International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 8 No. 1 Sep. 2014, pp. 271-274

http://www.ijias.issr-journals.org/

EFFECT OF GEOMETRIC DESIGN ON HIGHWAY SAFETY (ADO – IKERE ROAD, SOUTHWESTERN, NIGERIA AS A CASE STUDY)

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ABSTRACT: The economic growth of a country is somehow dependent on the road network of such country and for the highways to be very effective, its geometrical features must be in line with required standards. A study for the effects of geometrical features on highway was conducted on Ado-Ikere road, Nigeria. The paper therefore looks into the critical points where accidents occur frequently along the road. Some geometrical features on these points were examined and it was observed that the medians measured 1.00m to 2.00m instead of the standard of 5.0m while the shoulders measured between 1.50m to 2.7m instead of 2.75m. The specified drainage design width of 3.00m ranges between 0.60m and 0.63m when measured and the right of way of 60.00m standard value ranges between 25.50m to 45.00m while the sight distance of 150.00m for the design speed of 100km/h ranges between 38m – 120m at Chainage 0 + 000 to Chainage 3 + 150 along the route. It was also discovered that there was no provision for other features like pedestrian walkways, lay-by, road markings and traffic light at intersections. The improper construction on the field could be the cause of accident along the route and may need to be re-constructed in conformity with the standard specifications.

KEYWORDS: Effect, Geometric Design, Highway, Safety, Ado – Ekiti, Ikere.

1 BACKGROUND

Good road network is a factor on which the economy of a nation depends and the planning of the effectiveness and optimum utilization of the roads must be a continuous process. The geometric parameters such as intersections, interchanges, curves etc. are mostly incorporated into highway designs for convenience and safety of the users.

This paper therefore aimed at highlighting the problems of poor planning and layout (with regards to geometrical features) of Ado – Ikere road, which is one of the major roads affecting the economic, social and political development of Ekiti-State, Nigeria and has recorded some casualties due to accidents in the recent past as shown in tables 1 & 2.

The horizontal alignment of a road must be carefully chosen to have a good correlation with the vertical alignment and the elements such as radius of curvature, design speed, lane width, and details of super elevation and adequate sight distance must be adequately considered [8].

The design speed of a road may not necessarily be its maximum safe speed but a major factor in choosing super elevation rates and radii of curves, sight distances and length of crest and sag of vertical curves. Road with lighter travel speed requires sweeping curves, steeper curve banking’s, longer sight distances and more gentle hill crest and valley [9].

Provision of adequate drainage is of paramount importance in road design since it reduces / eliminates the energy generated by flowing water which adversely affects the engineering properties of the materials with which the road is constructed [6].

Shoulders must be adequate in both sides of the roadway but for congestion relieve, lane width reduction to about 3.4m should first be considered while reduction of the left shoulder must be considered with that of the right [5].

Super-elevation, which is described in terms of super-elevation rate, is the rise in the roadway super-elevation for inside to outside edge of the road and the maximum permissible super-elevation is recommended by I.R.C [3].

The lane width is limited by the physical dimensions of automobile and trucks to be a range of 2.7 and 3.6m and it increases with an increase in the design speed of the highway [9].

The general range of median width is from 1.2m usually in urban areas to 2.4m or more in rural areas [4].

2 MATERIAL AND METHODS

Geometrical features of the highway like median width, lane width, shoulder, drainage width and right of way was measured directly in site using the steel tape. Leveling of the route was carried out using a digital leveling instrument while the speed at which vehicles plies the critical portions was determined by boarding different vehicles plying the route and the speed of each vehicle observed and determined and the super-elevation calculated using the I.R.C recommended equation.

$$E = \frac{V^2}{225\ R}$$

E = Super – elevation
V = Speed Limit
R = Radius of curvature

Table 1: Accident recorded along Ado-Ikere road for the year 2010

S/N	DATE	NO. OF PEOPLE INVOLVE	NO. OF PEOPLE INJURED	NO. OF PEOPLE KILLED	TOTAL CASUALTY
1	13-032-010	02(2m)	02(2m)	-	02(2m)
2	02-04-2010	01(1m)	-	01(1m)	01(1m)
3	07-042010	01(1m)	01(1m)	-	01(1m)
4	10-04-2010	06(5m,1f)	04(4m)	-	04(4m)
5	28-06-2010	02(2m)	01(1m)	-	01(1m)
6	27-09-2010	02(2m)	01(1m)	-	01(1m)
7	26-10-2010	06(6m)	06(6m)	-	06(6m)
8	01-11-2010	01(1m)	01(1m)	-	01(1m)
9	23-11-2010	03(3m)	02(1m,1f)	-	02(1m,1f)

***N.B.** M – Male, F – Female*
Source: FRSC ADO-EKITI

Table 1. Table 2: Accident recorded along Ado-Ikere road for the 2011 (Source: FRSC, ADO-EKITI)

S/N	DATE	NO. OF PEOPLE INVOLVE	NO. OF PEOPLE INJURED	NO. OF PEOPLE KILLED	TOTAL CASUALTY
1	01-02-2011	09(6m,3f)	03(2m,1f)	-	03(2m,1f)
2	03-02-2011	04(4m)	03(3m)	-	03(3m)
3	23-02-2011	03(2m,1f)	03(2m,1f)	-	03(2m,1f)
4	14-04-2011	03(3m)	01(1m)	-	01(1m)
5	12-06-2011	02(2m)	01(1m)	-	01(1m)
6	28-06-2011	14(10m,4f)	01(1m)	-	01(1m)
7	01-08-2011	02(1m,1f)	-	02(1m,1f)	02(1m,1f)
8	24-12-2011	02(2m)	02(2m)	-	02(2m)

***N.B.** M – Male, F – Female*

Table 3: IRC Standard and field measurement values of Geometric Design parameter

S/N	Element of highway geometry	IRC standard specification (m)	IRC STANDARD VALUE AND FIELD MEASUREMENT VALUE OF GEOMETRIC DESIGN PARAMETERS									
			FIELD VALUE									
			CHAINAGE									
			0+000	0+025	0+850	1+400	1+900	2+250	3+000	7+025	8+100	11+250
1	Lane width	7.30	8.62	7.32	7.35	7.37	7.33	7.30	7.31	7.32	7.32	7.31
2	Shoulders	2.75	1.63	1.52	1.41	1.40	1.35	1.33	1.55	2.70	2.72	2.70
3	Camber	1:48 – 1:60	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1 in 48	1 in 48	1 in 48
4	Speed limit	100km/h	30km/h	40km/h	50km/h	60km/h	80km/h	80km/h	60km/h	100km/h	100km/h	100km/h
5	Right of way	60	28.50	25.50	35.00	37.00	35.00	35.00	38.00	60.00	45.00	45.00
6	Sight distance	150	38.00	50	77.00	87.00	120.00	75.00	150.00	150.00	150.00	150
7	Super elevation	0.10	Nil	0.04	Nil	0.10	0.03	0.10	Nil	Nil	Nil	0.10
8	Walk way	2.00	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
9	Median width	5.00	Nil	Nil	Nil	Nil	Nil	Nil	Nil	3.50	1.00	1.50
10	Drainage width	varies	0.61	0.62	0.62	0.62	0.61	0.60	0.62	0.62	0.61	0.62

3 DISCUSSIONS

From table 3, the lane width was seen to be adequate as it ranges from 7.30m to 7.38m while the shoulders were grossly inadequate, measuring 1.30m to 2.70m instead of 2.75m. Between chainage 0 + 000 to 3+ 350, the right of way was between 28.00m to 38.00m which is less than the standard of 60m. Since the road design speed was 100km/hr., the equivalent sight distance (I.R.C Recommendation) was 150m but 50m was measured at chainage 0 + 025, 77m in 0 + 850 and 38m in 3 + 350 which was far less than the specified value. No camber as provided between Ch. 0 + 000 to 3 + 350 while a camber of 1 in 48 was provided thereafter. Also, from Ch.0 + 000 to 3 + 350, no median was provided but thereafter a median of between 1.00m to 2.00m was provided which fell short of the 5.0m specified.

Speed Limit of 100km/hr. was adhered to by motorists but facilities such as road markings, walkways, lay-bys etc. were not provided on the roadway.

4 CONCLUSION

Though the entire route was designed as dual carriage way, single carriage way was seen between Chainage 0 + 000 to 3 + 350. Most of the geometrical features except the lane width do not conform satisfactorily to their respective specified values and the inadequacies may be the cause of increase number of accidents and congestion on the road.

However, the road may need to be re-designed and re-constructed in line with the specified geometric factors.

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