International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 10 Issue 3 ǁ 2022 ǁ PP. 04-09

Highway Safety Using Rolling Barrier

Ketan P Jaysingpure, Prof. A.R. Bijwe
[1]*Department of Civil Engineering, Dr. Rajendra Gode Institute of Technology & Research, Amravati*
[2]*Department of Civil Engineering, Dr. Rajendra Gode Institute of Technology & Research, Amravati*

Abstract
The road accidents are the serious problems in India. Millions of the people died every year because of the accidents. In order to reduce the accidents and the damage occur on the road and the vehicles. A small korean company in BUSAN develops a product which resist the impact of guard rails and saves million of lives. Every year more than billions of lives died during accidents. According to Fedreal Highway Administration the guardrail can operate to pushes back the vehicle to the roadway decrease the speed of vehicle or let it proceed past the guardrail. The guardrails cannot completely protect the situation driver may find themselves. In order to reduce the number of accidents a company called ETI(evolution in Traffic Innovation)design a barrier called Rolling barrier. Road accidents are increased by 10% in 2019 as compared to the 2018. To minimize the road accidents, Rolling Barrier System is newly concept invented with structure consists of urethane rings by Korean company. These rolling barriers are used in hilly areas, curved roads etc. When the vehicles hit the barrier, rolling barrier reduce the speed of vehicles and prevent it from accident. Rollers absorb the shock energy, when vehicle collapse on barrier and shock energy converted into rotational energy. To minimize the number of accidents, a company called ETI (Evolution in Traffic Innovation) designed "Rolling Barrier System". Here our target is to save the lives of passengers after clashing. For this we are introduce an idea Rolling barrier to save the lives.

Keywords: *Accidents, barrier, vehicle, safe barrier, rolling barrier.*

Date of Submission: 07-03-2022 Date of acceptance: 22-03-2022

I. INTRODUCTION

Barrier is a type of obstruction that tries to keep vehicles within their road lanes and prevent them from collision with obstacles or other vehicles. There are more chances of accidents on sharp horizontal curves. Barriers are provided on sides of horizontal curve. These barriers can reduce the number of accidents, but when vehicle collides with the barrier, it causes high damage to vehicle, injury to human body or even death. As after the collision the vehicle is not in control, it may be overthrown or suddenly stopped, causing high damage. A South Korean company called ETI (Evolution in Traffic Innovation) designed the "Rolling Barrier System". It converts the shock energy into rotational energy. Rolling barriers are barriers with rollers installed on it. Rolling barrier activates the rolling friction when vehicle collides with it. The roller on the barriers start to roll when it is hit by a vehicle and prevents vehicle from being suddenly stopped or overthrown, and thus reduce the severity of accident. Its use can be proved more effective on horizontal curves, where most accidents occur.

There have many round shape plastics elements (nearly like as tire) that's should set up serially one by one that's connected by a stainless steel. The round shape elements can roll. When a vehicle hits the rolling barrier it will roll and divert the impact force rotate to forward. For this the crash vehicles have to remain in the same area though that was hit but it can save the lives of passengers. If there have a RCC barrier it cannot divert the impact force into forward and would try to break it and can go outside the road [2]. If it hilly area then the vehicle can fall down or vehicle can go opposite side of the road then another vehicle can hit the vehicle which is coming from opposite side. Both cases are can take lives of passengers. The rolling barriers do more than absorb impact energy. They convert that impact energy into rotational energy to propel the vehicle forward rather than potentially breaking through an immovable barrier [3]. When a car hits the barrier, the rotating barrel converts shock from the vehicle to rotational energy. Upper and lower frames adjust tires of large and small vehicles to prevent the steering system from a functional loss. The vehicle crash test was performed on three different vehicles and the rolling barrier satisfied all the criteria such as small car, large car, bus. To minimize the number of accidents, a company called ETI (Evolution in Traffic Innovation) designed "Rolling Barrier System".

Figure: 1 Rolling Barriers on horizontal curve

1.1.1 Barriers

Barrier is a type of obstruction that tries to keep vehicles within their road lanes and prevent them from collision with obstacles or other vehicles. They are installed on both side of roads, especially on curves. The main use of barriers is to prevent collision of vehicles with other obstacles or vehicles. The barriers used maybe of steel, concrete or maybe even of cable. These barriers may be used as roadside barriers, median barriers, bridge side barriers or work zone barriers. They are rigid, they do not have much flexibility.

1.1.2 Rolling Barriers

A small South Korean manufacturing company invented the "Rolling barrier." After the rolling barrier was installed at two downgraded and curved roads sections in Busan (South Korea), the accidents at the sections were reduced by more than 50% in a year. 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. October 2016 Malaysian Government set to be used Rolling barrier to reduce the accident and achieve more safety.

The concept of rolling barrier is, 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. There have a rolling box which is attested with stainless steel. The rolling box can rotate when it will hit by traffic. It's made of special chemical compound like hard rubber which is capable to absorb the impact of the vehicle. In concrete or steel barriers there target to save the life of the humans but the vehicle situation would be worst and cable barrier try to reduce the impact of the vehicles.

Figure: 2 Rolling Barriers Night View

Sometime these three types of barrier fail to achieve its target and human lost his life.

Rolling barriers redirects(moving away from the expected path) the vehicle to the right direction by effectively soaking up(like a towel) or absorbing impact energy with rollers, upper and lower rails(impact energy is converted into rotational energy) [4].

Rolling barrier consists of both flexible property and semi rigid property stiffness. It's mechanism is different from other type of barriers and reduces the accidents and save lives. The material used in the rolling barrier(urethane)has very good performance. It is also being trialled on a road in malaysia that is known as accident hotspot [7].

RB can be placed 0n mountainous places , u-turns, barriers, curved alignment etc. As the rolling barrier activates the rolling friction when vehicles hit the barrier, the rolling barrier reduces severity of traffic accidents. There have a rolling box which is attested with stainless steel. The rolling box can rotate when it will hit by traffic. It's made of special chemical compound like hard rubber which is capable to absorb the impact of the vehicle. In concrete or steel barriers there target to save the life of the humans but the vehicle situation would be worst and cable barrier try to reduce the impact of the vehicles. Sometime these three types of barrier fail to achieve its target and human lost his life. A new type of barrier "Rolling barrier." we can say that rolling barrier have same features of these We can use it at road side, median, bridges.

1.1.3 Components of rolling barrier :-

- Top rail: There are two rails in rolling barrier system, which connects and supports the rollers horizontally. The upper rail is known as Top rail. It is like a guard rail, made of steel. Top rail splice is used to connect pipe with rails.
- Bottom rail: From the two rails, the lower rail is called Bottom rail. It also connects and supports the rollers horizontally. It is like a guard rail, made of steel. Bottom rail splice is used to connect pipe with rails.
- PVC Pipe: The rollers are installed on PVC pipes, which allows the rollers to rotate or roll freely. It is a vertical member connecting both the rails and rollers. It is made up of PVC or steel.
- Stopper boards: It is a disc like board, which is installed between rollers and rails, at both upper and lower sides. It is used to guide objects back to road.
- Shock absorbing roller: It is the main part of rolling barrier system. The rollers are usually made up of Urethane or recycled hard rubber. It absorbs the shock of vehicles, and convert impact energy into rotational energy.
- LED guide lamp: A small LED guide lamp is installed on PVC pipe. It is installed on top of PVC pipe.
- Reflective band: A reflective band is attached to the rollers to give better visibility at night. Yellow coloured reflective band/tape is used to increase visibility at night.

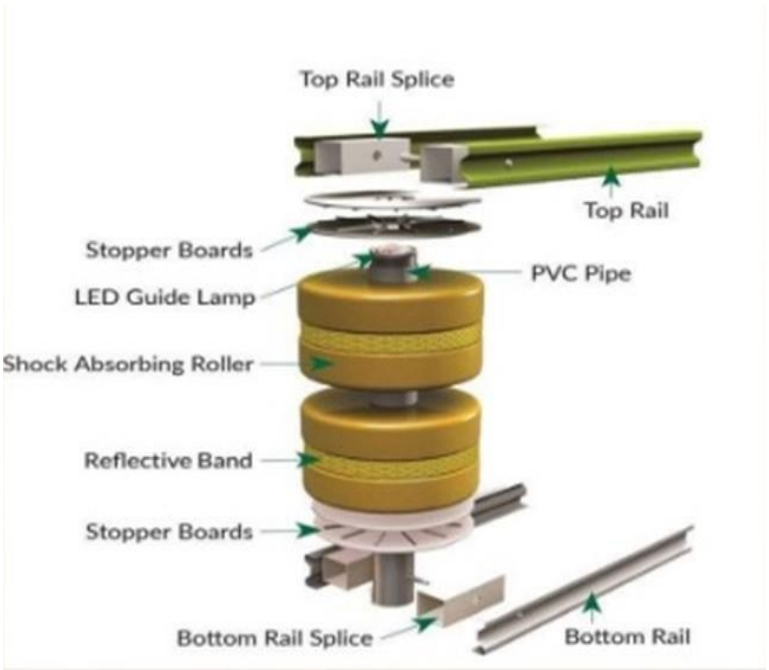


Figure: 3 Components of Rolling Barriers

II. LITERATURE REVIEW

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. 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.

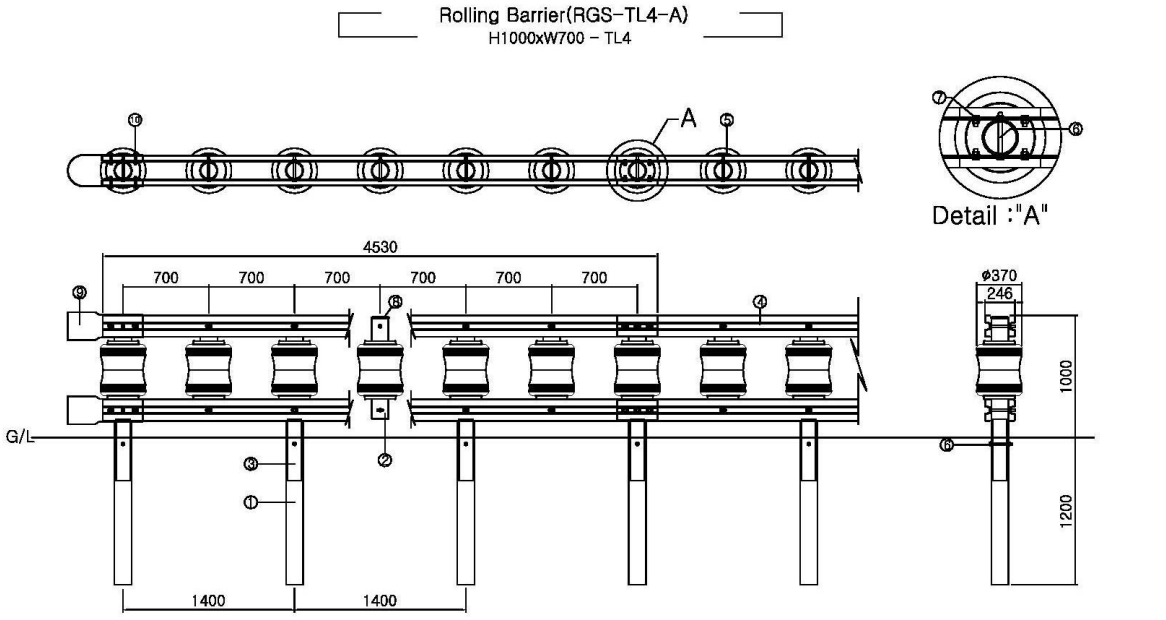
Figure: 4 Rolling Barrier at the U-Turn reflection system

III. 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 vehicles to prevent the steering system from a functional loss.

Rolling Barrier absorb high impact energy and then convert impact energy into rotational energy to push the vehicle forward rather than possibly breaking through an (not able to move) immovable barrier. It consists of both flexible properties and semi rigid properties of barrier stiffness. RB are different in methods/ways than other type of common, usual barriers. It reduces the danger/risk and road sudden unplanned bad events/crashes. Urethane are used in RB have become the material of choice in today's performance. The ETI product has a rotating barrel made of EVA with excellent shock absorption power having (height, width and depth) buffering frames and dense props supporting the frames. Rotating barrels comes with a political helped(mirror-like) sheeting for good visibility[3,8].EVA has better flexibility and ability to stretch compared to other polyethylene resins and has most almost the same features to rubber. In fact, it's lighter than rubber and more elastic than urethene. It can't be easily damaged. When a vehicle collide with guardrail, the barrels quickly converts the shock energy into the rotational energy. The tires of larger or small vehicles adjusted by upper and lower frames in order to prevent the steering system from the functional loss [12]. Front rails absorb the second shock and back rail absorb third shock and the metal pipe inserted into strengthen post.



Rolling Barrier(RGS-TL4-A) (1 SPAN : 4200mm)

NO	Product	Standard	Unit	Quantity	Material
1	Main Post	□139.8X216X4.5t	EA	3	SS400
2	Sub Post	□139.8X82X4.5t	EA	3	SS400
3	Inner Post	□145X50X4.5t	EA	3	SS400
4	W rail	175(+2)X50X4530X3.2t	EA	4	SS400
5	Shock Absorbing Roller	⊡370x240	EA	12	PE/Urethane
6	Hexagon Bolt/Nut/Washers	5/8X200	EA	15	SS400
7	Hexagon Bolt/Nut/Washers	5/8X35	EA	8	SS400
8	Post cap	⊡130.6	EA	6	SS400

Round rail(RGS-TL4-A) 1SPOT

NO	Product	Standard	Unit	Quantity	Material
1	Main Post	□139.8X216X4.5t	EA	0.5	SS400
5	Shock Absorbing Roller	⊡370x240	EA	1	PE/Urethane
6	Hexagon Bolt/Nut/Washers	5/8X200	EA	1.5	SS400
8	Post cap	□89.9	EA	0.5	SS400
9	Round rail	–	EA	2	SS400
10	Hexagon Bolt/Nut/Washers	5/8X60	EA	4	SS400

Figure: 5 Design of Rolling Barrier

3.1 Materials used in rolling barrier system:

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. It is a type of an artificial rubber. Urethane is flexible and malleable. It possesses non-brittle property along with elasticity. Polyurethane is also used for rolling barriers. Polyurethanes are linear polymers that have a molecular backbone containing carbamate groups. They are unique in combining the strength of rigid plastics with the flexibility and elasticity of rubber. It also possesses non-brittle property along with elasticity. Use of recycled artificial rubber is also possible.

3.2 Design specifications of rolling barrier:

Design of the rolling barrier is provided by the South Korean company "KSI". Here, the name of roller is given 'A'. The total diameter of the roller is 370mm and the rounded stainless steel's diameter is 246mm. The distance between one post to another post below the soil is 1400mm. A span's distance is 4200mm. Centre to

centre distance between one roller and another roller is 700mm. The vertical distance from ground level to further is 1200mm and the height of upper side is 1000mm.

IV. CONCLUSION

Accidents are the errors of humans while using motor vehicles and also nature creates problems like rain causing slippery 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 to the vehicles. Rolling barriers will not only reduce the impact of collision but also help in redirecting to the actual path, by converting impact energy into rotational energy. RB not only absorb the vehicle effect but also diverting the other vehicles moving in wrong direction. RB also helps us to undue traffic jam due to accidents will be decreased. RB has been shown to lower maintenance and repair costs. By its presence alone the barrier appears to be deterring and reducing the frequency of impacts. The rolling barriers systems are the future technology in Transportation Engineering.

REFERENCES

[1] Dani Nikhil, Shirsath Kunal, Langote Siddheshwari, 2017, "Study of rolling barrier system": Guru Gobind Singh College of Engineering Research Centre: *International Journal of Advance Research in Science and Engineering Pg. 538-540*

[2] Nagadarshan Rao, Nagaraja Bhagav, Naimish G Jagani, Jaydeep N Maravia, 2017, "An Alternative Method for Barriers: Rolling Barrier system", International Journal of Latest Engineering and Management research, Pg. 37-41

[3] Kyung-Whan Kim and Bu-Yong Shin, 2004, "A study on the characteristics of rolling barriers", KSCE Journal of Civil Engineering, 8, 135

[4] B. Mahendra Reddy, M. Sri Priya, 2017, "New Roller Barrier System Management and Efficiency on Highways", International Journal of Engineering Science and Computing 07- 14415-14418

[5] Zahoor Sarver, Sharma Tarun, 2018, "Study of rolling barrier system", International journal of information and computing science, Pg. 212-217

[6] Landage Hrushikesh, Ramekar Devanshu, Rude Durgadas, Sawale Yogini, Chandewar Lomesh, 2019, "Rolling Barrier System:An Innovative concept for safety and the reduction of the road accident a Review", International Conference on Innovation & Research in Engineering, Science & Technology, Pg. 09-10.

[7] G. Udaykumar, S. Chandralekha, "Designing a new technique to reduce highway barrieraccidents" International Journal of Research in Engineering and Technology, Vol 3 (2014).

[8] Peter Wright, "Barriers", grandprix.com (July21,2001).

[9] JP Research India Pvt Ltd, "Mumbai-Pune Expressway Road Accidents Study", (Dec 2014). [4] Mr.HoSeng Tim, "UNESCAP Expert Group Meeting on Improving Road Safety" Paper on Road Safety, Land Transport Authority, Singapore (May 2006).

[10] McDEVITT, C.F., Basics of Concrete Barriers, Public Roads, March/April 2000- Vol 63. No. 5.

[11] A Chequer, J Mitchell, S Thompson, "Traffic Management and Traffic Barriers" Published Project Report PPR 278.