



IMPLEMENTATION OF ROLLING BARRIER AND PLASTIC ROAD CONCEPT IN GHAT SECTION

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Abstract : In Maharashtra the transportation system is expanded rapidly also construction of highways is going on rapidly. Ministry of road transport and highway is looking for the latest techniques for a safety and construction of roads. Rolling barriers consist of continuous pipes with urethane rings invented by Korean company. The study of rolling barriers carried out to evaluate the effectiveness of rolling barrier and to understand the characteristics of crash cushioning and to evaluate the required strength of barriers. In 2016, 39878 accidents are recorded in Maharashtra and the number drop to 36056 in 2017, 35787 in 2018 and 32925 in 2019, 24971 in 2020. Sahyadri Mountains lies in Maharashtra state hence there are n numbers of ghats are situated in Maharashtra. Most of the accidents are occurred in ghat sections. The Rolling barriers are very useful to reduce the accidents in future. These barriers are used in curve roads, hilly roads on expressway etc. As like road safety, construction of roads is also now ongoing issue. Maharashtra state is facing major issue of plastic generation, from previous year data in 2019, 400 thousand metric tons of waste generated in state this number increases to 600 thousand metric tons in 2020. By using plastic in road construction, we will reduce plastic pollution in state. From this project we will suggest some better ideas to government regarding development of roads in Maharashtra

IndexTerms - Rolling barrier, Maharashtra, Accident, Ghat, Plastic waste.

I. INTRODUCTION

The state recorded 39,878 road accidents in 2016, and the number dropped to 36,056 in 2017, 35,717 in 2018 and 32,925 in 2019, as per the data. In 2016, a total of 12,935 people were killed in 11,780 fatal accidents, while 12,511 people were killed in 11,454 fatal accidents in 2017, as per the data. The Mumbai-Pune Expressway, and Pune, Solapur, Ahmednagar and Nashik districts have been contributing around 30% of the road accidents in Maharashtra, said by the highway police officials. Thirty-three of the 34 people in a bus were killed after it fell into a 500-foot deep gorge near Mahabaleshwar in Maharashtra's Raigad district on Saturday. Eleven bodies have been recovered so far. The bus had rolled down a hill road in Ambenali Ghat, near Poladpur town, after the driver lost control while taking a turn.

3 killed, 64 hurt as overcrowded tempo falls in Raigad Officials said the incident took place around 7 pm when the people in the tempo were returning to their hometown in Ratnagiri after attending a wedding in Satara. The vehicle fell down 50 feet into the gorge, said police. All 45 people travelling in a state transport bus were saved miraculously after a Maharashtra state transport bus, which plunged into a deep gorge, got stuck on a mango tree in Ambenali ghat between Mahabaleshwar and Poladpur. From all above data maharashtra government should adopt some new techniques for construction of roads. It has been noted that major accidents are happened in ghat sections. Ghats like Ambenali, Diva, Channapuri, Kashedi, Malshej etc. are most difficult to travel.

The threat of disposal of plastic will not solve until the practical steps are not initiated at the ground level. It is possible to improve the performance of bituminous mixed used in the surface course of roads. Studies reported in the use of recycled plastic, mainly polyethylene, in the manufacture of blend indicated reduced permanent deformation in the form of rutting and reduced cracking and crazing of the pavement surface. The field tests withstood the stress and proved that plastic wastes used after proper processing as an additive would enhance the life of the roads and also solve environmental problems. Plastic is a very versatile material. Due to the industrial revolution, and its large scale production plastic seemed to be a cheaper and effective raw material. Today, every vital sector of the economy starting from agriculture to packaging, automobile, electronics, electrical, building construction, communication sectors has been virtually revolutionized by the applications of plastics. Plastic is a non-biodegradable material and researchers found that the material can remain on earth for 4500 years without degradation. Several studies have proven the health hazard caused by improper disposal of plastic waste. The health hazard includes reproductive problems in human and animal, genital abnormalities etc. Looking forward the scenario of present life style a complete ban on the use of plastic can't be

put. Although the waste plastic taking the face of devil for the present and future generation, we can't avoid use of plastic but we can reuse it.

II. LITERATURE REVIEW

Aditya Bhardwaj et.al. (2017), Industrialization and population is increasing day by day leading to the increase in the amount of waste plastic. Plastic is a non-biodegradable substance i.e. it is not decomposed by bacteria easily. So, dumping it causes soil pollution which leads to decrease in the fertility of soil. Another way of getting rid of plastic is by burning it, which also produces a lot of harmful gases and leads to increase in air pollution. Soil and air pollution both are harmful for the environment. Waste plastic can be used in bitumen as a modifier. In this paper we will discuss the variation of the properties of bitumen on addition of waste plastic at different percentage.

Aakash K V et.al. (2020), A large amount of non-renewable resources is consumed by the construction industry throughout the world. This paper describes the various aspects of utilization of paper waste and plastic waste in construction of roads. Paper Crete will offer a way to turn "trash" paper into inexpensive roads that are quite strong, well-insulated and easily built. Fly ash, micro silica, steel slag, and plastic are some of the waste materials that can be used and also there has been an exponential growth in municipal plastic waste disposal especially in urban areas, use of plastic in road construction has gained importance these days.

Ibrahim Khansa.et.al. (2019), The prevalence of burnout is increasing among all physicians, including plastic surgeons. Burnout is not simply synonymous with being overworked. It is a complex physical, intellectual, and psychological entity that arises when the expectation and reality of the job do not match. In this article, the authors' goal is to define burnout, summarize its causes and consequences, and offer the plastic surgeons methods to prevent and address it.

Manoj Sharma.et.al. (2016), The waste materials is always a problem for the environment, some waste may be disposed easily some cannot. Plastic is also a kind of material whose disposal is always a tedious job. The disposal of waste effected the environment drastically, for minimizing this effect several research in various field is going on to recycle plastic safely. One of its ways is to use the waste plastics in road construction. Plastic road is a need of an hour as they not only consume waste plastic in an eco-friendly way, but also helpful in increasing the quality of the road. In this review paper we will thoroughly study some of the methods and technique through which plastic is used in the road construction and how these technologies suits in various conditions.

III. TYPES OF BARRIER

3.1 FLEXIBLE BARRIERS

These include metal beam crash barriers manufacturer and weak post corrugated guide rail systems. These are called Flexible barriers because they will deflect when struck by any vehicle. Impact energy is dissipated through tensions in the rail elements, posts, soil and vehicle body work and friction between the rail and vehicle.



FIG 1 : Flexible Barrier

SOURCE : (<https://www.csppacific.co.nz/uploads/news/highwaysafety01.jpg>)

3.2 ROLLING BARRIER

The Rolling Barriers are the barrier that absorbs impact energy and converts that impact energy into rotational energy and directs the vehicles forward rather than potentially breaking through an immovable barrier.



FIG 2 Rolling Barrier

SOURCE: (<https://wonderfuleengineering.com/wpcontent/uploads/2017/02/Safety-Rolling-Barrier1.jpg>)

IV. METHODOLOGY

4.1 THEORETICAL 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 a second shock. Back rail absorbs a third shock. Metal pipe inserted into the strengthened 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. CASE STUDY

5.1 INTRODUCTION

Ambenali ghat is one of the most dangerous ghat in Maharashtra state. It is the state highway that interconnect two district of Maharashtra (Raigad and Satara) having road width of 6m. and it has total stretch 40km. In 2018 bus accident was happened in this ghat in which 33 professors of Dapoli Agricultural College were died. After that the over loaded tempo fall 550ft into the valley in which 3 peoples are died and 64 peoples are injured. The tempo was returning to their hometown (Ratnagiri) after attending wedding in Satara.

From all above data Maharashtra Government should adopt some new techniques for construction of road safety for people.

5.2 PROBLEMS ON AMBENALI GHAT

On 8th of January 2022, we started survey of that ghat around 10am. We found that there were no proper super elevation provided on curves and also at some places there was not provided any type of safety barriers.

On bus accident place we measured velocities of vehicles, for that we marked two lines at distance of 30m with the help of lime powder. And noted time required for vehicles to travel from point A to point B. Bus accident was happened on straight road patch but, when we looked carefully there was a slight road widening provided. The road width at that patch was 6m and widening is 0.5m. and the speed of vehicles on that point is approximate 40-60km/hr. in our survey we found that there were so many dangerous curves on the entire ghat. On those curves drivers unable to see the vehicles that are coming from opposite direction. In this ghat, we select one curve for our survey and the elevation of that curve is 350m. the vehicles speed on this curve is approximate 40-50km/hr. In our study we saw that there is only one rusted barrier of height 1.5m. And we observed in that ghat there were no proper barriers are provided on some points/curves and also there was not any type of sign boards, reflectors and road markings are also not provided.

5.3 PROCEDURE OF SURVEY

On 8th January 2022, we started survey on Ambenali ghat (Poladpur-Satara). Around 10am. After observing entire ghat we selected a point/curve from which we started design the curve.

1. On that curve we found out point of curvature from where actual curve begins (T1).
2. We set total station on (T1), did proper levelling of total station by taking bubble on center.
3. We found point where curve ends (T2) point of tangency.
4. Distance between (T1-B) and (T2-B) was calculated by using total station and marked intersection point that is (B).
5. We marked distance by using lime powder. Found out angle of intersection (i).
6. We measured length of long chord by using total station.
7. The long chord was divided into two equal halves (left half and right half).
8. The mid ordinate O0 was calculated as follows.

$$O0 = R - \sqrt{R^2 - (L/2)^2}$$

Considering the left half of the long chord, the ordinates O1, O2.....calculated at distances X1, X2.... taken from D towards the tangent point T1.

Formula for calculation of ordinates is as follows.

$$Ox = \sqrt{R^2 - x^2} - (R - O0).$$

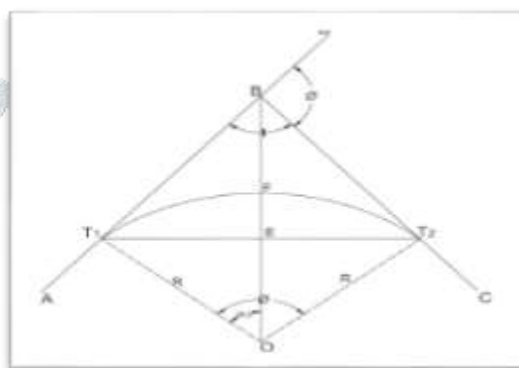


FIG 3. Curve Design



Fig 4 Location of Survey

VI.RESULT AND ANALYSIS

6.1 RESULT:- Speed of vehicle on bus accident place.

TABLE 1 SPEED OF VEHICLES AT BUS ACCIDENT LOCATION

Sr.no	Vehicle type	Time (sec)	Distance (m)	Km/hr
1	Car	3.50	30	30.92
2	Car	2.30	30	47.61
3	Car	3.11	30	34.88
4	Bus	3.30	30	32.72
5	Car	3.40	30	31.76
6	Bike	2.30	30	46.95
7	Car	1.94	30	55.67

8	Car	1.40	30	77.14
9	Car	2.49	30	43.37
10	Car	2.22	30	48.64
11	Car	2.21	30	48.86
12	Car	3.99	30	27.06
13	Car	3.42	30	31.39
14	Car	2.12	30	50.94
15	Car	2.70	30	40
16	Heavy tempo	2.49	30	43.37

6.2 RESULT:- Speed of vehicle going upsides.

TABLE 2 SPEED OF VEHICLES GOING UPWARD

Sr.no	Vehicle type	Distance (m)	Time (sec)	Km/hr.
1	Car	56	2.33	86.52
2	Car	56	2.03	99.31
3	Car	56	5.30	38.03
4	Car	56	5.40	37.33
5	Car	56	6.67	30.22
6	Car	56	6.69	30.13
7	Car	56	5.50	36.65
8	Car	56	4.30	46.88
9	Car	56	4.31	46.77

6.3 RESULT;- Speed of vehicle going down side.

TABLE 3 SPEED OF VEHICLES GOING DOWNWARD

Sr.no	Vehicle type	Distance (m)	Time (sec)	Km/hr.
1	Truck	56	6.30	32.00
2	Car	56	4.00	50.54
3	Car	56	4.08	49.41
4	Car	56	4.50	44.80
5	Truck	56	6.01	33.54
6	Car	56	5.14	39.22

6.4 RESULTS OF PLASTIC ROAD

6.4.1 AGGREGATE CRUSHING VALUE

TABLE.4 AGGREGATE CRUSHING VALUE

Aggregate Crushing value (Normal Aggregate) %	Aggregate Crushing Value (Plastic coated Aggregate) %
22.07	15.88

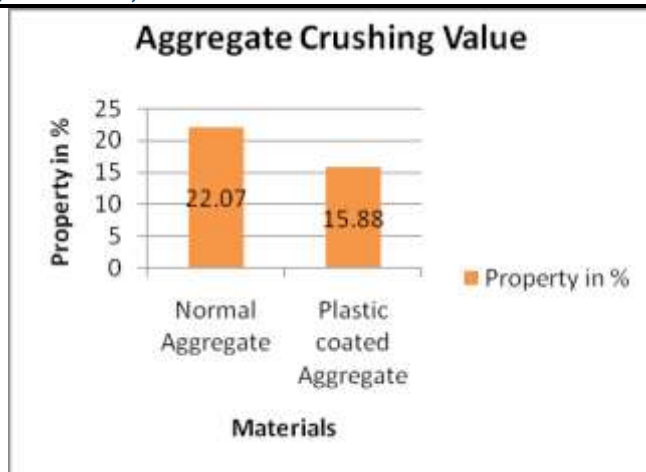


FIG 5 Aggregate Crushing Value graph

6.4.2 AGGREGATE ABRASION TEST

TABLE 5 ABRASION TEST VALUE

Abrasion Test value (Normal aggregate)	Abrasion Test Value (Plastic Coated Aggregate)
7.5	6.4



FIG 6 Aggregate abrasion value Test

6.4.3 SOFTENING POINT TEST

TABLE 6 SOFTENING POINT

Sr . No	Softening point (°C) (plain bitumen)	Softening point(°C) 10% bitumen replaced by plastic
1	62	71.1

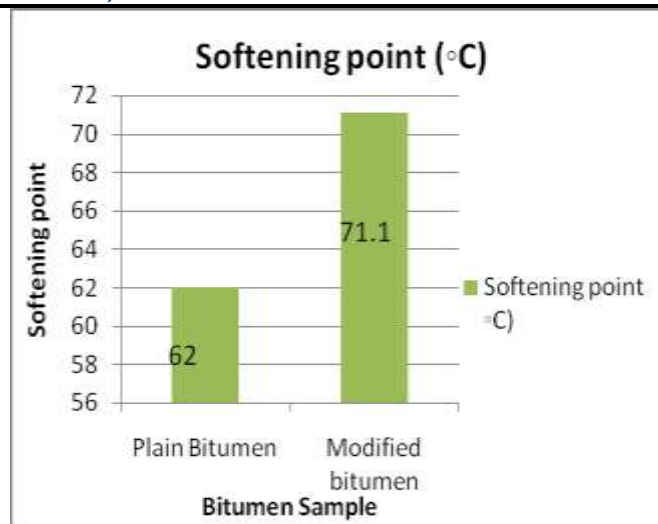


FIG 7 Softening Point Graph

VII. CONCLUSION

7.1 ROLLING BARRIER

1. As per our opinion 2018 bus accident took place on straight road but if you look closely road is slightly wide at that point. If at that time over speeded vehicle was came from opposite side and driver turns steering slide left for saving vehicle coming from opposite side after he loses his control on steering and bus collapsed in deep valley.
2. If proper barrier system had been adopted we could have saved the accident.
3. The accident is the case of human error or natural phenomenon.
4. India is a developed country in infra and transportation section. As an engineer we construct the roads, highways, express ways, but also we have to concentrate on the safety of the roads, to minimize the total accidents.
5. On the above curve vehicle coming from opposite direction is not visible to drivers. Speed of vehicles on curve was approx. 40 to 60Km/hr.
6. One side there is deep 350m valley. If driver losses his control or any wrong things happened in vehicle like failure of break, breaking gear box, then vehicle will collapse in valley.
7. If Maharashtra government adopt rolling barrier technique on this curve then we can save major accidents.
8. Life of people is more important than money.
9. Rolling barriers not only reduce the accident, it also helpful to vehicle to turn back on road after collision on barrier and converts the shock energy into rotational energy.
10. Rolling barriers also work as reflection in night. Residence of Poladpur and near villagers also said that some people steal reflectors, sign boards for their personal work. Police should take strict action against such type of people.
11. Rolling barrier system is future of our developing Maharashtra and we will suggest that PWD should take initiative to adopt this type of barrier in "Ambenali Ghat".

7.2 PLASTIC ROAD CONCLUSION

WET PROCESS

Polymer Modified Bitumen is used due to its better performance. But in the case of higher percentage of polymer bitumen blend, the blend is a more polymer dispersion in bitumen, which get separated on cooling. This may affect the properties and quality of the blend and also the road laid using such blend.

- i. Waste plastic-bitumen blend shows decrease in penetration point and ductility whereas increase in softening point and flash point of bitumen.
- ii. Blending requires a special type of mixing assembly for proper and effective blending.
- iii. Increase and decrease in specific values of bitumen shows improved performance of bitumen which in turn helps to improve quality and durability of road.
- iv. When modified bitumen is to be used at site of construction; there should be provision of maintaining proper service temperature and blending to prevent phase separation.

DRY PROCESS

In the modified process (dry process) plastics-waste is coated over aggregate. This helps to have better binding of bitumen with the plastic-waste coated aggregate due to increased bonding and increased area of contact between polymer and bitumen. The polymer coating also reduces the voids. This prevents the moisture absorption and oxidation of bitumen by entrapped air. This has resulted in reduced rutting, raveling, and there is not pothole formation. The road can withstand heavy traffic and show better durability.

- i. Coating is easy and the temperature needed is the same as the road laying temperature.
- ii. Bitumen is bonded with the aggregate by means of plastic which acts as a binder.
- iii. Bitumen bonding is strong as evidenced from higher Marshall Value.
- iv. Coated plastics acts as binder and the added bitumen binds strongly.
- v. Waste plastic is collected, shredded and can be used in the hot mix plant to lay the roads.
- vi. No new technology is involved. The existing Mini hot mix plant or Central Mix plant can be used without any modification.
- vii. The coated aggregate shows increased strength.
- viii. Dry process can be practiced in all type of climatic conditions. Process can be modified by varying the percentage of plastic with respect to the environmental conditions namely, Temperature, Rain, Snow, load, etc.,

No evolution of any toxic gases like dioxin as the max. Temp only 170°C

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