Square.

(d) This is the Picture of the section between the Bhawarsala Square and Raoti Range (BSF) Training Centre. This section consist of the many visible defects on the road. This section of the road doesn't have the marking on the road by which it don't confirms the number of lanes on the road. As in the picture you can see that the rutting is main problems on the side of the very dangerous for the road user. On this section the Oriental University Entrance get is situated where the U-turn is not provided on it, so the students and staff members mainly choose the wrong side to travel to reach to the university.

Fig 7. Condition of road in front of Raoti Range (BSF) Training Centre

(e) This is the picture of the section between the Alwasa Square to Baroli Toll Plaza. This is having the road marking on it but this square is not consisting the Signal on it this makes this square un-signalized. On this Square one Industry is situated and many warehouse are also has been constructed on it. On the left side the approach road is for the village Alwasa and the square. At the night time no lightning has been provided on the Square.

Fig 7. Condition of road on Alwasa Square to Baroli Toll Plaza.

(f) This section is from Baroli Toll Plaza to Shri Vaishnav Vidhyapeeth Vishwavidhyalaya U-Turn. Baroli Toll Plaza is one of the accident prone area declared by the government because of the lack of amenities. This section is one of the Un-Channelized Section because lack of presences of signal. On this road many defects has been noticed of the road, the longitudinal cracks has been noticed on road. Rutting is the main problem on this road. In this section the land acquisition on the peak level by local peoples.

Fig 8. Condition of road on Baroli Toll Plaza to Shri Vaishnav Vidhyapeeth Vishwavidhyalaya U-Turn.

IV. IMPACT OF SAFETY IMPLIMENTATION:

The parameters evaluating the impact of Road Safety Audit implementation included the simplification of traffic flow, number of road crashes, and the severity of road crashes before the implementation of road safety audit and to check the road safety audit has been implemented in the proper manner or not. In this regard the duration of data collection has been taken of 4 years.
The road crash data (FIRs) were collected from respective (Banganga) police station along the study of the section. The summary of road crashes on the study corridor is presented in Table 2.

Fig 9.Total Number of road crashes

Year	Total Road Crashes
2015	41
2016	38
2017	41
2018	63
2019	88
Total	271

V. EVALUATION OF CRASH REDUCTION FACTOR (CRF) AND CRASH MODIFICATION FACTOR(CMF):

Crash Reduction Factors (CRFs) are used in road safety studies to predict safety benefits due to reduced number of crashes. FIR Report 271 emphasises the necessity of the CRF studies. A Crash Reduction Factor (CRF) is the percent crash reduction that might be expected after implementing the road safety audit .Before-and-after method is used for calculating the CRF. In this method; the effects of interventions on safety are determined by number of crashes occurred on the section. The methods of estimation of CRF are discussed below in detail in the subsequent sections.

(a) Method-1: CRF by Number of Crashes

This method is simple for calculating the crash reduction factor for the safety improvements of a study area. It help to check the road safety audit is been successful or not .The formula used for calculating the crash reduction factor is as follows:

$$CRF = 1 - \frac{N_a}{N_b}$$

N_a = Number of road crashes after implementation N_b = Number of road crashes before implementation

(b) Method-2: CRF by Exposure of Crashes

Crash Reduction Factor is based on the assumption that if nothing has changed, the crash experience before improvement is a good estimate of what would have happened during the after period without improvement (Albert Gan,2005). The basic formula for deriving a Crash Reduction Factor in actual application, exposure to crashes is often considered in

order to account for any changes in crash exposure that may have occurred between the before and after period. According to this, the Crash Reduction Factor is calculated based on crash rates of the section which is derived by the study.

$$CRF = \frac{(CR_b - CR_a)}{CR_b} = 1 - \frac{CR_a}{CR_b}$$

CRa =Crash rates at a treated site before and after improvement. CRb = Crash rates at a treated site before and after improvement.

$$\text{Crash Rate} = \frac{Total\ Number\ of\ crashes}{Exposer}$$

$$\text{Exposure} = \frac{(Total\ kilometers) * (No.of\ days) * (Mean\ AADT)}{1{,}000{,}000}$$

$$\text{Mean AADT} = \frac{Sum\ of\ AADT\ from\ each\ crash}{Total\ no\ of\ Crashes}$$

AADT = Annual Average Daily Traffic

(c) Impact of RSA on Crash Reduction

The crash reduction factors calculated by two methods are given above**.** The crash reduction factors values using method-1 are constantly lower than those calculated by method-2. It is due to the number of parameters considered in two methods while calculating the crash reduction factors. Method-1 applied on number of road crashes in before and after implementation, while method-2 considers parameters like traffic volume and exposure. Therefore method-2 provides more realistic and higher values of crash reduction factor.

Example: If Crash Reduction Factor (CRF) for total road crashes is computed as 0.84 which indicates that the total crashes have exhibited 84 percent reduction after the implementation of Road Safety Audit recommendations. At the same time, Crash Reduction Factor values for fatal road crashes or persons killed was found to be 0.91, which implies that the fatal crashes exhibited a significant reduction trend of 91 percent. The Crash Reduction Factor value for persons injured has registered a negative sign which indicates the increase in number of persons injured. This was the techniques that how to read the sheet of Crash Reduction Factor.

(d) Crash Modification Factor

A Crash Modification Factor (CMF) is a multiplicative factor used to know the expected number of crashes after implementing a given measure at a specific section. The main difference between Crash Reduction Factor and Crash Modification Factor is that Crash Reduction Factor provides an estimate of the percentage reduction in crashes, while Crash Modification Factor is a multiplicative factor used to compute the expected number of crashes after implementing a given improvement. It is important to note that the Crash Modification Factor represents the long-term expected reduction in crashes.

Crash Modification Factor are used by several groups of transportation professionals for various reasons. The primary user groups include highway safety engineers, traffic engineers, highway designers, transportation planners, transportation researchers, and managers and administrators this are the advantages of the Crash Modification Factor . Crash Modification Factor can be used to:

1. Compare safety consequences among various alternatives and locations.
2. Identify cost-effective strategies and locations.
3. Capture the greatest safety gain with limited funds.
4. Check validity of assumptions in cost-benefit analyses.

Crash Modification Factor is used to calculate the number of accidents occurred after implementation of safety measures at specified section of road. The Crash Modification Factor is calculated according to the reduction of the accidents

before-and-after the implementation of Road Safety Audit. The CMF's are calculated as follows:

$$CMF = 1 - CRF$$

Here, CRF = Crash Reduction Factor

If the Crash Modification Factor is greater than "1.0" then it is considered as crashes have increased, while Crash Modification Factor less than "1.0" indicates that crashes have increased. The Crash Modification Factor for the persons injured is more than one indicating the increase in this type of crashes.

VI. CONCLUSION:

This State Highway 27 originates from Jhalawar (Rajasthan) passes through Ujjain (Madhya Pradesh) and ends at Malkapur Maharashtra and covers the length of 387 km approx. The major residential cum industrial/commercial township developments located on this road in Madhya Pradesh. Since this section gives the rapid growth to the area. This section is having more congestion because the railway takes two-three hours to travel Indore-Ujjain because it reached via Dewas. So that's the reason behind the people travel more with this highway because while travelling to the takes less times.

The Speed Enforcement Cameras and Close Circuit TV has to be installed so to keep the eye on the rule breaker
.It will be observed that total number of road crashes and persons killed will be reducing after implementation of Road Safety Audit. The Crash Reduction Factor and Crash Modification Factor will be helping the study to check the implementation of road safety audit is been successful or not. In the implementation of the road safety audit the crash reduction factor and crash modification factor plays vital role in it.

VII. RECOMMENDATIONS:

1. The Square which is Un-signalized has to be signalized for the proper flow of the traffic. Marking on road should be in proper manner.
2. On the Aurbindo Square the width of the median should be decreases and the buses has be run on the service road because the congestion the Square should be decreases.
3. The correction of all defects should be done which is visible on the road.
4. On the main gate of Vaishnav University the installation of the convex mirror should be takes place by which the condition of collision will be decreasing.
5. The up healing on the roads creates the problem for the bike user to ride the bike in the safe manner and the longitudinal defect also has to be correct as soon as possible.
6. Proper Marking has to be marked infornt of the Vaishnav University for the safety of the students and staff.

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