



New Roller Barrier System for Safety Management and Efficiency on Highways

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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. 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 path and also prevent the overturning of vehicles. The Road accidents are an outcome of the interplay of various factors, some of which are length of road networks, vehicle population, human population adherence/enforcement of road safety regulations etc. This study aims to evaluate the effectiveness of the Rolling Barrier and to understand the Rolling Barrier's characteristics of crash cushioning, how to correct the vehicles running direction and the required strength of barriers. The Rolling Barrier satisfied the ministry of construction and transportations, "Guidelines for Installation and management of road safety facilities". The Rolling Barrier can be effectively used in curved roads sections, ramps, medians and entrance or exit ramps in parking garages

Keywords: Accidents, Government, Highways, Life, Rolling Barrier, Safe Barrier, Urethane, Vehicles.Etc.

I. INTRODUCTION

'Safety Roller' is a safety fixture that prevents drivers and passengers from fatal accidents by not only absorbing shock energy but also converting shock energy into rotational energy. 'Safety Roller' needs to be installed at sites where vehicles are exposed to frequent accidents. 'Safety Roller' will safely lead a vehicle back to the road or stop the vehicle by absorbing shock energy. 'Safety Roller' will effectively function for drivers to properly control vehicles with its noticeable color and self-luminescence. One Korean company developed a product to reduce the harsh impacts of guardrails & hopefully save lives. Every year approximately 1.25 million people die as a result of a road traffic crash. According to Federal Highway Administration, the guardrail can operate to deflect a vehicle back to the roadway, slow the vehicle down to a complete stop or let it proceed past the guardrail. The guardrail can't completely protect against the situations drivers may find themselves. To minimize the no. of accidents a company called ETI (Evolution in Traffic Innovation) designed "Rolling Barrier System".

FEATURES

- LED guide lamp (solar energy).
- Two Pieces.
- Material is eco-friendly.
- It reduces the speed of vehicle.
- Reduces costs in repairing & maintenance due to Roller's resilience
- Made of special chemical compound like hard rubber.
- Easy to maintain due to separated barrels (recyclable).
- Stopper boards installed on the top and the lower part of the barrels to guide objects back to the road.
- Easy to adjust height, noticeable to drivers due to noticeable coloration and self-luminescence.

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II. BARRIER

Barriers or guard rails or longitudinal barriers or traffic barriers keep vehicles within their road way and prevent vehicles from colliding with dangerous obstacles such as boulders, sign supports, trees, bridge abutments, building walls and large storm drains.

TYPES OF BARRIER

Barriers are categorized in to two ways, by the function they serve and by how much they deflect when a vehicle crashes into them,

1. BARRIER FUNCTIONS:-

- Road side barriers are used to protect traffic from roadside obstacles or hazards.
- Median barriers are used to prevent vehicles from crossing over a median and striking an oncoming vehicle in a head on crash.
- Bridge barrier is designed to restrain vehicles from crashing of the side of a bridge and falling onto the roadway.
- Work zone barriers are used to protect traffic from hazards in work zones.

2. BARRIES STIFFNESS:-

- Flexible barriers include cable barriers and weak post corrugated guide rail systems. They will deflect 1.6 to

2.6m (5.2 to 8.5 feet) when struck by a typical passenger car or a light truck.

- Semi rigid barriers include box beam guiderail, heavy post blocked out corrugated guide rail and three-beam rail. They deflect 3-6 feet (0.91 to 1.83m).
- Rigid barriers are usually constructed of reinforced concrete. They deflect in negligible distance.

III. ROLLING BARRIERS

This consists of both flexible property and semi rigid property barrier stiffness. They are different in mechanism than other types of barriers also reduces the hazards or accidents. Urethane has become the material of choice in so many of today's performance driven applications because it exhibits extraordinary physical and mechanical properties that other materials simply can't match. 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.



Figure.1. Rolling barrier

ASSEMBLY OF THE SYSTEM

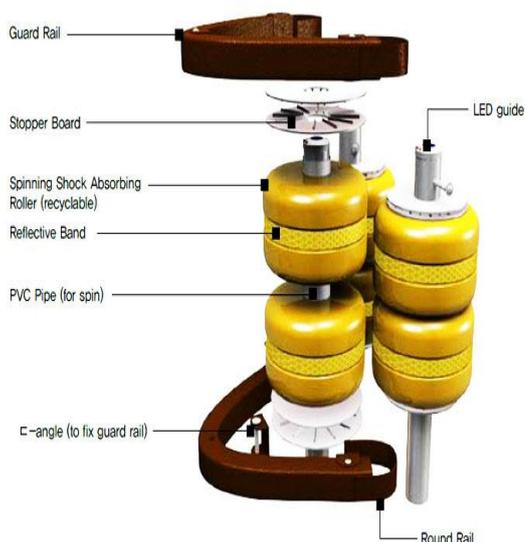


Figure.2. Components of rolling barrier

- 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.

IV. EXPERIMENTAL METHODOLOGY

The rolling barriers do more than absorb impact energy. They convert impact energy into rotational energy to propel the vehicle forward rather than potentially breaking through an immovable barrier. The ETI product has a rotating barrel made of EVA with excellent shock absorption power, 3D buffering frames & dense props supporting the frames. Rotating Barrels comes with attached reflective sheeting for good visibility. EVA has a better flexibility & elasticity compared to other polyethylene resins & has most similar features to rubber. In fact, it's lighter than rubber & most elastic than urethane. In shorts, it's not easily damaged. When a car hits the guardrail, the rotating barrel converts shock from the vehicle to rotational energy. Upper & lower frames adjust tires of large & small vehicles to prevent the steering system from a functional loss. Railways rails & liquid props absorb shock from accidents vehicles & frames with the smooth surface adjust tires of the vehicles & guide them in the moving direction to prevent second rear – end collisions. The 3D structure of the D – shaped frame & buffering bracket distribute & absorb the second shock. Props at an interval of 0.7 m increase bearing power to prevent vehicles from further derailing. As the props are independent only damaged parts need to be replaced. This keeps maintenance costs pretty low. Roller absorbs collision shock (shock energy- rotational energy). Front rail absorbs second shock. Back rail absorbs third shock.

Metal pipe inserted into strengthen post. 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. 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 vehicles to prevent the steering system from a functional loss. 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.



Figure.3. Working process of rolling barrier

V. TEST PERFORMANCE

SB5 crash test level:-

- **Passenger safety performance -**
 1. Theoretical head impact velocity (THIV): 32.4km/hr (below 33km/hr)
 2. Post impact head deceleration (THD): 9.9g's (below 20g's)
- Scatter prevention performance- No scatters of the fifty barriers.
- Test vehicle behavior performance – Not over thrown or a sudden stop after collision.
- 76.9% (Exit speed: 74.8km/hr) : 43.7% (Exit angle : 8.74 degree)
- Synthetic results satisfied with criteria.



Figure.4. Crash level test

1. **Small car** 900 kg car, 20 0 side collision. During the evaluation, it was observed that the ETI product sends an accident vehicle back to the normal moving track, protects occupants and second vehicle accidents.
2. **Large Car** 10-ton truck, 150 side collision. During the evaluation, it was observed that the ETI product changes the collision method to rotational friction to make collision continue for a long time and thus minimize momentary shock.
3. **Bus** 13-ton bus, 20 0 side collision. During the evaluation, it was observed that the ETI product changes the collision

method to rotational friction to make collision continue for a long time and minimize momentary shock.

PROBLEMS

1. **COST:** - Compared to other types of barriers like reinforced concrete, this rolling barrier which is made up of urethane, which is less cost, but while urethane resource availability is less compared to reinforced concrete
2. **HEAT TREATMENT:-** At high temperatures in summer season, the rubber characteristic feature is that it tends to low resistance property. So, that plays a major role in rolling barrier system but can be restricted or maintained by proper inspections periodically (once in two to four weeks or once in a month). Also a technique to cool down the heat is to sprinkle water on this rolling system, etc.
3. **MAINTANANCE:-** Due to periodical inspection, maintenance of the rolling barrier system is in high level and labor work is more.

IMPLEMENTATION

- Can be installed in curved road sections, Ex: National highway 22 (highway to hell) is considered to be India's most dangerous highways, median barriers are used here which is made up of metallic materials. Instead of these barriers if we use rolling barriers then the accidents occurring will be reduced which gives us safety level to a bit higher range.
- Ramps in city or state or national highways.
- Medians and entrance or exit ramps in parking garages.

VI.CONCLUSIONS

India, being on the verge of becoming a developed country needs to channel its efforts that sustain its development process. The accidents are the errors which are occurred or done by humans while on the usage of motor vehicles and also sometimes the nature creates problems like rainy and cold weather conditions for slippery surfaces of roads, which will create chaos situations and tends to hit the other vehicles or hit the barriers installed on the outer edge of the roads. Ultimately life is more precious than vehicles but when it comes to rolling barrier system usage, it safes life and also prevents maximum damage level of the vehicles. Inefficient infrastructural systems leading to loss of citizenry and hence a huge human resource deficit can prove disastrous. 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.

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