International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 08 | Aug 2022 www.irjet.net p-ISSN: 2395-0072

Geometric Features of Road and Causes of Accident

Ancy Genu C George[1], Abhirami K R[2], Anakha Haridas[3], Anusha Vinod[4], Divya K M[5]

[1]*Assistant Professor, Dept. of Civil Engineering, Viswajyothi College of Engineering and Technology, Kerala, India*
[2,3,4,5] *B.Tech Scholar, Dept. of Civil Engineering, Viswajyothi College of Engineering and Technology, Kerala, India*

Abstract - *Road safety has very importance in our day-to-day life, as many of our activities are depending upon roads and vehicles. The outcome of road accidents includes severe social and economic problems. The analysis of geometric features and its design improves highway design and reduces accident rates on road. The influences of horizontal curves, lane width, superelevation, curve radius, sight distance, etc. on road safety have been analysed. It is clearly shown that insufficient geometric elements such as inadequate sight distance, and sharp horizontal curve results in hazards. In this paper, road geometric design elements of a curved road stretch is determined and studied. The main causes of accidents and mitigation measures are identified by studying geometrical features.*

Key Words: Road safety, Accident, Geometric Features, Horizontal curves, Causes, Mitigation measures

1. INTRODUCTION

The geometric design of highways deals with the dimension and layout of visible features of highways such as horizontal and vertical alignments, sight distances, and intersections. Geometric design of highways deals with the elements consisting of cross-section elements, sight distance considerations, horizontal alignment details, vertical alignment details, and intersection elements. Under cross-sectional elements, the considerations for the width of pavement, formation, and land, the surface characteristics, and cross slope of pavements are included. The sight distance or clear distance visible ahead of a driver at horizontal and vertical curves and intersections govern the safe movements of vehicles. Changes in the road directions are made possible by introducing horizontal curves. The super elevation is provided by raising the outer edge of the pavement with respect to the inner edge to counteract part of the centrifugal force developed on a vehicle traversing a horizontal curve, extra width of the pavement is also provided on horizontal curves. In order to introduce the centrifugal force and the superelevation gradually, transition curves are introduced between the straight and circular curves. The gradients and vertical curves are introduced on the vertical alignment of a highway. Highway geometrics are greatly influenced by the topography or the terrain through which the highway is being aligned, the locality, traffic characteristics, and the requirements of design speed. The factors which control geometric design requirements are speed, road user and vehicular characteristics, design traffic, traffic capacity, and benefit-cost considerations.

2. OBJECTIVES

The main aim of our study are:

- To identify the geometric features of road section
- To identify the problems in road design
- To put forward the mitigation measures

3. STUDY AREA

The study area is a 350m road stretch of Muvattupuzha-Punaloor road near to AVM Hospital, Karinkunnam. The road is accompanied with 4 consecutive curves. A number of accidents occurred here because of the problems in geometrical parameters at that road stretch.

4. GEOMETRIC PARAMETERS

With the help of data collected using total station, curves are plotted on AutoCAD and find out the road geometric parameters using AutoCAD tools. Width of carriageway, extra widening provided, etc. are evaluated using measuring tool, radius of curvature is determined using 'ARC', 'DIMRADIUS' tools. The superelevation is calculated by computing the difference between ethe levation of inner and outer curves carriageway way width.

Table -1: Road Details

Chainage	Difference Between Inner And Outer Edge (m)	Width (m)	Super Elevation (e)
0	NIL	10	0
5	NIL	10	0
10	NIL	10	0
15	0.155	10	0.0155
20	0.174	10	0.0174
25	0.159	10	0.0159
30	0.176	10.2	0.0173

35	0.179	10.26	0.0175
40	0.263	10.36	0.0254
45	0.247	10.5	0.0236
50	0.372	10.6	0.0351
55	0.399	10.6	0.0377
60	0.486	10.65	0.0457
65	0.455	11.27	0.0404
70	0.575	13.14	0.0438
75	0.919	14.98	0.0614
80	1.043	17.37	0.0601
85	1.287	17	0.0758
90	1.18	16	0.0738
95	1.045	15.71	0.0666
100	0.825	14.91	0.0554
105	0.487	14.414	0.0338
110	NIL	13.13	0
115	NIL	13.57	0
120	NIL	14.4	0
125	NIL	15.17	0
130	0.443	15.37	0.0289
135	0.396	15.23	0.0261
140	0.419	15.21	0.0276
145	0.559	13.6	0.0412
150	0.646	11.68	0.0554
155	NIL	11.208	0
160	NIL	11.02	0
165	0.387	11.13	0.0348
170	0.56	12.18	0.046
175	0.598	13.18	0.0454
180	0.568	13.11	0.0434
185	0.707	12.727	0.0556
190	0.514	11.74	0.0438
195	0.509	11.66	0.0437
200	0.289	11.03	0.0263
205	0.225	10.79	0.0209
210	0.198	9.86	0.0201
215	0.159	9.65	0.0165
220	0.191	9.41	0.0203
225	0.149	9.65	0.0155
230	NIL	9.65	0
235	NIL	9.34	0
240	NIL	9.32	0
245	NIL	9.696	0
250	0.186	10.06	0.0185
255	0.256	10.97	0.0234
260	0.306	11.65	0.0263
265	0.431	12.58	0.0343
270	0.415	12.637	0.0329
275	0.529	13.6	0.0389
280	0.654	13.367	0.049
285	0.579	13.766	0.0421
290	0.518	13.51	0.0384
295	0.551	13.54	0.0407
300	0.431	12.31	0.0351
305	0.411	11.41	0.0361
310	0.383	10.857	0.0353
315	0.332	10.33	0.0322
320	0.293	9.74	0.0301
325	0.298	9.64	0.031
330	0.243	9.66	0.0252
335	NIL	9	0

Table -2: Radius of Curvature at Road Stretch

CURVES	INNER CURVE(m)	CENTRE CURVE(m)	OUTER CURVES(m)
Curve 1	7.3	11.15	17.26
Curve 2	29.37	40.67	30.03
Curve 3	12.07	19.67	22.94
Curve 4	8.72	15.67	20.73

5. DATA ANALYSIS

5.1 Superelevation

The super elevation is provided at the road section by gradually rising the outer curve with respect to inner curve. Super elevation reaches the maximum and gradually decreases to zero along the length of roadway. From the field measurement, it is to be understood that, in this road section super elevation is provided in an unsystematic manner.

5.2 Turning Circle of Vehicle

According to IRC 38:1998 - cl.4.4.5, the minimum radius of curve is governed by the minimum turning circle of a vehicle. The turning circle of public service vehicles have swept diameter not greater than 19.812m for a vehicle not exceeding 8.230m in length; 21.641m for vehicle exceeding 8.230m and not exceeding 10.973m in length; and 23.774m for vehicle longer than 10.973m. The turning circle of commercial vehicles mainly lies between 12 and 21m. The above findings uncover that curve 1 does not follow the

above mentioned criteria. Also, based on the accident analysis it is discovered that the majority of the vehicles involved in the accident at the Nellappara road stretch are heavy vehicles. The heavy vehicles are mainly of length greater than 11m. From the analysis of accidents and the geometric features, it is clear that accidents have been caused by failing of vehicles to turn the curve effectively because the turning circle of vehicle is greater than the radius of curve.

5.3 Super elevation and Radius of Curvature

The relationship between super elevation and radius is shown in the equation:

$e = V^2/225R$

Where, e – super elevation, V – Velocity of vehicle, R – Radius of curvature

Based on this equation and the superelevation and radius of curvature at the curves, vehicle must maintain a velocity lesser than 20 km/hr in that road stretch. It is more difficult to maintain that velocity range by vehicle than the radius of curve.

5.4 Sight Distance

Based on the investigation at the site, it is clear that the clear sight of the driver is restricted by plants and shrubs in the neighbouring plot. Usually, mirrors are fastened at the curves to provide safety for motorists on roads where there is a lack of visibility driver's view is blocked by obstacles. But, in this road stretch, no mirror is provided and it made it difficult to spot vehicles from the opposite direction.

5.5 Road Sign Boards

Chevron sign boards, speed limit, right reverse bend The sign boards, especially the chevron sign boards are improperly installed. Due to this, the drivers cannot notice the signboards effectively.

5.6 Extra Widening

Extra widening should be provided by a gradual increase in width. But, extra widening of the above road stretch is sudden, at is the transition length provided is insufficient; therefore vehicles cannot effectively use that widening. The extra widening provided in that road stretch is about 6m in the outer curve and there is no extra widening at the inner curve. According to IRC, extra widening will be provided at inner curves, if the curve roads are of radius less than 50m.

6. RESULTS AND DISCUSSIONS

The major problems observed were with the 1st curve.

6.1 Problems in Road Stretch

i. Insufficient road signs and their improper installation
ii. Super elevation is provided in an unsystematic manner
iii. Lack of clear sight at curves
iv. Presence of sudden curves without sufficient transition length & construction of immediate reverse curve
v. Inadequate radius of curvature
vi. Problems in extra widening

6.2 Mitigation measures

After examining the problems, mitigation measures are discovered. Road signs, road studs, and mirrors are installed, making drivers cautious about curves' danger. Then the construction of crash barriers and Irish helps in reducing the accident rate. The term 'Irish' is that concreted portion on roadsides at curves. It is constructed by leveling the area which makes obstruction of vision at curves to road level and then concreting that area.

Road redesign is an alternative and foremost suggestion to reduce the accident rate. Firstly, enlarge the radius of curvature which enables the smooth turning of vehicles. Then eliminate the second curve by connecting from the first curve to the third curve with a retaining wall. Subsequently, provide clean sight area at the side of the curve which contributes to obstruction to the driver's clear vision on curves.

Table -3: Geometric Parameters Before and After Redesign

Geometric Features	Before Redesign	After Redesign
Radius of curvature	11.15m	19.17m
Carriageway width at curves (including extra-widening)	17.37m	18.63m
Gradient	6.88%	7.305%

7. CONCLUSIONS

The geometric features such as radius of curvature, extra-widening, superelevation, carriageway width, etc., are determined by using total station and AutoCAD. The reason behind the accident was discovered by studying the geometric features and analysing questionnaire survey results. The sources of accidents are the insufficient radius of curvature, complications in superelevation and extra-widening, improper road signs and road studs installation, presence of blind spot on curves etc. Mitigation measures are put forward to reduce road accident rates. Road redesign is the foremost measure to reduce accident rate.

REFERENCES

[1] Adithya Abhayalal, Arya Mohanan, Dinoy P Jose, Agaja G, "Performance Evaluation And Improvements To Pala Civil Station Junction", International Research Journal of Engineering and Technology (IRJET), Vol. 08, Issue 06, June 2021

[2] Amit, "Standards of Geometric Design of Highway: A Review", Journal of Emerging Technologies and Innovative Research (JETIR), Vol. 4, Issue 9, Sept 2017

[3] Faheem Ahmed Malik, Shah Faisal, Inam ul haq, "Road Accidents and Prevention", International Journal of Engineering Development and Research (IJEDR), Vol. 5, Issue 2, April 2017.

[4] IRC:38-1998 "Guidelines For Design Of Horizontal Curves For Highways And Design Tables

[5] Mridula G M, Ashamol Jose, Lidiya P M, "Traffic Accident Analysis and Mitigation Measures at Kariyad (NH-544), Ernakulam, Kerala", International Journal of Science, Engineering and Technology, Vol. 4 Issue 5, 2016

[6] Muthusamy A P, Rajendran M, Ramesh K, Sivaprakash P, "A Review on Road Traffic Accident and Related Factors", International Journal of Applied Engineering Research, Vol. 10, Number 11, Jan 2015

[7] Sagar B. Patil, Saniya Attar, Divya Dugani, Tejaswi Desai, Simran Mahabri , "Study Of Geometric Features Of Road And Accident Rate" , International Research Journal of Engineering and Technology (IRJET), Vol. 06, Issue 04, Apr 2019

[8] Siddhant Karahe, Dr. Sunil Sugandhi , "Review On Road Safety Audit And A Case Study Of Sh26 & Sh27 From Khandwa To Sanawad (M.P.) India", International Research Journal of Engineering and Technology (IRJET) , Vol. 07, Issue 02, Feb 2020

[9] S K Khanna , C E G Justo. , "Highway Engineering", March 2011

[10] Younus Maqbool, "Road safety and Road Accidents: An Insight", International Journal Of Information And Computing Science, Vol. 6, Issue 4, May 2019