ISSN (Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization,   Volume 2, Special Issue 1, December 2013

Proceedings of International Conference on Energy and Environment-2013 (ICEE 2013)

On 12th to 14th December Organized by

Department of Civil Engineering and Mechanical Engineering of Rajiv Gandhi Institute of Technology, Kottayam, Kerala, India

ACCIDENT PREDICTION MODELS FOR URBAN UNSIGNALISED INTERSECTIONS

Lakshmi M Divakaran, Sreelatha T

M.Tech Student , Rajiv Gandhi Institute of Technology, Kottayam, Kerala, 686501 India

Associate Professor, Rajiv Gandhi Institute of Technology,Kottayam, Kerala, 686501 India

ABSTRACT

Nowadays, road safety is a topic that we discuss too often. There are many factors that cause road accidents. Among that, roadway and traffic conditions are two major factors. By analysing these factors, we can reduce the number of accidents. Crash models are found to be effective in the road safety analysis. In this study, Accident Prediction models are developed for the unsignalised urban intersections. Accident Prediction models for three legged intersections and four legged intersections are separately developed. Previous Accident Prediction Models for intersections predict the number of accidents for the intersection as a whole. This model can predict the number of accidents for each approach leg of an intersection. By knowing the factors that affect safety, we can do proper treatment and upgrading

Keywords: Accident Prediction Models (APM), Intersections, Unsignalised, Urban, Approach leg, Roadway factors, Traffic factors.

1.INTRODUCTION

In a Transportation system roads are an integral part. Today our road network of (3.314 million kilometres) serves as the bloodline of the country. Urbanization,
expansion in road networks and motorization can be called the root causes of increasing global road

accident rate. Ministry of Road Transport & Highways report reveals that India witnessed one road accident every minute in the year 2011 which claimed one life in 3 minutes. Road accident statistics 2012 of Kerala showed that Thiruvananthapuram district with 550 deaths topped the list of fatalities among the 14 districts. Thrissur district with 535 deaths in was second followed by Ernakulam with 516 deaths.

These facts are leading us to an important point. That is, the measures we are adopting now are not enough or this is not the correct way to approach this problem. According to a research done by the WHO representative in India in 2012, Out of the estimated 1.4 million serious road accidents/collisions occurring annually in India, hardly 0.4 million are recorded. Further, only a minimal percentage of these collisions are scientifically investigated, in the absence of which, the real causes and consequences are never known.

Road safety can only be improved when we understand the causes and consequences of road accidents/collisions so as to work out remedial measures. Crash models are used to analyse or predict accidents. According to Organization for Economic Co-operation and Development [OECD], there are four types of crash models, Descriptive models, Predictive models for aggregate data, Micro models for non- aggregate data and accident consequence models.

Predictive models for non aggregate data or Accident Prediction Models (APMs) are a way to gain insight to causes of road accidents**.** This study is carried out to analyze the accident data to identify the causes of accidents occurred. An Accident Prediction Model (APM) will be created for urban unsignalised intersections. The accident prediction models will be able to improve the location of accidents and thus helps to reduce the number of accidents.

2. METHODOLOGY

2.1 Identification of Study Area

Unsignalised intersections of Ernakulam and Kozhikode are selected. Only intersections in the city premises are selected. Care was taken in order to avoid intersections with very low traffic volume and accident frequency.

Three legged and four legged intersections are considered for this study. Details of '45' intersections were collected. It consists of '25' unsignalised three legged intersections, of which 15 from Calicut and 10 from Ernakulam. Then '20' unsignalised four legged intersections, of which '15' from Calicut and '5' from Ernakulam.

2.2 Crash Data Collection

Number of accidents is the dependent variable. In India, Traffic Police is the agency that collects the accident data. Crash data was obtained from City traffic police station of Ernakulam and Calicut. Crash history from 2008 to 2010 (3 years) is considered for the development of APM

2.3 Road Geometry and Traffic Parameter Data from Field Studies

Road geometric data and Traffic flow data are the independent variables for the Accident Prediction Models (APM). Road geometry of each leg of each intersection is collected separately. Geometric features of each leg up to 20m from the intersection are considered. Road geometry data of intersections was also collected after the traffic volume survey at respective intersections. Traffic flow data is an important variable to be considered. Average daily traffic (ADT) is the flow data variable used. In order to determine ADT, volume counts of 3 hours (peak) were taken. Manual count was taken. Traffic flow data consists of volume entering and leaving each leg of intersections. Classified volume count was considered.

2.4 Selection of Variables for Analysis and Modelling

From the Traffic flow data and Road geometry data collected, some variables are selected for analysis and modelling. They are listed in table 1

TABLE 1. VARIABLES FOR MODELLING

VARIABLE	ABBREVIATION
Entering volume	ADTE
Exiting volume	ADTX
Total volume	TADT
Entering volume in PCU	EPCU
Exiting volume in PCU	XPCU
Total volume in PCU	TPCU
Approach width	AW
Flared width	FW
Turning restriction	TR
Presence of Central island	CI
Presence of median	PM
Median height	MH
Median width	MW
Centre marking	CM
Presence of Bus stop	BS
Presence of Lighting	PL
Shoulder width	SW
Presence of Parking	PP
Speed restrictions	SR
Pedestrian facilities	PC
Total number of accidents	TOT
Fatal accidents	FI
Grievous injury	GI
Minor Injury	MI

3. MODELLING AND ANALYSIS

Models are developed using LIMDEP 7.0. Separate models are developed for three legged and four legged intersections. Models developed are given below.

Model for total accidents in three legged intersections

A Poisson regression model is obtained for the total number of accidents in three legged intersections

$$TOT = e^{(8.81E-06TPCU+0.138TR-0.478CI-9.62EFW+0.586BS+0.678PP+0.522CM)} \quad (1)$$

Model for total accidents in four legged intersections

A Poisson regression model is obtained for the total number of accidents in four legged intersections

$$TOT = e^{(9.04E-06TADT-4.68EFW-0.653CM+0.404PL+0.33SW)} \quad (2)$$

Model for fatal accidents in three legged intersections

A Negative Binomial Model has been developed for the number of fatal accidents in three legged intersections

$$FI = e^{-9.03E-05TPCU - 0.40866DW - 8.68BS} \quad (3)$$

Model for fatal accidents in four legged intersections

A Poisson regression model is obtained for the total number of accidents in four legged intersections.

$$FI = e^{-4.39E-05TPCU - 0.263DW + 16.12MW - 30.8MH - 1.47BS} \quad (4)$$

Model for grievous injury accidents in three legged intersections

A Poisson regression model is obtained for the grievous injury accidents in three legged intersections.

$$GI = e^{(1.22E-05TPCU - 0.683SR + 1.179PP - 0.48PM + 0.65PL - 6.07EFW)} \quad (5)$$

Model for grievous injury accidents in four legged intersections

A Poisson regression model is obtained for the number of grievous injuries in four legged intersections

$$GI = e^{1.43E-05TPCU - 5.20EFW + 2.87MH - 0.833CM} \quad (6)$$

Model for minor injury accidents in three legged intersections

A Poisson regression model is obtained for the total number of accidents in four legged intersections

$$MI = e^{-1.07E-05TADT - 0.209DW + 0.95CM} \quad (7)$$

Model for minor injury accidents in four legged intersections

A Poisson regression model is obtained for the total number of accidents in four legged intersections

$$MI = e^{-2.02E-05TPCU + 1.013MM - 0.35TR + 0.545PC} \quad (8)$$

4. MODEL VALIDATION

. All together '8 'models were developed. Separate models are developed for three legged and four legged intersections. Models for predicting total number of accidents and models for predicting the severity of accidents are developed. Chi square test was conducted for validation.

TABLE 2. MODEL VALIDATION

Models	Likelihood Ratio Tests		
	Chi-Square	Df	Sig.
1	28.13739	14	0.010
2	10.86697	11	0.100
3	8718665	14	0.000
4	3339.539	11	0.000
5	43.85238	14	0.000
6	33.11236	11	0.000
7	20.65547	14	0.100
8	8.876243	11	0.100

5. CONCLUSION

On the whole, the results of modelling shows that traffic exposure function TPCU (Total volume in a leg expressed in PCU) produced much better results than TADT (Total Average Daily Traffic).The most influential variables are found to be FW (Flared Width of approach leg) and DW (difference in flared width and approach width). These variables are found to be negatively correlated. If FW and DW are increased, number of accidents can be reduced.

In the models for predicting total accidents in three legged intersections, Presence of Centre Island reduces the number of accidents. Presence of bus stops, presence of parking and presence of centre marking increases number of accidents. But it is found that presence of central marking reduces total number of accidents at four legged unsignalised intersections. Total number of accidents decreases as the shoulder width is increased in four legged intersections.

For fatal accidents prediction model, presence of bus stops reduces the number of fatal accidents. As median width is increased number of fatal accidents in four legged intersection increases. But as the median height increase number of fatal accidents in four legged is decreased.

In the models for predicting grievous injuries, speed restrictions and presence of marking in three legged intersections reduces the number of accidents in three legged intersections. In four legged intersections, presence of centre marking reduces the number of accidents.

In the models for predicting number of minor injury accidents, presence of turning restrictions at four legged intersections reduces the number of accidents

These models can be used to predict the number of accidents and from the results obtained we can provide proper treatment to roads in order to reduce the number of accidents.

REFERENCES

[1] Mohammed Salifu. (2004). "Accident Prediction Models for Unsignalised Urban Junctions in Ghana". IATSS Research, 28(1), 68-81.

[2] Kim Se Hwan, Chung Sung Bong, Song Kitlan and Chon Kyung Soo. (2005). "Development of an Accident Prediction Model using GLIM(Generalized Log – Linear Model) and EB method : A case of Seoul". Journal of Eastern Asia Society for Transportation Studies, 6, 3669 -3682.

[3] Rokade S, Singh K, Katiyar S K and Gupta.S. (2010). "Development of Accident Prediction Model". International Journal of Advanced Engineering Technology, 3(1), 25-40.

[4] S.Gopalakrishnan.(2012) . "A Public Health Perspective of Road Accidents". Journal of Family Medicine and Primary Care, 1(2), 144- 150.

[5] Pratap S Raizada and Prakash Tikare. (2012). "Safe Roads : A Mission Impossible ?". Indian Highways, 40(6), 41- 46.

[6] Mandar Khanal and P.K .Sarkar. (2012). "Safety on Indian Roads". Indian Highways, 40(6), 69- 73.

[7] Ms.Karen Stephen and Dr. Stuart Newstead .(2012). " Towards safer urban roads and road sides : factors affecting crash risk in complex urban environments". Australasian Road Safety Research Policing and Education Conference 2012".

[8] Manisha minesh Desai and Prof .A.K Patel . (2011). " Road Accidents Study Based on Regression Model : A Case Study of Ahmedabad City". National Conference on Recent Trends in Engineering and Technology 2011".

[9] Harnen Sulistio. (2010). "Effect of Traffic flow and Shoulder width on Motorcycle Accidents at Non- Signalized Intersections". Journal of Mathematics and Technology. 5

[10] Dabee Hong, Youngkyun Lee, Jeonghyum Kim, Hoon Chull Yang and Wonchal Kim. (2005). " Development of Traffic Accident Prediction Models by Traffic and Road Characteristics in Urban Areas". Proceedings of the Eastern Asia Society of Transportation Studies, 5, 2046- 2061

[11] S.Turner and A. Nicholson. (1998). " Intersection Accident Estimation : The Role of Intersection Location and Non – Collision Flows". Accident Analysis and Prevention, 30(4), 505-517.

[12] P.P. Valli. (2005). "Road Accident Models for Large Metropolitan Cities of India". IATSS Research. 29 (1), 57- 65

[13] Tim De Ceunynck, Stijin Daniels, Tom Brijis, Elke Hermans and Greet Wets. (2011). "Explanatory Models for Crashes at High – Risk Locations". 24th International Co – operation on theories and concepts in Traffic Safety workshop. 1-21.

[14]Wang Yuaym, Chen Yongsleng and Zhong Xiaoming . (2007). "Crash Prediction Model for Four – Leg Intersections with Unsignalized Control". International Conference on Transportation Engineering 2007, 229- 234.

[15] M.Parida, S.S .Jain and C. Naveen Kumar (2012). "Road Traffic Crash Prediction on National Highways". Indian Highways, 40(6), 93-104.