



Study of Geometric Design & Safety on Expressways

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Abstract: The Study has been undertaken because Road safety is an issue of major importance in all countries. Studies focused on geometric design and safety focuses on the improvement of highway design and to eliminate hazardous locations. The relationship between accident rates and geometric design elements is complex and not fully understood. Relatively little information is available on relationships regarding this. In this paper, road geometric design elements and characteristics are taken into consideration, and explanations are given on which extent they affect highway safety. Although it's been clearly shown that geometric elements like very short sight distances or sharp horizontal curve leads to a considerably higher accident rates which certain combinations of elements causes severe accident problem. It compares the results of studies in several countries and summarizes current international knowledge of relationship between safety and therefore the principal non-intersection geometric design parameters. These relationships between road geometric design and safety are studied through results made in different countries. In general, there's broad international agreement on these relationships.

1. Introduction

Traffic safety is of major concern during a developing country. Several studies are administered to spot the factors contributing to road crashes and measures to scale back the crash rate. Several reported studies relate geometric design consistency to road crashes are under homogeneous traffic conditions. Road crashes are complex events and are influenced by many factors like road geometric design, traffic volume and composition, speed differentials between vehicles of an equivalent class and different classes, weather, motivation for traveling, driver's physical and mental conditions. In India, as per the recent statistics, around 0.14 million people die and 0.4 million people get injured due to road crashes every year, with a fatality rate of 11.8 (MORTH, 2015). Approximately half of the road crash victims are vulnerable road users viz. motorcyclists, pedestrians and cyclists (WHO, 2009). The traffic conditions are highly heterogeneous in India.

1.1 Objective and survey: The study area including Delhi and Meerut has been rapidly urbanized with both planned and unplanned developments. Under the rapid urbanization and population growth, urban environment and traffic congestion in the city has become worse in recent years and characteristics throughout Metropolitan Area. The main purpose of these traffic surveys includes

- To provide new traffic facilities
- To provide smooth transportation
- To study main characteristics of residents in the study area, which enables to provide various sources for setting up the integrated transport plan
- To offer the necessary data for transport modeling

1.2 Various type of traffic survey includes:

1. Cordon line survey- The type of survey is used to obtain the current traffic volume entering and exit from Delhi to Meerut to study travel characteristics of passenger.
2. Household interviews survey- It is done to get major data for transportation modeling to obtain important characteristics of resident.
3. Screen line survey- This is conducted to obtain the current traffic volume within the study area. It provides a means of comparing the result of traffic assignment with current traffic data.
4. Study area- Delhi – total length of this expressway is 96km. the expressway is divided into 4 segment. Meerut expressway is India's widest connecting Delhi to Meerut via Dasna.

First phase : Nizamuddin Bridge to Delhi-UP border

Second phase : Delhi-UP Border to Dasna

Third phase : Dasna to Hapur

Fourth phase : Dasna to Meerut

To define representative transport mode, there is a need to determine the priority among various transport modes. In the Study, the priority was defined based on the following considerations:

- a) Private mode has a lesser priority than public mode.
- b) Feeder mode has a lesser priority than line-haul mode.

The order of priority is given as below:

1.2.1 Vehicle classification

Category	Type	Mode priority
1. Walking	Bi-cycle	9
2. Passenger car	Small van	4
	Car	4
	taxi	4
	Motor cycle	6
3. Auto rickshaw	Auto rickshaw	7
	Tuck 3 axle	8
	tanker	8
4. Truck	Truck 2 axle	8
	Large	2
	mini	2
5. Bus	micro	2
	Railway	1

In the table smaller number represent higher priority.

1.2.2 Key points of project:

Project name	Delhi-Meerut expressway
Project starting date	30 Dec 2015
Expected completion date	March 2020
No of phase	4
Phase 1 length , lane and cost	8.7 km long, 14 lane, 841.50 crore
Phase 2 length , lane and cost	19.2 km long, 6 lane, 1998 crore
Phase 3 length, lane and cost	22.2 km long, 6 lane , 1081 crore
Phase 4 length, lane and cost	46 km long , 6 lane , 1087.8 crore
Total Budget	7566crore
Total length	96km

1. RESEARCH METHODOLOGY

The road accident results in serious social and economic problems. The effects of design elements such as horizontal and vertical curves, lane width, shoulder width, super elevation, median width, curve radius, sight distance, etc. on safety have been studied.

The construction of a highway includes following methods:

- Map study: The direct and alternative routes are discussed with the help of topographic survey available of that area. The alignment is decided after avoiding valleys, ponds or lakes, bends of river and possibilities of crossing through mountains pass. This study gives rough guidance of the routes to be further surveyed.
- Reconnaissance survey: This survey is conducted to decide the most feasible routes for detailed studies. The data of this survey includes various obstructions, geometric parameters, soil characteristics and geological features.
- Preliminary survey: It is conducted after collecting physical information and details of topography.
- Geometric and structural design: It includes various parameters like super elevation and sight distances.

1. Super elevation – It is the transverse slope provided to counteract the effect of centrifugal force and reduce the tendency of vehicle to overturn and to skid laterally outwards by raising the pavement outer edge with respect to inner edge.

$$\text{Super elevation formula, } e + f = \frac{v^2}{127R}$$

2. Sight distances – It is the minimum distance required to stop the vehicle without collision. It includes SSD, ISD, OSD.

- Stopping sight distance - It is the minimum sight distance available on a highway at any spot having sufficient length to enable the driver to stop a vehicle traveling at design speed, safely without collision with any other obstruction.

$$SSD = v_b t + \frac{v^2}{2gf}$$

- Intermediate sight distance - Intermediate sight distance (ISD) is defined as twice SSD.

- Overtaking sight distance - It is the minimum distance open to the vision of the driver of a vehicle intending to overtake the slow moving vehicle ahead safely against the traffic moving in the opposite direction.

$$OSD = v_b t + 2s + v_b \sqrt{\frac{4s}{a}} + vT$$

3. Extra widening – The rear wheel of vehicle does not follows the exact path of front wheel. So, extra widening is the extra width that is given to the curve of the pavement. It includes mechanical and psychological widening.

$$\begin{aligned} \text{Extra Widening (We)} &= W_{\text{mech}} + W_{\text{psy}} \\ &= \frac{nl^2}{2R} + \frac{v}{9.5\sqrt{R}} \end{aligned}$$

n-number of lane

l -length of wheel base

R- radius of circular curve

V -design speed of road (kmph)

- Earthwork and Pavement construction: An earthwork and paving includes placing, material digs and forming the surface of the earth, in such a manner that a cut, fill, excavation, grade, trench, backfill, or tunnel can be executed, including the use of explosives for these purposes. This classification includes the fabricating, mixing, and placing of paving and any other surfacing materials.

2. CONCLUSION: -

The influence of geometric design characteristics on the level of safety on a six-lane divided highway in India, operated under homogeneous and mixed traffic condition was studied. Bi-directional data were used for generating models by statistical modeling approach. Poisson and NB regression models were developed for both year-wise and direction-wise. Based on the developed models, the following conclusions are drawn.

In geometric design of roads and highways the basic design controls serve as the foundation for generating the physical parameters such as safety, and functionality of the transportation system. Some design methodologies are inherent characteristics of the facility. Some basic design controls are selected or determined by the designer, working with communities, societies and users to address a purpose of the project and need. Selecting appropriate values or characteristics for these basic design controls is essential to achieve, safe, efficient, cost effect, sustainable and context sensitive design.

4. REFERENCES:

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