

MOVABLE DIVIDERS as a SOLUTION to TRAFFIC CONGESTION in INDIAN METRO CITIES

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Abstract: Today we are facing heavy traffic problems such as congestion, accidents, delays to work, environmental hazards, fuel wastage etc. due to increase in population and inadequate infrastructure to cater it. This paper introduces a new yet effective solution of movable dividers to reduce traffic congestion. It also lays emphasis on conveying the design of a suitable system before the actual execution. Use of software to explain the system helps in effectively conveying the concept.

Keywords: movable, dividers, traffic, congestion

I. INTRODUCTION

In recent years, with an ever increasing rate of development in cities around the world, there has been a proportional increase in number of automobiles on the roads and even though the number of vehicles using the roads have increased, the static road infrastructure is almost the same and is unable to cope with changes like congestion, unpredictable travel-time delays and road-accidents that are taking a serious shape. Traffic congestion is one of the major concerns faced by developing cities today in spite of measures being taken to mitigate and reduce it. It has emerged as one of the primary challenge for developers in urban areas while planning for sustainable cities.

II. ASSOCIATED PROBLEMS

We all know that developing cities densely populated. Therefore, they face some basic traffic problems which need attention and solution as soon as possible so as to maintain the actual growth in terms of development. Whenever we talk about the traffic in such cities, we hear words like disgusting, chaotic, unsafe, infamous, etc. Infrastructure is an important tool for the development of a country and transportation consists of 80% of the total infrastructure.

India has a comparatively poor infrastructure when compared to the developed countries. Major traffic issues are noticed on the roads connecting outskirts areas to the Metro cities out of which the major concern is traffic jams that happen due to non-recurring highway accidents such as a crash or ongoing road works, which may reduce the road's capacity below normal levels.

Traffic involves large queues, slower speeds and increased travel times, which impose costs on the economy and generate multiple impacts on urban regions and their inhabitants. A recent study by the Centre for Science and Environment (CSE) on Delhi revealed that the traffic congestion at certain places has increased the NO₂ level in these areas to an alarming level exposing the environment and the residents to hazardous air.

According to a study by IIT Madras, in New Delhi alone, at least about 300,000 US\$ worth of fuel was being wasted every day, by vehicles idling at traffic signals as early as in 1998. This figure jumped to approximately 1.8 million US\$ per day as of 2020. It has also been observed that in areas having high density traffic and congestions, there can be a scenario where emergency services such as an ambulance, fire brigade or police cannot reach their destination on time.

Road accidental fatalities have increased more than 9 times, from 14,500 in 1970 to 137,400 in 2017. In comparison to 2007, fatalities and injuries in 2017 are higher by 53,000 and 87,000, respectively. From 2007 to 2017, fatalities have increased at a rate of 5% per year while the population of the country has increased only at the rate of 1.4% per year.

III. LITERATURE SURVEY

A. Movable traffic divider: a congestion release strategy, Kavin Doshi, SPCE Mumbai:

This paper focuses on the traffic problems faced by the city of Mumbai in India and proposes the concept of movable divider as a solution to it. Metro Count Method, which works on the principle of Doppler Effect, is used to carry out the traffic survey. The results were plotted against the solutions given to move the divider at certain points and at specific time of the day.

B. Congestion costs incurred on Indian roads: a case study for New Delhi, Gaurav Raina, IIT Madras:

This paper from IIT Madras typically focuses on the capital city of India, New Delhi. The paper lays emphasis on how traffic congestion not only impacts the environment, but also is a decider in fuel prices and thus the economy of a nation.

C. Automatic movable smart road dividers - iot based solution to traffic congestion problems, Dr. Sumaiya M N:

The concept of movable dividers has already been discussed as a solution to growing traffic woes around globe. But the main concern has been to execute the idea with maximum productivity and ease of operations. Use of IoT has been a key addition to the transportation designing industry recently. This article studies the use of IoT in working of movable dividers.

D. A review paper on movable divider and cost efficiency, Prof. Raju Bondre:

This paper states that a lot of solutions which involve heavy construction work, use of advanced and heavy materials, road zipper systems are effective but costly solutions for traffic congestion. The paper puts forth the concept of movable dividers as a cost-efficient solution to traffic congestion and analyzes the concept through economic point of view.

IV. RESEARCH STUDY

A. Causes of traffic jam

According to our study, there are 12 major causes for traffic congestion in Indian Metro cities. They are: -

- 1) Traffic rules violation,
- 2) Improper Planning,
- 3) Inadequate sideways,
- 4) Unplanned stops/ parking,
- 5) Over population,
- 6) Insufficient road for the traffic,
- 7) Lack of law implementation,
- 8) Increase in private car ownership,
- 9) Illegal establishments and
- 10) Lack of driving sense/training.

Dividers are usually provided to earmark the segregated movement of a particular type/ category of traffic, such as, segregating carriage way from a service road, segregating thorough traffic from turning traffic and dedicated BRT corridor and corridors for non-motorized transport (cycles). The dividers can be in the form of low height central verge, curb, railing, etc. which can be either permanent (steel, concrete etc.) or flexible/ movable such as rubberized cones, precast curbs and electrically/ mechanically operated shiftable divider railings.

V. CONCEPT OF MOVABLE DIVIDER

After conducting various surveys and understanding the traffic flow, the suggested solution to the problem scenarios mentioned above can be put forward as Movable Traffic Divider (MTD). The MTD can be used to effectively change the configuration of the existing roadway so as to optimize its usage by the distributing vehicular traffic evenly which will minimize the traffic congestion making optimum use of the existing road structure. Instead of having traditional non movable dividers, a mechanical setup of movable divider is to be installed on road such that during peak hour period on congested direction lane, width of road can be increased by just moving the divider.

Assuming a 3+3 lane road connecting location A (residential areas) and location B (official areas), the traffic density is high on the carriageway going from A to B and low on the carriageway going from B to A during morning hours. Whereas at evening time the traffic density is high on the carriageway going from B to A and low on the carriageway going from A to B.

For this kind of pattern, movable traffic dividers can be installed on road so that during morning hours carriage way towards location B can be widened by mechanical movement of divider making the lane 4+2 in place of the original 3+3 lane. This repositioning would result in the roadway going from A to B widened by a lane. Consequently, the number of lanes going from B to A is reduced from 4 to 2. As the number of vehicles going from B to A during the morning peak hours is very less, this reduction in the number of lanes would not cause traffic congestion in that stretch. The expansion will be out of question after the area allotted for development terminates. Movable Traffic Dividers (MTD) aims to maximize the efficiency on the existing road structure to minimize congestion. The movable traffic barrier being flexible yet rigid structure acts as an interim solution. For the traffic heading in particular direction, the widening of the roads, thus adding an extra lane by the movement of the traffic divider assures the decongestion in the traffic.

VI. DESIGN OF MOVABLE DIVIDER

A. Design principle

The design principle of movable dividers is based on the same principle as that of trams. Trams are small-sized urban metros operating specially in the Europe. The trams run on a similar principle as that of a railway where the bus carrying passengers runs along a carriageway by means of rails. However, the trams do differ from the railways. They are light in weight; therefore the tracks are not designed for high loads. The tracks, situated in the heart of various cities and important roads are grooved using inbuilt ground system where only one edge of rail is the chief rail rising while the other edge doesn't rise and only works as a check rail.

With advancements in track design, Girder Guard Rail was introduced. In this system, the rail is embedded into the road pavement itself as the comparatively lighter weight of tram is transferred to and resisted by the road bed and foundation. The blend of track with road pavement means that besides the thin steel lining on which the tram runs, nothing else is visible about the track. This also means that the evenness of the road is maintained throughout.

B. Working

We propose the same system of Girder Guard Rail to be used in the movement of dividers so that their movement is smooth for such a light weight and an even road is available for the carriageway.

The design of plastic-parabolic dividers is done such that they have an in-built locking system wherein it locks and unlocks using a remote. The interlocking is between the divider and the road surface below wherein the provision is given without disturbing its evenness. The locking provision in road is given at specific intervals on both sides of the road in normal divider condition. Nut and bolt system of locking along with a jack is the simplest form of interlocking that can be provided.

The dividers being light in weight can be moved around using small sized wheels provided at regular intervals. The movement of divider along the rails can be done using a motor. The divider can be moved to its desired side by using a lever.

A combined system wherein, the interlocked divider is unlocked using a remote and the motor is started to make the divider move along the rails using their wheels is adopted. Once the divider reaches the side that is destined, the motor should be stopped and the remote should be used to lock the divider at that point. The same process should be repeated to move the divider back to its original position.

C. Use of software

Just like we mentioned about the use of intelligent transportation system for a futuristic analysis and tech-savvy data collection, using various new age software's to convey the concept is necessary.

We used various BIM (Building Information Modeling) software's for this purpose. REVIT was one such software that we used to design the basic 3-Dimensional view of our model. We designed two different models, one which had a normal road layout while one having road layout after the divider was moved. The 3-Dimensional model contained details about road, divider, rails, footpath and lanes.

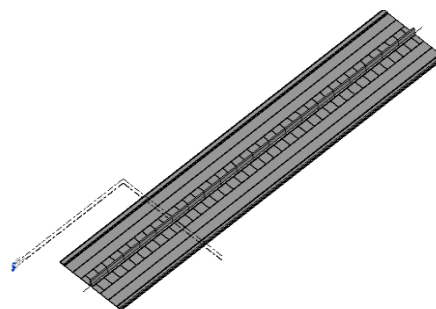


Fig. 1 REVIT 3D Initial Model



Fig. 2 REVIT Model Elevation

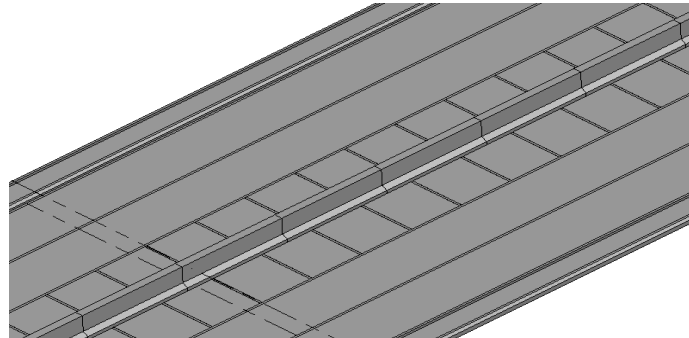


Fig. 3 REVIT Model Detailing

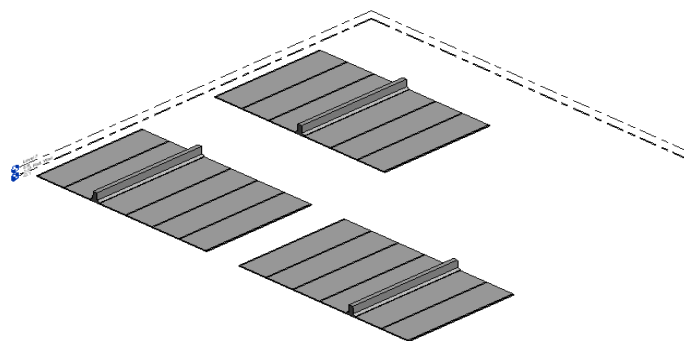


Fig. 4 REVIT Base Model

VII.APPLICATION

Owing to a large amount of excavation work to be carried out on stretches that have severe problems, laying of Girder Guard Rails can be done. The locking system in the ground should be effectively laid on one lane apart on each side of divider when in normal position. This means the lanes can be switched from 3+3 on both sides to 4+2 on either side as per requirement.

The light-weight plastic dividers should be precast using waste plastic materials. The dividers should be of parabolic shape and have a locking system that locks and unlocks into the provision given in roads which will be operated using a remote. Apart from this, the divider should be equipped with small sized wheels at equal intervals that rest on the rails and also provide easy movement of divider over them. The movement of dividers should be controlled by a motor-operating unit.

The movement of divider and interlocking on the desired side should pave way for equal distribution of traffic and reduce traffic congestion considerably.

VIII.CONCLUSION

Today, the population is increasing drastically every year. Because of this, the need of vehicles rapidly increases and thus the number of vehicles on road increases. Therefore, we are facing heavy traffic problems such as congestion, accidents, delays to work, environmental hazards, economic crunch etc. The solutions recommended in this paper are going to help avoid such traffic problems. This study is mostly useful in developing countries, states, towns etc.

The paper introduces a new yet effective solution of movable dividers to reduce traffic congestion. It also lays emphasis on conveying the design of a suitable system before the actual execution. Use of software to explain and convey the concept helps in getting to know the effectiveness of the system by means of modern day tools and technology.

IX.FUTURE SCOPE

In future, roads of developed countries cannot be increased in their width. So there will be an increase in traffic congestion, and we need to find the alternative options to control traffic. Use of modern day intelligent transport systems such as IoT can make it easy to operate the moving of dividers using artificial intelligence (AI) software's. The use of IoT can pave way for a cost efficient and time saving execution of movable dividers.

Another important scope can be regarding the rails on which the movable dividers would move. The rails would be on the road surface and the vehicles would be moving on it. The rail could be an electrified rail that will charge the electric

vehicles moving over it. As per **The Guardian's** (a leading newspaper based in London) report, 70% vehicles moving on the roads could be electric vehicles by 2030. Considering the future, Sweden has designed electrified rails which charge the electric vehicles running over it. Such electrified rails can be used for movable divider movement so that it would cater to multiple purposes – to provide smooth movement of dividers over it and to charge electric vehicles moving over it.

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