Assessment and Evaluation of Crash Barrier for enhanced safety performance – Review paper

Alan Paul[1], Sachin Prabhu P[2], Soundarya D[3], Mohan Kumar N.S[4]

[1,3,4] PG students, Dept of Civil Engineering, Kumaraguru College of Technology, Coimbatore
[2] Assistant Professor, Dept of Civil Engineering, Kumaraguru College of Technology, Coimbatore

---

Abstract- *Increase in population increases transportation, Roadway design includes crash barriers to redirect an out of control vehicle avoid veering off the road trajectory back on to the road while keeping the level of damage to vehicle within acceptable limits. In this study, a new crash barrier is to be designed and to be developed using nonlinear finite element simulations with design optimisation of the structure. Different types of guardrails have different protection mechanism.*

Before placing Crash Barrier on highways, computer simulation and crash testing are generally simulated for impact performances. Using finite element (FE) analysis computer simulations are done. There are three major areas for evaluation criteria 1) Structural adequacy 2) Occupant risk 3) Vehicle trajectory after collision.

Keywords: Crash Barrier or guardrails, roadways, optimisation, FEM analysis.

1. INTRODUCTION

With an exponential growth of vehicular traffic, the pedestrians are often exposed to accidents. The pedestrians are invariably channelized on the narrow footpaths which sometimes are encroached and are expected to use the pedestrian underpasses or foot-over bridges to cross the traffic roads. With the increase in flyovers and speed of the vehicles, the frequency of accidents involving the pedestrians has increased. With the objective to ensure the entitlements of the pedestrians in terms of mobility, slow and fast vehicular traffic crash barriers, safety and convenience, dividers and pedestrian's railings are provided on the central verge, together with Foot Over Bridges (FOB), sub-ways etc.

2. LITERATURE REVIEW

A) Zweden and Bryden (1977)

A statistical analysis was performed to compare the performance of the investigated barriers based on occupant injury, vehicular responses, and after impact maintenance. Although there was no significant difference in fatality rates between the two barriers, weak-post barriers exhibited a combined fatality/serious injury rate significantly lower than that for strong-post barriers. The study also related barrier damage to their stiffness: stiffer barriers had less damage or shorter damaged sections than weaker barriers.

B) Ross et al. (1984)

This paper investigate the impact performance, when longitudinal barriers are placed on sloped terrain using both crash tests and the Highway-Vehicle-Object Simulation Model (HVOSM) computer program. In the study, they determined typical conditions to place longitudinal barriers on sloped terrain and evaluated the impact behaviour of widely used barrier systems. for the selection and placement of barriers on sloped terrain Guidelines were developed. It was found from the study that W-beam and Thrie-beam guardrails were more sensitive to the terrain slopes than cable barriers.

C) Lynch et al. 1993

The objective is to identify high cross-median accidents, to determine possible safety improvements, to develop a priority listing of these locations with recommended improvements, and to develop a remedy identifying potentially dangerous locations on North Carolina interstate highways. Data collected in the study showed that 751 cross-median crashes took place in North Carolina, resulting in more than 105 fatalities. These crashes represented almost three percent of total crashes on interstate highways during the study period. The main outcome of this study was to recommend to construct median barriers at interstate highways in North Carolina at dangerous locations.

D) Gabler et al. (2005)

This project includes field investigation of crashes into the subject barriers and a survey on the median barrier of other state DOTs. This study was based on three-strand cable barriers which can contain and redirect passenger vehicles, that cable barriers were effective at reducing the incidence of cross-median collisions in wider medians, and cable barriers reduced the overall collision severity despite typically increasing the total number of accidents..

E) Hampton et al. (2010)

Crash tests and finite element analysis (FEA) is conducted on already damaged sections of the G4(1S) W-beam guardrails. The testing of already damaged barrier systems had not previously been conducted. Two crash tests were performed by the MGA Research Corporation for the NCHRP Project 22-23, "Criteria for Restoration of Longitudinal Barriers," to evaluate the performance of guardrails with pre-prescribed rail and post deflections. The barrier provided little to no resistance to the impacting vehicle, which vaulted over the barrier. The study concluded that a deflection of 0.92-ft (0.279-m) or more on the post and rail would result in the vehicle vaulting over the median barrier.

F) AASHTO (2011)

AASTHO (2011) have Presented a synthesis of information and practices related to roadside safety at a recent study. It was focused on safety treatments that could minimize the likelihood of serious injuries when a motorist leaves the roadway. The 2011 edition was updated to include hardware systems that had been tested to meet the evaluation criteria contained in the NCHRP Report 350. It also included an outline of the most current evaluation criteria contained in MASH.

G) Findley et al. (2012)

A state-wide performance of structural and safety investigation on the weathered steel beam guardrails (WSBG) in North Carolina is conducted. Due to the harsher weather conditions, New Hampshire found that the WSBG deteriorates at a much faster rate compared to the galvanized steel guardrail (GSG) in the northeast. The study concluded that in all test sites across North Carolina, there were no structural concerns about using WSBG in the state. Additionally, the research results suggested a lower percentage of injury collisions associated with WSBG installations than the GSG installations at comparison sites.

H) Midwest Roadside Safety Facility (MwRSF)

Researchers at the Midwest Roadside Safety Facility (MwRSF) performed a study on the safety performance of the Midwest Guardrail System (MGS) with no block-out. This revised design could possibly be used at locations where the required 12-inch block-out would not work and an alternative was required. They successfully crash tested the non-proprietary design of the MGS with 31 inch of rail height using a passenger car and a pickup truck under MASH TL-3 conditions (Schrum et al. 2013). The results of this report suggested that the MGS with no blockout could be used on roadways where the width of the block-out was a limiting factor and the standard MGS with block-outs was recommended for other locations.

OBSERVATION FROM THIS STUDY:

From this study, it is observed that different types of guardrails are adopted and tested and each guardrail has different advantages, mostly the guardrails systems are based on the strong post and weak beam concept to reduce damages. Finite Element Method (FEM) tools are used to analyse the systems generally. An on-site crash test is done for more accurate results and to study the behaviour.

REFERENCES

[1] CEN European Committee for Standardization. BS EN1317-1:2010 Road restraint systems. Terminology and general criteria for test methods, 2010

[2] A.O. Atahan, Finite-element crash test simulation of New York portable concrete barrier with I-shaped connector, J. Struct. Eng. ASCE 132 (2006), pp. 430-440

[3] AASHTO, Manual for Assessing Safety Hardware (MASH), American Association of State Highway and Transportation Officials (AASHTO), Washington, DC, 2009

[4] American Association of State Highway and Transportation Officials (AASHTO). Roadside design guide. Chapter 5 roadside barrier, section 5.6.3 flare rate. Washington, DC: AASHTO; 2002. pp. 5–21.

[5] Development of the MGS approach guardrail transition using standardized steel posts- Midwest roadside safety facility

[6] Delhi Development Authority- unified traffic and Transport infrastructure (UTTIPEC)

[7] Powell GH. BARRIER VII: a computer program for evaluation of automobile barrier systems. Prepared for: federal highway administration. Report No.FHWA RD-73-51; April 1973.