Safety Guard Highway Rolling Barrier 
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Abstract— The government is always looking at the latest technology that can ensure safety of road users, as outlined in the construction industry transformation plan. In India, total accidents of 2016 are 489400 and in 2017 are 501423. Total number of persons killed in 2016 is 139671 and in 2017 are 146133. Total number of accidents on highways in 2016 is 137903 and in 2017 are 142268. A small Korean manufacturing company invented a new concept Longitudinal barrier, (The Rolling Barrier) which had continuous pipes covered with urethane rings. 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. In this paper, the description and studies of Rolling Barriers are elaborated and 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. Total barrier or guard-roll assembly comprises series of individual guard-roll barrier units spaced along one or both sides of a roadway. Each unit comprises support and guard structure rotatable about generally upright axis with upper portion closer to roadway axis to form overhang. When vehicle strikes one or more units they start rotating, attenuate impact, and redirect the vehicle. The overhand effect prevents climbing and keeps vehicle on ground. Impact surfaces are pneumatic low-pressure rubber tubes arranged to form frustocones rotating on vehicle spindle. They may also be of uniform diameter or may be single resilient conical bodies but are preferably series of heavy rubber tubes of variable diameter arranged to provide maximum surface to impacting vehicle. The attitude of the spindle may vary from vertical to permit use of uniform buffer elements. Barrier elements may be arranged in tandem parallel to the road shoulder to intercept errant vehicles and promote straight line attenuation. For positive arrest, elements are deployed in lead-in lines in paired sequences to promote pocketing. Lateral spacing between paired elements converge to attenuate by actuating wringer effect. Special pocketing arrangements may be used to trap and decelerate trucks at critical locations.

Keywords: Safety Guard Highway Rolling Barrier

I. INTRODUCTION

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. Road accidents cause injuries, fatalities and hospitalization with severe economic costs across the country. Consequently, road safety has become an issue of concern both at national and international levels.

<table>
<thead>
<tr>
<th>Table 1:</th>
<th>Year-2016</th>
<th>Year-2017</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Accidents</td>
<td>489400</td>
<td>501423</td>
<td>2.5%</td>
</tr>
<tr>
<td>Persons Killed</td>
<td>139671</td>
<td>146133</td>
<td>4.6%</td>
</tr>
<tr>
<td>Accidents on Highway</td>
<td>137903</td>
<td>142268</td>
<td>3.2%</td>
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</table>

It is expected to be increased 40% of 2017 to 50% in 2018 and even more in future where the number of vehicles manufacturing is increasing and also the vehicles on road are increasing. India is one of the highest motorization growths in the world accompanied by rapid expansion in road network and urbanization over the years and is facing with serious impacts on road safety levels. The analysis of road accident data 2017 reveals that about 1,374 accidents and 400 deaths take place every day on Indian roads which further translates into 57 accidents and loss of 17 lives on an average every hour in our country. A small Korean manufacturing company invented a new concept longitudinal barrier (the rolling barrier), a structure equipped with continuous pipes covered with urethane rings. Its general feature resembles an erected abacus. As the rolling barrier activates the rolling friction when vehicles hit the barrier, the rolling barrier reduces severity of traffic accidents. After the rolling barrier was installed at two downgraded and curved roads sections in Busan, the accidents at the sections were reduced by more than 50% in a year. 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. 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. This study aims to evaluate the effectiveness of the rolling barrier and understand rolling barrier’s features in crash cushioning, correcting the vehicles running direction and required strength of the barriers.

Fig. 1: View of Rolling Barrier
A. Features

- 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.
- Noticeable to drivers due to noticeable coloration and self-luminescence.
- Less costs to install (less post- 1 unit per 2m).
- 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.

B. Advantage 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 Viny Acetate (EVA).

II. 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.2 that 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 vehicles to prevent the steering system from a functional loss. Following Fig.1 shows the precise working principle of the rolling barrier system.
A. 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.

Fig. 5: Roadside Barrier

B. 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.

    Fig. 6:

- Bridge barrier is designed to restrain vehicles from crashing of the side of a bridge and falling onto the roadway.

    Fig. 7:

- Median barriers are used to prevent vehicles from crossing over a median and striking an oncoming vehicle in a head on crash.

    Fig. 8:

- Work zone barriers are used to protect traffic from hazards in work zones.

2) Barriers 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.

Fig. 10:

- Semi rigid barriers include box beam guiderail, heavy post blocked out corrugated guide rail and thriebeam rail. They deflect 3-6 feet (0.91 to 1.83m).

Fig. 11:

- Rigid barriers are usually constructed of reinforced concrete. They deflect in negligible distance.

Fig. 12:

C. Rolling Barriers

This invention lies in the field of safety barriers for highway sand other roadways of the general type which are mounted along the sides of the roadways to intercept errant vehicle and stop them or redirect them in a desired direction. It is directed particularly to such apparatus which suffers little or no damage from impact and which causes minimum damage to the contacting vehicle.

Many types of highway barriers have been proposed over the years and many varieties are presently in use. The conventional type is cable or metal plate, beam, or box beam guardrail mounted on posts parallel to shoulder lines of highways. Other types are heavy stone guardrails adjacent the highway, rustic log guardrails, and concrete barrier walls. These devices are mounted along the marginal limits and in the center medians to contain errant vehicles. Basically they are rigid, relatively non yielding and have little capability for absorbing the energy of the impacting vehicle through elastic or plastic deformation of the barrier. Because of their rigidity and con formation, vehicles impacting them even at low angles of incidence are severely damaged by impact, catapulting, or rich with attendant danger of exploding fuel from ruptured fuel tanks.

Fig. 13:

D. Highway Rolling Barrier

Another type, which is widely used in the medians or divider strips of freeways, is chain link or expanded-metal type fencing mounted on metal posts designed to yield fairly readily and usually reinforced by a pair of vertically spaced horizontal cables. The theory of operation is that the concentrated force of impact of the errant vehicle stretches and distorts the metal, using up the inertia in the way of work. The yielding of the fence is intended to minimize damage to the vehicle. However, it has been found from experience that the vehicle still suffers a great deal of damage from the twisting and tearing action of the fence. In addition, a large section of fence is destroyed and the repair work amounts to several hundred dollars per accident.

To prevent head-on collision with bridge piers, abutments, traffic islands, etc., various protective devices are being used. Included are empty barrels, sand filled containers, water-filled containers, shock-absorbing rails, etc. All are destructive to the impacting vehicle. None pocket and stop the vehicle. Light standards, signposts, power poles, telephone poles, and traffic signal poles in the marginal areas flanking the traffic lanes are potential collision elements for errant vehicles. Both the vehicle and the objects encountered are damaged by impact. Many casualties result. Conventional protection of the objects comprises an enveloping guardrail or mounting them on raised concrete bases which protect the installations but severely damage the impacting vehicles and passengers. Barrier protectors are now being discontinued in favor of
breakaway design of post. This design permits impacting vehicle to shear the posts, minimizing vehicle damage, and reducing casualties. Although this device is an improvement over barrier protection, vehicles require costly repairs and the poles must be reinstalled. The proposed pneumatic guard rolls provide a better solution. The poles already in place can be made to serve as the spindle for the buffering elements. 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.

III. DESIGN & PARAMETERS
A. Camber
It’s the transverse slope in roadway for drainage purpose only. According to IRC we provide 1.7% (High Bitumen pavement with Light rainfall condition).

B. Width of Carriageway
Width of carriageway is totally depends upon the number of lane. In our project we provide TWO lane so width of carriageway is SEVEN METER.

C. Width of formation
It’s the width of roadway considering width of carriageway, shoulder and medians.

<table>
<thead>
<tr>
<th>TYPES OF PAVEMENT</th>
<th>ROLLING/PLAIN</th>
<th>STEEP/HILLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH &amp; SH</td>
<td>12 METER</td>
<td>8.80 METER</td>
</tr>
</tbody>
</table>

Table 2:

D. Superelevation
When a vehicle is negotiating horizontal curve an extra force called centrifugal force is acting radially outward direction to counter the effect of this force outer edge of pavement is raised with respect to inner edge which is called super elevation.

Maximum elevation for plain and hilly terrain covered with snow – 7%
Minimum elevation = Camber

1) Rolling minimum Radius –
It’s the minimum design radius.

\[ R_{\text{min}} = \frac{V^2}{g(e+u)} \]

Where,
- \( R_{\text{min}} \) = minimum rulling radius
- \( V \) = vehicle speed as per IRC
- \( g \) = gravitation acceleration
- \( e \) = super elevation, \( u \) = lateral friction
- For plain terrain \( V = 100 \) kmph as per IRC –

\[ R_{\text{min}} = \frac{9.81(0.07+0.15)}{100^2} \]

\[ R_{\text{min}} = 357.52 \text{ meter} \]
- For hilly terrain \( V = 50 \) kmph as per IRC –

\[ R_{\text{min}} = \frac{9.81(0.07+0.15)}{50^2} \]

\[ R_{\text{min}} = 89.38 \text{ meter} \]

E. Design Superelevation
\[ e_{\text{design}} = \frac{V^2}{225R} \]

- For plain terrain-

\[ e_{\text{design}} = \frac{225+357.52}{225} \]

\[ e_{\text{design}} = 12.43\% \]
- For hilly terrain-

\[ e_{\text{design}} = \frac{225+89.38}{225} \]

\[ e_{\text{design}} = 12.43\% \]

Design superelevation is greater than maximum superelevation
\[ e_{\text{design}} > e_{\text{max}} \]
so we provide maximum super elevation.

\[ e_{\text{design}} = e_{\text{max}} = 7\% \]

F. Extra Widening
When a vehicle is negotiating horizontal curve path followed by front axle wheel and rear axle wheel will not same, for that purpose extra width is required which is called MECHANICAL WIDENING for overtaking and crossing operation to enhance the visibility. extra width of pavement is required which is called psychological widening and on the basis of this widening total widening is calculated as-

**EXTRA WIDENING = MECHANICAL WIDENING + PSYCHOLOGICAL WIDENING**

- Extra widening for hilly terrain Radius ≤ 300m.

Mechanical widening = \( \frac{nV^2}{2R} \)

Where,
- \( n \) = no. of lane
- \( l \) = wheel base length
- \( R \) = radius of curve

Mechanical widening = \( \frac{2.6^2}{2 \times 89.38} \)

= 0.402m

Psychological widening = \( \frac{V}{9.5\sqrt{R}} \)

= \( \frac{9}{9.5\sqrt{89.38}} \)

= 0.556m

Total extra widening = 0.402 + 0.556 = 0.958m

This extra widening is provided both side of the curve because radius is less than 300m.
- Extra widening for plain terrain Radius is greater than 300m,

When the radius is greater than 300m there is no need of Extra widening.

G. Length of Transition Curve
It’s provided between straight and circular curve to gradually vary radius from infinity to \( R \) or centrifugal acceleration from 0 to \( V^2/R \). It’s the maximum of following three conditions–

- ON THE BASIS OF JERK-

\[ L_s = \frac{V^3}{6gR} \]

Where,
\[ L_s = \text{length of transition curve} \]
\[ V = \text{velocity of vehicle} \]
\[ R = \text{radius of curve} \]
\[ C = \text{jerk (rate of change of acceleration)} \]

For hilly terrain-
\[ L_s = \frac{(50 \times \frac{5}{18})^3}{0.64 + 0.38} \]
\[ = 46.83 \text{ m} \]

For plain terrain-
\[ L_s = \frac{(100 \times \frac{5}{18})^3}{0.5 + 357.52} \]
\[ L_s = 119.90 \text{ m} \]

ON THE BASIS OF EMPIRICAL FORMULA –

For plain terrain
\[ L_s = 2.7 \times \frac{V^2}{R} \]
\[ = \frac{2.7 \times 100 \times 100}{357.52} \]
\[ = 75.52 \text{ m} \]

For hilly terrain
\[ L_s = \frac{V^2}{R} \]
\[ = \frac{50 \times 50}{89.38} \]

ON THE BASIS OF SUPER ELEVATION-

For plain terrain rotate about inner edge
\[ L_s = N \times e \times (W + W_e) \]
\[ L_s = 150 \times 0.07 \times (7.0 + 0) \]
\[ = 73.5 \text{ m} \]

For hilly terrain rotate about inner edge
\[ L_s = N \times e \times (W + W_e) \]
\[ L_s = 60 \times 0.07 \times (7.0 + 0.958) \]
\[ = 33.42 \text{ m} \]

So the length of transition curve is ,
For plain terrain = 119.90 m
For hilly terrain = 46.83 m

SHIFT OF CURVE -
\[ \text{Shift} = \frac{L_e^2}{24R} \]

For plain terrain-
\[ \text{Shift} = \frac{119.90^2}{24 \times 357.52} \]
\[ = 1.67 \text{ m} \]

For hilly terrain-
\[ \text{Shift} = \frac{46.83^2}{24 \times 89.38} \]
\[ = 1.02 \text{ m} \]

H. Drawing

IV. CRASH TESTING

A. SB5 crash test level:

1) Passenger safety performance
   - Theoretical head impact velocity (THIV): 32.4 km/hr (below 33 km/hr)
     2. Post impact head deceleration (THD): 9.9 g’s (below 20 g’s)

2) Scatter prevention performance- No scatters of the fifty barriers.

3) Test vehicle behavior performance – Not over thrown or a sudden stop after collision.

76.9% (Exit speed: 74.8 km/hr) : 43.7% (Exit angle : 8.74 degree)

Synthetic results satisfied with criteria.

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.

B. How Does It Work?
- 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.

1) Test on Truck

![Fig. 15:](image)

- TEST ARTICLE Barrier System
- POST IMPACT VEHICLE BEHAVIOUR
  Vehicle Stability: Low
  Vehicle Stopping Distance: 48 metres
  TOTAL LENGTH: 60 m
- KEY ELEMENTS – BARRIER
  Description: Roller Barrier with box rail and steel line posts
  Length: 60.0 metre LON
  Rail Height: 970 mm
  Post Spacing: 667 mm nominal
- VEHICLE SNAGGING: None
- VEHICLE POCKETING: None
- OCCUPANT IMPACT VELOCITY
  Longitudinal: 0.5 m/s at 0.2483 sec.
  Lateral (optional): 2.8 m/s at 0.2483 sec
- TEST VEHICLE
  Designation: 10,000S
  Make/Model: 2001 Mitsubishi Fuso Fighter
  Dimensions (lwh): 7665 x 2040 x 3100 mm
  Curb Weight: 5760 kg
  Test Inertial weight: 9960 kg
  Gross Static weight: 9960 kg
- OCCUPANT RIDE-DOWN ACCELERATION

x-direction: 0.6 g (1.4851-1.4951 seconds)
y-direction: 4.3 g (0.3585-0.3685 seconds)
THV (optional): 2.5 m/s at 0.2359 seconds
PHO (optional): 4.3 g (0.3585-0.3685 seconds)
- TEST ARTICLE DAMAGE: Mild
- IMPACT CONDITIONS
  Speed: 89.8 kph
  Angle: 15°
  Impact Point: 0.7 m upstream of line post 22
- TEST ARTICLE DEFORMATION:
  Dynamic: 0.215 m
  Permanent: 0.190 m
  Working Width: 4.85 m
- EXIT CONDITIONS
  Exit Speed: est. 8.0 kph
  Exit Angle: 0.0°
- VEHICLE DAMAGE
  VDS: 11-LFQ-5
  CDC: 11FLEE2
  MAX. Deformation: 280 mm

2) Test on Car

![Fig. 16:](image)

- TEST ARTICLE. ROLLING BARRIER SYSTEM
- TOTAL LENGTH: 60 m
- KEY ELEMENTS – BARRIER
  Description: Roller Barrier with box rail and steel line posts
  Length: 60.0 metre LON
  Rail Height: 970 mm
  Post Spacing: 667 mm nominal
- TEST VEHICLE
  Designation: 2270P
  Make/Model: 2005 Dodge Ram 1500 Quad Cab
  Dimensions (lwh): 5720 x 2050 x 1930 mm
  Curb Weight: 2260 Kg
  Test Inertial weight: 2282 Kg
  Gross Static weight: 2282 Kg
  Curb weight: 2260 Kg
- IMPACT CONDITIONS
  Speed: 98.4 k mph
  Angle: 25°
  Impact Point: 0.7 m upstream of line post 22
- EXIT CONDITIONS
  Exit Speed: est. 48.3 kph
  Exit Angle: 21°
- POST IMPACT VEHICLE BEHAVIOUR
  Vehicle Stability: GOOD
  Vehicle stopping distance: 26.5 meter
- VEHICLE SNADDING... NONE
- VEHICLE POCKETING ... NONE
- OCCUPANT IMPACT VELOCITY
  Longitudinal .................. 0.1m/sec at 0.1309 sec
  Lateral (optional) ............ 5.9m/sec at 0.1309 sec
- OCCUPANT RIDEOWN DECELERATION
  x-direction .................. 1.1 g (0.1606 -0.1706 s)
  y-direction .................. 9.7 g (0.1477 - 0.1577 s)
  THV (optional) ................. 5.6m/s at 0.1278 sec
  PIID (optional) ............... 9.7 g (0.1477 - 0.1577 sec)
- TEST ARTICLE DAMAGE LOW
- TEST ARTICLE DEFLECTION
  Dynamic..........................0.0458 m
  Permanent......................0.270 m
  Working Width................0.293 m
- VEHICLE DAMAGE – EXTERIOR
  VDS................................11 – LFQ-3
  CDC.................................11FLE2
  MAX: Deformation..............145meter
3) Test 4-10-1100C -Model selected KIA RIO 2003 (3 years over maximum age limit):
   Our preferred 1100C vehicle is the Generation 1 Kia Rio. This model is recommended in MASH Table H-2 and has been widely adopted as the vehicle of choice by the accredited testing laboratories. The Kia Rio was maintained as a constant model from 2001-2005 after which it was updated to a Generation 2 model. The Safety Roller Barrier project was initiated in June 2011 and thereby the later years of this model vehicle do comply with the specific requirement in MASH, namely:
   Towards the end of 2005 Ule Kia Rio was updated to the Generation 2 model, however this model lies outside MASH Specifications in a critical dimension; it is 4.3” (110 mm) shorter than allowable. Given the criticality of the vehicle length the updated model was not considered a suitable substitute for the previous Generation 1 model.

When the Kia Rio model was updated, a critical assessment was completed between the older Generation 1 model (2003) and the newer model (2005). It was determined that the pre 2005 model Kia Rio achieved the most consistent fit against key physical dimensions and the centre of mass requirements of MASH. A series of comparisons with other models is provided below in Table 1. All figures which are outside of the MASH limitations are shown in Red. We noted that the actual vehicle used in the testing for the Roller Barrier System is shown in Table 3 as the 2003 generation model highlighted.

4) Comparison of suitable 1100c vehicles

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>MASH 1100C REQUIREMENT (Y/N)</th>
<th>KIA RIO USED (Y/N)</th>
<th>COMPLIANT (Y/N)</th>
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</thead>
<tbody>
<tr>
<td>MASH (Kg)</td>
<td></td>
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<tr>
<td>TEST</td>
<td>1100±25</td>
<td>1080</td>
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<tr>
<td>INERTIA</td>
<td>75</td>
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<tr>
<td>DUMMY</td>
<td>80</td>
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<tr>
<td>MAX. BLAST GROSS STATIC</td>
<td>1175±25</td>
<td>1150</td>
<td>YES</td>
</tr>
<tr>
<td>DIMMENSIO N (mm)</td>
<td></td>
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<tr>
<td>WHEEL BASE</td>
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<tr>
<td>FRONT OVERHANG</td>
<td>2500±125</td>
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<td>830</td>
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<td>OVERALL WIDTH</td>
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<td>HOOD HEIGHT</td>
<td>1650±75</td>
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<tr>
<td>TRACK WIDTH</td>
<td>600±100</td>
<td>700</td>
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<tr>
<td>LOCATION</td>
<td></td>
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<tr>
<td>FRONT</td>
<td></td>
<td></td>
<td>YES</td>
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</table>

<table>
<thead>
<tr>
<th>CRITICAL MEASURE</th>
<th>KIA RIO (LIFT BLACK)</th>
<th>KIA RIO (HAT CH)</th>
<th>HON DA CITY (SAE)</th>
<th>NISA AN (HAT CH)</th>
<th>TOYT A (SAE)</th>
<th>LOCATION</th>
</tr>
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<tbody>
<tr>
<td>PRODUCT ON YEAR</td>
<td>2003</td>
<td>2005</td>
<td>2005-07</td>
<td>2009</td>
<td>2009</td>
<td>FRONT</td>
</tr>
<tr>
<td>WEIGHT (Kg)</td>
<td>1060</td>
<td>1079</td>
<td>1240</td>
<td>1120.5</td>
<td>1237</td>
<td>FRONT</td>
</tr>
</tbody>
</table>
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 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.

### V. 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.

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### VI. 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.

### VII. SUMMARY OF THE INVENTION

The present invention overcomes these difficulties and provides a guide-roll barrier system which is practically permanent, suffering no damage except in very severe circumstances, and at the same time performing its function with little or no damage to the vehicle in the usual case. Conformation of the basic unit may be varied by adding additional buffering elements for height or varying the diameters. The most functional conformation is the inverted frustocone one which exerts a downward restraining force which prevents the climbing and catapulting of vehicles.

Generally stated, the barrier system is made up of a series of individual guide-roll barrier units of basically the same type which are arranged in longitudinally spaced relation along the side or sides of a roadway, including locations in a median between sections of a divided highway. Each unit comprises a support spindle anchored to the ground or a bridge abutment or the like and a guard structure or roller means mounted on the support for rotation about a generally upright axis, the roller means having a resilient surface for contact by an errant vehicle. The support includes a spindle on which the roller means is rotatably mounted and the latter may be a single body but preferably is a series of individual rollers, each of which is individually rotatable on the spindle.

In either event the unit is preferably so constructed and arranged that the contacting surfaces diverge upwardly from a vertical reference line passing through the base of the support in a direction toward the axis of the roadway to produce an overhang. In one form, the spindle is substantially vertical and the roller means enlarge upwardly to define an inverted frustoconical contour. In another form the spindle is upright but inclined toward the axis of the roadway, and the roller means may be of substantially constant diameter from end to end. In all forms the guard structure has a substantial vertical height, preferably of the
order of 4 feet, thus enabling the upper portion to overhang the fender of body of the vehicle and exert a downward restraining force to keep it in firm contact with the ground.

In the presently preferred form, the guard structure comprises a series of individual rollers individually rotatable on a substantially vertical spindle. The rollers are low-pressure pneumatic tubes mounted on a hub, cone, or wheel, which is rotatably mounted on the spindle. The wheel carries a heavy hollow rubber tube filled with air at low pressure. Spacing collars are mounted on the spindle between the wheel hubs to maintain the tubes out of engagement with each other so that each may rotate independently when contacted by a vehicle. The resilience of the tube reduces the impact force and minimizes damage to the vehicle. In some cases standard automobile wheels may be used and equipped with worn tires instead of special tubes to reduce the cost of installation.

The barrier units are spaced closely enough so that in anything but a head-on approach the side of the vehicle will engage at least two of the units in a general broadside manner. The tangential contacts cause the rollers to rotate so that the vehicle is readily redirected substantially along the line of successive rollers. Considerable energy is used up in overcoming the inertia of the rollers, and this may be increased by the use of friction, magnetic, or other types of braking equipment.

VIII. MODEL AND DETAILED SHEET

A. Safety Provide at Night Time

Fig. 17: Safety Guard Highway Rolling Barrier

Fig. 18: Safety Guard Highway Rolling Barrier

Fig. 20:

Fig. 21:

IX. CONCLUSION

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 saves 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
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. These barriers are of different types and have their own characteristic features but the new idea is about the installments of the rolling barrier systems which will stop the accidents occurring to surpass the road to gravel or steep hill down or other part of the road, and also saves life of the people present inside the vehicle. As above explanations of barriers and their proofs tells us that the rolling barrier systems are a high priority towards safety, better than other types of barriers in terms of stiffness and strength, high positive results in the crash test performances, etc. Ultimately life is more precious than vehicles but when it comes to rolling barrier system usage, it saves life and also prevents maximum damage level of the vehicles. The rolling barrier systems are the future technology in Transportation Engineering.

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