

ROAD ACCIDENT STUDY AND IDENTIFICATION OF ACCIDENT PRONE LOCATION: A CASE STUDY OF NATIONAL HIGHWAY- 47

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Abstract : Road safety becomes a major concern for road users, statistics show that 1.5 million people are killed in road accidents every year. Road accidents are dependents on various factors like road condition, surface type, geometry, weather condition, etc. This study has been carried out to develop road accident model. Piplod to Khangela (National Highway 47) has been selected for this study. Road accidents data from the year 2013-2018 for Dahod police department. Accident prediction model has been developed by considering a number of accidents per kilometer as a dependent variable and shoulder width and spot speed as an independent variable. Based on the analysis, it is recommended that to improve safety provide adequate lighting for the entire intersection area and speed restriction has to be imposed near built-up area adjacent to the road

Index Terms – Road safety, Regression model, Accident prone location.

1. INTRODUCTION

3,000 people are dying every day in Road Accidents. This is a global humanitarian disaster, and it is man-made. (Global Road Safety Partnership Annual Report 2011) Road safety is one of the furthestmost serious problems in our society. Every year around 1.2 million people are killed and between 20 and 50 million people are injured in road traffic accidents. If current tendencies continue road traffic accidents are estimated to be a third top provider to the global burden of Disease and injury by 2020. Traffic accidents occur under specific traffic circumstances, involving drivers, road users, and various other elements. Road traffic safety remains a perennial topic for all transportation professionals across the globe. In India, 4.65 lakhs road accidents have been reported by UTs in the calendar year 2017 in which 1.48 lakhs persons died. It means 1274 accidents and 405 deaths every day or 53 accidents and 17 deaths every hour in the country. Every four minute, one person is died in India because of a road accident.

Road accidents enforce a huge socioeconomic cost in terms of untimely deaths, injuries, and loss of potential income. The consequences of road traffic accidents can be huge and its negative impact is handled not only on individuals, their health and welfare but also on the economy. Therefore, road safety has become a matter of national concern. Road Safety is a multi-sectoral and multi-dimensional issue.

2. LITERATURE REVIEW

Liu Yichao dived accident contributing factors into subjectives factors and objectives factors, subjective factors mainly refer to the influence of drivers and pedestrians, objective factors mainly include the road conditions, traffic safety facilities, along with the routing environment and traffic flow, etc. Human factor can't be controlled and mastered timely, but grasp the objective factors can improve road security.

Jonathan J et Al. investigated causes of road accidents reported in accident records and compared them with expert views of police officers and lay views of the driving public. Study results reveal potential underreporting of factors in existing accident records, identifying possible inadequacies in law enforcement practices for investigating driver distraction, drug and alcohol impairment, and uncorrected or defective eyesight. Their investigation highlights a need for accident report forms to be continuously reviewed and updated to ensure that contributing factor lists reflect the full range of factors that contribute to road accidents.

Sanjay Kumar analyzes road accidents in India at national, state, and metropolitan city level. The analysis involves distribution of road accidental deaths and injuries according to age, gender, month and time. Results show that Age group 30-59 years is the most vulnerable age group and male face high fatalities and injuries. Road accidents are relatively higher in extreme weather and during working hours.

Gourav Goel has carried out a study on analysis of road accidents on NH-1. He found that head on/Rear end collision occurred more. Over speeding/Driver's fault is the major reason for road accidents. Heavy vehicles are involved in most of the road accidents, therefore, enforcement measures should especially focus on truck/bus.

Guler Yalcin distributed road accidents uniformly according to seasons, months, days of a week, daylight, and hours of the day. Analysis shows that maximum number of accidents occurred in the peak period of day 8:00 - 9:00 AM, 1:00 – 2:00 PM and 5:00 – 6:00 PM.

3. METHODS FOR DATA COLLECTION

3.1. STUDY AREA

National Highway 47 has been selected as a study corridor. The study area is located in Dahod district of Gujarat State. The study area is selected from Bhatwada Toll Plaza (CH 147+400 km) to Gujarat–MP border check post (CH 216+000 km). The total length of the study corridor is 69km and it is a 4 lane divided highway.

3.2. DATA COLLECTION

3.2.1. ROAD ACCIDENT DATA

Road accidents data for 6 years from the year 2013-2018 were collected from Dahod police department. Information regarding accident location, vehicles involved and causality occurred.

Table 1: Road accident data

Year	Fatal	Serious	Minor	Damage Only
2013	29	22	13	0
2014	19	27	5	0
2015	23	22	7	1
2016	19	32	11	1
2017	28	18	4	0
2018	12	13	6	1

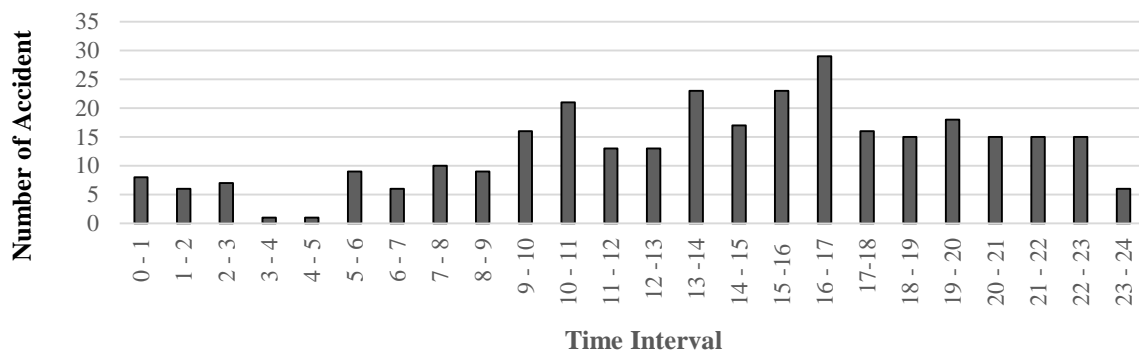


Figure 1: Distribution of Accident per hour

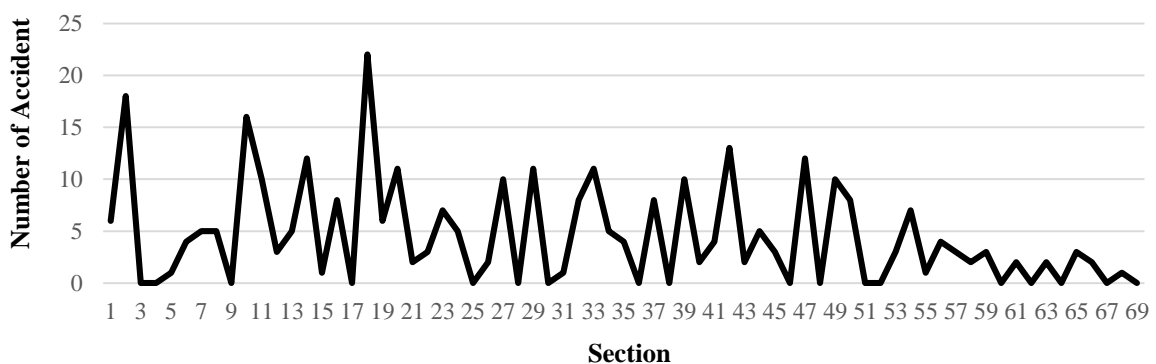


Figure 2: No. of Road accidents in each section

3.2.2. SPOT SPEED

Speed is an important parameter contributing to road accidents, spot speed of light vehicles and slow-moving vehicles are not considered because they are involved in very few road accidents (Gourav Goel). Spot speed of two-wheeler, Car, Heavy vehicles are recorded at every kilometer.

Average spot speed of Motorcycle, car, and Heavy vehicles were collected.

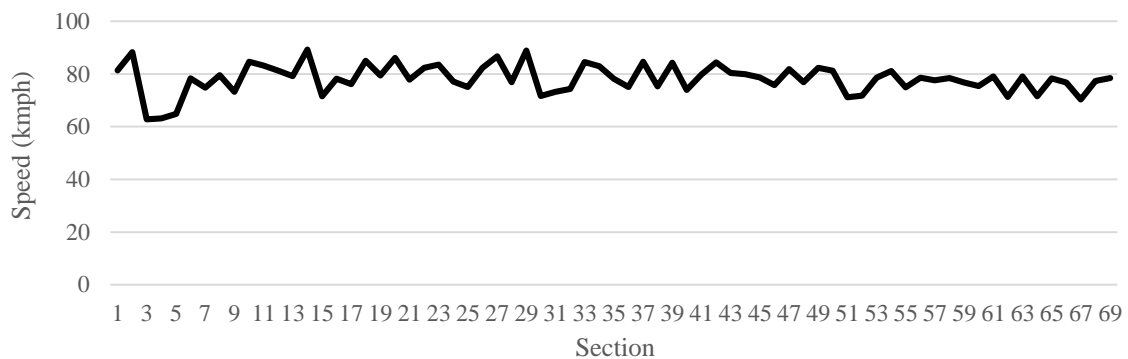


Figure 3: Average spot speed at each section

3.2.3. ROAD INVENTORY

Road geometry is an influencing factor for road accidents (Liu Yichao). Field surveys were carried out by a trained data collection team on the study corridor for the purpose of establishing the road characteristics. Carriageway width, shoulder width, and median width were measured. A number of junction and road character (Inclined/Flat) were also recorded.

4. MODEL DEVELOPMENT

4.1. MODEL FORM

Multiple linear regression analysis was used to develop road accident model. Regression analysis is a simple method for investigating the functional relationship among variables. The relationship is expressed in the form of an equation. Study stretch were segmented into 69 section (one section = one kilometer). A number of accidents per kilometer were considered as a dependent variable in the model.

The regression model was developed for predicting a number of accidents by considering a number of accidents as dependent variable and shoulder width and spot speed as independent variables.

The multiple regression model:

$$Na = \beta_0 + \beta_1 (Sw) + \beta_2 (Ss)$$

Where,

Na – Number of accidents, Sw – Shoulder width, Ss- Spot speed, β_0 is additive constant (Intercept), β_1 and β_2 are multiplying constant (Coefficients).

4.2. VARIABLE INCLUDED IN THE MODEL

A large number of data were collected for this study. Variable to be considered in model development is shoulder width and spot speed. Shoulder width is inversely proportional to the traffic accident rate and severity of accident depend on the speed of the vehicle (Liu Yichao). Shoulder width and spot speed were considered as independent variables.

Table 2: Model variables

Variable description	Range of value
Number of accidents (per km)	0-22
Shoulder width (m)	0 - 1
Speed (kmph)	62.8-89.3

4.3. MODEL RESULT

The resulting model has been determined as follows:

$$Na = 0.407(Ss) - 4.041(Sw) + 0 \quad (1)$$

Table 3: Summary Output

<i>Regression Statistics</i>	
Multiple R	0.873976
R Square	0.763835
Adjusted R Square	0.745385
Standard Error	3.264836
Observations	69

Table 4: ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	2	2309.837	1154.918	108.3499	1.42E-21
Residual	67	714.1633	10.65915		
Total	69	3024			

Table 5: Coefficients Table

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A
Speed	0.407414	0.030686	13.2767	1.97E-20	0.346164	0.468664
Shoulder width	-4.04187	0.730764	-5.53102	5.68E-07	-5.50048	-2.58326

4.4. MODEL VALIDATION

R-squared (R^2) is a statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable or variables in a regression model and proportions range between 0 and 1. It is observed in Table 3. that R^2 value is closer to 1.

$$F_{108.3} > F_{\alpha}(p, n-p) = 3.1;$$

From the F distribution table with $F_{0.05}$, for p = number of independent variables and n = sample size. The null hypothesis is rejected if test statistic $F > F_{\alpha}(p, n-p)$; the resulting F is significant.

The P value (Sig), which indicates the meaningful level to obtained coefficient for the model parameters. Generally, variables with Sig value of less than 0.05 are statistically meaningful in the model. For this model, parameters were found significant therefore it is statistically good.

T-test for observed and expected number of accidents, paired two samples for means $T < T$ critical (Accepted).

4.5. MODEL INTERPRETATION

4.5.1. SHOULDER WIDTH AND SAFETY

In the model, the negative sign of shoulder width coefficient indicates that less shoulder width increases crash frequency. An increase shoulder width would reduce the accident crash that may take place in future.

4.5.2. SPOT SPEED AND SAFETY

Spot speed is a significant variable that affects road crashes. From the model (1), for other variables held constant, an increase in speed by 5% and 10% is expected to cause an increase in road traffic crashes by 12% and 20% respectively.

5. CONCLUSION

During the day, about 33% of road accidents occur at night, the reason is lack of visual information necessary for drivers to drive safely. Road accident type analysis shows the proportion of serious injuries and death accident is larger at night. Provide adequate shoulder width, the model shows that an increase in shoulder width reduces accident frequency.

Regression model shows the relation between speed and road accidents, a maximum number of accidents occurred at sections, where average spot speed is more.

6. RECOMMENDATIONS

Road accidents occurred at night can be greatly reduced by providing road lighting at a major intersection and at the section where buildup area is adjacent to the roadway.

Speed of vehicles was high near hotels and major intersections, speed restriction has to be imposed at those locations.

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