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# Improving traffic flow by implementing dynamic lane reversal to widen NH 65 in India

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## ABSTRACT

National Highway 65 (NH 65), a vital arterial road in India, faces increasing traffic congestion due to rapid urbanization and economic growth. To mitigate this issue and enhance road capacity, this research proposes the implementation of dynamic lane reversal on specific sections of NH 65. Dynamic lane reversal involves the ability to adjust the direction of traffic lanes in real-time based on traffic demand, allowing for efficient utilization of existing infrastructure. This paper presents a methodology of optimization of roads for collection and transportation of traffic management using with dynamic lane reversal for widening of NH 65 Hyderabad -Vijayawada District. The organization, collection and transportation of municipal waste are conditioned by the limitations related to geographic and environmental criteria. The project of optimization of transportation routes and improvement of municipal waste collection system consists of three phases: the formation of a 3D network of roads, calculation of fuel consumption and optimization of waste collection and waste transportation. The highly predictable traffic patterns in spite of the heterogeneity of drivers' behaviors and the variability of their origins and destinations enables development of accurate predictive models for eventually devising practical strategies to mitigate urban road congestion.

## I.INTRODUCTION

Traffic congestion is a major issue in today's transportation systems. Contraflow lane reversal, the reversal of traffic flow along a lane to temporarily increase the capacity of congested roads at the expense of under-utilized ones, is a method to increase traffic flow without adding additional roads or lanes. On the left of Fig.



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1, the top lanes are being more heavily utilized than the bottom ones. Today, contraflow lane reversal is used at a macro time scale at rush hour or for quick evacuations from an area. In both cases however, the change in flow must be carefully planned before the event, with little or no room for dynamic changes. Today's hardware for traffic monitoring is good enough to gather real-time traffic data. With the help of modern computerized traffic control systems, it is possible to quickly and dynamically open and close lanes or entire roads, or even change the directionality of lanes based on real-time usage statistics, such that effective capacity of a road can be dynamically changed based on the demand. Rapid changes of lane directions, however, may confuse human drivers. To fully utilize the potential of dynamic lane reversal, we will need to rely on the upcoming availability of computer-aided driving systems and fully autonomous vehicles that will help vehicles to adjust to the rapid changes of lane directions. With the help of computerized driving systems, more aggressive contraflow lane reversal strategies can be implemented to improve traffic flow of a city without increasing the amount of land dedicated to transportation. An important component of implementing dynamic lane reversal is fully understanding the systemwide impact of increasing capacity on an individual link. We define the objective of contraflow as follows: given a road network, a specification of vehicles' locations and destinations, and a method for determining network efficiency (such as an objective function), assign a direction of flow to each lane such that network efficiency is maximized. To study the network effects of dynamically repurposing lanes, we cast the problem as a maximum multi-commodity flow problem— a version of the maximum flow problem in graph theory with multiple commodities (or goods) flowing through the network. Then we propose an integer programming formulation and a bi-level programming formulation to compute the maximum flow in the network. We evaluate our approaches in grid-like transportation networks representative of many downtown metropolitan areas where it will have the most potential impact.

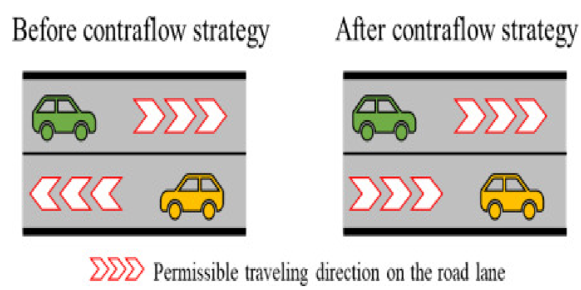


**Fig. 1. An illustration of contraflow lane reversal (cars are driving on the right side of the road).**

**Traffic Management and Operation of Traffic Signals at Intersection:**

The problem of large waiting time at busy signaled intersection will be studied and the number of phases in which signal operated is noted. The numbers of conflict points encountered at the intersection will be recorded. Using the methods of

Mathematical Modeling The 4-leg intersection and pedestrian crossing are represented by Graph in the form of Vertices and Edges, and make them Planarity (by eliminating edge crossings) Using the methods of Graph Theory, the edges are altered and intersection graph is partitioned into non-empty planar sub-graphs. The non-planar part of the graph will be represented as union of isomorphic sub-graphs. The remaining portion is proved to be of thickness of one since it cannot be Planar; we have opted to introduce come controls by Traffic Signals and revise the Graph to 8 Conflict points and adopted it to intersection with Traffic Signals operating in two Phases, to save fuel and time.

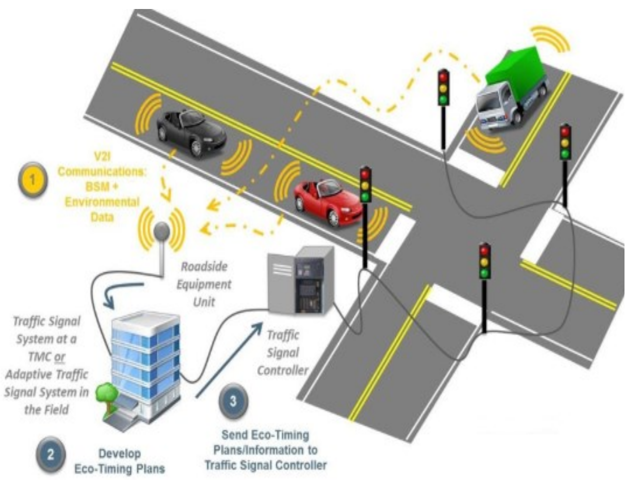


**Figure: Traffic Management and Operation of Signals at Intersection**

**Classification of Roads:**

The roads are named according to the type of constructions, jurisdiction and important function etc. Names like earth, metaled roads, asphalt roads, and concrete roads indicate the type of constructions. Names like local roads, district roads, state highways, national highways indicate their jurisdiction. Names like rectangular roads, ring roads, and diagonal roads, radial and circular roads indicate their geometric shape. Names like Avenue, Promenade (a pleasure drive, with water front at least on side), Boulevards and Parkways indicate their dominant function. The urban roads are classified as per their importance such as:

- Arterial roads
- Secondary or sub-arterial roads
- Local roads
- Other roads

## II. LITERATURE REVIEW

**Bing Liua, , Linli Yan b , Zhiwei Wang (2017)** This paper aims to find a reclassification approach which could balance the different requirements of management , street activity and green transport priority, and provide a better basis for urban road planning and design. This paper firstly reviews the provisions of road classification in the current and points out the defects of the single classification standard based on car-oriented management, which resulted in many problems such as inadequate bus priority, squeezed space for non-motorized transport and street life decay. Then, it compares the international practices of road classification updates and adjustments; and further clarifies the relationship from three aspects of management and place, multi-modes and differentiated priorities, as well as standardization and flexibility of road classification system, thereby establishing a theoretical framework for urban road reclassification. In the background of green transport and street revival, this paper argues the necessity of urban road reclassification, and proposes a three-dimensional road classification system integrating "hierarchy of management, types of street activity and travel mode priority". The new HAM system is expected to provide a more balanced, comprehensive and flexible approach for urban road design accommodating multi-modes of green transport and a variety of street activities, to meet the policy shift from the "car-oriented" to the "people-oriented.

**Yazan Issa (2014),“**Driven by the increasing travel demands of cars, lots of urban roads were built or upgraded to adapt to the large scale motorization process of Chinese cities. For them, car-oriented road network was formed rapidly during the last two decades, whereas “multi-modal transport network with complementary advantages” was far from the requirements of Code TPUR. The outcomes arising from this road classification are not aligned with the green transport principles, and it has caused more concerns in the fields of urban planning and transport planning. Urban road system is considered to be an essential part of this transformation, for it determines the rights of way of all kinds of surface modes and the space quality for numerous road users. Since the lock-in effects of road classification system for the overall layout of transport network and urban areas, it is of great significance to reclassify urban roads to coordinate multi-modal traffic as well as to facilitate street activities, which will help to improve road conditions for green modes and accordingly, enhance street vitality.

**Arasan, T.V (2012).** Necessity of urban road reclassification system from the above, car-oriented road classification system which separated the functions of “traffic and place” as well as “movement and access”, had led to the fragmentation of non-motorized network and degradation of place function. Today, the integrated development of road multiple functions is being recognized, and the ideology of urban road classification has begun to change. Based on vehicular access and management needs on one hand, the “place” dimension could correct the rigid tendency of road planning and design. Only with a comprehensive consideration of cross-scale management , environmental capacity and community values, can it fully respond to the aspirations of the neighboring areas. One the other hand, the function of movement and access presents a greater/ wide range of compatibility within multi-modal transport system.

## III. METHODOLOGY

Improving traffic flow using dynamic lanes on national highways can be a highly effective strategy to adapt to changing traffic conditions in real time. The concept of dynamic lanes involves altering lane assignments based on traffic demands, which can be accomplished through the use of advanced technologies and traffic management systems. Traffic operation on a dynamic lane reversal for widening highway is unique. Lane changing and overtaking are possible only in the face of on-coming traffic in the opposing lane. The overtaking demand increases rapidly as traffic volume increases, while passing opportunities in the opposing lane decline as volume increases. Therefore, flow in one direction influences flow in the other direction. The problem is more acute in case of mixed traffic flow when speed differential among different categories of vehicles is quite substantial. It increases the desired number of overtaking considerably with limited opportunities to overtake. Prediction and knowledge of capacity is fundamental in design planning, operation and layout of road network sections.

**1.Data Collection & Monitoring**

Real-time Traffic Monitoring: Install traffic sensors, cameras, and GPS-based systems along the highway to continuously monitor vehicle density, speed, and types of vehicles. Historical Data Analysis: Study past traffic patterns, especially peak hours, bottlenecks, and accident-prone areas to understand how traffic flow changes throughout the day, week, and seasons.

**2. Dynamic Lane Allocation**

- Adaptive Lane System: Use digital signs and lane indicators that can change in real time. Lanes can switch between:
- Regular Travel Lanes: Open to all vehicles.
- Reversible Lanes: These lanes change direction depending on traffic flow, e.g., during rush hours, more lanes can be allocated in the direction with higher traffic demand.
- Dedicated Lanes: Temporary dedicated lanes for buses, freight trucks, or high-occupancy vehicles (HOV) during peak traffic times.
- Emergency Use Lanes: Allocating special lanes for emergency vehicles or breakdowns during peak traffic or accidents.

**3. Integrated Land Use Transport Planning:**

Urban transport is influenced by urban growth policies, making integrated land-use and transport planning crucial to minimizing transport demand. Certain land-use patterns can either increase or decrease vehicle travel. Transport policies like increased road capacity, generous parking, low user charges, and poor transit services tend to promote sprawl and higher travel demand. In contrast, policies such as improved transit services, affordable fares, better pedestrian and cycling infrastructure, reduced parking, and traffic calming promote smart city growth and reduce travel demand. The current trend, however, is urban sprawl rather than smart growth.

**4. Transport Demand Management:**

Improving traffic flow and transport infrastructure alone is not enough. There is a limit to how much services can be expanded, so controlling transport demand is crucial. Without this, supply may never meet demand. A **Transport Demand Management (TDM)** program is essential for shaping travel behavior. TDM includes policies and services that influence **why, when, where,** and **how** people travel. The

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goal is to make travel more sustainable, efficient, and equitable. TDM has four main components that work together to manage transport demand effectively.

**5. Recommendations to improve development connectivity:**

For the purposes of this report, we define “connectivity” as the degree of interconnection between roadways. The recommendations in this report are geared towards improving the efficiency of movement using the roadway system. “Management” (i.e. ease of movement) is one attribute of such efficiency but so is “accessibility” (i.e. the ability to go from an origin to a desired destination). The benefits of better connectivity go beyond improved management and accessibility and can include enhanced potential for transit (through better pedestrian connections and shorter, more direct walk trips) as well as more constant speeds and less congestion, which in turn results in lower greenhouse gas emissions

**6. Removing intersections eases traffic flow:**

Of late there is a trend in the city to replace intersections with “U turns”, which is neither a clever form of planning nor traffic engineering. From the planning perspective, traffic signals are an important part of city’s transport system as it helps various modes of transport, including pedestrians and cyclists, in crossing the road. They provide access to people on either side of roads that have continuous development such as Sohna Road, Old Gurgaon Road or any other road inside the city. Removal of these intersections forces cyclists and pedestrians to violate traffic rules as detours are often lengthy and impractical leading to accidents and often deaths. From an engineering perspective, it is well documented that an intersection with traffic signal has much more throughput than if the same is replaced by ‘U turns’. A simple stroll in the morning or evening hours on Sohna Road, HUDA City Metro Station, etc, will reveal the true picture of this experimentation .It’s time that city moves towards prioritising planning for walking, cycling and public transport and a starting point of this is planning multi-modal streets, rather than streets only for cars. Else, it will be locked in, with no escape.

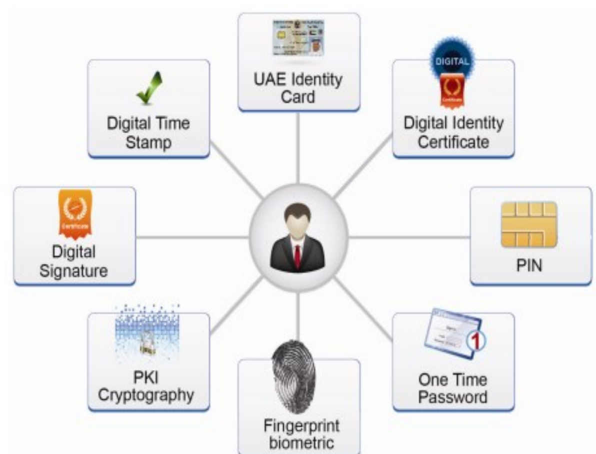


**Figure: Modern Smart Identity Card**

Capabilities Modern identity cards are designed to provide multi-factor authentication capabilities. This should in turn provide higher levels of protection to individuals’ security and privacy needs. With such infrastructure, e-government service providers are given verification and authentication services to enable secure remote transactions.

**Survey with current systems**

Conducting a survey to assess the effectiveness of current traffic flow systems, especially with the use of dynamic lanes, can help identify areas for improvement and validate the benefits of such a system. Here's how you can structure your survey and the methodology for gathering insights on traffic flow using dynamic lanes.This section will capture basic information about the respondent to understand traffic behavior trends based on different groups.

- Type of Vehicle: Car, truck, motorcycle, public transport, etc.
- Frequency of Highway Use: Daily, weekly, occasional.
- Commute Distance: Short (less than 10 km), medium (10–50 km), long (over 50 km).

**Traffic Flow Observation**

- In addition to the survey, conduct direct observations of traffic flow at peak and off-peak hours.
- Vehicle Count Studies: Use automated vehicle counting systems to track the flow of traffic before and after dynamic lane implementation.
- Video Analysis: Use CCTV footage to analyze traffic patterns, congestion points, and how well drivers adapt to lane changes.

## IV. RESULTS AND DISCUSSIONS

**Database of Management Centers:**

All the aforementioned tasks are feasible if the MMC is based on complex data collection. From these data, the MMC can create the information necessary to manage management demands and give information to travelers.

**Management Centre Solutions:**

According to the needs of modern society, online planning software plays an increasingly important role in optimizing the flow of traffic, and utilizing the capacity of dynamic network traffic models that are strongly connected with real-time traffic management systems.

**Trends influencing urban management in Hyderabad:**

The predominant trends influencing management of urban population in Hyderabad cities are rapid urbanization, rising motorization and dwindling modal share of Non-Motorized Transport (NMT). However, there is an urgent need to ensure that the data collection is standardized, systematized and that the data is regularly collected for it to be meaningfully used in planning, research and training, etc

- Need for upgrading of road infrastructures (repair to roads);
- Need for upgrading signage systems, especially for tourists‘ benefits
- Need for radial roads connecting outer ring road and upgrading inner ring road;
- Need for an outer peripheral road for diverting heavy traffic away from outer ring road;
- Need for an integrated rapid transport system.

**Table: Existing Modal Split in Hyderabad to Vijayawada road way**

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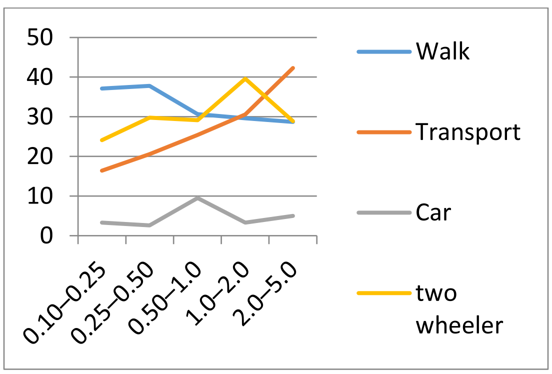
| City Population (in millions) | Walk | Transport | Car | **two wheeler** |
|---|---|---|---|---|
| 0.10–0.25 | 37.1 | 16.4 | 3.3 | 24.1 |
| 0.25–0.50 | 37.8 | 20.6 | **2.6** | **29.8** |
| 0.50–1.0 | 30.7 | 25.4 | 9.5 | **29.1** |
| 1.0–2.0 | 29.6 | 30.6 | **3.3** | 39.6 |
| 2.0–5.0 | 28.7 | 42.3 | 5.0 | **28.9** |




**Overall case study of central cities of Hyderabad:**

**Performance evaluation – Traffic efficiency (Management)**

For the assessment of the management of travelers as a result of the introduction of the priority measures each of the three bus lines has been broken up into four route segments of given length per direction, resulting in eight route segments per line and 24 route segments in total. Average peak-time bus travel times for each of the route segments have been measured over periods before and after the implementation of the priority, in order to identify travel time gains. Furthermore, a number of route segments of given length have been identified on the private transport network as being affected by the central city of Hyderabad management average vehicle traffic travel times (Lb nagar) were measured for the same periods before and after the implementation.

The management is used to perform an assessment of the overall impact of the scheme in terms of management on each of the lines, for public and private transport separately, taking equal weights for each of the route segments.

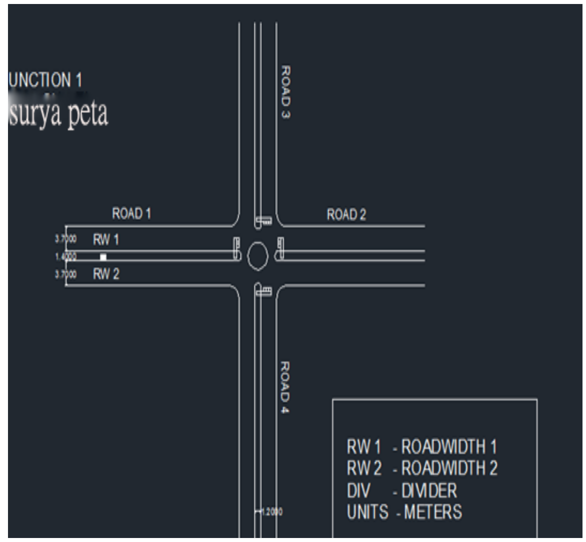
**Factors Impacting the Accumulation of Roadside Soils:**

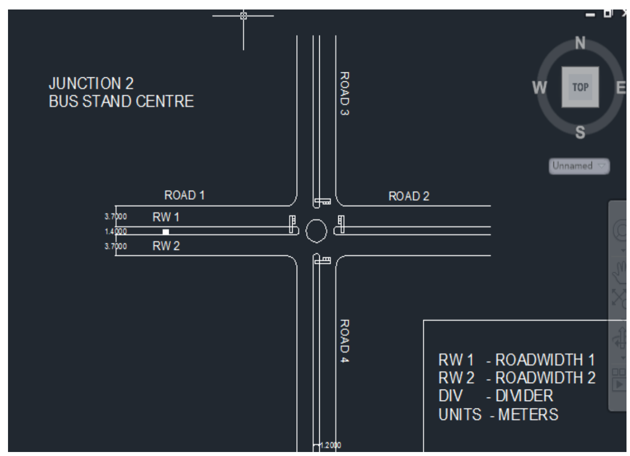
Soil properties including pH and organic matter content, prevailing wind direction, vegetation cover, and traffic intensity, etc. are important factors impacting the accumulation of heavy metals in soils The study by showed that the pH in roadside soil would increase to neutral or even above neutral levels due to road abrasion. An increased pH was reported to increase the adsorption of metals by competition between protons and metal cations and by the increase in the solubility of organic matter Soil organic matter was considered as the other important factor contributing the retention of heavy metals in roadside soils It was found that vehicle emissions and asphalt paving materials were main sources of insoluble organic matter in roadside soils and Pb, Zn, and Cu were largely concentrated in the insoluble organic fraction. In our investigation, the significance of pH and soil organic matter explained almost 100% of the variance of the accumulation of Cu, Zn, Pb, and Cd in roadside soil, which means that the pH and organic matter were two important factors influencing the retention of heavy metals in roadside soil. The grouping of sampling sites based PCA suggested that the highest Pb, Cd, and Cr took place in the places where the traffic burdens were heavy. The higher concentrations of Pb, Cu, Cd, and Zn in the roadside soil of CUR compared with other two types of roads might also be related to the heavy traffic intensity and the burden of high-emission vehicles.

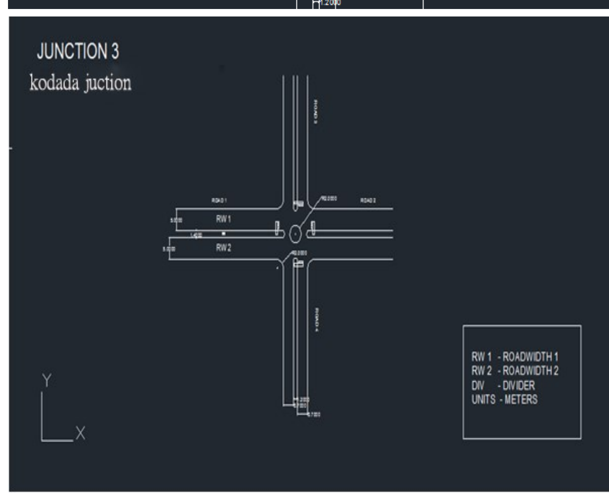
**Figure: Accumulation of Roadside Soils**

Effects of traffic volumes would be complicated by other factors, such as the age of the road, direction and speed of wind, amount of rainfall, and soil properties, which all had direct influences on metal concentrations Overall, there was a trend for higher heavy metal roadside concentrations in locations where traffic intensity is higher However, unlike those studies conducted in highways, roadside soils in urban area are usually involved with much more complicated factors.

**NH 65 ROAD PLANNINGS:**



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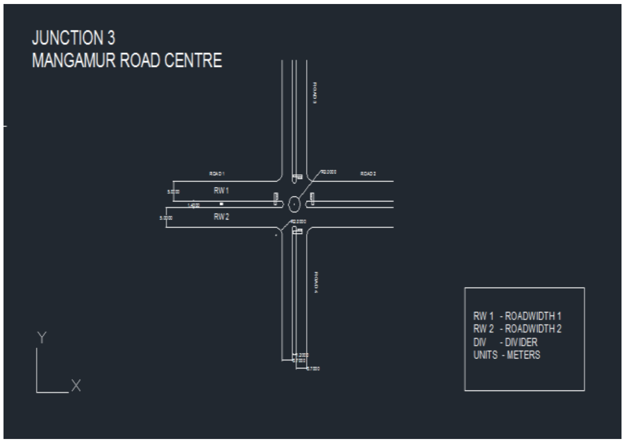


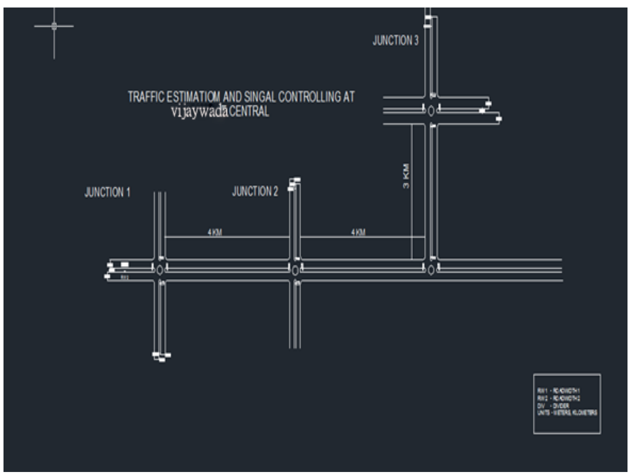
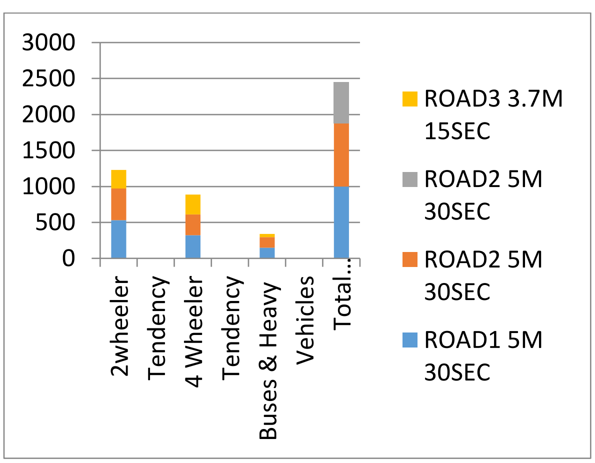




**Table: Vijayawada Road center**




**Graph: Vijayawada Road center**

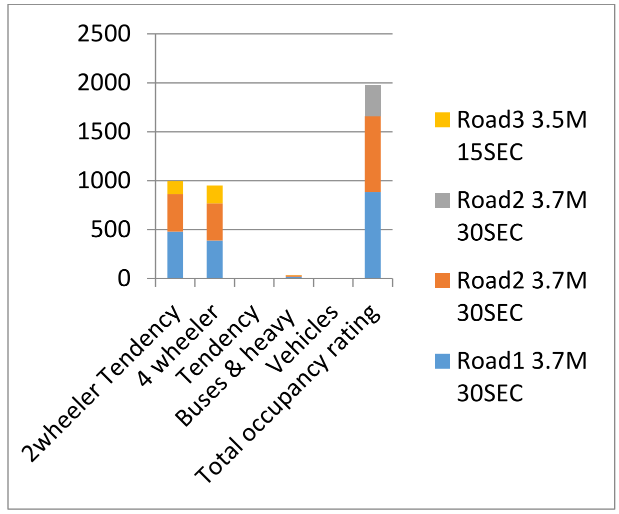



**Table: Traffic Estimation and Signal Controlling at Vijayawada Bus stand centre**

**Table: Traffic Estimation and Signal Controlling at surya peta Central Bus stand**

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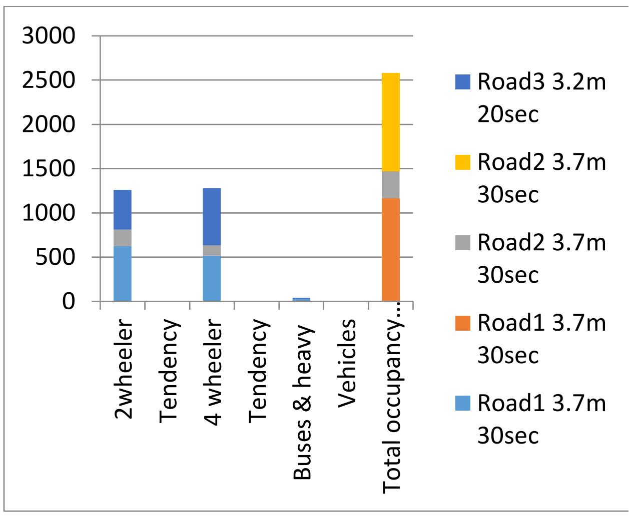
| S.no | Road1 | Road2 | Road3 |
|---|---|---|---|
| Road width | 3.7m | 3.7m | 3.2m |
| Signaling time | 30sec | 30sec | 20sec |
| 2wheeler Tendency | 623 | 189 | 446 |
| 4 wheeler Tendency | 517 | 116 | 648 |
| Buses & heavy Vehicles | 25 | 2 | 15 |
| Total occupancy rating | 1165 | 307 | 1109 |




**Graph:Traffic Estimation and Signal Controlling at surya peta Central Bus stand**

## V. CONCLUSION

Dynamic Lane Reversal is a valuable tool for improving traffic management and enhancing road safety. By carefully considering the benefits, challenges, and implementation strategies, cities can effectively utilize DLR to address congestion and optimize traffic flow. As technology continues to advance, DLR is likely to become an even more important component of modern transportation systems. Comprehensive integration of urban transport and land use planning systems is needed so that synergies are harnessed, interconnections are promoted and functionality optimized through multimodal management solutions for NH 65 Road ways. Present urban transport issues such as congestion, road accidents, pollution, etc. cannot be wished away by conventional interventions that favour public funding and investments for private transport instead of public modes of transport More public resources need to be allocated to developing NMT and high capacity public transport infrastructure.

## VI. FUTURE SCOPE

Advancements in technology present exciting opportunities to enhance Dynamic Lane Routing (DLR) systems. Emerging technologies such as connected vehicles and artificial intelligence (AI) can significantly improve the efficiency and responsiveness of DLR systems by enabling real-time communication between vehicles and traffic infrastructure. AI algorithms can optimize lane usage based on traffic patterns, weather conditions, and accident data, allowing for more adaptive and predictive traffic flow management. Furthermore, integrating DLR with other traffic management strategies, such as intelligent traffic signals, congestion pricing, and public transit systems, can create a more cohesive and comprehensive solution



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to urban mobility. This holistic approach can better balance demand and supply, reduce congestion, and improve overall traffic efficiency. Additionally, the sustainability of DLR systems should be a key consideration, as transportation contributes significantly to environmental concerns.

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