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STUDIES ON GEOMETRIC IMPROVEMENTS ON HIGHWAYS : A REVIEW

Engineering

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ABSTRACT

The dimensions and layout of a highway is governed by a geometric design. The objective of geometric design is to provide safety, driving comfort and fuel efficiency at a reasonable cost and with less impact to the environment. This paper reviews studies on the same and aim at providing much-needed attention to efficient planning and design for infrastructure projects.

KEYWORDS

geometric design, environment impacts, efficiency, safety

INTRODUCTION

Geometric Improvement is improving the geometric features and layout of the highway for ensuring safe movement of vehicles. The process involves improving existing deficiencies in alignment, vertical profile and cross sections to design standards for safe travel. Studies have presented the dependence of road geometric elements on accident rates and the necessity of planning and design to reduce accident occurrence. This paper reviews the studies conducted on the geometric design, impacts on environment, economy and safety

CRITICAL REVIEW:-

Anitha Jacob and Anjaneyulu, M.V.L.R (2013) et al conducted a Research study on the necessity of geometric design consistency rural highways. The study recommends that sudden changes in road geometry or increase in design speeds shall be avoided to ensure safe travel in two-lane highways. Multiple curves shall be designed in such a way as to avoid abrupt changes which driver will not be able to negotiate and may result in accidents

Jesna, N.M. and Anjaneyulu, M.V.L.R., 2016 studied dependability of Horizontal Curves with respect to geometric elements on two lane roads in Kerala, India. Utilizing data from horizontal curves in Kerala, the consistency for single horizontal curve was performed in this work. Sight distance, superelevation, and extra widening were used in the analysis as the geometric features that affect the safety of a horizontal curve. Superelevation and extra widening can also be employed for the examination of horizontal curves, it was discovered, in addition to sight distance. Safety can be gauged using the values which was obtained as a result of the analysis. The findings demonstrate that curves with higher dependability values are safer than those with lower ones. This analysis helps the designers to give attention to geometric elements which will improve road safety.

Jacob, A., Akkara, J., Jinesh, K.J. and Therattil, J.P., 2022. submitted a research paper on impact of road geometry on passenger car and bus drivers in Kerala. The study involved test runs on road alignments within specific range. The extent of fatigue caused to drivers due to the road geometry were analysed and it was observed that it was more for car drivers than bus drivers observed that more for cars. The study concludes that major desirable factors for drivers on horizontal curves are sufficient width of shoulders and sight distances

Sujith K Ma (2015) presented a study on the benefits of geometrically designed access controlled highway along Kerala state. The study has identified the positive impacts as safe travel due to designed horizontal and vertical curves, reduced traffic on the existing state highways and other major routes, extension of development to outer areas, and socioeconomic growth in urban as well as rural areas.

Kang, M.W., Shariat, S. and Jha, M.K., 2013. proposed new geometric design techniques to reduce vehicle costs and to improve road safety. The paper analyses options to enhance the essential requirements of road users while considering the existing road details. Suggestions to improve mileage is a) to improve the road geometry by adopting consistency in design so that frequest gear changes are avoided and b) to adopt a sedate driving method to drive within the fuel economy range suggested by car manufacturers and to avoid sudden acceleration or deceleration etc

Karlaftis, M.G. and Golias, I., 2002. presented a research paper on the relation between road alignment, traffic and the number of accidents. An extensive statistics based approach was used to establish the interconnection between these three vital aspects and the future growth rate of accidents is also arrived at. The study helps in analysing planning and design requirements of road stretch to reduce accident occurrence.

Russo, F., Mauro, R. and Dell'Acqua, G., 2012. conducted a research study assessment of design consistency which is the key factor for enhancing road safety. The study included a design review on two lane roads without spiral curves to check design consistency. A model is developed which can maintain design consistency over the entire length of the highway

Gichaga, F.J., 2017. presented the statistics on Socioeconomic growth as well as an increase in accidents on a road in Kenya after a major upgradation program. Traffic increased on the project road and overspeeding is found to be a major cause of the accident in the new road. Another topic discussed is the results of road safety monitoring on another busy road. The research paper finds errant drivers and careless pedestrians as major contributing factors for major causes of accidents. It is concluded with recommendations for education and training to drivers on a regular basis on all aspects of road safety.

Rafiqul Tarefder (2015) studied the benefits of road geometric improvements in people's lives. Safety, less fuel operation costs, good fuel efficiency, savings and earnings, good productivity etc are some of the advantages of a roadway project. However, it is noted that job opportunities don't increase with the roadway development

Vayalamkuzhi, P. and Amirthalingam, V., 2016. conducted a study on the effects of geometric design features on traffic flow and safety. The study's main goal is to use two way -directional data from an Indian-divided highway with variable traffic circumstances to analyse how geometric design features affect traffic safety. When the geometric profile changes, the crash frequency rises. Additionally, it was found that crashes are more with vehicles travelling toward the south than towards the north. This demonstrates unequivocally that the crash frequency varies in relation to direction. According to the study, the horizontal curve radius shall be as per safe limits for a safe and with less fatigue to the driver

Federica Nobilia et al (2019) submitted a study on impacts on environment caused due to highway geometric features. Fuel usage and exhaust air from vehicles were considered as deciding factors for the study. It is observed that vehicle requires more fuel for negotiating acute curves and emissions are high. Road alignments with flat curves cause fewer gear changes which in turn cause better efficiency and less fuel costs and emission levels are substantially less. Also it is concluded that emissions are directly proportional to speed of the vehicles

Bosurgi, G., Pellegrino, O. and Sollazzo, G., 2013. suggested solution for selection of highway alignment with less impact to environment hence reducing overall project cost. A algorithm was developed considering environmental facts which need to be avoided in planning and design stage itself to arrive at optimized costs.

Hamid Farhad Mollashah (2017) studied the actual superelevation required by vehicles for negotiating curves at various speeds and found that the values are greater than codal provisions for speeds less than 100kmph. The study provides adjusted superlevation charts which can be used by designers for develop alternative options for improvement of horizontal curves without compromising on road safety.

Mohammad Mahanpoor (2020) conducted a comparative study on the costs for pavement repair and vertical alignment as per gradients suggested in codes. Pavement condition survey and sections were classified based on distress percentage. Construction costs, vehicle operation costs and fuel costs were calculated for both the options. Pavement repair with less improvement to vertical gradients is found to be the option with maximum savings in Total Project costs.

Fambro, D., Fitzpatrick, K. and Koppa, R., 1998. presented a paper to estimate stopping sight distances for geometric design. Real world driving tests were conducted to understand the driver behaviour, driver viewing height, and car stopping tendencies to arrive at the findings. It is concluded that obtained results are within the limits mentioned in cosdes and that vertical geometric details can be further optimised without impacting road safety.

Kalita, K. and Maurya, A.K., 2020. The goal of the research is to develop an up-to-date evaluation of tasks that deal with dependability-based practices in geometric design and their potential for future analysis. Sight distances and geometric layouts developed using this method aids in design evenness which enhances road safety.

Bivina, G.R., Landge, V. and Kumar, V.S., 2016. studied whether geometrical design functions and variables applied to reduce accidents vary from country to country and a common function can be applied to all over the world. Studied have been conducted and it is found that there are similarities in the geometrical design variables applied for Curve radius, sight distances, desired gradients and superelevation criteria

Bivina G R (2014) did research on the socioeconomic value of traffic delays and need for efficient planning and geometrically designed road. The main objective of the study is to assess the entire costs of vehicle delays encountered along a particular corridor in Trivandrum city. Data gathering, questionnaires, and analysis were the study's methodology choices. It is concluded that traffic delays affect the economy to a great extend and also affects efficiency of individuals and effective planning, management of road asset and resource development will aid in reduction of traffic congestions.

CONCLUSIONS

This paper provides insight to the various studies related to geometric improvement conducted all around the world. This literature study emphasizes the necessity of geometric improvement in road safety. All aspects related to highway design such as improvement to horizontal alignment, sight distances, and desirable gradients are discussed in detail. Many research papers explain how a well-designed and safe road corridor can bring change in the day to day life. Researchers have shown a light on the changes an efficient planning and design system can bring to people's lives. Particular emphasis is given to the relationship between road geometric elements with accident rates and forecasts to help planners and designers develop safe and efficient transportation systems for the future.

REFERENCES:

[1] Jesna, N.M. and Anjaneyulu, M.V.L.R., 2016. Reliability analysis of horizontal curves on two lane highways. Transportation research procedia, 17, pp.107-115.

[2] Jacob, A., Akkara, J., Jinesh, K.J. and Therattil, J.P., 2022. Effect of Non-urban Two Lane Highway Geometry on Car and Bus Drivers–A Physiological Study. Transportation research procedia, 62, pp.358-365

[3] Sujith, K.M., 2016. Access controlled high speed corridor and urban development of Kerala. Procedia Technology, 24, pp.1851-1857Yannis T.H (2014) A review of the effect of traffic and weather characteristics on road safety, International journal of engineering research & technology, 72C:244-256.

[4] Kang, M.W., Shariat, S. and Jha, M.K., 2013. New highway geometric design methods for minimizing vehicular fuel consumption and improving safety. Transportation research part C: emerging technologies, 31, pp.99-111.

[5] Russo, F., Mauro, R. and Dell'Acqua, G., 2012. Rural highway design consistency evaluation model. Procedia-Social and Behavioral Sciences, 53, pp.952-960.

[6] Bosurgi, G., Pellegrino, O. and Sollazzo, G., 2013. A PSO highway alignment optimization algorithm considering environmental constraints. Advances in Transportation Studies, (31).

[7] Mollashahi, H.F., Khajavi, K. and Ghaeini, A.K., 2017. Safety evaluation and adjustment of superelevation design guides for horizontal curves based on reliability analysis. Journal of Transportation Engineering, Part A: Systems, 143(6), p.04017013.

[8] Mahanpoor, M., Monajjem, S. and Balali, V., 2021. An optimization model for synchronous road geometric and pavement enhancements. Journal of Traffic and Transportation Engineering (English Edition), 8(3), pp.421-438.

[9] Kalita, K. and Maurya, A.K., 2020. Probabilistic geometric design of highways: a review. Transportation research procedia, 48, pp.1244-1253.

[10] Fambro, D., Fitzpatrick, K. and Koppa, R., 1998. A new stopping sight distance model for use in highway geometric design. Transportation research circular, (E-C003), pp.33-1.

[11] Bivina, G.R., Landge, V. and Kumar, V.S., 2016. Socio economic valuation of traffic delays. Transportation Research Procedia, 17, pp.513-520.

[12] Karlaftis, M.G. and Golias, I., 2002. Effects of road geometry and traffic volumes on rural roadway accident rates. Accident Analysis & Prevention, 34(3), pp.357-365.

[13] Elvik, R., 2013. International transferability of accident modification functions for horizontal curves. Accident Analysis & Prevention, 59, pp.487-496.

[14] Jacob, A., Dhanya, R. and Anjaneyulu, M.V.L.R., 2013. Geometric design consistency of multiple horizontal curves on two-lane rural highways. Procedia-social and behavioral sciences, 104, pp.1068-1077.

[15] Tarefder, R., 2015. Human benefits of road improvements: a case study. Procedia Manufacturing, 3, pp.3254-3261.

[16] Gichaga, F.J., 2017. The impact of road improvements on road safety and related characteristics. IATSS research, 40(2), pp.72-75.

[17] Vayalamkuzhi, P. and Amirthalingam, V., 2016. Influence of geometric design characteristics on safety under heterogeneous traffic flow. Journal of traffic and transportation engineering (English edition), 3(6), pp.559-570.

[18] Nobili, F., Bella, et al 2019. Environmental effects of road geometric and operational features. Transportation research procedia, 37, pp.385-392.