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#### “A REVIEW ON HIGHWAY GUARDRAIL FAILURE ANALYSIS ”

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#### ABSTRACT

*For aesthetic reasons, several government organisations install timber guardrails on scenic highways and roads instead of traditional steel guardrails. To carry the huge tensile pressures induced by vehicle collision and transfer load to the posts, most acceptable timber guardrails rely on a continuous steel backing component. Due to the use of big, solid-sawn timber sections, these guardrails are relatively expensive and hefty. The guardrail framework to assimilate more energy and offer better security to the vehicle, an inflexible wooden blackout was supplanted by another crushable blackout plan that was assessed at the segment level. The new blackout was framed by three accident jars and set off at the corner, then, at that point was carried out in the full-scale mode.*

**Key Words:** FRP, FRP, guardrails, crash tests.

#### I. INTRODUCTION

Indians are among the most versatile individuals on the planet. Insights show that 74% of residents matured 40 years or more seasoned own an engine vehicle and voyaged a normal of 16,000 kilometers on India's streets during the year 2004, Transport India. The quantity of authorized drivers hopped from 17.1 million of every 1988 to over 22.5 million out of 2005, Transport India. This degree of versatility accompanies a cost. Truth be told, Statistics India shows that the quantity of mishaps, however diminished during the last decade, actually stays high as delineated in Table 1.1. The quantity of fatalities diminished from 4154 of every 1988 to 2767 out of 2007 while the quantity of genuine mishaps diminished from 28031 out of 1988 to 13723 out of 2007. The expense of the revealed mishaps in 2004 was around \$63 billion Vodden et al., (2007). On account of the passings and wounds, car accidents keep on being the significant transportation security issue in India and stay one of the main supporters of long stretches of lost life among Indians, to a great extent because of passings among youngsters, Transport India. In the United States, Baker and Krueger (1992) revealed that in 1985 engine vehicle mishap wounds cost \$49 billion dollars in clinic spending, treatment and circuitous expenses. The vehicles are exposed to various types of crash: full front, back sway, side effect, back rakish effect, rollover and so forth Mishaps can occur in the city, at low velocities, or on the expressways at higher rates. To further develop the vehicle execution and diminish the engine vehicle wounds and fatalities, government associations issue guidelines and wellbeing principles. The decrease of wounds can be accomplished either by upgrading the traffic guideline or by executing more dynamic security highlights or by further developing latent wellbeing execution of the vehicle. In India, the Ministry of Transportation is the authority substance that directs vehicle security. The Transportation Development Center (TDC) is Transport India's focal innovative work branch, under the Policy Group's Transportation Technology and Innovation directorate. As Transport India's focal point of mastery for innovative work, it deals with a multimodal R&D program pointed toward working on the wellbeing, security, energy proficiency, and availability of the Indian transportation framework, while ensuring the climate. Its order is to improve the office's mechanical ability, to address the office's essential targets and national government needs, and to advance development

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in transportation.

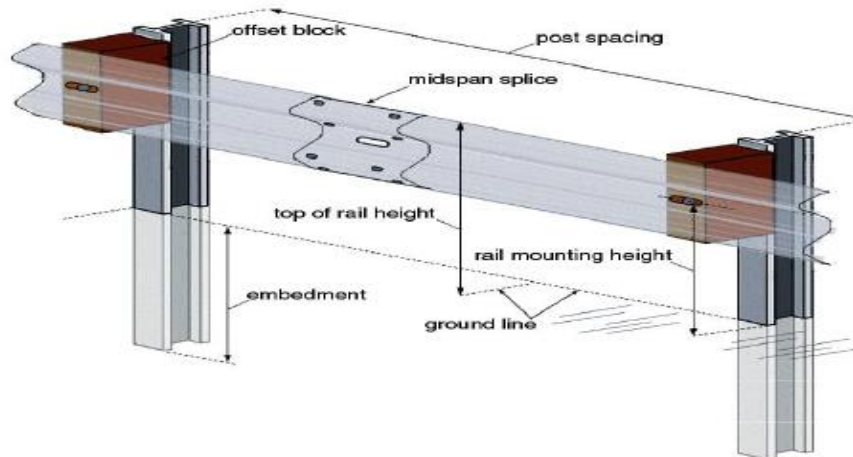


Figure 1 Use of midspan splices and offset blocks in a MGS (Ochoa, C & Ochoa, T, 2011)

## II. LITERATURE REVIEW

**Olegas Prentkovskis et al.**[1] in their work 'An investigation of the redirections of metal street guardrail components, 2009' has examined Statistical information on auto collisions in 2008 in Lithuania. Metal guardrails, comprising of  $\Sigma$ -shape metal posts and a defensive W-shape even shaft, are generally famous. The creators inspected the disfigurement cycles of the components of the previously mentioned guardrail. They have additionally assessed flexible distortions, just as the impact of soil on the covered post part of the guardrail. In view of the created numerical model of metal street guardrail, the diversions of its components brought about by the effect of a vehicle moving at different not set in stone. The got upsides of avoidances of guardrail components (a defensive W-shape level shaft and a  $\Sigma$ -shape post) introduced in paper don't surpass the permissible upsides (of bar diversions). The model created might be altered to utilize it for the examination of distortion cycles of shaft framework's designs in transport foundation (for example light posts, traffic-signals and street signs).

**D.A.F. Bayton et al** [2] in his work "Investigation of a security boundary association joint post-testing (Elsevier, 2007)" inspect the impact of a full effect vehicle crash test on the joint material and the mechanical latches that structure part of the wellbeing obstruction pillar to radiate association joint. The outcomes show changes in the wellbeing hindrance bar material microstructure in the space of the opened openings where the mechanical clasp were exposed to shear stacks because of strain powers in the security obstruction shaft. Extra data is introduced to exhibit that adjustments of the material microstructure have not been brought about by cool work disfigurement supported in the assembling cycle. Further testing utilizing various materials, diverse space profiles and distinctive breadth bolts would decide their commitment to joint execution. They might even upgrade the hindrance execution as far as decreasing joint slip and obstruction avoidance or in fact they might have little impact on in general framework execution.

**M. Borovinsek et al** [3] in their work "Reenactment of crash tests for high regulation degrees of street wellbeing hindrances (Elsevier,2007)" presents the aftereffects of programmatic experiences of street security obstruction conduct under vehicle crash conditions for high control levels as commanded by the European standard EN 1317. An excellent understanding of reenactment and genuine accident tests results was noticed, which thus legitimizes the utilization of programmatic experiences during the time spent turn of events and affirmation of street wellbeing obstructions. In spite of the more prominent affectability of speed increases to not completely obliged test boundaries, the aftereffects of the reproduction and of the test contrast inside worthy  $\pm 10\%$  edge. In any case, utilizing parametric programmatic experiences the best boundary plan for anticipated examination boundaries not really settled with sensible exactness.

**Omer F. Cansiz, et al [4]** in their work "Crash test recreation of an altered three-bar high regulation level guardrail under NCHRP Report 350 TL 4-12 conditions (Inderscience,2006)" depicts subtleties of a programmatic experience study performed on an adjusted three-bar high control level guardrail assigned as SGR09b. An itemized limited component model of the SGR09b guardrail framework has been created and exposed to 8000 kg single unit truck sway under NCHRP Report TL4 conditions. In view of the accident test results, still up in the air that the limited component models for both the SGR09b guardrail framework and the 8000 kg single unit truck are genuinely exact and can be utilized with trust in additional PC mimicked virtual side of the road wellbeing research. At long last, it is suggested that as a future report, the crashworthiness of the SGR09b guardrail framework ought to be assessed under EN 1317 H4a or H4b guidelines which indicate sway by a 30 000 kg truck.

**Wen Hu, et al [5]** in their work 'Middle hindrance crash seriousness: Some new experiences (Elsevier, 2010)' they talks about the assessment of a settled logit model of middle boundary crash seriousness utilizing 5 years of information from country isolated roadways in North Carolina. Vehicle, driver, street, and middle cross-area plan information were factors considered in the model. A remarkable part of the information used to gauge the model was the accessibility of middle hindrance arrangement and middle cross-slant information, two components not ordinarily remembered for street stock information documents. The assessment results demonstrate that impacts with a link middle hindrance increment the likelihood of less-serious accident results comparative with crashes with a substantial or guardrail middle obstruction. Expanding the middle obstruction offset was related with a lower likelihood of serious accident results. The presence of a link middle hindrance introduced on foreslopes that were somewhere in the range of 6H:1V and 10H:1V were related with an increment in extreme accident probabilities when contrasted with link middle boundary establishments on foreslopes that were 10H:1V or compliment.

**Gabriel Jiga et al [6]** in their article "Investigation of Shock Attenuation for Impacted Safety Barriers.( Elsevier 2014 the writers propose and dissect the effect conduct of two new security guardrail frameworks to raise the effect energy assimilation. The tests were performed utilizing as effect or a 1500 kg Chevrolet C1500 get truck from the NCAC models library. the creators propose and dissect the effect conduct of two new security guardrail designs to expand the effect energy ingestion. Furthermore, this framework ought to be planned as an encased complex attenuator cap would fit at the interface between monitor rail and fixing post. Indeed, even that the lamellar and elastic damping components framework is mounted on a U profile with a lower flexural modulus, the primary honesty of the guardrail is influenced just, the vehicle being securely diverted on the street. The new proposed arrangement is extremely proper one, because of the vehicle yaw uprooting rotational point, keeping away from huge disfigurements of the vehicle structure and all the while a decent redirection on the street. In future, new exploratory tests will be acted to check the accessibility of the proposed arrangement.

**Jean-Louis Martin et al [7]** in their work "Long haul examination of the effect of longitudinal obstructions on motorway wellbeing (2013 Elsevier)" evaluate the impact of longitudinal boundaries situated on the middle strips and hard shoulders of cost motorways on crash seriousness in vehicles running off the street. The examination depended on crashes including injury and property harm just, recorded from 1996 to 2010 on a French cost motorway organization of around 2000 km. A particular uneven W-bar guardrail ("GS4") had all the earmarks of being the best answer for vehicles, and in any event, for LUVs and trucks. This doesn't influence the suitability of explicit guardrails for spans or of substantial boundaries, when limited working widths are required. In run-off onto middle strips, a particular guardrail ("GS2") gave off an impression of being the most productive, trailed by the three other metal guardrails as of now introduced. Substantial obstructions, be that as it may, are considerably more viable in forestalling total intersection of the middle, which is extraordinary and basically includes trucks, however frequently with intense outcomes. certain angles, for example, the impact of vehicle configuration change (as far as mass, calculation and uninvolved security frameworks), traffic conditions and paces, were not concentrated here, and require further examination.

**Detlef H.- J.F.Neuenhaus et al[8]** in their work "Utilizing multibody-framework displaying to make exact forecasts of vehicle impacts on street limitation frameworks (2012 Elsevier)" they characterize and affirm a vehicle restriction systems(VRS) to these levels,EN1317requires completing normalized full-scale sway tests ,causing generous costs. To

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decrease such expenses, EN1317-section 5 expressly permits supplanting those full-scale sway tests. Because of the great necessities on replicating the genuine effect tests by reenactments, the displaying of the VRS just as of the vehicle requests for extraordinary precision and high abilities. Effectively minor changes on the model of the VRS or vehicle might cause critical changes in outcomes by computational reproductions under specific constraints, specifically if a VRS is simply dependent upon adjustments.

**Myung-Hyun Noh et al [9]** in their article "Development resistance impacts of built up posts on crash exhibitions of an open-type guardrail system(2017 Elsevier)" clarifies about precision of the reproduction was checked utilizing subjective and quantitative correlations with a full-scale crash investigation of trucks and vehicles. Ensuing reenactment results present that the further developed model performs much better in containing and diverting the affecting vehicle in a steady way. The mathematical outcomes for different boundaries are confirmed by contrasting various models and dynamic reactions and traveler not set in stone in the hindrance from the accident recreation. For expanded points the negative way. The complete firmness of hindrance framework is influenced very little by the little establishment point variety of the supporting plate.

**John D. Reid et al [10]** in their work "Effect execution of W-pillar guardrail introduced at different flare rates (2008 Elsevier)" examined The possibility to increment recommended flare rates for solid post, W-shaft guardrail frameworks and along these lines diminish guardrail establishment lengths. Programmatic experience and five full-scale crash tests were finished to assess expanded flare rates up to, and including, 5:1. Programmatic experiences demonstrated that traditional G4(1S) guardrail changed to join a directed wood square couldn't effectively meet NCHRP Report 350 accident test models when introduced at any more extreme flare rates than the 15:1 suggested in the Roadside Design Guide. All tests directed up to, and remembering for, a flare pace of 5:1 passed all NCHRP 350 security execution assessment necessities, including inhabitant hazard estimates that are not explicitly needed for Test 3–11 and including not diverting any vehicles back into the street into adjoining traffic. Also, all tests had higher effect points and rates than those predefined in NCHRP 350, coming about in considerably higher powerful flare rates than planned. These tests show that the MGS is an extremely hearty framework when introduced in an erupted design. Carrying out discoveries from this investigation ought further develop side of the road security, yet additionally diminish guardrail development and fix costs.

**Z. Ren et al [11]** in their article "Computational and test crash examination of the street wellbeing hindrance (2005 Elsevier)" depicts the computational investigation and trial crash trial of another street security boundary. The reason for this exploration was to create and assess a full-scale computational model of the street wellbeing hindrance for use in crash reenactments and to additional contrast the computational outcomes and genuine accident test information. The effect seriousness and solidness of the new plan have been assessed with the dynamic nonlinear elasto-plastic examination of the three-dimensional street security boundary inside the structure of the limited component strategy with LS-DYNA code. Examination of computational and test results demonstrated the rightness of the computational model. The tests have likewise shown that the new security hindrance guarantees controllable accident energy assimilation which thusly builds the wellbeing of vehicle inhabitants. From correlation of computational (Section 6) and exploratory (Section 7) results it very well may be seen that the outcomes contrast very well in connection with the functioning width of the framework (processed 1.2 m; estimated 0.95 m) and contact length (registered 10.8 m; estimated 12 m). The distinctions can be credited to boundaries used to portray material unique conduct in calculations, which were clearly thinking little of the solidness increment of the material under powerful effect stacking. ASI file for the tried framework doesn't surpass the restricting worth regardless. The most noteworthy qualities (computational 0.66; estimated 0.63), are seen when the front wheel hits the primary post.

**Sadok Sassi et al [12]** "Basically of crushable blockouts on a full-scale guardrail system(2016 IJC)" examines about the communication of the vehicle with the guardrail framework by adding more consistence to the guardrail framework. A limited component gauge model of a guardrail framework comprising of a light truck (2000 kg) going at 100 km/h and striking a guardrail was created as per the NCHRP Report 350 rules for Test Level 3 wellbeing execution. All together for the guardrail framework to assimilate more energy and offer better security to the vehicle, an inflexible wooden blockout was supplanted by another crushable blockout plan that was assessed at the segment level. The new blockout was framed by three accident jars and set off at the corner, then, at that point was carried out in the full-scale

model. The aftereffects of the examination show that the two models fulfill the prerequisites of NCHRP Report 350 for the Test 3-11 conditions. In the principal reproduction, where the guardrail radiates utilized an incompressible blockout, the vehicle was securely diverted get-togethers sway. In the subsequent reproduction, a crushable blockout was utilized to substitute the current rectangular wooden blockout. It comprised of longitudinal cylinders sandwiched between two plates and set off at the four countenances. The reproduction results unmistakably show that the vehicle was securely diverted, as in the pattern.

**Ala Tabiei et al [13]** in their work "Guide for crashworthiness "limited component reproduction of side of the road wellbeing structures (2000 Elsevier)" examined to foster an exact reenactment of truck affecting a solid post W-shaft guardrail. Itemized strategies for framework reproduction are proposed and three significant issues which include the utilization of springs to reenact part crashworthiness conduct is examined. Rail to blockout bolt association, soil-post powerful communication, and the impact of guardrail closes are displayed and recreated. Soil-post association is displayed utilizing both Lagrangian and Eulerian networks; results utilizing the two techniques are introduced. The current paper gives a guide to reenactment of expressway security structures. Three significant issues are significant when demonstrating the G4(1S) solid post guardrail for sway reproduction. Rail to blockout bolt association., Soil-post unique cooperation., Impact of guardrail closes Approximating the firmness of the unmodeled segments of the guardrail by a straightforward direct spring dependent on the revealed condition is rearrangements. The model should represent the dirt post connection. Since position of the bolt in the opened opening of the guardrail is arbitrary, two outrageous cases are mimicked and both should be utilized in the full model reproduction to decide their impact on the complete conduct. Both Lagrangian and Eulerian definition is utilized in the reproduction of post-soil dynamic connection. Hypothetically these two techniques should prompt similar outcomes. Notwithstanding, there is some distinction saw in the outcomes, which is ascribed to the cross section insecurity in the Lagrangian definition. Eulerian network is more steady for soil reproduction. All the above discoveries are joined in the full framework model for crashworthiness reenactment.

**Weijia Wu et al [14]** in their work "An investigation of the communication between a guardrail post and soil during semi static and dynamic loading(2006 Elsevier)" examines the collaboration of rock with a Sigma-post of a standard Swedish guardrail in tests and mathematical examination. The point was to quantify the strength of the single post installed in rock and utilize the information to approve a PC model for the examination of the dirt post association. A semi static and dynamic test series were planned and done. Two halls were shaped by the test information for the semi static and dynamic stacking conditions, separately. The collaboration of rock and post was explored through investigations and programmatic experiences. In the trials, the power applied straightforwardly to the post was estimated to get the strength of the single Sigma-post moored in rock. Two hallways were shaped from the deliberate information of the semi static and dynamic tests. At the point when a test was continued utilizing an indistinguishable post, the deliberate obstruction power showed a few contrasts presumably on the grounds that the level of compaction of rock around the post was not by and large the equivalent. As indicated by the estimation information the powerful opposition was about double the semi static obstruction. Both the uninvolved repression of the dirt and the strain rate impact of the steel brought about this distinction. The upgraded strength of the steel material during dynamic stacking was the predominant explanation that the unique obstruction power was double the semi static opposition power. In the virtual experiences two material models in LS-DYNA were explored and used to reenact the dirt, individually. The consequences of this investigation showed that the dirt and substantial material model can viably catch soil-post communication under sway stacking for roughly 280mm of post redirection, while the FHWA soil acted excessively hardened comparative with the dirt tried. The dirt and substantial model can be utilized for the effect recreations of a full-scale guardrail framework given that the post diversion is kept inside the bound not set in stone in this examination. The info boundaries of the dirt and substantial material model were prescribed to display side of the road rock.

### III. CONCLUSION

This chapter discusses the methods of analysis that are used in this study, including modelling the G4(2W) guardrail system, performing the dynamic tests and validating the FEM model. Computer simulation is the most versatile approach for investigating a wide range of possible impact scenarios (e.g., vehicle type, guardrail type, and impact conditions). Computer simulation can also be very useful for determining the precise effects of a crash with a barrier on

a vehicle's performance. Experiments and finite element analysis (FEA) are two methods that were considered for use in this study. In an experiment, a static test is performed to validate the model of the W-beam rail section, and the FEA model is used to model different crash scenarios.

## REFERENCES

- [1] Shailesh S. Sengar, Vaibhav Raghav, Chadaram Srinivasu . Design & Fabrication of a Special Tool to Produce Square Hole. *Procedia Materials Science* 6 ( 2014 ) 1823 – 1836. pages 14 ,2014.
- [2] Michael J. Mossinghoff . Enumerating isodiametric and isoperimetric polygons. *Journal of Combinatorial Theory, Series A* 118 (2011) 1801–1815. Pages 15.2011.
- [3] Raviraj.D.Gohil, Manhar.S.Kagthara, Piyush.J.Mandaliya . Design of cam geometry for minimization of fillet radius effect in square hole drilling operation. Pages 10. *International Journal of Advance Engineer ing and Research Development (IJAERD)* Volume 1,Issue 5,May 2014, e-ISSN: 2348 – 4470.
- [4] Bangar Sunil Kisan, Prof. Mythili Sreeram. Modification of drilling tool to make square hole. Pages 3. *IJFEAT*. ISSN: 2321-8134.
- [5] Rahul D.Mankar, Dhananjay M.Titarmare and Amit S.Ghade. Design anf fabrication of square drilling machine by using special tool. Pages 6 , ISSN: 2456 – 2084.
- [6] Shahram Hosseini Ch., Ehsan Zamani, Seyed Matin Mortazavi . Analysis of square hole drilling mechanism using Oldham's non-coaxial couplings. pages 6. *Bull. Env.Pharmacol. Life Sci.*, Vol 4 [Spl issue 1] 2015: 197-202.
- [7] R.D. Gohil, M.S. Kagthara. Review on Design of Cam Geometry for Minimization of Fillet Radius Effect in Square Hole Drilling Operations. Pages 3. *International Journal for Research in Technological Studies|* Vol. 1, Issue 5, April 2014 | ISSN (online): 2348-1439.
- [8] Jim Foster, Tamas Szabo. Diameter graphs of polygons and the proof of a conjecture of Graham. Pages 11 *Journal of Combinatorial Theory, Series A* 114 (2007) 1515–1525.
- [9] Scott G. Smith . Drilling Square Holes. Pages 5 Vol. 86, No. 7 • October 1993.
- [10]Giorgio Figliolini, Pierluigi Rea. Reuleaux Triangle and its Derived Mechanisms. Pages 11. *Mechanism and Machine Theory*, 44 (8), 1595–1606, (2009).
- [11]A.S. Besicovitch.,1963. Minimum area of a set of constant width, in *Proceedings of Symposia in Pure athematics*. Vol. 7, pp. 13-14, Convexity, Amer. Math. Soc., Providence, RI.
- [12]Advancing EDM through Fundamental Insight into the Process, pages 6 *Annals of the CIRP*, 54/2:599-622.
- [13]Barry Cox and Stan Wagon. Circle-Squaring. A Mechanical View.Pages 5 Kunieda, M., Lauwers, B., Rajurkar, K.P., Schumacher, B.M., 2005. Francis.
- [14]H. G. Eggleston.,1952. A proof of Blaschke's theorem on the Reuleaux Triangle, Pages 8 *Quart. J. Math.* 3 296-297.
- [15]Rajurkar, K.P., Zhu, D., 1999. Improvement of Electrochemical Machining by Using orbital Electrode Movement,Pages 6 *Annals of the CIRP*, 48/1:139-142
- [16]<http://www.steelexpress.co.uk/engineeringsteel/EN9.html>.

- [17] R. Klotzler.,1975. Beweis einer Vermutung über n-Orbitformen kleinsten Inhalts, Pages 11 Z. Angew. Math. Mech. 55 557-570.
- [18] R. G. Sparber "makingsquare holes"Pages 6. version 4April 17, 2012
- [19] <https://www.slideshare.net/Arahvinth/square-hole>.
- [20] Roger J. Morell February 21, 1978 "square hole drill" Pages 7 U.S. Patent 4074778.
- [21] Watts Brothers Tool Works (1996)..How to Drill Square, Hexagon, Octagon, Pentagon Holes. Wilmerding, Penn.
- [22] A. K. Hajra Choudhury and Niranjana Roy(2010) review on "Drilling machines"-Elements of workshop Technology vol 2, pp 227-255.
- [23] Tong S.H., Yan J. and Yang D.C.H., " Design of deviation-function based gerotors ", Mechanism and Machine Theory, 44 (8), 1595–1606.
- [24] Zayas E.E., Cardona S. and Jordi L., "Analysis and synthesis of the displacement function of the follower in constant-breadth cam mechanisms ", Mechanism and Machine Theory, 44 (10), 1938 – 1949.