WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Study on Geometry Design of the Highway

Vishal P. Kamble.[1], Akshay B. Sunsule.[2], Rshikesh U. Agre.[3], Tushar G. Dongare.[4], Pratikesh A. Satkar.[5], Rohan S. Takalkar.[6], Prajwal C. Dhage.[7]

[1,2] Project Guide, Department of Civil Engineering, Samarth Polytechnic Belhe Tal. -Junnar, Dist.-Pune, Maharashtra
[3,4,5,6,7] Students, Department of Civil Engineering, Samarth Polytechnic Belhe Tal. - Junnar, Dist.-Pune, Maharashtra

ABSTRACT-

Geometric design of highway deals with designing of physical visible features of highway those comprise of crosssectional elements, sight distances, alignment, curves, superelevation, and other allied features. In India, population growth has been steadily increasing, resulting in higher levels of traffic volume. Additionally, the funding allocated by the government to support the development of transportation infrastructure has not been sufficient. So that it is preferable to plan and design the geometric elements of the road during the initial alignment stage itself by considering future traffic growth. It can be difficult to make improvements to the geometry of a structure after it has been built, which can lead to additional costs. This paper presents a review of prior research on highway geometric design, with a focus on the planning and design of geometric features. When designing a highway, a variety of factors should be taken into consideration in order to achieve the most efficient traffic operation while also providing adequate safety measures at a reasonable cost.

Keywords: - Geometric design, super elevation, cross-sectional elements, optimum efficiency.

1. INTRODUCTION

Highway geometric design is concerned with the physical, visible aspects of a highway, such as cross-sectional elements, sight distances, alignment, curves, superelevation, and other related features.. Line: A line is a straight path connecting two or more points. A line is an imaginary construct consisting of a continuous path between two or more points.

Alignment: The arrangement of the road is composed of a series of straight lines and bends.

Profile: The profile of the road includes the vertical curvatures and gradients, such as crest and sag curves, as well as the straight grade lines connecting them.

Cross- section: The cross section shows the position and number of vehicle and bicycle lanes and sidewalks, along with their cross slope or banking. Cross sections can display various characteristics, such as drainage features, pavement structure, and other elements not related to geometric design. Additionally, the geometry of the road can affect the sight distance available to drivers.

Sight distance: The geometry of the road can influence the amount of visibility available to drivers. Sight distance in road design refers to the length of roadway that is visible to the driver when looking ahead.

Cross slope: Cross slope is the slope of a roadway at right angles to the centreline. When a road is perfectly horizontal, water will drain away from it.

Crest curves: Vertical curves are curves which, when viewed from the side, form a convex shape. These curves can appear at hill crests and other locations where an uphill grade changes in slope, or a downhill grade increases in steepness.

Superelevation: The pavement is designed with an outer edge higher than the inner edge in order to counter the effects of centrifugal force and reduce the risk of a vehicle overturning or skidding outwards. Increasing the slope of a road or railway line in order to reduce the effects of centripetal force is referred to as Super elevation.

Horizontal curves: Horizontal curves are used to alter the trajectory of the centerline of a road. When a vehicle proceeds through a horizontal curve, centrifugal force is generated from the center of gravity of the vehicle based on the radius of the curve and the speed of the vehicle.

Transition curve: A transition curve is used to introduce superelevation and centrifugal force on a vehicle in a horizontal curve, so that the vehicle does not experience sudden jerks. whose radius reduces from infinity at tangent point to a designed radius of the circular curve

2. LITERATURE SURVEY

Hameed Aswad Mohammed (2013). It has been observed that shoulder widths of greater than 2.25m may provide increased safety. Additionally, research has found that the average single vehicle accident rate for highway curves is approximately four times that of highway tangents. Moreover, it is thought that horizontal curves may be more hazardous when combined with gradients and surfaces of low coefficient of friction. Drivers tend to reduce their speed when approaching curves with a radius which is lower than the minimum recommended for the particular design speed. Furthermore, crash rates on horizontal curves are typically higher than on straight sections of roads with similar length and traffic composition, especially when the radii are below 1000m, with a particularly significant increase in crash rates at radii below 200m. It is worth noting, however, that because of the shorter length of smaller radius curves, their impact on crashes may not be as pronounced as initially assumed.

Neeraj and S.S.Kazal (2015).

Mechanical widening of pavement at horizontal curves is a method used to provide additional widening of pavement to prevent off tracking.

$W_m = nl2/2R$

W_m is mechanical widening

"R" is mean radius of curve

"n" is number of lanes

"l" is length of wheel base

$W_{ps} = v/(2.64\sqrt{R})$

"v" is design speed in metre per second

A fuel consumption model was developed in 2013 by Min-Wook Kang et al. Which uses highway geometric characteristics such as grade, length, location of crest and vertical curves, speed, road surface type and condition to predict the amount of fuel consumed by a vehicle travelling at cruising speed on a highway.

Fuel consumption model limitations:

- This update will consider all types of vehicles, not just passenger cars. □
- It is yet to take into account the potential impact of integrating existing roads with any potential intersection or junction points. □
- Vehicle travel on highway curved sections may require acceleration and deceleration due to varying design speeds.

Research conducted by Ali Aram in 2010 found that horizontal curves on two-lane highways are associated with higher crash rates than straight sections of similar length and traffic composition, particularly for radii less than 200 m. The roadway and geometric features that impact safety at horizontal curve sections were also examined.

- The amount of vehicular traffic on the curve, as well as the proportions of different types of vehicles, such as trucks.
- Curve features (such as degree of curve, curve length, superelevation, presence of transition curves) • Cross sectional curve element (such as lane-width, shoulder width, shoulder type, shoulder slope)
- The roadside features of curves, such as clear slope, rigidity, and types of obstacles, as well as the stopping sight distance on the curve or at the approach to the curve, should be considered.
- Vertical alignment on horizontal curve
- Distance to adjacent curves
- The distance of the curve to the nearest intersection, driveway, or other point of connection.
- Pavement friction

Jha and Schonfeld (2004) conducted a study on highway alignment optimization based on cost minimization. The study focused on costs that were sensitive to alignment characteristics, such as differences in grades, horizontal curves, and vertical curves. A comprehensive form of the cost function was developed that accounted for these factors and was used to determine the optimal highway alignment.

3. CONCLUSION

After studied different sources and past work it should be stated some objectives of geometric design of highway given below

- The geometry of a design should be optimized to ensure cost-effective traffic flow and safety.

- When designing highways, it is important to adhere to the guidelines set forth by AASHTO and IRC. Additionally, it is recommended to adhere to any specific state highway specifications.
- The MX Road software is a commonly used program for the design of highways, with pre-programmed values for various factors influencing highway design.
- Arc GIS software could be used to optimize the alignment of a construction project, potentially reducing the costs.
- Extra care should be taken while designing super elevation (Min 4%- Max 10%) and pavement widening on horizontal curves.
- 2.25m wide shoulder gives extra safety and median width should be in between 0-6m to 1.2m.
- Maintaining proper sight distance and vertical alignment can result in reduced propulsive force, thus resulting in lower fuel consumption.
- Horizontal curves at grade separation are more dangerous and causes 30% of accidents

References

1. Jha, M.K., Schonfeld, P., 2004. A highway alignment optimization model using geographic information systems. Transportation Research – Part A 38 (6), 455– 481.
2. Council, F., and Steward, J.R., " Safety Effects of the Conversion of Two-Lane Rural to Four-Lane Rural Roadways Based on Cross-Sectional Models ", Transportation Research Board Annual Meeting, 2000.
3. Hadi, M.A., Aruldhas, J., Chow, L.F., and Wattleworth, J.A., "Estimating Safety Effects of Cross-Section Design For Various Highway Types Using Negative Binomial Regression" Transportation Research Center, University of Florida, 1995.
4. Karlarftis, M.G., and Golias, I., "Effect of Road Geometry and Traffic Volumes on Rural Roadway Accident Rates ", Accident Analysis and prevention 34, P.P 357-365, 2000.
5. Ali Aram, "Effective Safety Factors on Horizontal Curves of Two-Lane Highways", Journal of Applied Sciences 10 (22), Malaysia, P.P 2814-2822, 2010.