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Analysis Of Geometric Parameters For Increased Design Speed Of Highway-A Case Study On NH-27

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Abstract: ***Roadway geometry design involves such as creating the road alignment and plotting the alignment profile using coordinates, stations, and elevations of points along the selected route, and designing the horizontal alignment, vertical alignment and superelevation. This study deals with the minimum standards for geometry that needs to be followed to achieve the minimum design speed of 140 Kmph. The various important factors related to Geometry of road are: -***
Horizontal Radius on Curves, Sight Distance on Horizontal and Vertical alignment, Superelevation, Vertical Curve length or radius, Maximum Gradient.
The available Indian manuals and standards related to the Geometric design for highways is limited to the design speed of 120 Kmph. The author thinks about the setting of the base standards for the Geometric design of Highways for high-speed corridors.
Keywords: Geometric Parameters, Increased Design Speed, Horizontal Alignment, Vertical Alignment, Superelevation.

I. INTRODUCTION

In India, roads are a crucial form of transportation. In India, motorways with a total length of 2,037.1 km are in use as of November 2021. There were only 200 kilometres of motorways in the nation in 2017. All motorways are six or more lane wide controlled-access motorways, with slip roads used to regulate entry and exit. One of the lowest highway concentrations in the world is in India.
In a recent meeting with the officials, Union Minister for Road Transport and Highways, Ho. Chief Shri. Nitin Gadkari, proposed to increase the speed limit of vehicles on expressways (controlled-access highways) by up to 20 kilometers per hour (kmph). He claimed that this was because India's motorways have been improved, enabling faster travel than in the past. Currently, the top speed limit for automobiles on motorways is 120 kph, and the top speed limit for cars on national highways is 100 kph.
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Shri. Nitin Gadkari, however, held a different viewpoint on the matter. He continued by saying that modern motorways had been constructed throughout the nation to the point where not even a dog could go on them due to barricades placed on both sides of the road. He said that he had created a "file to adjust the maximum speed limitations for cars" for the various sorts of roads. "In a democracy, people have the power to make laws and judges have the power to interpret the law... Thanks to a Bill that will soon be tabled in Parliament, the speed limit for cars on Indian roadways will soon be altered.
Through this paper, the various geometric parameters will be highlighted. This will help to decide the minimum values for geometric parameters required for highspeed corridors.The main objective of this study is to analyse relation between the speed and geometric parameter of highways to prepare the minimum standards required for highspeed corridors.

II. LITERATURE REVIEW

1) Manual of Specifications and Standards for Expressway IRC SP 99-2013
(Published by Indian Road Congress)
A standard Manual of Specifications and Standards for Expressways was decided by the Ministry of Road Transport & Highways and the Planning Commission through a series of meetings held in December 2012 and January 2013 in recognition of the need for the rapid development of Access Controlled Facilities while simultaneously ensuring safe and high-speed travel that, among other things, increases the productivity of the road transport system (IRC).
Accordingly, the IRC formulated the proposal and the task for the same was entrusted to IRC by the Ministry of Road Transport & Highways on 11th February, 2013.

The Ministry of Road Transport & Highways constituted a Peer Review Group under the Chairmanship of Director General (Road Development) & Special Secretary having members representing all categories of stakeholders. The Expert Group prepared a Technical Note on Critical Issues which was discussed during the Workshop organized by the MORTH on 22nd February, 2013 and also in Planning Commission on 6th March, 2013. The Critical Issues were deliberated, discussed and frozen during these two meetings, which enabled the Expert Group to move forward.

2) Theoretical Review on the Vertical Geometric Design Standards for High- speed Roadways

(Song Mint ae, Kang Hoguen, Kim Heungrae, Lee Euijoon, Shin Joonsoo, Kim Jongwon International Journal of Highway Engineering)

The goal of this study is to theoretically review the process of deriving vertical grades in an extremely fast environment while contrasting domestic design standards with those used abroad. It also develops high-standard vertical grade design criteria that are appropriate for domestic circumstances in Korea.

The speed-distance curve of the vehicle is calculated under each design speed condition by investigating domestic vehicle registration status, computing typical vehicles, and utilising the traffic simulation tool Vissim. Maximum longitudinal inclination is suggested using the speed-distance curve, critical length of grade estimation, and critical length of grade consideration.

The typical vehicle for determining vertical grade is determined using a gravity horsepower ratio of 200 lb/hp as a function of domestic vehicle registration status. Utilizing Vissim, a speed-distance curve is developed to determine the essential length of gradient based on the change in uphill entrance speed. Based on the point of retardation criteria of design speed 20 km/h, the critical length of the gradient is computed. Based on the estimated critical length of the gradient, which is 808 m, the maximum longitudinal inclination in the design speed range of 130 to 140 km/h was confirmed.

The scenario of the usual vehicle (truck), which has a design speed between 130 and 140 km/h and a maximum longitudinal gradient of 2%, is suitable in a super high speed environment.

III. CONCLUSION

In the present study we tried to find out the minimum Geometric design standards required to maintain the Design speed of 140 Kmph for Indian roads. Also, the comparison of the specific site of case study with increasing the speed to 140 kmph to check the additional requirement of Land, Approach Length and Earthwork filling.

From the results of present study following conclusions can be made for Indian Roads.

1) The minimum Horizontal Radius of curve shall be 1290m to achieve 140 Kmph considering 5% maximum superelevation.

2) The minimum Stopping Sight Distance (SSD) and Discission Sight Distance (DSD) shall be 325m and 660m respectively maintained.

3) The Transition length shall be provided to the horizontal curves as per below Table

Sr. No.	Horizontal Radius in m	Length of Transition curve by rate of change of acceleration in m	Length of Transition curve by rate of change of superelevation in m	Length of Transition curve to be adopted for Design in m
1	1290	92	135	135
2	1300	91	132	132
3	1400	85	109	109
4	1500	79	89	89
5	1600	74	72	72
6	1625	69	NR	NR

4) The Minimum Superelevation shall be provided for the horizontal curves to counteract the centrifugal forces as per below Table

Sr. No.	Horizontal Radius in m	Superelevation in %
1	1290	5%
2	1300	4.87%
3	1400	4.02%
4	1500	3.29%
5	1600	2.65%
6	1625	2.5% (NC)

5) The minimum Length of Vertical Curves or K Value shall be as per below Table.

Sr. No.	Length of Summit Curve				Length of Valley Curve		
	Stopping Sight Distance (SSD)		Intermediate Sight Distance (ISD)				
	(L>S)	(L<S)	(L>S)	(L<S)	(L>S)	(L<S)	
1	1200.28	562	2268.75	1128	272.58	262.5	Length of Curve in m
2	240.056	112.4	453.75	225.6	54.516	52.5	K Value

6) As results from the comparison of case study, to modify the designed alignment from Design speed of 100 Kmph to 140 Kmph, the Approximately Two-times Land, Approach length and Earthwork filling is required

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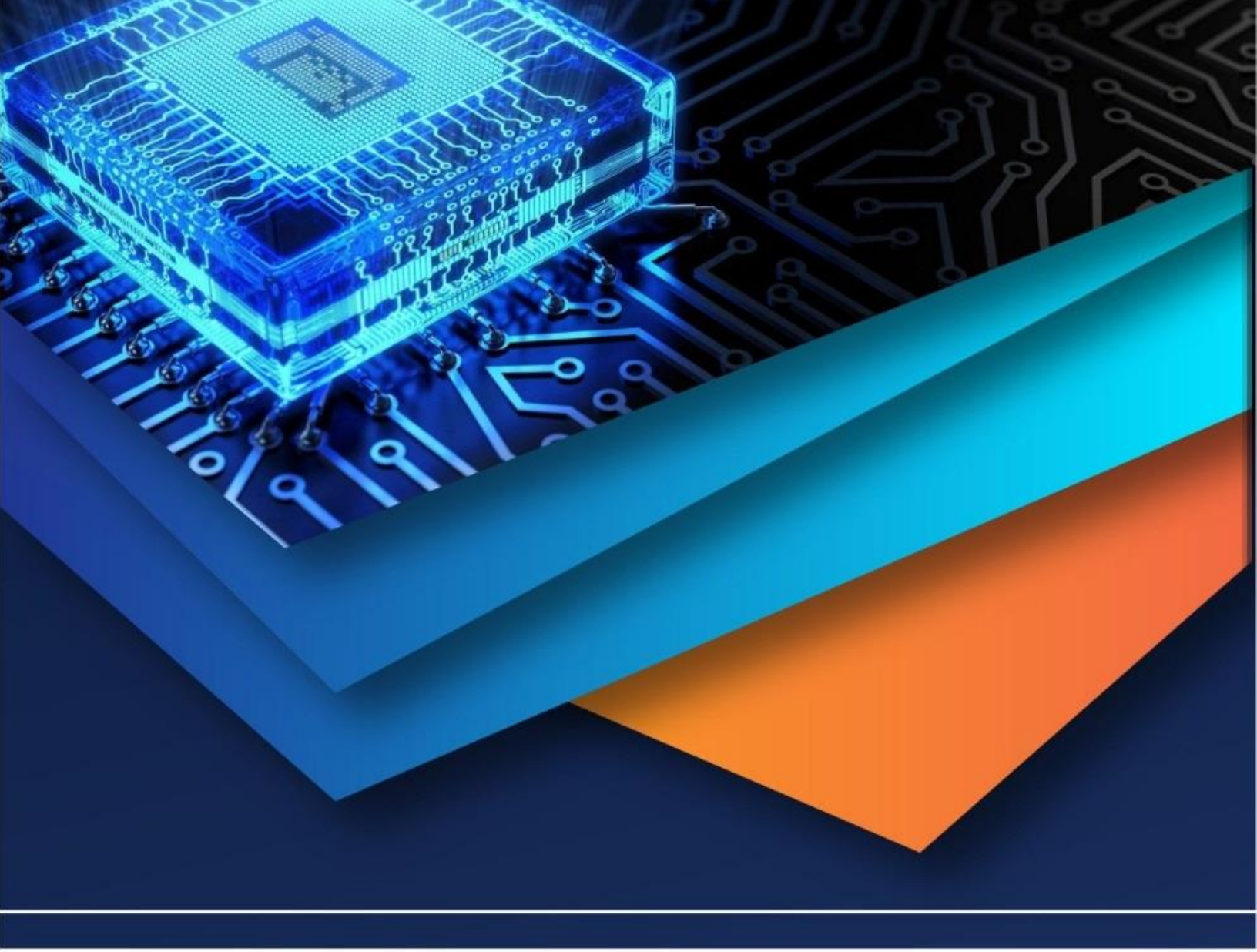

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