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A Review on Traffic Control of Road Bridge (A Case Study of Navale Bridge, Pune)

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ABSTRACT: Traffic congestion on bridges has become one of the major challenges in urban transportation, particularly in fast-growing cities like Pune. The Navale Bridge on the Mumbai–Bangalore Highway is a crucial traffic corridor that experiences severe congestion, accidents, and travel delays during peak hours. This project aims to study Traffic Control of Road Bridges, focusing on the Navale Bridge, Pune, and propose modern, efficient, and sustainable solutions using smart traffic management systems. The research explores IoT-based sensors, adaptive traffic lights, CCTV-based monitoring, and AI-driven traffic analysis to enhance real-time traffic control and safety. By implementing smart traffic management techniques, congestion can be reduced, vehicle delay minimized, and accident frequency lowered. The study proposes measures such as automated lane control, smart surveillance, synchronized signals, and improved pedestrian safety systems for better bridge operation.

KEYWORDS: Traffic Management, Smart Bridge, IoT, Adaptive Signals, Congestion Control, Navale Bridge, Pune

I. INTRODUCTION

Traffic congestion is a major concern in rapidly developing cities like Pune, where increasing vehicular growth and limited infrastructure lead to severe delays and safety risks. Urban bridges, such as the Navale Bridge on the Mumbai–Bengaluru Highway, face continuous traffic pressure due to mixed vehicle flow and poor signal coordination. Traditional control systems fail to adapt to real-time conditions, causing long queues and accidents.

The use of Smart Traffic Control Systems (STCS) offers a modern, efficient solution. By integrating IoT sensors, adaptive signals, and AI-based monitoring, these systems can dynamically manage vehicle movement, reduce congestion, and improve safety. This project focuses on analyzing traffic conditions at Navale Bridge and proposing intelligent control measures for smoother, safer, and sustainable urban mobility.

II. CURRENT PROBLEMS

Although Navale Bridge is a crucial transportation link in Pune, it continues to face several persistent challenges in traffic management and infrastructure efficiency. The bridge experiences heavy congestion due to uncontrolled vehicle flow, poor traffic discipline, and lack of real-time traffic monitoring systems. Most traffic control operations still rely on conventional methods rather than intelligent traffic management systems, leading to frequent bottlenecks and long travel delays.

Another major issue is the poor integration of surveillance systems, traffic signals, and monitoring mechanisms. Although CCTV cameras and signal systems may be installed in surrounding areas, the absence of centralized coordination results in fragmented data and limited optimization of traffic movement. This reduces the effectiveness of congestion management strategies.

Infrastructure limitations further aggravate the situation. The bridge connects major highways and city roads, carrying high volumes of heavy vehicles, local traffic, and intercity transport. The road geometry, merging points, and inadequate lane discipline often create accident-prone conditions. Frequent breakdowns and improper parking near the bridge area also worsen congestion.

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In addition, the lack of strict enforcement, insufficient pedestrian facilities, and inadequate planning for peak-hour traffic increase safety risks. Environmental concerns such as increased air pollution and noise pollution due to continuous traffic jams negatively affect nearby residential areas.

Furthermore, limited coordination among traffic authorities, urban planners, and transport departments restricts long-term sustainable solutions. As a result, Navale Bridge continues to experience recurring congestion, safety hazards, and inefficient traffic flow, highlighting the urgent need for smart traffic management systems, better infrastructure planning, improved enforcement, and integrated monitoring solutions.

III. NEGATIVE EFFECTS

The continuous traffic congestion at Navale Bridge has several negative effects on commuters and the surrounding areas of Pune. Frequent traffic jams increase travel time and fuel consumption, causing financial loss and daily inconvenience to the public. The heavy movement of vehicles leads to higher air and noise pollution, which negatively affects the health of nearby residents. Poor lane discipline and overcrowding also increase the risk of road accidents, making the area unsafe for drivers and pedestrians. In addition, constant congestion creates stress and frustration among commuters and reduces the overall efficiency of the transport infrastructure. These issues highlight the urgent need for better traffic management and infrastructure improvement at Navale Bridge.

IV. METHODS FOR ADDRESSING TRAFFIC CHALLENGES AT NAVALE BRIDGE

- Integrated traffic planning and coordination: – Effective traffic management at Navale Bridge requires proper coordination between traffic police, municipal authorities, and highway departments in Pune to ensure smooth vehicle movement and systematic control of traffic flow.
- Standardization and intelligent traffic systems: – Adoption of Intelligent Traffic Management Systems (ITMS), synchronized traffic signals, and standardized road markings is essential to improve interoperability between monitoring devices, CCTV cameras, and traffic control centers for efficient data exchange and congestion control.
- Accurate traffic monitoring and data collection: – Installation and regular maintenance of traffic sensors, speed detectors, and surveillance cameras are necessary to collect accurate real-time data on vehicle density, peak-hour load, and accident-prone zones, which supports data-driven decision-making.
- Road safety and enforcement measures: – Implementation of strict traffic rule enforcement, speed control mechanisms, lane discipline monitoring, and heavy vehicle movement regulation during peak hours is required to reduce accidents and improve road safety.
- Infrastructure improvement and optimization: – Widening of merging points, construction of service roads, redesign of entry and exit ramps, and development of pedestrian facilities should be undertaken to enhance traffic efficiency and reduce bottlenecks.
- Public awareness and driver education: – Awareness campaigns and driver training programs should be conducted to promote responsible driving behavior, reduce unnecessary honking, and encourage adherence to traffic rules.
- Sustainable and long-term planning: – Development of alternative routes, promotion of public transportation, and regular maintenance of road infrastructure should be practiced to minimize congestion and ensure sustainable traffic management at Navale Bridge.

V. IMPORTANCE OF EFFECTIVE TRAFFIC MANAGEMENT AT NAVALE BRIDGE

- Effective traffic management at Navale Bridge plays a crucial role in improving transportation efficiency by enabling smooth vehicle flow, reducing congestion, and minimizing travel delays in Pune.
- Proper traffic control systems help reduce fuel consumption, air pollution, and carbon emissions by preventing long traffic jams and unnecessary vehicle idling.
- Improved road planning and monitoring enhance public safety by reducing accident risks, ensuring lane discipline, and providing safer movement for pedestrians and heavy vehicles.
- Real-time traffic monitoring and coordinated signal systems support quicker response to accidents, vehicle breakdowns, and peak-hour congestion, thereby improving overall road performance.
- Efficient traffic management contributes to economic growth by ensuring timely transportation of goods and reducing financial losses caused by delays.

- Overall, the implementation of smart and sustainable traffic solutions at Navale Bridge is essential for long-term urban development, environmental protection, and improved quality of life for daily commuters.

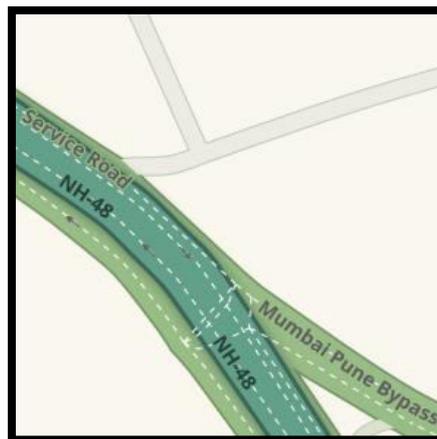
VI. CASE STUDY: NAVALE BRIDGE, PUNE



Overview

Traffic control on road bridges is essential for maintaining smooth traffic flow, ensuring safety, and reducing congestion in urban transport networks. Navale Bridge, Pune, located on the NH-48 Mumbai–Bengaluru Highway, experiences heavy traffic volumes throughout the day due to its strategic location and connectivity. Frequent congestion during peak hours, mixed traffic conditions, poor lane discipline, and inadequate coordination between nearby intersections have significantly affected traffic efficiency. This case study examines the existing traffic conditions at Navale Bridge and evaluates suitable traffic control measures to improve vehicular movement and reduce congestion.

Key Features of Traffic Control Measures



Traffic Volume Analysis – Classified traffic volume counts are carried out to understand traffic composition, peak hour flow, and demand patterns on the bridge.

- **Signal Coordination Improvement** – Better coordination between upstream and downstream traffic signals is proposed to reduce queue formation and delays.
- **Lane Management and Discipline** – Proper lane allocation for different vehicle categories is suggested to minimize conflicts and improve traffic flow.
- **Heavy Vehicle Regulation** – Control of truck and bus movement near merging and bottleneck zones to prevent congestion buildup.

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- **Pedestrian Movement Management** – Identification of pedestrian conflict points and implementation of suitable crossing control measures to enhance safety.
- **Traffic Flow Evaluation** – Assessment of delays, queue lengths, and level of service to evaluate the effectiveness of proposed traffic control measures.

Traffic Management Outcomes

The proposed traffic control measures at Navale Bridge are expected to reduce congestion during peak hours, improve travel speed, and enhance road safety. Improved signal coordination and lane discipline will lead to smoother traffic flow and reduced delays. Effective traffic management will also help in lowering fuel consumption and vehicular emissions while improving overall commuter convenience. The study contributes toward efficient and sustainable traffic management for urban road bridges.

VII. CONCLUSION

Effective traffic control on road bridges is essential to reduce congestion, improve safety, and ensure smooth vehicular movement. The case study of Navale Bridge, Pune, shows that high traffic volume, mixed traffic conditions, and poor signal coordination are the main causes of traffic delays. Proper traffic analysis, improved signal coordination, and better lane and vehicle management can significantly enhance traffic flow. A systematic and sustainable traffic management approach is necessary to improve travel efficiency and overall commuter experience.

VIII. ACKNOWLEDGMENT

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