International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 09 | Sep 2022 www.irjet.net p-ISSN: 2395-0072

Case Study on Highway Geometry for Two Lane Highway

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Abstract - *In India, due to rapid growth in vehicular traffic, it is very important to construct safe highways. While constructing highways, geometric design is very important in highway design, it can be greatly used to reduce road accidents significantly.*

Geometric design elements consist of carriageway, median, horizontal and vertical curves, lane width, shoulder width, superelevation, curve radius, sight distance, etc. Based on previous studies had shown that sharp curve or short sigh distance results in higher accident problem, therefore these issues should be accounted in design and developing stage. It is important to plan and design the geometric elements at initial stage taking into consideration of future growth and also the cost otherwise it will be becoming more expensive or very difficult to construct as surrounding area gets developed. The research would help to identify design issues in geometric design and to find out accidental prone areas where most accidents likely to happen.

Key Words: **Carriageway, median width, Pavement width, Horizontal Curve, Vertical Curve, Intersection.**

1. INTRODUCTION

While designing any highway, it is important to study the geometric design elements and one must have guidelines, standards and specification to developed the highway with maximum safety. The geometric design of a highway deals with visible features of road consists of cross section of roads, median width, intersection, horizontal & vertical curve, sight distance etc. Below is the brief definition of some geometric elements.

Cross Section: The cross section of highway shows the vehicle, bicycle lanes, sidewalks/footpaths along with their cross slope. Generally, cross sections show features or roadside facility and type of road with layers.

Shoulder: It is the part of formation width except carriage ways. They are used by the vehicular traffic as the emergency lanes or sometimes as service lanes.

Median: Median separates the opposite traffic and provides safety features as well as reduces headlight glare, improve comfort for night driving. Two types of medians provided on highways as per requirement i.e., raised and depressed median.

Camber: Cross slope can be defined as the slope of a roadway perpendicular to the centre line. If a road were completely level, water would drain off it. Three types of camber are straight camber, parabolic camber and mixed camber.

Superelevation: The outer edge of the road with respect of the inner edge of road is raised, this is called superelevation. It is very important to provide at horizontal curve to smooth passage of vehicle.

Horizontal Curve: A horizontal highway curve is a plan to provide a change in direction in the centre line along the highway. Horizontal alignment includes the design of horizontal curves, super elevation, transition lengths, speed, extra widening. Simple curve, compound curve, reverse curve and spiral curve these are the types of horizontal curve.

Vertical curve: Vertical curve are provided to change the slope in the road. Sag/valley curve and summit curve are the types of vertical curve.

Sight Distance: Sight distance length of road is length visible ahead the driver at any instance. Stopping sight distance (SSD), Overtaking sight distance (OSD) and Intermediate sight distance (ISD) are the types of sight distance.

2.OBJECTIVE

- The main objective of the study is to examined the existing geometry of highway.
- To identify the safety issue in highway design and accidental prone area of highway
- To provide the simple geometric design to meet all expectation of road users like pedestrian, bicycle, motorist etc at reasonable cost.

3. LITERATURE REVIEW

In past periods many studies have been done on geometric design elements of road to improve road safety and optimum efficiency of use. The study will help to minimize the errors occurring roadway design which is helpful for the system to avoid future cost and difficulties with improved traffic operation.

Ali Aram (2010). He presented study of two-lane highway on horizontal curve. He stated that horizontal curve has higher crash rates rather than straight section of comparable length and traffic structure. The increase in crash rates become particularly important at radii below 200 m.

Zhang Yingxue (2009), stated that it is important for traffic accident to bring high accident rate if the sight distance is not enough and this is visible on the places where have the bad visual distance of small horizontal curve radius, small crest vertical curve radius, intersection, and lack of overtaking sight distance on some road section. In order to ensure traffic safety, the traveling sight distance should be design enough when design horizontal or vertical alignment.

Vikas golakot (2018) his thesis included that the aim of his study is to find the role of the geometric factors of road on accident rate in the case of plain terrain and also find the extent to which these factors affect the accident rate for rural areas. The study aims to find the impact of factors like extra widening, horizontal radius, sight distance, K-value, super elevation, horizontal arc length, vertical arc length, vertical gradient on the accident rate and aims to study the significant factors causing accidents and to find the values for future design of roads.

Indian Road Congress SP 73: 2015. It gives the specification and standards for two laning highways provide guidelines like types of terrain classification, right of way, different types of cross section, design speed for different types of traffic and geometric elements. The policy includes vertical clearance, structure cross section & capacity of bridges and about tunnels.

4. METHODOLGY

It is proposed to study for the national highway starting from chainage at 19+300 km near Piliv village (Latitude of 19°82'400"N and Longitude of 54°47'55"E.) and end at 31+ 700 km near Tandulwadi (Latitude of 19°70'95"N and Longitude of 54°27'73"E.) in Maharashtra State. Various factors are studied and verifying with the relevant specification and standards. Detailed primary data for the selected road is collected from companies/organizations and verifications of the designed parameters with respect to IRC provisions.

5. DATA ANALYSIS

The plan and profile design drawings and the data collected, are thoroughly studied visited site for selected project, and analysed based on the proposed methodology. Following observations were noted:

- Project stretch is located in Solapur District of Maharashtra state, India.
- The length of the project stretch is around 12.4 km.
- The project stretch is shown in map with reference of Maharashtra and India Map.
- The terrain of road through which it passing is plain terrain.
- Design of Typical cross section- The typical cross section for the road project stretch is designed over the horizontal alignment and presented as below

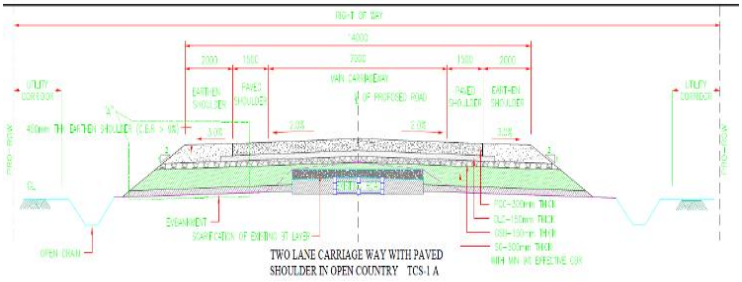

Fig -1: Typical Cross Section

- Justification with IRC provision - proposed key elements are checked with the IRC provisions to validate the design, the same are mentioned as below,

Table -1: IRC Validations

Items	IRC Provision	Remarks
Carriage - way	IRC SP 73 2015, Carriage way 7 mtr [Fig 2.2, Page No 20]	Followed
Shoulder	IRC SP 73 2015, Shoulder 1.5 mtr for paved shoulder 2 mtr for earthen shoulder [Clause No 2.6, Page No 10]	Followed
Camber	IRC SP 73 2015, Crossfall on straight section, 2% for cement concrete surface [Clause No 2.8, Page No 12]	Followed
Design speed	Minimum design speed for plain and rolling terrain 80 Kmph where ruling speed is 100 Kmph [Clause No 2.2, Page No 10]	Followed

Horizontal Curve: The horizontal alignment data based on the plan and profile is analysed step by step and the observation related to each design element is recorded.

Table -2: Horizontal Curve Radius with Speed

Sr No	Chainage		Curve Radius	Remarks
	From	To		
1	19+450	19+530	250 m	80 Kmph (Maximum speed)
2	19+710	19+760	250 m	80 Kmph (Maximum speed)
3	20+550	20+730	250 m	80 Kmph (Maximum speed) Need to upgrade/Realign ment.
4	22+880	22+930	250 m	80 Kmph (Maximum speed)

Vertical Curve: The vertical curve data based on the plan and profile is analysed step by step and the observation related to each design element is recorded.

Table -3: Vertical Curve Radius with Type and Length.

Sr No	Chainage	Type of curve	Remarks
1	20+419	Summit	300 mt length
2	21+462	Summit	385 mt length
3	21+831	Valley	145 mt length

Junction geometry: The general design principles of intersection design also include design of the approach speed and restriction on the available land. Following Observation are recorded at major intersections at Ch. 27+150, Ch. 31+600 and minor junction at Ch. 21+450 and Ch. 22+800.

- Layout at major intersections is not channelized which is a major safety issue, hence the to make traffic flow effective these intersections to be channelized.
- Visibility at junction location in approaches is a safety deficiency which is need to be designed for junction approaches and also need to maintain.
- Proper Sign boards are provided at location.

6. CONCLUSIONS

Following conclusions can be made from the research;

- Geometric design guidelines encourage more safety and comfort for road users, so it is very important to design accordingly specification and standards.
- More care should be taken at curve locations as more accidents likely to happen at theses location while designing highway.
- Carriageway, camber, shoulder and design speed are found in order in selected stretch with respect to IRC Provisions.
- The study would be helpful to examine the existing geometry of highway and can be used to improve or enhance the efficiency of road users.

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