ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Introduction of a New Road Barrier System for Safety Management and Efficiency on the Mumbai-Pune Expressway

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Abstract :- **The transportation sector in India, has expanded rapidly especially after the onset of the new century. The Government of India is investing huge amounts of revenue in the infrastructure and transportation sector in order to link various cities and towns. The Mumbai-Pune expressway, connecting the commercial capital of the country, Mumbai, and the cultural and educational capital, Pune, is one such example of the progressive transportation sector. Though the expressway has proven to be a pioneer of infrastructure development, large number of accidents occurring is becoming a major concern for national highway authority of India. On the backdrop of such mishaps, improving the efficiency and competence of the expressway is the need of the hour. In view of this, this research paper emphasises on the optimisation and utilization of safety barriers as one of the most common methods for immunisation of road sides. This paper highlights on the need for cost effective road safety investments using 'rolling barrier' systems which can redirect the deviated automobiles onto the right pathand also prevent the overturning of vehicles.**

Keywords: **- accidents, expressway, infrastructure, transportation, optimisation, safety barriers.**

I. INTRODUCTION

In India, the transportation sector has grown leaps and bounds since the beginning of the 21st century. The expressway has witnessed 14,500 accidents leading to 1,400 deaths since its inception.The Mumbai-Pune Expressway, inaugurated in the year 2002, is an epitome of technological and infrastructural advancement of the country. Albeit it has paved the way for a faster and a comfortable journey, it has also witnessed thousands of fatal accidents. These accidents impose a huge socio-economic cost in terms of untimely deaths, injuries and loss of potential income. Moreover, accidents lead to traffic jams resulting in an overall delayed journey, contradicting the basic purpose of construction of such expressways. Therefore, road safety and management of the expressway has consequently become an issue of national concern.

II. LITERATURE SURVEY

G.Udayakumar et al.,has come up with a research paper which suggests and devises flexible median divider using suitable polymer material, so as to reduce the risk level during median divider accidents.In view of this, he has examined and analyzed the existing barrier systems and has also suggested a new flexible barrier system to overcome the drawbacks of the existing system. He has also analyzed the suggested flexible barrier with the help of ANSYS, which is an engineering simulation software and helps to put a virtual product through a rigorous testing procedure. He has suggested the use of PVC barrier in place of the conventional RCC barrier, citing its flexibility, collision impact reduction and cost effectiveness.

NCHRP report 711, suggests the use of cable barrier system to redirect errant vehicles that deviate from the actual path. The report also compares the low tension cable barriers and the high tension cable barriers on the basis of their performance. It emphasizes on the need for using high tension cable barriers considering its cost effectiveness and swift maintenance.

The report made use of vehicle dynamic programs like HVE (Human Vehicle Environment, by the Engineering Dynamics Corporation) and CarSim (by MechanicalSimulation Corporation). The programs were developed for benefit of engineers and safety researchers, to analyze the interactions among humans, vehicles, and their environment. They arehigh-level simulation tools aimed at creating three-dimensional models of vehicles and environmentsand allow the study of their dynamic interaction under selected conditions.

But, maintenance concerns for cable barriers included weak soil, foundation breaks, repair delayscaused by wet or icy medians, anchor creep, post lean, unreported nuisance hits, and costs. Although the

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newer technologies for cable barriers date back to the1990s, many agencies may have been cautious about applying the technology due to the lack of experience and limited guidance in doing it effectively.

Guido Bonin et al., has suggested the use of road safety barriers with short elements of light weight concrete. They also suggest the replacement of the conventional concrete barriers by the short elements of light weight concrete citing the chances of higher dissipation of energy, thus reducing the overall dynamicity and helping in maintaining a good containment capability. They have made use of the finite element models of the vehicles used and that of the actual portable concrete barrier to help them in the process of simulation and also emphasize on solving the barrier problem using computational mechanics

with finite element models, which try to reproduce real time situations on the computer.

However, due to the rigidity of a material like concrete can have repercussions like severity of impact leading to harsher consequences. Also, during the use of the dummy model, though the analysis validity is good, the behavior with a different model can be different. Such uncertainty during the virtual phase can prove catastrophic in the real world.

Also, as we can see from the Table no.1below that instead of preventing accidents, the concrete barriers, guard rails and the likes have fuelled it.

Objects of Impact of vehicles	Total Percentage
1. Concrete Barriers	23%
2. Guard Rails	19%
3. Flowerpots and Curb Stones	15%
4. Bridge Wall	13%
5. Overhead Bridge Pillar / Tunnel Wall	13%
6. Trees	5%

Table no.1 Percentage of Impact of Vehicles on Various Objects

`The solutions mentioned above, however effective they propose to be, seem satisfactory only in the lab scale operations. India of the 21st century needs pragmatic solutions which can be effective on the field itself. The rolling barrier system, which can prevent,and also bring down the severity of accidents, can be the solution for the present problem. Sighting the aptness of the system, the Malaysian government has already installed it oncertain roads around the town of Subang as part of a two-year pilot project.

III.PURPOSE OF THE RESEARCH

As we can see from Table no.2, we can easily analyze that most of the accidents on the expressway are caused by the vehicles deviating from their path and running off road to either of the sides. Due to lack of infrastructural facilities at the median and the sides, the deviating vehicles meet with fatal accidents. In order to avoid such mishaps and maintain the efficiency of the expressway, there is a dire need of technological and infrastructural solutions for the same. The rolling barrier system is one such solution to maintain and regulate the competence of the expressway.

Type of Accident	Total Percentage
1. Run off road to left	32%
2. Run off road to right	23%
3. Collision with another vehicle moving ahead or waiting	21%
4. Collision with another vehicle which starts, stops or stationary	10%
5. Collision with another vehicle moving laterally in same direction.	5%
6. Collision with another oncoming vehicle	2%

Table no.2 Percentage of Type of Accident

IV. WORKING PRINCIPLE

The conventional barrier system which includes the likes of concrete barriers as well as the steel guardrails try to absorb as much shock energy from the impact of collision as possible and thus potentially break the momentum of the colliding vehicle. However, as we can see from the number of fatal accidents on the expressway, this prevailing customary system has proven to be substandard. Whereas, the rolling barriers not only absorb the impact energy but also convert it into rotational energy, assisting the vehicle to stay on track and prevent overturning. As we can see from Fig.2that as soon as an automobile swerves from the actual path and hits the barriers laterally at any angle, the rollers convert the impact energy into rotational energy by rotating with the impact. The rotational energy not only helps to cut down the impact of the collision but also helps to propel the vehicle forward rather than potentially breaking through an immovable barrier. Upper and lower frames adjust tires of large and small

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vehicles to prevent the steering system from a functional loss.

Following Fig.1 shows the precise working principle of the rolling barrier system.

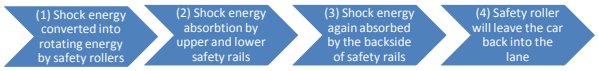

Fig.1

Fig.2

Props at an interval of 0.7 m increase bearing power to prevent vehicles from further derailing. As the props used in the system are independent, only damaged parts need to be replaced. This keeps maintenance costs pretty low and the efficiency of the system intact. Fig.3 shows the easy removal of components from the assembly.

Fig.3

V. ASSEMBLY OF THE SYSTEM

1) Firstly, the supporting post and safety rails, bolts and middle post are assembled.
2) Secondly, the stopper board which decreases the speed through friction is assembled.
3) Then the shock absorbing rollers with strong cushions are installed.
4) The upper part of the assembly includes the same components as used in the lower part viz. the stopper board and safety rails.
5) Lastly, the LED caps, post cover and the round rails are assembled.

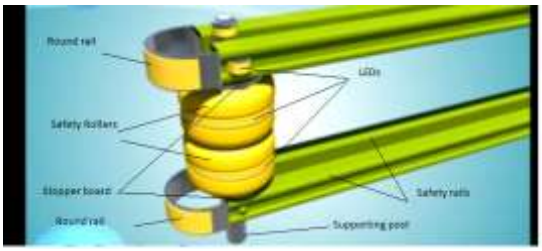

Fig.4 shows the assembly

The rotating barrels are made from Ethylene Vinyl Acetate (EVA), which is a copolymer of ethylene and vinyl acetate. It is an extremely elastic and transparent material. It is produced under high temperature and high pressure. It offers good gloss, low-temperature toughness, good chemical resistance, high friction coefficient, and resistance to UV radiation. Moreover, EVA has the advantage of being 100 % recyclable of all production waste which means that no waste is achieved producing from the material. This helps to exploit the resources using EVA in all productions. EVA is free of chlorides, heavy metals, phenols, latex and all toxics.Use of EVA barrels will make the entire rolling barrier system cost effective and environment friendly which is the need of the hour.

Fig.5 Rolling Barriers during Night and Day Time

VI. ADVANTAGES OF ROLLING BARRIER SYSTEM

- Highly effective shock absorber.
- Impact severity reduction due to its conversion into rotational energy.
- Keep the vehicle on track and avoid deviation.
- Self luminescence to help drivers control vehicles during night time
- Easy maintenance.

- Cost effective due to reduction in costs of repairing and maintenance due to roller's resilience.
- Easy height adjustment of barriers for passenger cars and lorry.
- Eco-friendly due to the use of Ethylene Vinyl Acetate (EVA).

VII. CONCLUSION

India, being on the verge of becoming a developed country needs to channel its efforts that sustain its development process. Inefficient infrastructural systems leading to loss of citizenry and hence a huge human resource deficit can prove disastrous. The use of modern technological innovations like the rolling barrier system on the Mumbai-Pune expressway can help reduce accidents, diminish fatalities and also stimulate national growth. It will not only reduce the impact of collision but also help in redirecting to the actual path, by converting the impact energy into rotational energy. Considering the diverse terrain of the expressway, there can be several solutions to address the problem. But the rolling barrier system can prove to the panacea for most of the road transport ills, if correctly designed, properly installed and regularly supervised during the normal service. Moreover, the eco-friendliness of EVA being conducive to sustainable development makes the employment of the rolling barrier system a win-win situation.

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