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Development of Traffic Management Plan and Safety in A Road Ways

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Abstract
The traffic management plan and safety in roadways project is to improve the movement of vehicles as well as safety measures considering the high rate of urbanization and high volume of traffic. It attempts to resolve problems of traffic jams, accidents, and bad road sholicitation. The plan is developed from the analysis of traffic movement with regard to roads, pedestrian activity, and the history of accidents. Measures include control of traffic flow and communication system modification (intelligent transportation systems) and monitoring through cameras. The project also places primary emphasis on the safeguarding of sensitive road users such as pedestrians, cyclists, and public transport users by improving the infrastructure through the provision of cycle tracks, pedestrian friendly structures, and better visibility of traffic signals. It also considers traffic speed moderation in residential areas and near schools, public transport system integration, and road safety education. The overarching aim is to develop reliable and high-quality roads that are easy to manage and care for while at the same time taking care of the natural surroundings.

Keywords: *Traffic Management, Road Safety, Congestion, Intelligent Transportation Systems (ITS), Pedestrian Safety, Urban Mobility.*

1. Introduction
The Traffic Management Plan and Safety in Roadways project seeks to tackle the challenges posed by traffic jam and safety risks in peri-urban areas. Cities and traffic tend to grow together, and it becomes critical to manage them effectively to reduce the risk of accidents. The problem statement aims at creating an overall plan that incorporates measures for traffic control, improvement in road design, and application of modern technologies. The plan aims to assess traffic flow, accident rate statistics, and pedestrian traffic to identify bottlenecks and recommend precise measures for security and productivity improvements. Indeed, the project will involve classical approaches like improving traffic signals and road signs, as well as modern ones such as Intelligent Transportation Systems (ITS), where monitoring traffic in real time is possible. The resulting roadways are expected to be much safer and less congested to improve the experience of all road users, from pedestrians and cyclists to vehicle drivers [1].

2. Traffic Management Techniques and Tools
Traffic management techniques and tools are essential for optimizing the flow of traffic, improving road safety, and reducing congestion on roadways. These techniques involve a combination of planning, real-time monitoring, and infrastructure design. Tools such as adaptive traffic signals, Intelligent Transportation Systems (ITS), real-time data collection, and traffic flow simulations help manage traffic more effectively. By using technologies like Variable Message Signs (VMS) and dynamic routing, traffic managers can respond to congestion, accidents, and road closures. These methods not only enhance efficiency but also improve the overall experience for motorists, pedestrians, and cyclists, contributing to safer, more sustainable road networks.

3. Problem Identification
Effective traffic management and road safety remain major challenges in urban and rural transportation systems worldwide. With increasing population, urbanization, and vehicular traffic, roadways are facing higher volumes of traffic, leading to congestion, delays, and safety risks. The core

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problem is the growing mismatch between road capacity and the rising demand for mobility, causing both inefficiency in traffic flow and increased road accidents. In many regions, poorly designed road networks, outdated traffic control systems, and inadequate infrastructure contribute significantly to these issues. Problems include traffic bottlenecks at intersections, lack of proper signage, and insufficient pedestrian and cyclist facilities. Furthermore, poorly synchronized traffic signals, ineffective enforcement of traffic laws, and lack of real-time traffic monitoring worsen congestion and contribute to road safety hazards. Another issue is inconsistent road maintenance and poor road conditions, which lead to unsafe driving conditions, especially in high-traffic areas [2-5].

4. Methodology

Table 1 Traffic Management Process Flow

Project Initiation

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Data Collection and Analysis

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Traffic Flow and Safety Evaluation

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Development of Traffic Management Plan

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Safety Enhancements and Risk Mitigation

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Stakeholder Consultation and Public Engagement

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Implementation Planning

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Implementation of Traffic Management Measures

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Monitoring, Evaluation, and Adjustment

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Conclusion

4.1 Project Initiation

The initiation phase of the Traffic Management and Safety Improvement Project sets the foundation for the entire project's success. During this phase, the project's scope, objectives, key stakeholders, timeline, budget, and resources are clearly defined. The objective is to align all parties involved and ensure that the project moves forward in a structured and efficient manner, addressing traffic-related issues while prioritizing safety improvements. Table 1 Shows Traffic Management Process Flow

- Conduct meetings with key stakeholders
- Define the scope of the project
- Set clear objectives
- Determine the project timeline and milestones
- Establish a budget and allocate resources

4.2 Data Collection and Analysis

The objective of this phase is to gather critical data that will inform the design and implementation of traffic management strategies and safety improvements. Understanding existing traffic conditions, road quality, accident statistics, environmental factors, and public sentiment is key to developing an effective traffic management and safety improvement plan. The systematically collecting and analyzing data from multiple sources, project teams can make data-driven decisions that address specific problems and prioritize interventions. This comprehensive approach ensures that the final solutions are tailored to the actual needs of the community and that resources are allocated effectively. The traffic volume study is one of the first and most crucial steps in understanding how traffic flows on various roadways. This study involves the collection of data on the number of vehicles passing through certain points at different times of day, vehicle types, peak hours, and traffic patterns. The goal is to gather a comprehensive picture of traffic conditions, which will help inform decisions about congestion hotspots and areas that require specific interventions.

- Traffic Counts
- Peak Hour Analysis
- Vehicle Classification
- Traffic Flow Patterns

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4.3 Traffic Flow and Safety Evaluation

The objective of this phase is to conduct a thorough evaluation of the current traffic conditions, identify problem areas where congestion and safety concerns exist, and assess the effectiveness of existing safety measures. This evaluation is crucial for developing targeted solutions to improve traffic flow and enhance road safety for all users' motorists, pedestrians, and cyclists. By using advanced tools such as traffic modeling and simulation, along with accident data analysis and safety assessments, the project team can prioritize areas that need urgent attention and optimize the implementation of improvement measures. The activities involved in this phase help to ensure that the project outcomes are based on accurate, data-driven insights.

4.3.1 Traffic Flow Analysis

A comprehensive traffic flow analysis is the foundation of evaluating existing traffic conditions. This activity involves the use of traffic modeling and simulation tools to assess congestion points, traffic bottlenecks, and overall traffic patterns. Traffic modeling involves simulating how traffic behaves under different scenarios, including various traffic volumes, road conditions, and signal timings. The analyzing these models, engineers can gain insights into where congestion occurs, how traffic moves through intersections, and where improvements can be made.

- Traffic Volume Measurement
- Bottleneck Identification
- Signal Timing Optimization
- Intersection Analysis

4.3.2 Identifying High-Risk Areas

The safety of road users is a primary concern in any traffic management and improvement project. Identifying high-risk areas, such as intersections, curves, or road sections with a history of accidents, is critical to designing effective safety solutions. This step involves reviewing historical accident data and analyzing accident hotspots to pinpoint locations that need urgent intervention.

4.3.3 Safety Assessment

The safety assessment aims to evaluate the effectiveness of existing safety features on the roads, such as pedestrian crossings, traffic signals, signage, and lighting. A comprehensive safety assessment helps identify gaps in current safety provisions and suggest improvements to protect all road users, particularly those most vulnerable, such as pedestrians and cyclists.

- Pedestrian Crossings and Safety Measures
- Traffic Signals and Signage
- Road Lighting
- Traffic Calming Features

4.3.4 Integrated Traffic Flow and Safety Strategy

After completing the analysis of traffic flow, identification of high-risk areas, and safety assessment, the next step is to integrate the findings into a comprehensive strategy for improving traffic management and road safety. This involves developing targeted interventions that address both traffic flow issues and safety concerns simultaneously.

- Optimizing Traffic Flow and Safety Together
- Smart Traffic Solutions
- Public Engagement and Education
- Monitoring and Evaluation

4.4 Development of Traffic Management Plan

The development of a traffic management plan aims to design a comprehensive framework that improves both road safety and traffic efficiency. Key activities in this process include the redesign of roads and intersections, where proposals such as road widening, adding new lanes, or reconfiguring intersections can significantly ease traffic flow and reduce congestion. Traffic control measures are another essential component, which may involve signal optimization, the introduction of variable speed limits based on traffic conditions, or even implementing one-way streets to streamline traffic movement and reduce the risk of accidents.

4.4.1 Work in Center of Low/High-Volume Roads

In roadway construction and maintenance zones, ensuring proper lane width is essential for maintaining traffic flow and ensuring safety. Open lanes on either side of the center workspace should have a minimum width of 10 feet, measured from the near edge of the channelizing devices (such as cones,

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barrels, or barricades) to the edge of the pavement, paved shoulder, or face of the curb. Figure 1 shows Work in Center of Low/High-Volume Roads.

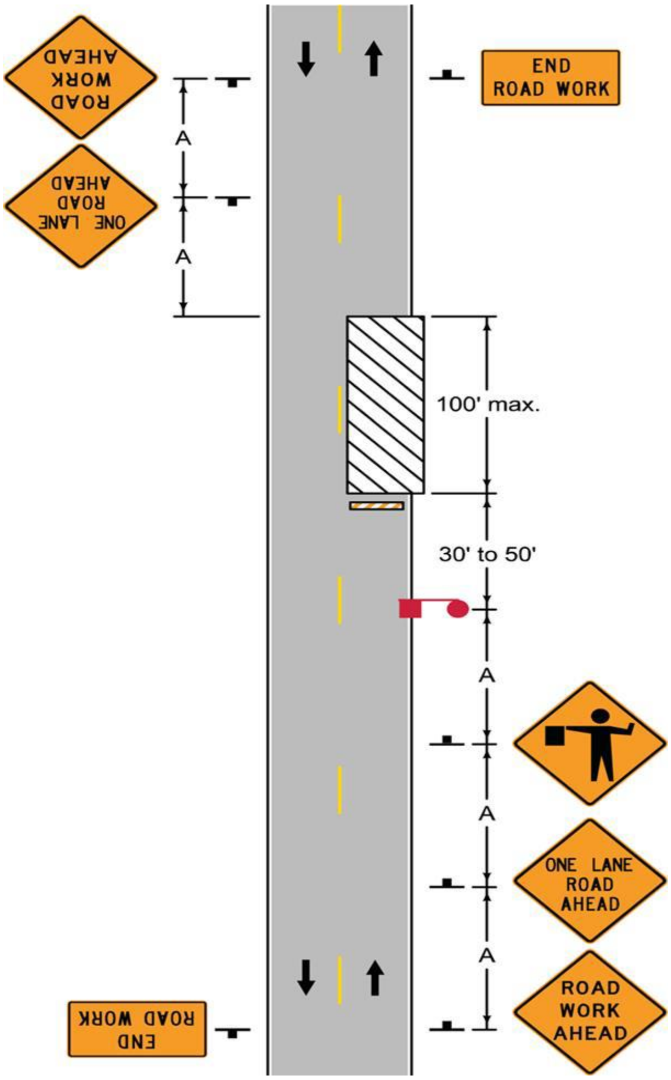

Figure 1 **Work in Center of Low/High-Volume Roads**

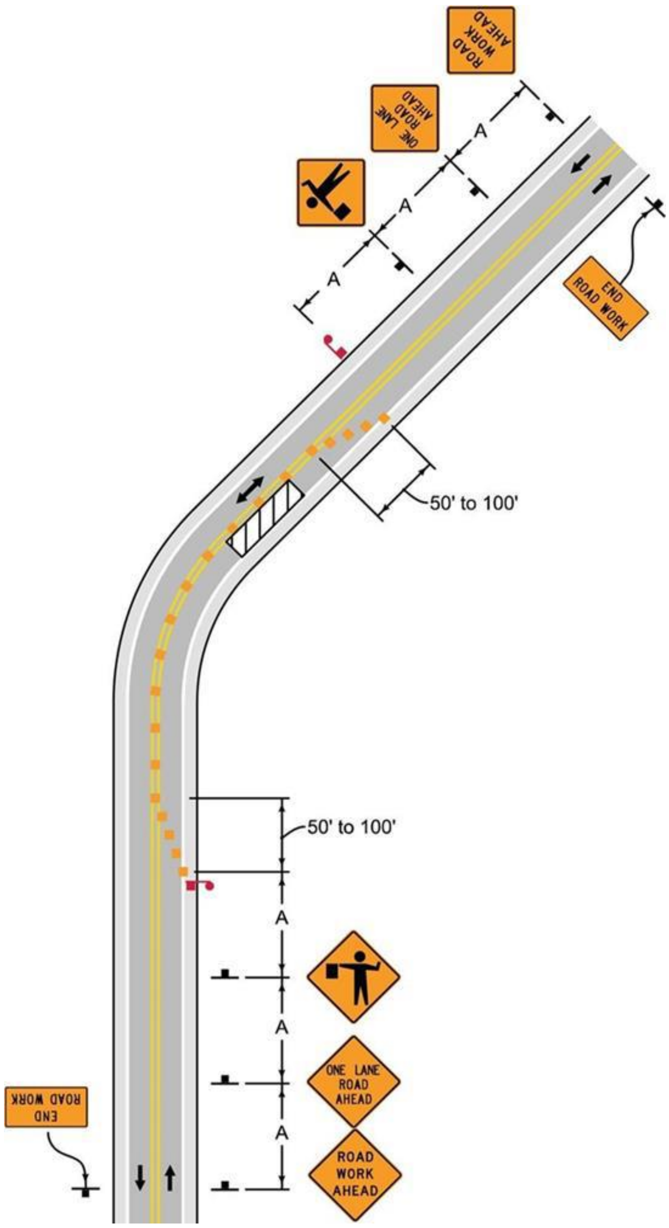

Figure 2 **Lane Closure on Two-Lane Road Using Two Flaggers**

4.4.2 Lane Closure on Two-Lane Road Using Two Flaggers

A single flagger may be used for low-volume situations with short work zones on straight roadways. When used, the BE PREPARED TO STOP sign should be located between the Advance Flagger sign and the ONE LANE ROAD sign. Lighting shall be provided to mark flagger stations at night. Figure 2 shows Lane Closure on Two-Lane Road Using Two Flaggers.

4.4.3 Road Closure Procedures

When distance "A" is less than 500 feet, the barricade should be placed in the middle of the traffic lane approaching the work area. A Type III barricade must be visible to both directions of traffic. The barricade may be omitted if the distance to the work area is less than 250 feet. Safety fence closures must be maintained to prevent unauthorized vehicles from passing through. Place staggered Type III barricades in the roadway after the last public road intersection

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prior to the closure. If local traffic is allowed to pass a Type III barricade, retro reflective sheeting is required on both sides of the barricade. Figure 3 shows Road Closure Procedures.

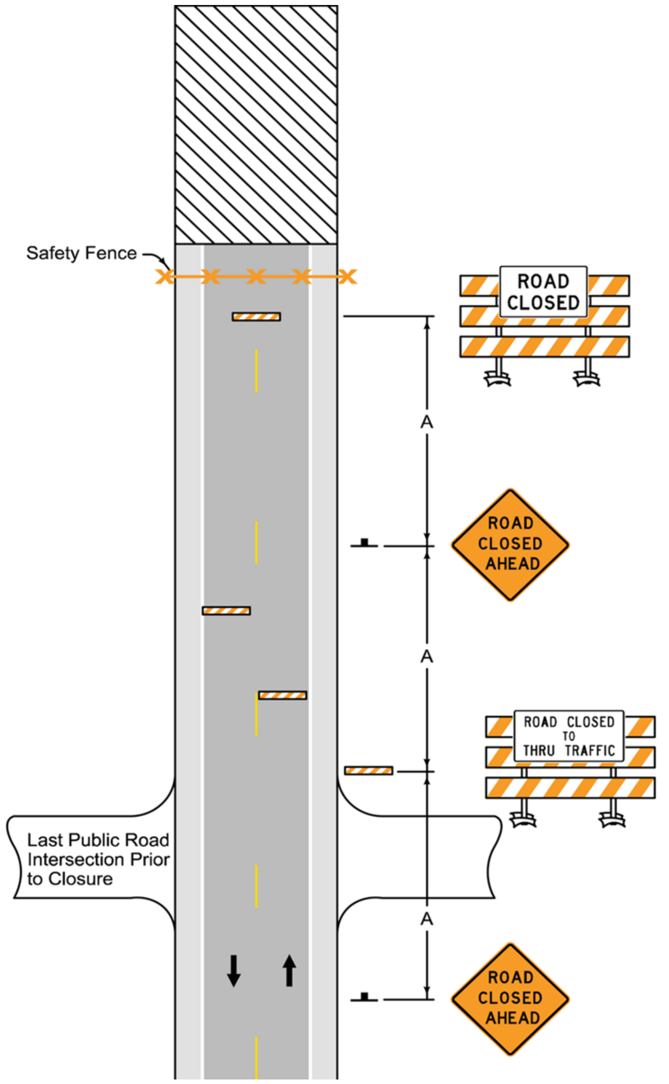

Figure 3 **Road Closure Procedures**

4.4.4 Road Closure with Off-Site Detour

Existing traffic control devices should be modified as needed for the duration of the detour. If the road is open to local traffic beyond the last intersection, the signs on Type III barricades may be located at the edge of the travelled way. If the road is closed beyond the intersection and local traffic volumes are low the ROAD CLOSED and DETOUR signs may be placed on a Type III barricade in the center of the roadway. If local traffic is allowed to pass a Type III barricade, retro reflective sheeting is required on both sides of the barricade. A designated detour is required when closing a numbered road for more than 48 hours.

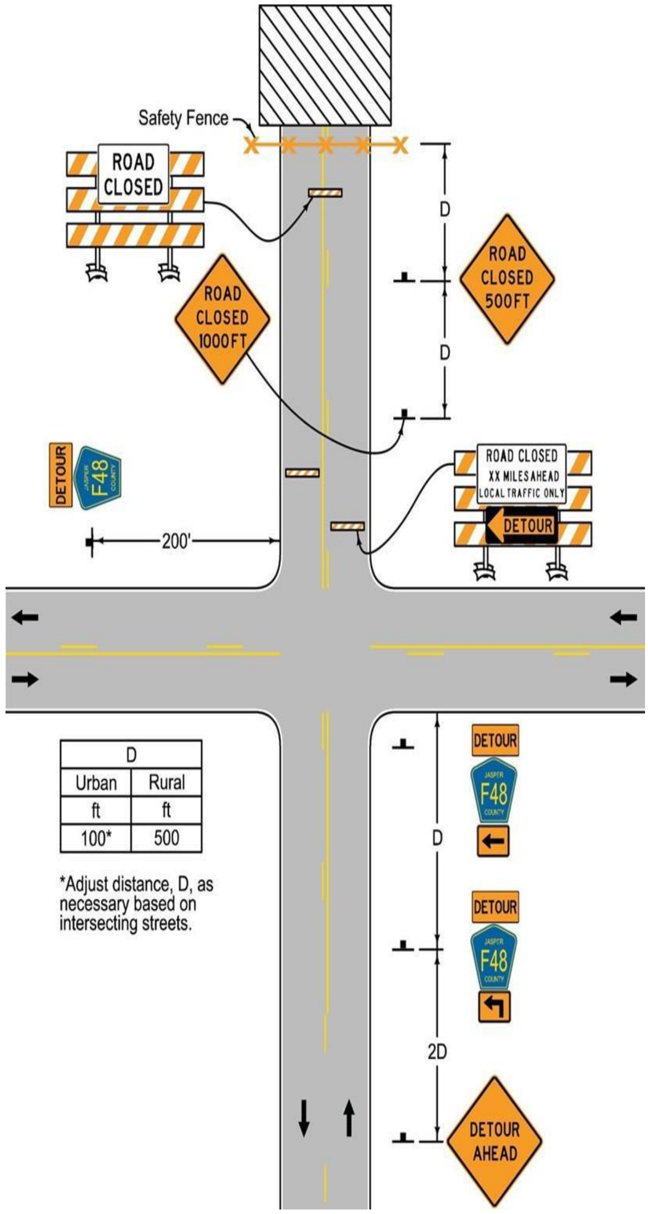

Figure 4 **Road Closure with Off-Site Detour**

4.4.5 Lane Closure at an Intersection

If the work area extends across the crosswalk, the crosswalk should be closed using appropriate information and devices. For traffic signal maintenance, consider using law enforcement and/or a shadow vehicle. For intersection approaches reduced to a single lane, left-turning movements may be prohibited to maintain capacity for through motor

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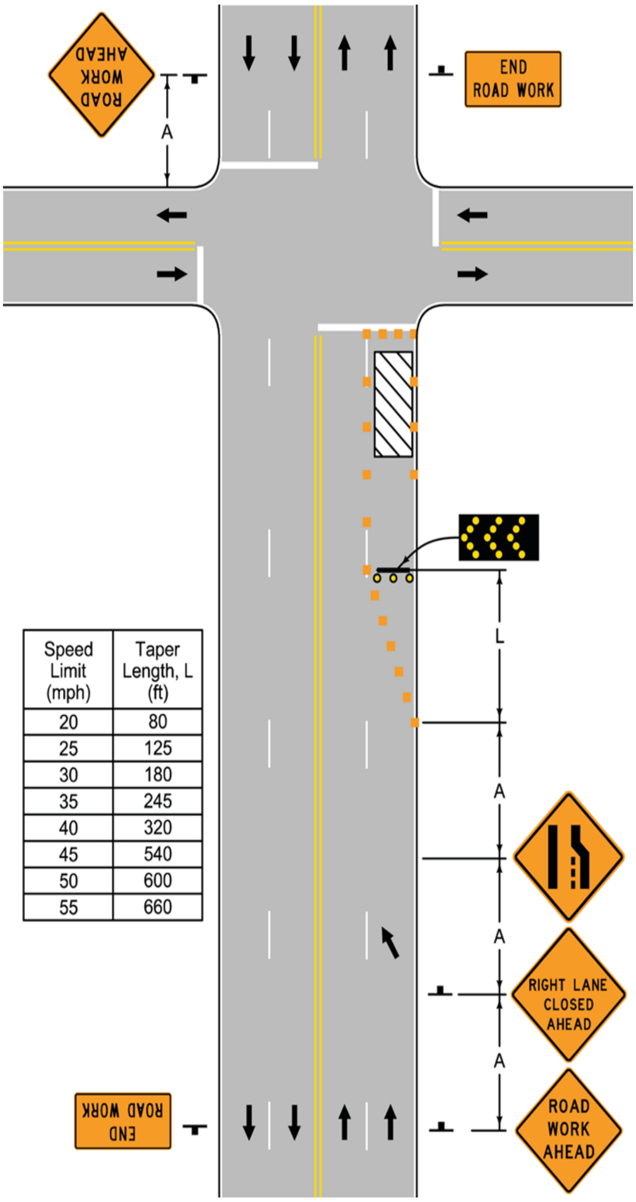
vehicle traffic. Right lane closure shown; for left lane closures, modify sign messages and arrow board. Place arrow board within the closed lane behind the devices and as close to the beginning of the taper as practical, while keeping it on the paved surface. Figure 5 shows Lane Closure at an Intersection.



Speed Limit (mph)	Taper Length, L (ft)
20	80
25	125
30	180
35	245
40	320
45	540
50	600
55	660

Figure 5 Lane Closure at an Intersection

4.4.6 Closure on the Far Side of an Intersection

If the work area extends across the crosswalk, the crosswalk should be closed using appropriate information and devices. Right lane closure shown; for left lane closures, modify sign messages and arrow board. Figure 6 shows Closure on the Far Side of an Intersection.

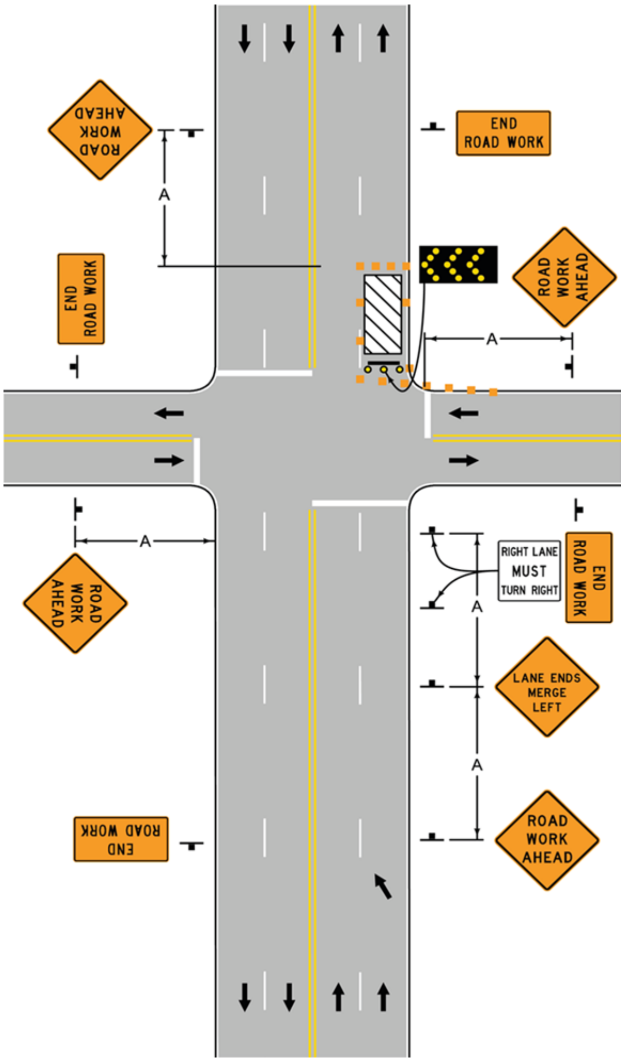


Figure 6 Closure on the Far Side of an Intersection

4.4.7 Closure Within an Intersection

The situation depicted can be simplified by closing one or more of the intersection approaches. If this cannot be done, and/or when capacity is a problem, motor vehicle traffic may be directed to other roads or streets. Positioning of flagger(s) is dependent upon the location of major driveways, physical characteristics of the intersection, and traffic flow. Adjustments may be necessary as the traffic flow changes throughout the day. Figure 7 shows Closure Within an Intersection.

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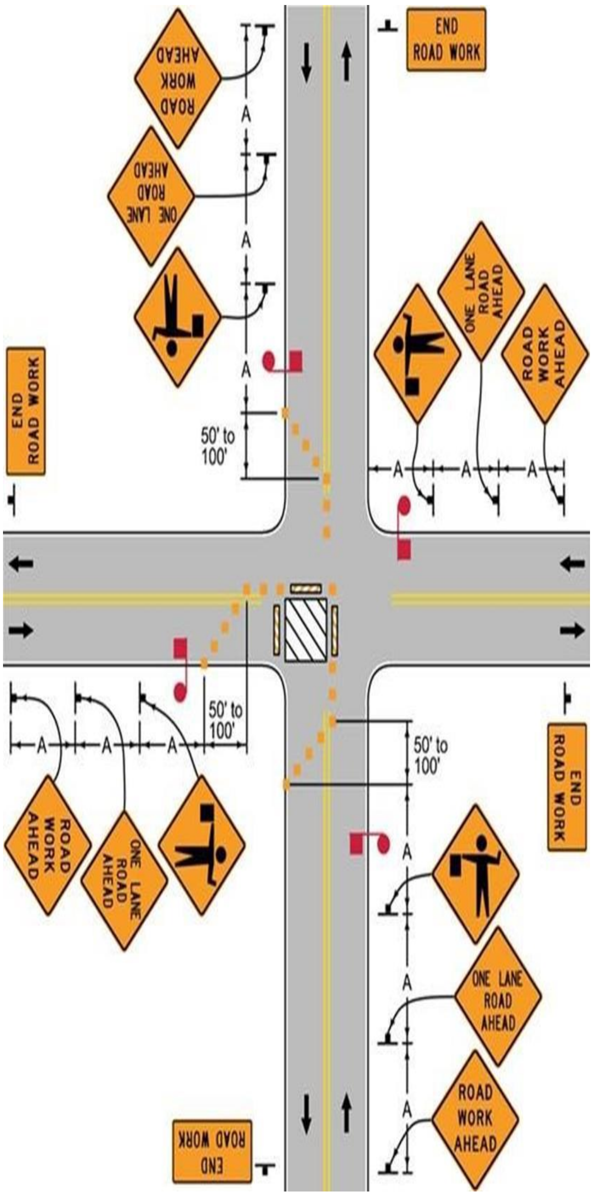

Figure 7 **Closure Within an Intersection**

4.4.8 Closure in Center of Intersection

The situation depicted can be simplified by closing one or more of the intersection approaches. All lanes should be at least 10 feet wide when measured to the near face of the channelizing devices. For short-term use on low-volume, low-speed roadways that do not include large commercial vehicles, a minimum lane width of 9 feet may be used. Left turns may be prohibited as required by geometric and traffic conditions (unless the streets are wide, turning left may be impossible, especially for large vehicles). For short-duration work operations, the channelizing devices may be eliminated if a vehicle displaying vehicle warning light(s) is positioned in the workspace. Figure 8 shows Closure in Center of Intersection.

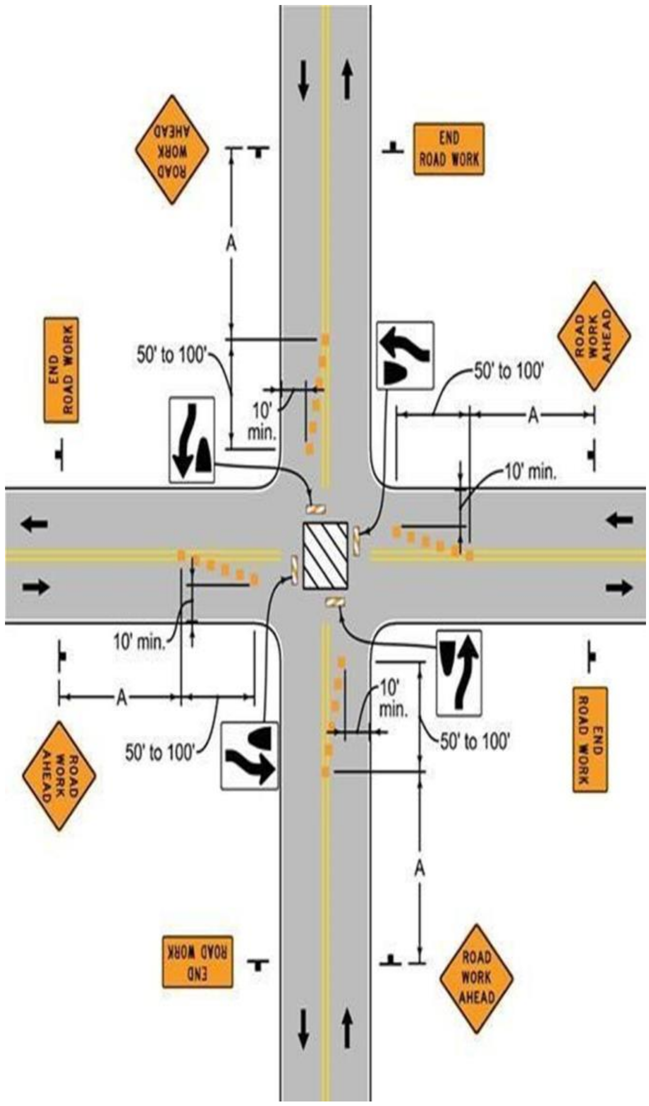

Figure 8 **Closure in Centre of Intersection**

4.4.9 Current Road Safety Measures and its Control Measures

2-wheelers on the left lane are try to get into the exit ramp making 3 lane changes. This usually happens after the BMRCL Barricades giving the vehicles very little weaving length to make a safe manoeuvre. Sometimes the sign to the exit is seen in the last minute where the driver comes to a complete stop before turning right from the left lane. Figure 9 shows Plan of the Main Access Road.

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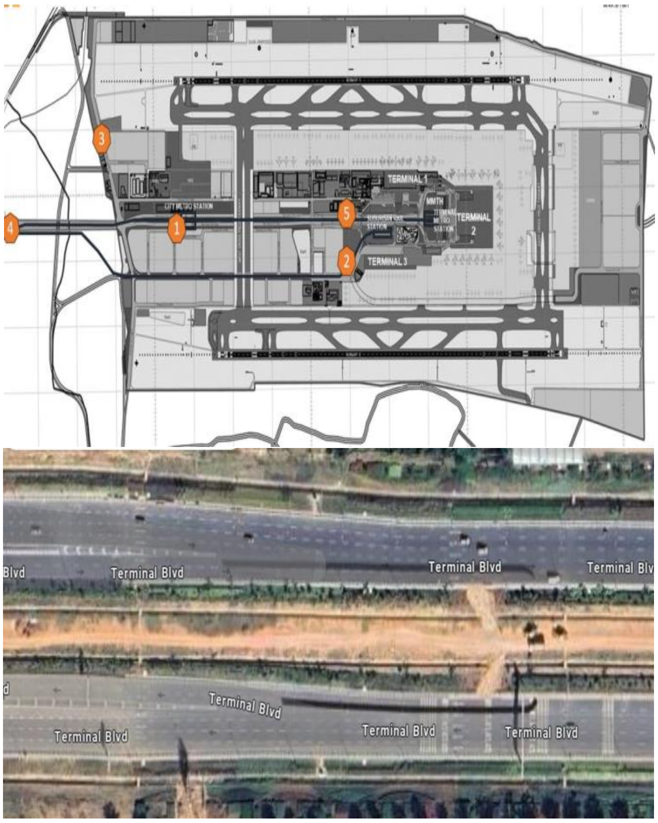

Figure 9 Plan of the Main Access Road

4-wheelers in the through lanes towards the city are going in high-speeds of 100 km/hr and aren't able to stop in time when the exiting vehicle moves from the left lane to the right lane in the nth moment leading to 90-degree side impact collisions, some leading to fatality.

4.5 Safety Enhancements and Risk Mitigation

The objective of safety enhancements and risk mitigation within a traffic management plan is to reduce accidents and improve the overall safety of all road users. The implementing targeted safety measures across roadways, intersections, pedestrian zones, and traffic control systems, the aim is to create a safer environment for drivers, pedestrians, cyclists, and other vulnerable road users. The activities involved in this phase focus on addressing the most common causes of accidents, enhancing visibility, and ensuring that there are efficient systems in place for responding to emergencies. A comprehensive strategy that incorporates these safety measures can significantly reduce the likelihood of accidents and promote safer road behavior. Table 2 shows Safety Enhancements and Risk Mitigation.

Table 2 Safety Enhancements and Risk Mitigation

Road Safety Features	a) Guardrails b) Rumble Strips c) Speed Bumps/Traffic Calming d) Traffic Calming Measures
Pedestrian and Cyclist Safety	a) Dedicated Lanes for Cyclists b) Safer Pedestrian Crossings c) Pedestrian Bridges/Tunnels d)Improved Signage for Pedestrians
Lighting and Visibility Improvements	a) Street Lighting b) Reflective Markings and Signs c) Adaptive Street Lighting
Emergency Response Planning	a) Rapid Response Systems b) Traffic Incident Management c) Detour Routes d) Post-Accident Recovery
Technology Integration for Safety	a) Smart Traffic Systems b) Vehicle Detection Systems c) Public Alert Systems

4.6 Stakeholder Consultation and Public Engagement

The success of a traffic management plan largely hinges on the involvement of various stakeholders and the community. A traffic management plan affects different groups in distinct ways, and therefore it is essential to ensure broad support and address concerns through thorough consultation and engagement. Effective stakeholder consultation and public engagement foster collaboration, build trust, and ensure that the traffic management strategies meet the needs of the community while promoting safety, mobility, and sustainability. The consultation process must be transparent, inclusive, and open to suggestions, as the ultimate goal is to create a traffic management system that serves both public interests and government policies.

- Stakeholder meetings

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- Public workshops
- Revise plan

4.7 Implementation Planning

Developing a clear and detailed implementation plan for traffic management and safety measures is essential for ensuring that proposed solutions are executed effectively and efficiently. The goal of this phase is to create a roadmap for the project, with well-defined activities, milestones, timelines, and resource allocations. By carefully prioritizing interventions, establishing a phased timeline, allocating necessary resources, and identifying potential risks, the project team can ensure that the plan is successfully carried out and delivers tangible improvements to road safety, traffic flow, and overall user experience.

- Prioritization of interventions
- Timeline and milestones
- Resource allocation
- Risk management

4.8 Implementation of Traffic Management Measures

In roadway construction and maintenance zones, ensuring proper lane width is essential for maintaining traffic flow and ensuring safety. Open lanes on either side of the center workspace should have a minimum width of 10 feet, measured from the near edge of the channelizing devices (such as cones, barrels, or barricades) to the edge of the pavement, paved shoulder, or face of the curb. This width accommodates the safe passage of standard vehicles, allowing for sufficient space for both vehicle maneuverability and worker safety.

4.9 Monitoring, Evaluation and Adjustment

Creating a comprehensive monitoring, evaluation, and adjustment process is vital for ensuring that the traffic management plan achieves its intended outcomes of improved safety, traffic flow, and overall effectiveness. The objective of this phase is to continually assess the performance of implemented traffic solutions, evaluate their impact on road safety, and adjust strategies based on real-world data and feedback. This process enables cities and authorities to fine-tune interventions and adapt to changing traffic conditions, ensuring long-term success and sustainability. Table 3 shows Traffic Management Performance Monitoring.

Table 3 Traffic Management Performance Monitoring

Metric	Description	Target	Current Value
Traffic Flow (V/C ratio)	Vehicle-to-Capacity ratio, indicating congestion.	< 0.85	0.92
Average Speed (km/h)	Average vehicle speed on monitored roads.	> 40 km/h	38 km/h
Queue Length (vehicles)	The number of vehicles in a queue at intersections.	< 20 vehicles	25 vehicles
Incident Response Time	Time to address and clear incidents.	< 15 mins	12 mins
Signal Timing Efficiency	Efficiency of traffic signal management.	> 90%	85%
ongestion (hours)	Total hours of road congestion during peak times.	< 5 hours	7 hours
Traffic Volume (vehicles/day)	Total volume of traffic on monitored roads.	N/A	10,000 vehicles
Accident Rate (per 100,000)	Number of accidents per 100,000 vehicles.	< 5 accidents	6 accidents
Public Transport Efficiency	Timeliness and reliability of public transport.	> 95%	92%
Environmental Impact	Emissions from traffic, fuel consumption	< 50g CO_2/km	55g CO_2/km

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Conclusion

The purposes of this project are to design a safe and efficient traffic flow and to assign the right way to minimize delay waiting time in road. This project, a traffic light controller is to improve the movement of the vehicles on the road at the junctions. This project is design to add direction movement and to change the timing for green timer. This project also can detect a busy and non-busy road. For examples, the long timer is remaining at the same road if the other road has no vehicle and the long timer is 'off' when have vehicle in the next road. The intelligent traffic light controller was chosen because to practice designing a program and implementing a sequential machine in hardware using the gate logic. When using this product, it will be able to reduce a traffic jam in road, to avoid an accident and it also to minimize a waiting time. I believe that my product is very brilliant idea to solve a traffic jam. This is because almost of the traffic controller in city using a semi-actuated timer mode. This mode only can sense the vehicle in the side street. That why; I believe that my product is better compare with the others product. Actually, the application of this product is used actuated timer mode, that means there are detection all approaches and Main access roads leading to airport.

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