

**FEASIBILITY ANALYSIS FOR THE IMPLEMENTATION OF
INTELLIGENT TRANSPORT SYSTEM (A CASE STUDY OF
LUDHIANA CITY-BHARART NAGAR CHOWK)**

**Submitted in partial fulfilment of the requirements
of the degree of**

MASTER OF TECHNOLOGY

in

CIVIL ENGINEERING

By

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2017

DECLARATION

I, Nikhil Kumawat (11304053), hereby declare that this thesis report entitled **“Feasibility analysis for the implementation of intelligent transport system (a case study for Ludhiana city-Bharat Nagar Chowk)** submitted in the partial fulfilment of the requirements for the award of degree of Master of Civil Engineering, in the School of Civil Engineering, Lovely Professional University, Phagwara, is my own work. This matter embodied in this report has not been submitted in part or full to any other university or institute for the award of any degree.

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CERTIFICATE

Certified that this project report entitled “Feasibility analysis for the implementation of intelligent transport system (a case study for Ludhiana city-Bharat Nagar Chowk)” submitted individually by student of School of Civil Engineering, Lovely Professional University, Phagwara, carried out the work under my supervision for the Award of Degree. This report has not been submitted to any other university or institution for the award of any degree.

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ACKNOWLEDGEMENT

This report on ITS was developed as part of the activities at the Lovely Professional University, sponsored by the. We thank our mentor. We also thank the Director, Dean (Civil Engineering Department), the Head of the Department, Dr. V. Rajesh Kumar, Department of Civil Engineering for their support and guidance to the Centre. We thank the other coordinators for providing us the opportunity to work on this report. Special thanks to Mr Akash Verma for the prompt and professional technical editing support.

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ABSTRACT

This paper offers a concept of installing everlasting Dynamic Message Signs (DMS) in a street visitors network. The primary hobby is to attain a right planning and gain our objective to install finest type of DMS with a view to unfold together with Advanced Traveller Information Systems (ATIS). Functioning and upkeep price of DMS, and occasion-interrelated operator rate beneath casual site visitors prevalence conditions. The required DMS location design problem is need to be done after a complete survey of location study and choose appropriate location for installing each DMS so that it have to be seen from a favoured distance. Its visibility need to be loose from barriers like constructing, any avenue shape and bushes. The maximum congested and with heavy visitors float area is to be determined on in a couple of stretches of Ludhiana city. The main city area having higher volume traffic in regular week days and weekends is also viewed. A study is carried over a complete stretch of 6100 m approximately. The entire stretch of approximately 6.1 Km is damaged down in 5 stretches for the cause of ease in records series. DMS reaction rate and event characteristics have on the resolution. The expected final result recommends that designing and installing of DMS and ATIS collectively is more monetary and successful than the regular separate set out of each the utility from the machine control factor of notion. The implementation of such visitors facts and control structures guides users to pick their mode of transportation and facilitate a extra powerful use of assets and already existed avenue community structure. Road safety and congestion consequences can be treated as well because risky locations or situations are notified and extenuated on a real-time basis system. Real time offerings for avenue consumer's information cover using eternal Dynamic message signs and signs and symptoms (DMS) through displaying statistics on website site visitors for green and at ease maneuvering of site visitors quantity.

Keywords: ATIS, Conjunction, DMS, Real-time, Congestion

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LIST OF ABBREVIATIONS

ITS:	Intelligent Transportation System
ATIS:	Advance Traveler Information System
DMS:	Dynamic Message Sign
LED:	Light Emitting Diode
GIS:	Geographical Information System
GPS:	Global Positioning System
CCTV:	Closed Circuit Television
IVHS:	Intelligent Highway Vehicle System
APTS:	Advance public Transportation System
PCU:	Passenger Car Unit
AADT:	Annual Average Daily Traffic
LMV:	Light Motor Vehicle
NMV:	Non- Motorized Vehicles
TMC:	Traffic Management Centers
MUTCD:	Manual on Uniform Traffic Control Devices

Chapter 1

Introduction

1.1 General

ITS refers to various gadget, which include a concept of site visitors engineering, hardware, software program application and communication era, that can be useful in an incorporated form on the transportation device if you want to beautify its effectiveness and safety. ITS offers help to improve services inside the transportation gadget operations, inclusive of traffic supervision, business vehicle operations, transportation management and statistics to road customers. It provides and alternative or enhancement to traditional solution to transportation problems. Traditionally transportation network attempts to meet the annoying conditions of increasing adventure name for by means of building extra capacity. This selection might not paintings in areas that have already been constructed up and face manufacturing obstacles because of strict surroundings law. In such instances, ITS can assist as an first rate opportunity to meeting upcoming call for of future site visitors.



FIGURE 1.1: Intelligent Transportation System

ITS gives many application and techniques to remove complicated transportation problem. ITS has the capability to enhance traffic waft and reducing congestion hassle in that specific region, it also improves air exceptional through decreasing contemporary air contamination and journey interruption, and improvise protection through presenting develop interest of anticipated crash situations and lessening the results of environmental road, and human factors that ends in crashes. It can also foster economic growth in the improvising vehicle movement and reducing oil or gas consumption.

In addition, Intelligent Transportation machine has high-quality functionality for making road adventure greater appropriate and greater handy by giving well timed and accurate data on the online systems in addition to on to be had tour alternatives. More modified information, such as predictable travel times and the shortcut travel route to a destination, can be made available to travellers through handheld or in-vehicle devices and the web connectivity.

Commercial vehicle operator, controlling and taxing vehicles, and highway users can also take advantage from ITS application which support automatic administrative procedures and automatic wayside safety inspection. ITS also provide many application that benefits to the public transit users and operatives. This includes the safety improvement on transportation motors and at transportation stations, providing actual-time scheduled records to transit avenue users, by guiding trade instructions for transit in case of any incident, and giving transit a desired remedy at the alerts.

ITS efforts to enhance the effectiveness of the shipping facility by way of actual-time data and former data at the systems up to date to correctly assign sources via all the transportation machine mechanisms. ITS applications progress existing transportation facility by permitting it to function more carefully and proficiently. In over-all, ITS utility has a capacity to reduce overall tour time, lessen the regularity and severity of crashes, advance float of site visitors, decrease tour prices and improve traveler's pride, Assessments studies and operative assessments have revealed that ITS application are supplying noteworthy benefits at some stage in numerous surface modes of transportation device.

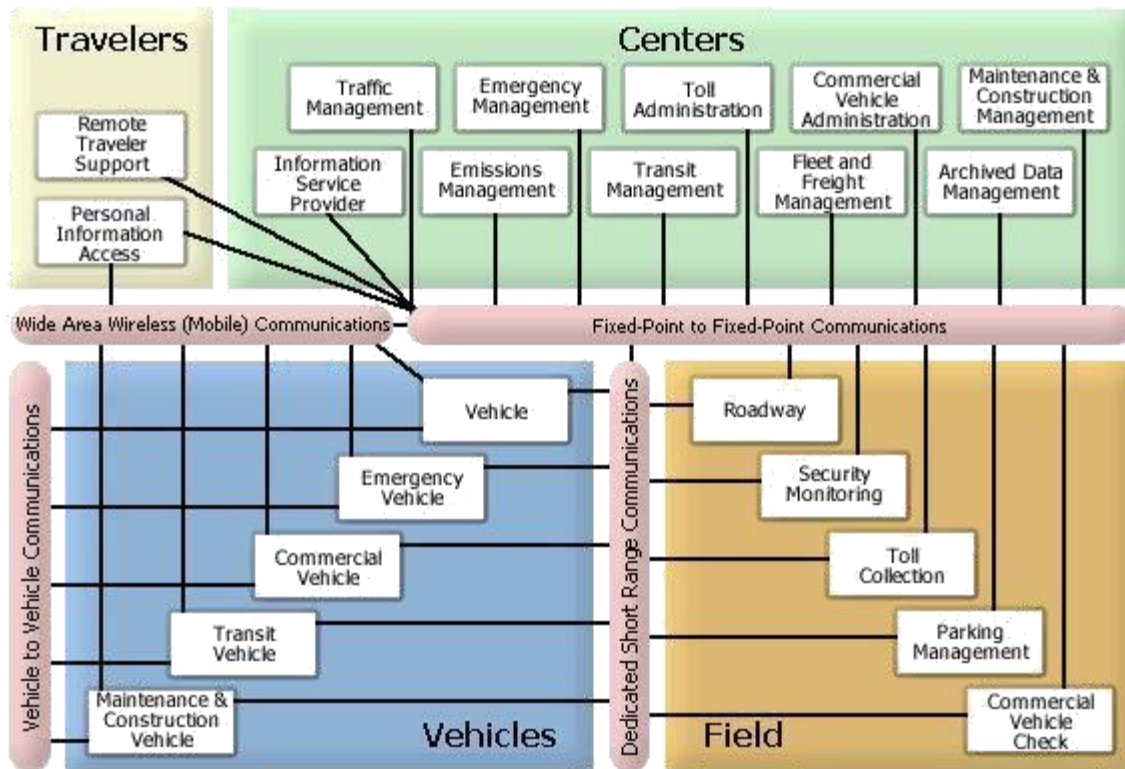


FIGURE 1.2: Broad Overview of ITS

1.2 ITS Now and Tomorrow

In large city parts, ITS initiatives have come to be a part of the transportation gadget. ITS is presently being carried out, either independently or as a part of traditional transportation initiatives, in lots of areas with a view to aid the goals of a safe and more efficient transportation machine. Some metropolitan regions have already seeing the benefits of ITS thru improved journey conditions. As a result, many smaller metropolitan and rural areas are also severe by using thinking about ITS or, in some cases already imposing it.

ITS technology, however is altering very quickly. New and increase technologies come into element every day, and the demand for a greater efficient and safer transportation machine lasts to grow. ITS is possibly to develop hastily, each geographically and functionally, to fulfil future demand at the transportation gadget.

1.3 ITS Training and Education Needs

ITS is new subject, Traditional Education agendas in transportation engineering at the kingdom's universities aren't good enough to prepare college students to devise, layout and perform ITS. In accession to previous transportation engineering courses, ITS masters require training in many diverse ranges, such as system engineering, electronics, communication system, and official issues.

ITS research and ideas were given considerate attention inside the round Nineteen Nineties as an implemented way to satisfy destiny needs on the transportation gadget. The components and elements of ITS are still being focused and developed. As ITS proceed to become more prevailing in the transportation sector, transportation professionals are trying to identify the training and education needs to plan, install, function, and evaluate ITS. The countrywide ITS specialised ability constructing application diagnosed 10 foremost crucial areas in which ITS schooling and education desires to be concentrated [1]. These are as follows:

- Planning and local concept of Operation: Planning for ITS is not identical as planning for previous transportation initiatives, including a motorway creation. ITS planning involves a more from construction to another explanation integrating advanced technologies to meet upcoming traffic demand. The undertaking to the ITS professionals is to merge ITS planning into the previous making plans manner to carry ITS to mainstream transportation activities.
- System evaluation and design: This consist of the capability to identify customers, restoration their requirements and layout a technique which satisfy the necessities. The electricity to stud and design software and verbal exchange device may be necessary in lots of initiatives.
- Technology assessment: ITS professionals ought to be successful to undertake the maximum appropriate and most-cost effective method and generation. Furthermore, further to deliver familiar with diverse assessment techniques, they ought to additionally be familiar with diverse evaluation strategies, they should also recognise the special technologies and their competences and boundaries.

- Data analysis and managements: ITS utility normally involve the collection of large quantity of information. ITS professionals have to know how to analyze these records, the way to extracts beneficial statistics from them, and a way to manage and distribute the facts.
- System integration: systems integration involves connecting individual deployments and institution together into a comprehensive local transportation system to optimize service provided to users. It gives most advantages with the aid of lessening redundancies and maximizing competences through the integration of different additives and instructions.
- Organization and institutional troubles: For ITS to be successful, ITS specialists ought to understand about organizational and institutional troubles related to ITS deployments and challenges the pose. Such problem includes the changes needed in procurement and contracting procedures for ITS in highway construction projects and coordination requirements between different agencies for an ITS project.
- Contract control: ITS expert want to be taught on ITS undertaking management tactics, that are one-of-a-kind from the ones required to manage a creation mission. In many cases, production contractors who may additionally adopt an ITS assignment lack the background knowledge wished for successful ITS programs.
- Financing: ITS professionals need to recognize the funding assets for ITS initiatives. In addition, they should recognize how to optimize the assets of those funding resources to satisfy undertaking targets.
- Coalition building: Building and preserving consensus amongst stake-holders is a key to a hit regional and state-wide ITS deployment. ITS professional should be able to engage stakeholders and develop consensus in meeting mission targets.

- Writing/communication: ITS professional must be capable of write specifications with a view to assist procure the excellent possible gadget. Common problem in ITS deployment are false impression and miscommunication between the deploying employer and the contractors.

1.4 Advance Traveller Information System (ATIS)

Advance tourist statistics machine uses the collective facts and verbal exchange generation to offer information-information to an extensive variety of travellers using special modes of transportation and feature an intensive type of features. Information enable traveller to make better travel choice and supports a better use of existing transportation facilities. When it is prearranged, established, and executed in a thoughtful and well-structured way.



FIGURE 1.3: In Built GPS System in Vehicle

The term advance traveller information system open to appropriate since it is a relatively unfamiliar term to most people.

Let us begin by means of reading the expression Advanced Traveller Information System:

Advanced: There are many approaches to collect information, manner it, and disseminate traveller records, a number of which require little by way of statistics and verbal exchange generation software.

For example, a telephone network or wireless radio facility connection people in the field back to a central base can relay anecdotal from the public and form some spotter planes or helicopters in which it's far disseminated via TV or radio to the public. While this method makes use of a number of information and communication technologies.

Traveller: A fairly obvious definition of traveller is the one who travels. It appears trivial first, however there's a bit more to it while you start to discover the term. Travellers may have quite a number characteristic in line with the mode of tour chosen, the cause of the experience being made, and the characteristics of the character.

Information: what can we suggest by information? We achieved a brief net search and got here up with following two definition for information :

1. Past document information, or preparation in any general or in any shape
2. The sense that a person assign to facts with the acknowledged resolutions used in the depiction.

Required information also lessen uncertainty through offering additional knowledge and adding to what the person of the data already is aware of. Definition based totally on the web searches: Information is the records that has been subjected to processing to investigate the underlying pattern and tendencies to show data that are beneficial to the customers because they reduce uncertainty and shed light on the problem that is important to the person.

1.5 Dynamic Message Sign (DMS)

Dynamic message signal is referring to the passing unit or a big display screen board that give information display era to inform in formational and guidance to vehicle riders and additional tourists. They may be positioned at key choice pints within the travel system, consisting of vital intersections alongside the highway, methods to parking garages, or at multimodal interchange factors, such as airport concourse, bus stops, or railway stations. When the records concerning contemporary site visitors scenario on avenue displayed at the dynamic message sign that can be modified rapidly via a connection to controlling device. It is public medium which constraints the comfort and customization of the messages. All viewer of the sign see the equal message at any given time [3]



FIGURE 1.4: Dynamic Message Sign

Road users present traffic information in the form of road traffic messages and announcements, which is conveyed through the use of information opinion and shows mounted sideways of the roadway network. This comprises the dynamic message sign situated at strategic location on the conveyance network, such as main decision locations for direction-finding, transit, halts, posts, shopping hubs and large workplace centres. It is the most predominant application respectively to the surface transportation is the variable message sign also called as dynamic message sign (DMS) or Changeable message sign (CMS) or also termed as moveable message sign depending upon your country.

These signs are characteristically permanent fitting which uses a display technique, such as closed fibre optics, magnetic flip diskette, light emitting diode (LED), or revolving prism to allow the display to be changed as per according to the traffic situation. Few of these signs are completely addressable or few special mapped displays allowing any combination of graphic and text messages to be displayed. Other displays have restricted predetermined set of messages to display. These can be colorless or fully coloured. These are castoff at planned positions sideways the road network to send direction choice or information regarding present traffic condition.

1.6 ATIS Operational Concept

In order to achieve our action of data information and communication technology. It is required to deliver a complete image that exemplify in what way the technology skills might be functional in unity to give traveller information through system distribution. We say it operational concept as because We have reserved features and its functions from various number of ATIS to make a projected example that how these techniques can be arranged in order to function together. Below the given figure demonstrate the operational concept of advance traveller information system, that comprise of different four data processing or administration- processing or supervision centers and single private- sector data facility provider.

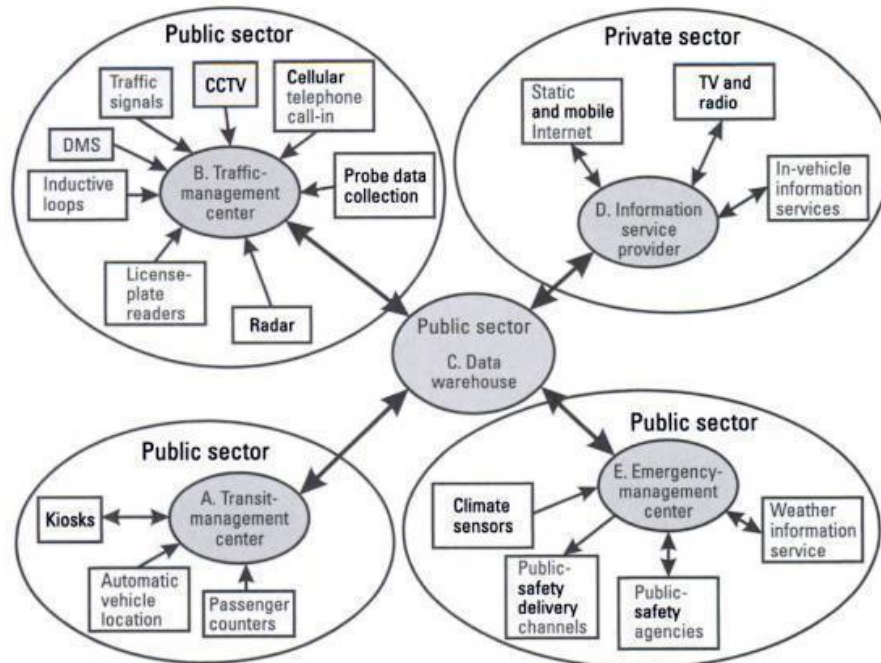


FIGURE 1.5: ATIS Concept

1.7 Scope of the Study

The world of ITS provides many opportunities for collaboration, advent, and jointly beneficial actions involving each the private and non-private sectors. New mechanism and new application had been carried out effectively for a number of years in other utility area and just new to Transpiration machine. The development and implementation of ATIS are essential for you to permit us a transportation and commercial enterprise community to make progress toward a few perfect situation. Where visitor records is without difficulty to be had to the general public and completely supports high-quality travel behaviour. The future scope of ATIS to supply a context inside which there are not any surprises for visitors. Information accessibility need to be such that the massive majority of the journeying public has easy access to the full variety and high-quality of information required to aid knowledgeable and sensible choices in any respect degrees within the trip and protecting all modes.

To make some particular points regarding the operational components of the destiny system. We take a glance through the eyes of the operators and bosses of the destiny ATIS. This presents greater of a again-workplace view of the future system with the aid of exploring the records series and statistics processing facilities which might be to be had and the transportation objective to attain a easy waft of automobiles on street community with the minimum delays.

To offer users records which is related to tour with a purpose to guide whilst making selection on course selections, approximation of travel time, and stay away from congestion. It can be empowered by means of handing over one of a kind records statistics with the help of the use of ATIS technology.

Use of dynamic road message signs and symptoms real time message of records concerning traffic blockings, blockages, incidents and opportunity course steering in case of any closure of roads and preservation paintings.

1.8 Objective of the Study

The goal of ATIS is to deliver a context within which there are not any surprises for visitors within the selected stretch of Ludhiana City. Information accessibility ought to be such that the massive majority of the touring public has easy get admission to the whole variety and best of facts required to assist informed and smart choices at all tiers within the trip and protecting all modes of transportation along with Non-Motorized cars (NMV).

- The implementation of ATIS is mapped to the actual objective of saving time, lives, and cash, decreasing stresses and optimizing use of current capacity.
- Gives the tour time, transit schedule facts, adventure time reliability, pre-journey planning statistics, tour related climate facts, Alternate routes and modes and additionally the outline of coincidence and incidents (Including length). Which helps to ravel readily and protection.
- Effective use of Advance traveller system to supply transit riders a actual-time facts, to make nicely knowledgeable choices regarding journeys, Information concerning routes and safety, with co-incidence of Dynamic message signal (DMS).

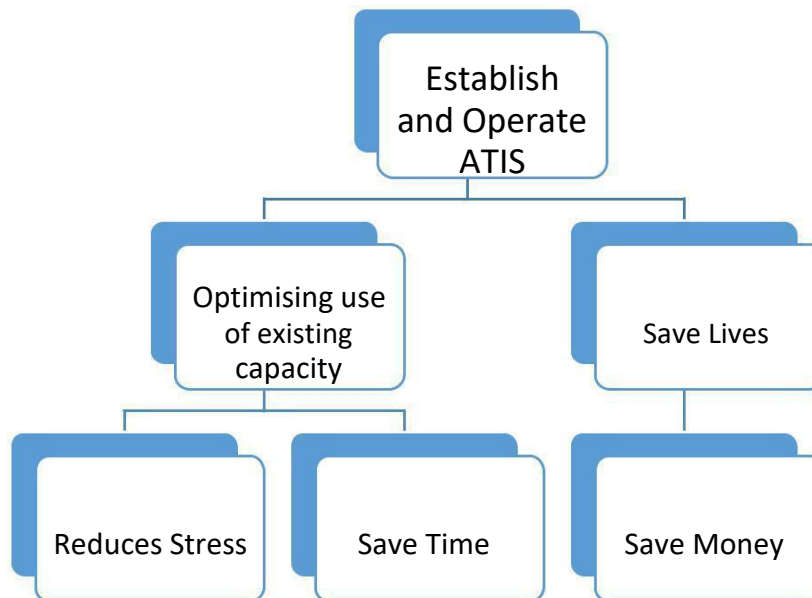


FIGURE 1.6: Flow Chart of ATIS Objective

With the example that features the use of multiple information delivery channels, such as dynamic message sign as we are working in this thesis, internet and interactive voice response. The traveller information related to roads and driving condition that's why most of the current deployments of ATIS that take data from multiple sources and then further delivered advance traveller information technologies.

Chapter 2

LITERATURE REVIEW

2.1 Praveen Kumar, ATIS is a one the important thing application of ITS comprises of compute, technology and information technology to offer the statistics to avenue users approximately the traffic law, safe direction with the minimum time tour and approximately the protection factors in conjunction with dangerous conditions if any. ATIS requires very distinct and distinguished quantity of information for the implementation, beneath this study the author have used the GIS application along with the Advance vacationer records device. GIS based ATIS provide most robust and maximum handy for storing and graphical depiction for conveying the existing visitors statistics to the street customers. ATIS is typically wide under sensible transportation gadget through the quick boom of internet and wireless generation competencies from ultimate couple of years. [5]

2.2 Yi-Chang Chiu, this paper gives a method of implantation of everlasting dynamic sign (DMS) in a transportation community, the specified variety of dynamic message sign with the co-occurrence of Advance visitor in formation system. Then similarly DMS deployment cost is to be expected for the deliver described location. Simulation method is hired to overcome this case. The numerical outcomes display that the implementation of DMS and ATIS simultaneously is greater efficient and greater value powerful. The writer further concludes that this system of deploying permanent DMS is suitable for each long term making plans and brief time period operations. This paper also addresses the effect the interrelation between ATIS and DMS for it powerful impact on high-quality direction choice and time journey. Experimental effects show the coolest inter-relation among the 2 strategies. [6]

2.3 Rijurekha Sen, Bhaskaran Raman. In this paper, the author provides a complete take a look at of all viable ITS utility in India as in line with the modern-day state of affairs device of visitors situation which encompass each research prototype and deployed structures. This paper set a list of private and public business enterprise that performs a major component in traffic management and research. This paper specializes in the Indian site visitors situations and some of the visitors associated troubles and solutions marked on this paper. In the end, it concludes that presently site visitors

congestion on Indian roads is the major issue. There is range for examine previous method and ideas in different and disputing traffic conditions, come up with new solutions and mathematically evaluate thought within both private and public sphere. [7]

2. Alexis A. Avgoustis, Measuring the Safety impact of Intelligent Transportation Systems. An common of 6.Five million twist of fate are recorded as on yearly foundation statistics in U.S. Safety is important component to do not forget on a rapid boom of traffic quantity in American traffic situation. This thesis explains the development of a protection version having the primary goal is to get the blessings of Intelligent Transportation Systems (ITS) on contemporary street situation. Traffic sign right coordination enables to smoothens visitors on a road community and decreases its probabilities for accident hazard via producing much less car-to vehicle interactions. Also, visitors signal manages to control the design pace properly on that avenue. The main gain of this safety model that it may be without problems used to get a spread of ITS application and technologies and also the sign coordination that's evaluated in detail on this thesis [8]

2.5 Kay Noyen, on this paper the supposition is made that new Modern clever cell telephones with incorporated GPS tool and Wi-Fi net connection are now in trend of turning into primary equipment of man or woman's life. They offer a commodious person interface to disseminate the customers' transportation needs the usage of present developed infrastructure. The aim of the paper is to broaden a device that is capable to procedure despatched off transportation request into as top-rated routes for a set of motors that could handle massive range of request right now in real time foundation. The public transportation systems deliver a price-effective way to travel extra or less freely in urban regions. The results conducted in this thesis challenge that from a theoretical evaluation it is feasible and big to apply the sensible transportation system especially in urban regions and the experimentations made indicate excessive opportunities to later improve the quality of the complex transportation gadget. [9]

2.6 Jaehoon Jeong, this dissertation considers the Wireless Sensor community technology underneath Intelligent Transportation device, trimmed and optimized for the chosen road networks. For navy purposes, the equal avenue networks are used for major motion of navy troops in the major cities and different urban regions, they need to be saved for navy technique and proceedings.

From civil engineering, point of view the Intelligent Transportation Systems have been formulated and been developing to support the driver's safety and increase efficiency in transportation through the computer information system and good coordination between transportation base and vehicles. Roadways transportations are mainly used for the transportation of people, goods and services and also are nowadays are fitted with intelligent device techniques, such as electronic toll plazas and dynamic message signs for route guidance. Now in this coming era, vehicles are nowadays fitted with GPS based technology for navigation purposes and accident and emergency notification systems for making the trip more efficient and safe. This thesis mainly focused on wireless sensors networking technology for the safety, security and communications purposes for the particular chosen road network. [10]

2.7 Lelitha Vanajakshi Gitakrishnan Ramadurai Asha Anand. Intelligent Transportation Systems (ITS) is a properly-described manner to resolve, or as a minimum reduce the site visitors troubles. ITS covers nearly each mode of transportation inclusive of airways, subways, roadways and railways, that's interrelated to every different's base shape, verbal exchange and operational system. Many nations have running on numerous schemes and strategies, which is based on their geographic, ethnical, socio-monetary and environmental heritage knowledge, to merge the numerous ITS factors into a single interrelated device. Generally, any of the ITS programs works with the information which is provided via Traffic Management Centre (TMC) where statistics is gathered, look at and blended with practical and manage concepts to address the composite transportation issues. Generally respective organizations contribute the administration of transport device, through a community of visitors controlling centers. There is frequent a localized distribution of gathered records and available information further which is conveyed to major middle hub of visitors centers that choose exclusive techniques to accomplish their purpose to manipulate and manage the site visitors. This mutualist latest operation and making selection is needed because of the heterogeneous nature of call for and overall performance crucial due to the heterogeneity of call for and overall performance functions of interrelating subsystems. In the end finish they it concludes that ITS in India can't be absolutely implemented on existing avenue structure as of like different developed state's because of the basic differences among the countries like ethnic, geographical and socio- economic.

The existing traffic structure need to be completely understood and modified in order to deploy ITS in Indian traffic system. [11]

2.8 Bhupinder Malik, it is crucial requirement to attain site visitors troubles and avenue consumer safety on the National motorway in any united states of America. The modern-day National motorway machine that advanced over a few years has diverse lacks. The predominant and simple goal of the current take a look at is to key out a management system that offers you higher and green site visitors performance at the given avenue community. An effort was made to become made to recognize most important issues, causes and thinkable answers for stepped forward visitors the problems, motives and possible solutions for higher site visitors supervision.

In many areas in India avenue visitors situation is complex and non-lane primarily based which is completely unique from the western regions. The distinction may be easily visible through experience. So, Intelligent Transport Systems (ITS), utilized in western and in different evolved countries for the efficient traffic drift and management can not be applied as it's miles in India. ITS have a requirement to match the visitors features of Indian roads. In this paper, he has extra targeted on traffic and avenue monitoring device of present day road situations. The important trouble associated with building a traffic situation monitoring device on Indian roads were mentioned. [12]

2.9 Subramanian Gopalakrishnan, Intelligent transportation can carry a exceptional essential element to overcome the visitors congestion problems which confronted through the modern toll road road users. A efficient execution of Intelligent delivery machine is possible best depending on the accurate estimation of anticipated destiny generating site visitors. An successful short time period destiny generating traffic expect to be a extensive part on this situation. This paper gives an concept to expected destiny generation visitors by using a couple of regression evaluation and method of neural networking (Intelligent modeling technique) for looking forward to the subsequent hour future generated site visitors of a Highway. The records has been gathered in week days and weekends. The prediction is also carried out for the height hours (Morning/Evening) and the effects suggests the heavy commuters site visitors go with the flow at some stage in the peak hours of morning and

evening, which assist for deploying the suitable ITS application. [13]

2.10 P. D. Heerman, underneath this paper it describes about the Intelligent Vehicle-Highway System (IVHS). This appears for approaches to boom the prevailing road capability the use of technological inputs. While non-public automobiles are the primary recognition beneath this program IVHS. It also looks for the new improvisation in public conveyance gadget. This thesis work comes as much as the public transport elements, which we called as Advance Public Transportation System (APTS). The future scope of Advance Public Transportation System is introduced, by using giving a merging transportation network for the laid improvements inside the services of avenue users. A bus centre is considered in order to enhance the first-class and look of the machine for both new and antique users, operators, and additionally for individuals who manages the site visitors. In this paper, additionally the importance of Advance public transportation device to the purpose of IVHS are been very well mentioned. [14]

2.11 Mohammad Mahmudul Haque, the objective of this paper is to create a Real-Time Traveller Information System in an effort to Support the operation of an Advanced Traveler Information System (ATIS). The approach will study the cutting-edge site visitors condition of each single course and tell robotically as according to to the accumulated records. It will even let the street person to inform about any even or incident, weather grievance and any unusual occasion in the road. The information amassed from the roads might be examined in conjunction with the closing recorded data. A real-time facts will be generated so that it will guide tourists to take the high-quality choices concerning their tour routes to stay clear of traffic congestions and put off. [15]

2.12 Abhijit Kenjale, In the implementation of a huge-ranging and superb road network, the requirement of re-set up, resurface, or exchange in additives of a roadway will usually come into play. This in the long run effects upward thrust to the modern of work areas wherein labours entire their preservation and creation paintings on an existing roadway community in near separated region with the shifting cars. The transportation engineer is chargeable for setting up these paintings areas to control the subsequent tasks: Completion of the development or protection work in stipulated time period, Protection of the capacity of the street network and, the safety of the labours, the aim is to achieve advanced safety in motorway work

zones areas, there are numerous special approach that have to be measured. These include keeping drivers attentive, alert, and wide-awake; making labours and the work regions more significant; enlightening the control of traffic in merging areas to permit the lane adjustments extra expectable; Introduce stepped forward safety devices; and controlling vehicle pace and speed variations in the paintings zone regions. This paper emphases on the final of those techniques, by using controlling automobile velocity, thru the utility of a pace monitoring display with variable message sign. [16]

2.13 Vaibhav Rathi, Combination of Intelligent Transportation Systems (ITS) technologies with visitors surveillance has the capability of dropping the delays and costs incurred due to non-recurrent site visitors on roadways through the distribution of dynamic path course to drivers. Variable Message Signs (VMS), installed on expressways or freeways, are used for incident supervision and to present the records concerning the incidents and deviation routes. CMS proved to be an vital tool utilized by the Traffic Management Center (TMC) to improvise the efficiency and reduce delays of the road community by means of supplying trade path steering. Dynamic Traffic Assignment (DTA) tool may be used to make predictive route, and the visitors control middle can distribute it via VMS to the road users. The online evaluation of such systems is very high-priced and there's a need to simulate the real visitors conditions so that it will evaluate the DTA equipment earlier than their software inside the discipline area. [17]

2.14 Ning Zhang, Variable Message sign (VMS) has been set up in Minnesota given that Sixties. The exams for the use of the signs are vital for his or her suitable set up and distribution. Under this paper, five VMS gadgets had been particular alongside Interstate-ninety four (Particular region) amid at downtown Minneapolis and St. Paul. The statistics collection was taken in length from January 2006 to December 2012. Initially, a linear model was used to study the outcome of variable message sign over velocity adjustments, inside the constant effect regions. The examine changed into performed using two methods along with the eight different situations. The result suggests that the speed variant, the effects indicated that the association of variable message sign messages become now not probably a chance component for crash occurrence.

The projected odds ratios for both type, warning and informative message types were not expressively different. [18]

2.15 Azadeh Norouzi, Dynamic Message Signs (DMS) are key detail in Advanced Traveler Information Systems so that you can control transportation networks, decrease congestion problems and increase protection by way of presenting road customers a with actual-time records regarding downstream site visitors situations. Whereas DMSs are proposed to develop performance and protection capabilities of the given road networks, Small scale evaluation has been executed for checking the impact of the VMS signs and symptoms on driving force safety and their neighborhood protection impressions. This thesis offers information of real floor truth facts accrued on the basis to take a look at the site visitors related issues in State of Maryland for 4-12 months length i.E. (2007-2010). The results show that there are no sizable adjustments inside the accident pattern within the proximity of variable message signs and the forward adjacent mid-block street segments. On-and-off analysis turned into also being carried out on Variable message sign operation repute (on/off). The effects congregate with the preceding analysed data suggesting that there may be no expressive dating between occurring of accidents and existence of Variable message signal. This thesis assessed localized safety impacts of dual carriageway Variable Message Signs (VMS). The recorded twist of fate information from year 2007 to 2010 served because the floor-primarily based records for the study of road crashes in complete State of Maryland. The twist of fate and report of messages facts in examine length changed into taken from the Centre of transportation department for deployment of Advanced Transportation Technology. [19]

2.16 Nedal Taisir Ratrou, The Dynamic Message Signs (DMS) have been provided in Saudi Arabia and their consistency below local surroundings is being skilled. This paper functions to assess the probable response of the drivers to Dynamic message signal while it's miles used for messages regarding the prevailing traffic conditions. A main arterial in Al-Khobar city in Saudi Arabia with a massive Dynamic Message Sign board turned into specified for this specific paper. The assessment method began by means of interviewing drivers selected randomly from the examine area. Results suggests that there have been about seventy seven% of the interviewed drivers confirmed encouraging attitude towards Dynamic messages guiding alternate of course. The driver's interviews established statistical connection between the response to messages inviting change of particular route and also displays the reason for such suggestion. The extreme response was for dynamic

messages about accidents, roadwork doings, and traffic congestion. A field trial was also conducted along the considered arterial. In results, it was found that Dynamic Message Sign statistically improved the proportion of diverted traffic throughout specific peak duration when traffic count is more. [20]

2.17 Lowisa Hanning, The Dynamic message signs and Dynamic speed limits are these days often used in lots of quantities of Europe however isn't as nicely used in Sweden. The aim of those symptoms is e.G. To make a greater comparable traffic go with the flow and reduce congestion on expressways or freeways. There are many in locations of Sweden, the control technique is old and in need of an modification. In this paper, the capability of more development and execution of an advanced control process and regulator layout for changeable velocity limits is examined. There are strategies to increase the visitors drift of automobile, as an instance improve metering or changing the adjacent infrastructure of the street community, has no longer been inspected. To look at the capability and develop a controller design of changeable message symptoms, with changeable speed limits, for that to begin with the microscopic version that is known as METANET was executed and analysed in MATLAB. Both macro and micro stage models had been joint with the intention to examine the road traffic both as a glide and as a machine of one by one simulated motors. Both the models had been used to generate a manage layout which make versions inside the pace limits with the purpose at enhancing the vehicular site visitors float. [21]

2.18 Afzal Ahmed, Precise illustration of cutting-edge site visitors situations is important to create operative real-time site visitors control strategies by using the usage of Intelligent Transportation Systems (ITS). The Existing applications of Dynamic Traffic Assignment (DTA) strategies are based on either the forecast from macroscopic traffic drift models or analysing by means of the use of the sensors and do now not take advantage of visitors country valuation strategies, which offers estimation of the traffic states with a lesser amount of uncertainty than that of prediction or analysing it one at a time. Where the alternative side, research revisions offers significance to the approximation of real-time traffic kingdom are attentive simplest on traffic nation evaluation and feature now not used the calculated site visitors nation for Dynamic Traffic Assignment packages. This paper introduces a context which integrates real-time visitors state evaluation with the usage of applications of Dynamic Traffic Assignment to decorate street community

performance in the course of inexact traffic conditions via Advance traveller statistics gadget.

[22]

2.19 Niharika Mahajan, Traffic overcrowding remains a serious trouble in most of the international locations, with important economic and ecological losses. 'Intelligent Transport Systems (ITS)' that use advanced information and conversation generation for dealing with the existing road infrastructures which includes motors and street customers, have discovered immoderate potential in managing this site visitors difficulty. But, most current visitors control techniques, like alternate direction steering, ramp metering and dynamic pace limits are deliberate and performed independently. The most important objective of this paper is to combine a Dynamic velocity manage approach together with the ramp metering, to function efficaciously at an expressways or freeways merging segments. According to the policy viewpoint, that is a venture as because freeways and urban street network are controlled by using unique authorities. This is objectionable for the expressway governor measure. So, the development of the included strategies considers both, an enhancement in throughway or expressways effectiveness, and on other hand on the identical time line regulation on the on-ramp. [23]

2.20 Rasib Majid, In Highway traffic quantity, production and renovation works are pretty common. Upstream avenue merging motion and ability bottleneck can lead from a piece area zone stop, which pose enlarged protection chance and decrease traffic flow effectiveness. Dynamic Merge Control (DMC) is an utility of Intelligent Transportation Systems (ITS) technology in paintings areas, that's projected to develop the safety and flexibility of the via visitors pressure by way of guiding the lane modification manoeuver of vehicles from closed course to the open route. The fundamental objective of this take a look at is to take a look at the efficiency of the two sorts of Dynamic Message Sign in paintings zones. The purpose of this assessment became to study the effectiveness of dynamic merge control (DMC) in expressway work zones in a virtual environment. This motive changed into assisted by using concerning the overall performance of dynamic merge manipulate in comparison with the conventional merge as according to consistent with MUTCD. In accumulation to this, a Particular transient site visitors manipulate plan is likewise advocated below a selected traffic demand.

2.21 S.K. Mahajan, The Traffic Rotary at intersections is superior shape of a grade alternate of lanes that allows you to channelize the pressure of cars in unmarried route about a primary site visitors island i.e. Rotary. By speedy growth of site visitors, it is practiced that broadening of roads and introducing flyovers have now become domineering to conquer principal struggles at the intersections inclusive of crash between via and proper turning vehicles. In this gadget, major conflicts are converted into minor conflicts like merging and diverging of vehicles. The automobiles ingoing the rotary are slightly enforced to exchange their movement in a clockwise path. Than they weave out of the rotary island to the wanted path. The passage of cars is prevented with the aid of permitting all automobiles to join right into a stream around the rotary island after which to deviate out to the preferred street. Thus, the crossing struggle factors get rid of and exchange into weaving movement or a merging maneuver from right and a diverging maneuvers to the left. In this paper, designing of principal rotaries at avenue the intersections are being examined and a secure movement approximately rotary island is advanced this is for use in avenue network [25]

Chapter 3

EXPERIMENTAL PROGRAMMES

3.1 Methodology

We adopted the methodology for deploying permanent Dynamic Message Signs (DMS) in a given road traffic network. The objective is to install optimum number of DMS to spread with co-occurrence of Advanced Traveller Information Systems (ATIS), functioning and upkeep price of DMS, and event-interrelated operator price under casual traffic occurrence situations. As real time traffic data, will be delivered by traffic management centres, which will help traffic riders to choose best suited route at that particular time. Real time information can be supplied by traffic management centres via internet connectivity. The DMS system, on the other hand to give travellers information about special events. These signs give warning of current traffic condition situation or congestion updates if any, coincidences, disruption, roadwork regions, weather info, or speed restrictions over a particular stretch of highway segment or mid-blocks section in city areas for efficient and safe manoeuvring of traffic

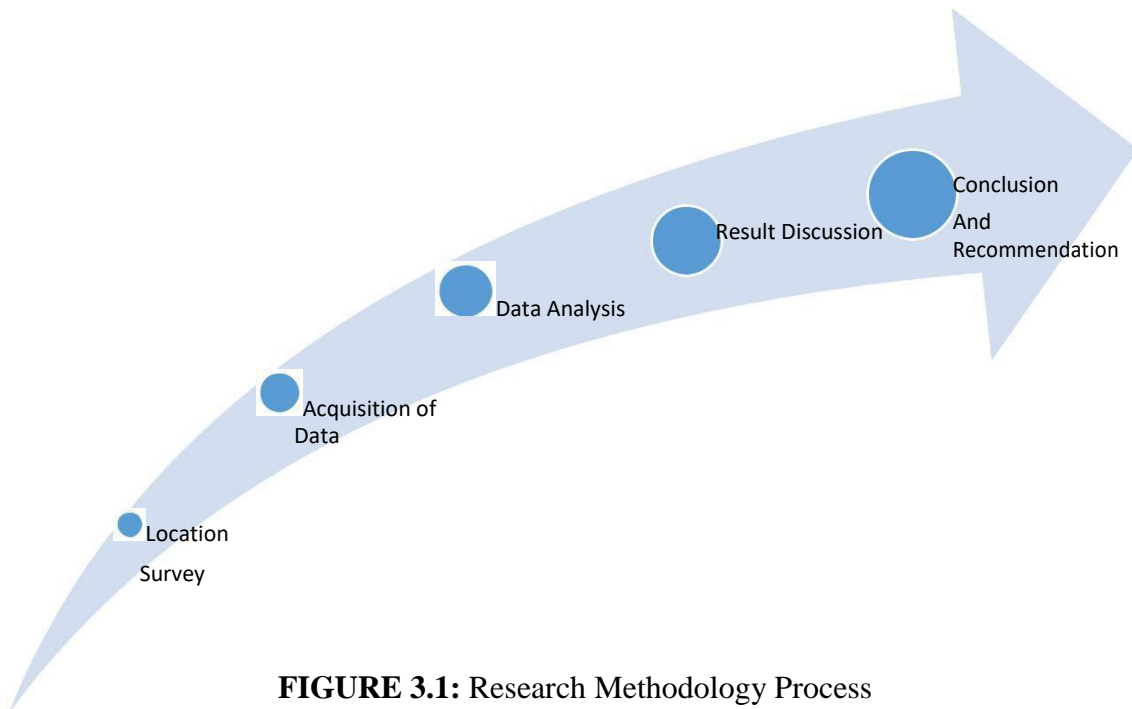


FIGURE 3.1: Research Methodology Process

3.2 Area Taken into Consideration

The most congested and with heavy traffic flow area is to be selected in multiple stretches of Ludhiana City. The main city area having high volume traffic in regular week days and weekends is also viewed. A carried out our study over a complete stretch of 6000 m approximately. The complete stretch of approximately 6 Km is broken down in five stretches for the purpose of ease in data collection.

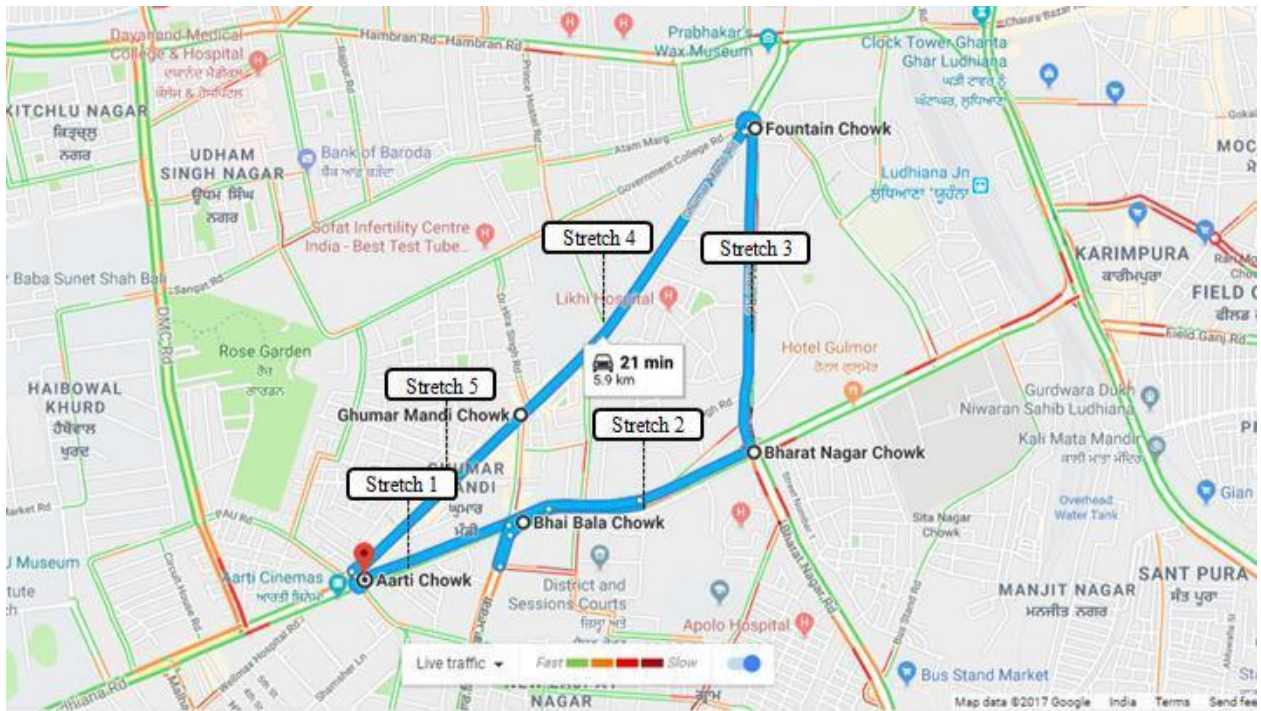


FIGURE 3.2: Area into consideration

TABLE 3.1: Calculated Distance of 5 Stretches in Meters

Serial No.	Area Description of Point A	Area Description of point B	Distance (m)
Stretch 1	Aarti chowk	Bhai Bala Chowk	1500
Stretch 2	Bhai Bala Chowk	Bharat Nagar chowk	1200
Stretch 3	Bharat Nagar Chowk	Fountain Chowk	1200
Stretch 4	Fountain Chowk	Ghumar Mandi Chowk	1200
Stretch 5	Ghumar Mandi Chowk	Aarti Chowk	1000

Total: 6100 m

The length of the total stretch is calculated to be approximate 6.1 Km.

VOLUME DATA COLLECTION

3.3 Method of Manual Count

In the method, manual count most of the application requires minor trials of data for the certain location. Manual count methods are generally used when the determination and expenditure of automatic equipment are not defensible. Manual count method is essential when the automated device for procedure is not accessible.

Manual counts are characteristically castoff for phases of less than a single day. Standard breaks for manual count was of 20 minutes and then it was calculated on hourly basis.

3.3.1 Methodology Adopted

The volume study was conducted at the mid -section on different stretches

3.3.2 Data Collection

Counting breaks: 20 minutes (Period of short count)

Location of data collection: Ludhiana city

Time period: Six weeks' data on ADT in weekdays and weekends

Observation Data: Vehicular Classified count

Method Used: Manual count Method (Direct Method)

Equipment Used: Record Data Sheet, Stopwatch.

3.4 Observation Tables

1.

TABLE 3.2: Calculated PCU for Stretch 1

Vehicle Classification	Observation in 20 min	Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)	17	58	2.461	3	174
Truck (T)	6	18	0.764	0.75	14
Light Vehicle (LV)	478	1467	62.266	1	1467
Auto Rickshaw (AR)	187	290	12.308	0.5	145
Motorcycle(MC)	201	460	19.527	0.5	230
NMV	36	63	2.674	0.2	13
Total =	925	2356	100	---	2043

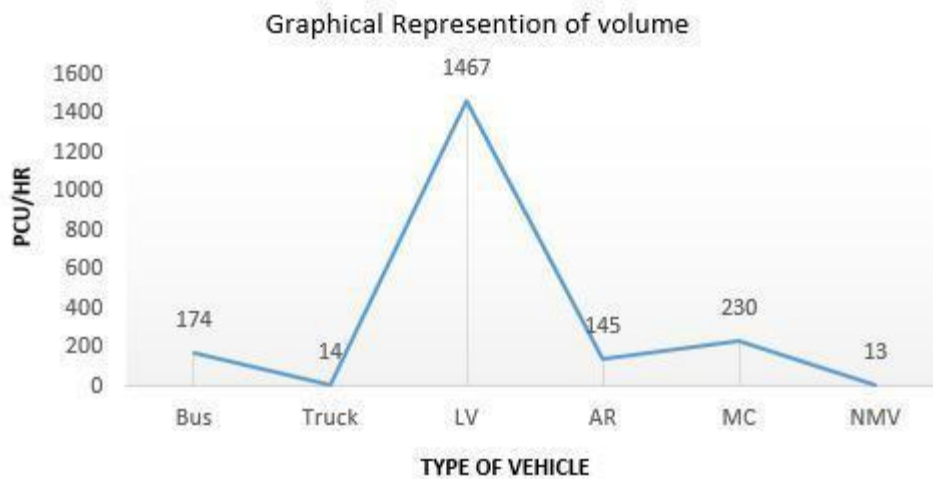


FIGURE 3.3: Graphical Representation of PCU

2.

TABLE 3.3: Calculated PCU for stretch 2

Vehicle Classification	Observation in 20 min	Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)	14	42	2.216	3	126
Truck (T)	3	11	0.609	0.75	9
Light Vehicle (LV)	247	749	41.495	1	749
Auto Rickshaw (AR)	136	446	24.822	0.5	223
Motorcycle(MC)	190	508	28.144	0.5	254
NMV	17	49	2.714	0.2	10
Total =	607	1805	100	---	1371

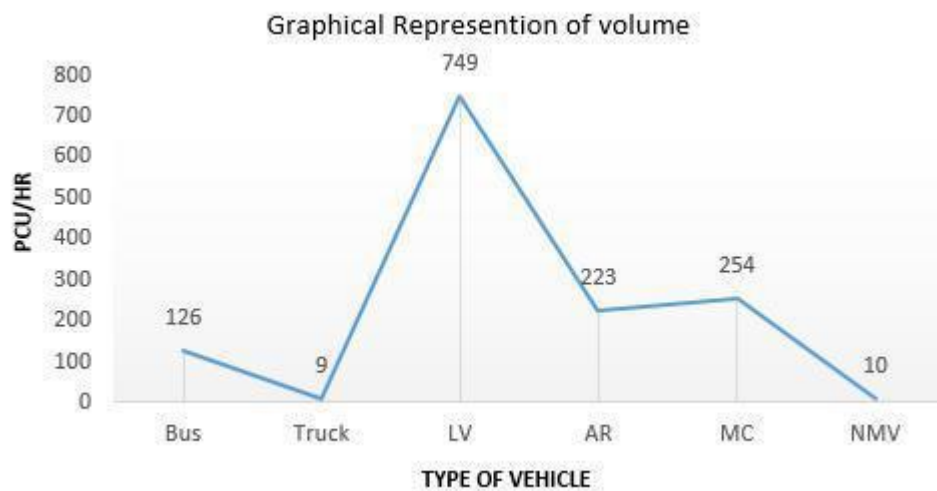


FIGURE 3.4. Graphical Representation of PCU

3.

TABLE 3.4: Calculated PCU for Stretch 3

Vehicle Classification	Observation in 20 min	Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)	19	50	2.696	3	150
Truck (T)	8	23	1.240	0.75	18
Light Vehicle (LV)	396	941	50.755	1	941
Auto Rickshaw (AR)	148	277	14.940	0.5	139
Motorcycle(MC)	248	493	26.591	0.5	247
NMV	38	71	3.778	0.2	15
Total =	857	1854	100	---	1510

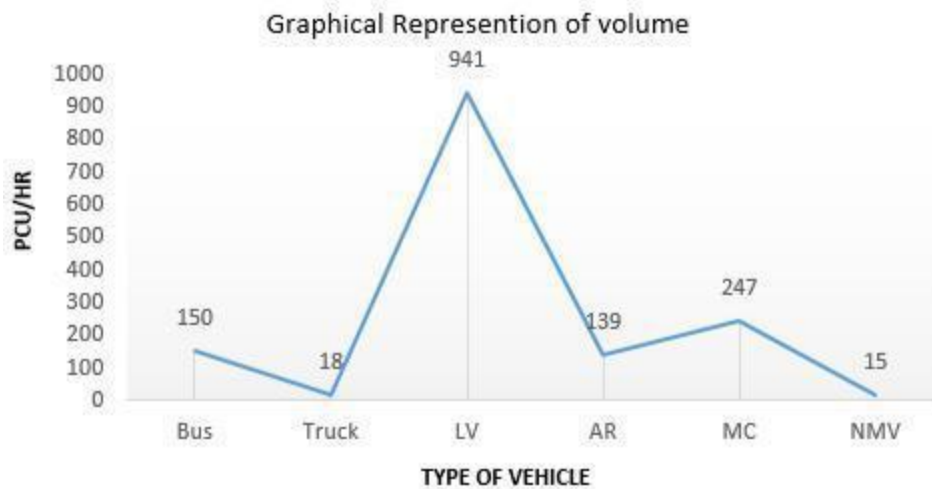


FIGURE 3.5: Graphical Representation of PCU

4.

TABLE 3.5: Calculated PCU for Stretch 4

Vehicle Classification	Observation in 20 min	Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)	6	21	0.912	3	63
Truck (T)	4	10	0.434	0.75	8
Light Vehicle (LV)	412	1136	49.369	1	1136
Auto Rickshaw (AR)	159	477	20.730	0.5	239
Motorcycle(MC)	174	518	22.511	0.5	259
NMV	47	139	6.044	0.2	28
Total =	802	2301	100	---	1733

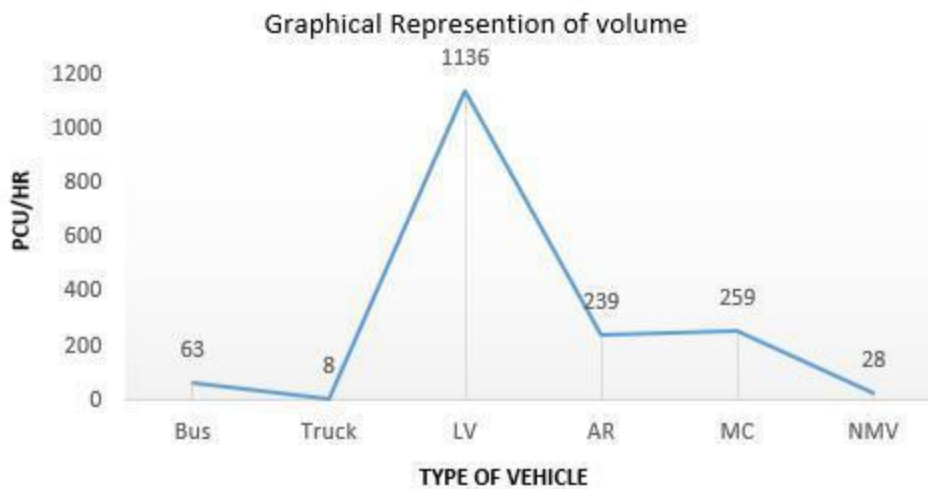


FIGURE 3.6: Graphical Representation of PCU

5.

TABLE 3.6: Calculated PCU for stretch 5

Vehicle Classification	Observation in 20 min	Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)	16	49	2.102	3	147
Truck (T)	9	31	1.329	0.75	24
Light Vehicle (LV)	418	1254	53.796	1	1254
Auto Rickshaw (AR)	132	396	16.988	0.5	198
Motorcycle(MC)	183	541	23.211	0.5	271
NMV	22	60	2.574	0.2	12
Total =	780	2331	100	---	1906

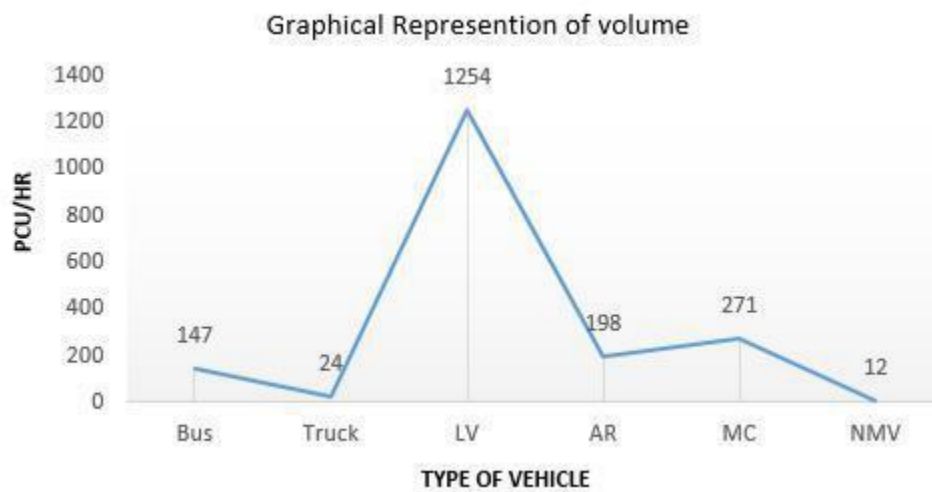


FIGURE 3.7. Graphical Representation of PCU

Average Daily Traffic calculated (ADT) for weekdays on hourly Basis in morning and evening peak hours i.e. 10-11:30 AM and 6:45-8:00 PM

1.

TABLE 3.8: Calculated PCU for Stretch 1

Vehicle Classification	Observation in 20 min	Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)	14	47	1.927	3	141
Truck (T)	9	30	1.230	0.75	23
Light Vehicle (LV)	401	1217	49.917	1	1217
Auto Rickshaw (AR)	204	586	24.036	0.5	293
Motorcycle(MC)	267	490	20.101	0.5	245
NMV	29	68	2.789	0.2	14
Total =	924	2438	100	-	1933

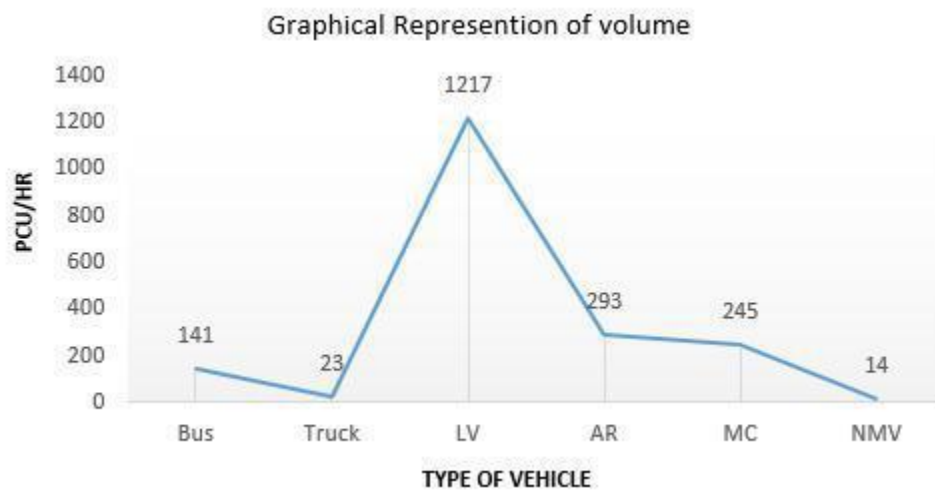


FIGURE 3.9: Graphical Representation of PCU

2.

TABLE 3.9: Calculated PCU for stretch 2

Vehicle Classification	Observation in 20 min	Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)	8	31	1.333	3	93
Truck (T)	6	20	0.860	0.75	15
Light Vehicle (LV)	302	937	40.301	1	937
Auto Rickshaw (AR)	197	595	25.591	0.5	298
Motorcycle(MC)	218	658	28.301	0.5	329
NMV	29	84	3.614	0.2	17
Total =	1367	2325	100	-	1689

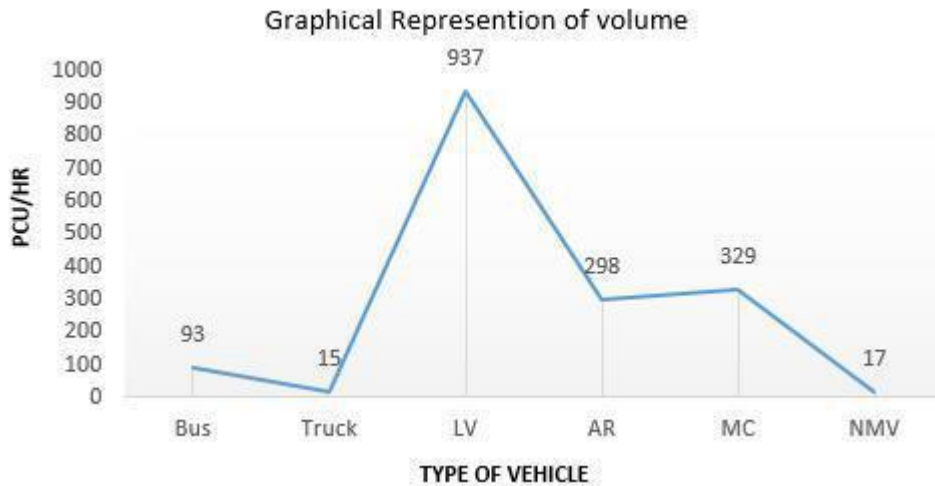


FIGURE 3.10. Graphical Representation of PCU

3.

TABLE 3.10: Calculated PCU for Stretch 3

Vehicle Classification	Observation in 20 min	Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)	23	69	2.631	3	207
Truck (T)	12	36	1.372	0.75	27
Light Vehicle (LV)	364	1092	41.647	1	1092
Auto Rickshaw (AR)	181	543	20.709	0.5	272
Motorcycle(MC)	255	765	29.328	0.5	283
NMV	39	117	4.313	0.2	24
Total =	874	2622	100	-	1905

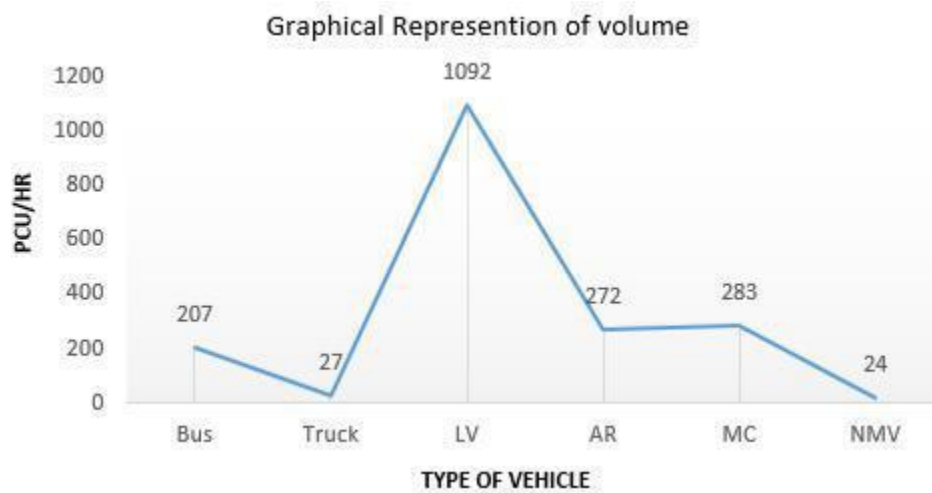


FIGURE 3.11: Graphical Representation of PCU

4.

TABLE 3.11: Calculated PCU for Stretch 4

Vehicle Classification	Observation in 20 min	Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)	6	18	0.746	3	54
Truck (T)	9	27	1.119	0.75	81
Light Vehicle (LV)	390	1170	48.509	1	1170
Auto Rickshaw (AR)	162	486	20.149	0.5	243
Motorcycle(MC)	186	558	23.134	0.5	279
NMV	51	153	6.343	0.2	31
Total =	804	2412	100	-	1858

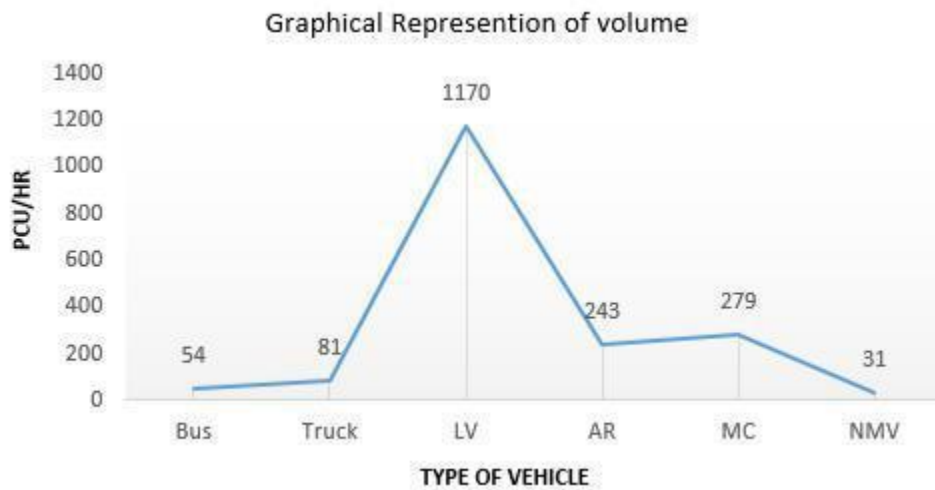


FIGURE 3.12: Graphical Representation of PCU

5.

TABLE 3.12: Calculated PCU for stretch 5

Vehicle Classification	Observation in 20 min	Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)	17	51	1.798	3	153
Truck (T)	13	39	1.375	0.75	30
Light Vehicle (LV)	509	1527	53.866	1	1527
Auto Rickshaw (AR)	167	501	17.671	0.5	251
Motorcycle(MC)	203	609	21.481	0.5	305
NMV	36	108	3.809	0.2	22
Total =	945	2835	100	---	2288

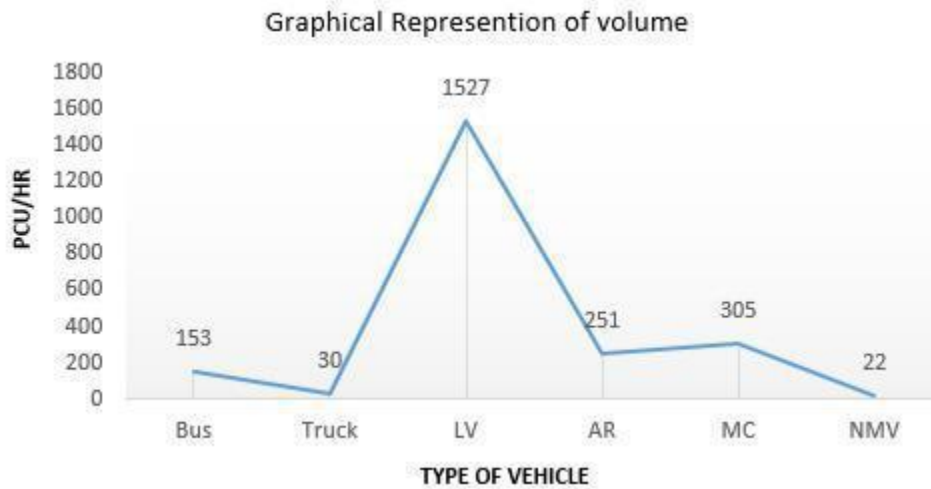


FIGURE 3.13. Graphical Representation of PCU

3.5 Dynamic Message Sign

Maryland Manual for Uniform Traffic Control Devices (UTCD) defines the Variable Message Signs. A sign that is able of exhibiting more than single message for road users, changeable physically, by using remote control or by using automatic regulator. These signs are referred to the term Dynamic Message Signs in the Nationwide Intelligent Transportation Systems (ITS). Dynamic Message Signs (DMS), also called as Variable Message Signs (VMS) and also Changeable Message Signs (CMS), Which can be used by various transportation bodies and operating departments to give travel information to vehicular traffic on a nearby real-time basis.

3.6 DMS Process and Operations

The information showed on DMSs is collected from a various traffic controlling and surveillance systems and means with video detection technology, magnetic loop detection, automatic automobile identification and toll identifiers and is conveyed to Traffic Management Centres (TMC). Travel time required to be examined which computes the distance covered to calculate the approximate travel times from a located DMS location to desired destination. The destination is generally taken into consideration as a main intersection or main interchange. In most of the authorities, the travel time data is displayed during morning peak travel time and evening peak travel times and the system is usually scheduled to begin and finish certain time of whole day. The Traffic management centre operator is accountable for monitoring, controlling, interpretation and choice making for displaying the messages on DMS board.

3.7 DMS Types

Dynamic Message Signs are further divided into two categories i.e. permanent and portable dynamic message sign with respect to its installation. They also can be fitted with beacon and or can also have blinking messages.

3.8 Portable vs. Permanent Signs

DMSs generally located (overhead or roadside) or portable. Either immovable location or moveable DMSs are castoff to support any road incident supervision and other useful and informative functions. Fixed DMSs can be positioned above the arterial roads and highways, bridges, tunnels or toll booths. The moveable truck or trailer mounted Dynamic message sign are sometimes forwarded by the highway departments to inform or warn road users of incidents such as accident happening or work zones areas in the areas where permanent Dynamic message sign are not obtainable or nearly adequate to inform drivers to slow down speed and prevent secondary coincidences. Trailer-mounted Dynamic message signs are used to adjust traffic patterns nearby work regions and to control traffic in special events like sporting events, any natural tragedies and other impermanent changes in standard traffic patterns. Most of constructors produce trailers that obey with the National Transportation Communications in use with Intelligent transportation system

3.9 Dynamic Features

Dynamic message sign can be equipped with blinking beacons, which are usually fitted on top of the message panel board. They are generally yellow in colour and would meet the necessities as directed by suitable standards in terms of size and shape. The exhibited messages on Dynamic message sign can be blinking or can also be flashing particularly in the school regions, but meanwhile blinking line messages might have an adversative effect on understanding of messages.

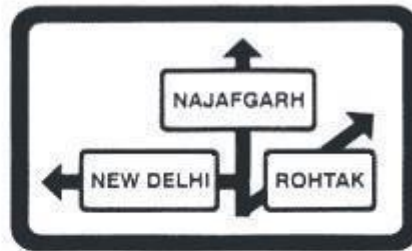
DMSs inform motorists concerning different conditions and provide a real-time information to the traffic, roadway and ecological conditions, location and anticipated duration of happening related to delays, provided alternate routes for a roadway closing, readdressed routes for diverted motorists and passable shoulders in the event of a major event occurrence to bring back the traffic flow safely to normal condition.

TABLE 3.14: Message Classification

Message Grouping	Displayed Messages
Form 1: Danger/Warning	Incidents, Incapacitated Vehicles, Non-recurring Slow- Downs, Roadway Wreckage, Accidental
Form 2: Informative/Public Road	Roadwork Closings, Major & Minor Delays, Congestion Ahead, Travel Time, Other travel
Form 3: Regulatory/ Related Non-Traffic	Work Zone Speeds, Buckle up Seatbelt, Cell Phone Use Regulations, Two-wheeler Awareness, Amber



Warning / Cautionary Sign



Informative Sign



Regulatory Sign

FIGURE 3.16: Traffic Sign Categorization

13.10 Traffic Management Centre

The Transportation Management Centre (TMC) is the centre or main control unit of most throughway management systems. It is the information about the roadway system is collected and then deal with, attached with other working and regulating data, created to produce "information", and disseminated to stakeholders such as like media, other concerned agencies, and the travelling community. Traffic management centre staff uses the data to monitor the movement of the freeway and to introduce control tactics that affect variations in the operation of the roadway network. It is also where transportation department and other government bodies can coordinate their replies to traffic conditions and other incidents.



FIGURE: 3.17 Traffic Management Centre (TMC)

The main role of traffic management centres often drives outside the roadway network and the specific accountable agency, functioning as the main technical and official centre to take together the various authorities, modal interests, and other facility providers to emphasis on the public goal of enhancing the performance of the whole surface transportation system.

Because of its critical part in the fruitful operation of a roadway management system, it is important that the Traffic management centre must be planned for, designed, custom-made and well maintained to allow workers and other consultants to be able to control and also manage the functional essentials of the roadways management system.

3.11 Operations

The Traffic management centre would obtain the data/information from the ground and the similar would be received and understood for taking further decisions which would be made and the decisions that are made from the centre will be communicated to the end user to act on it to attain the required result.

In direction to allow better understanding of the condition, field experts in the form of Transportation Engineers will also be held in the Traffic management centres to deliver their experts in analysing and interacting with the required output on the field area.

3.12 Traffic Signals

The traffic signal, a stable flow of traffic indication timings, traffic movement data etc. would be established and this real-time data will to be treated instantly to achieve an optimized effect on the chosen road networks. The Traffic management centres will receive the real-time data from the ground and the same will be observed on a screen and then enhanced plan will be created. The plans so produced then will be linked to the native police officers on the field either by the wireless system present in the Traffic management centres or by the controlling team.

3.13 Road Traffic Surveillance cameras

The cameras positioned at selected locations across the city would displaying live images into the TMC. The traffic management team will see at the live feeds approaching in from the ground and then based on certain constraints like bearable queue length, congestion or an accident/event that has happened on the filed would be able to interconnect to the field officers and required action will

be initiated. Also, violations happening on the filed can be perceived through the system and recorded for additional use as an evidence.

3.14 Traffic Enforcement Cameras

The enforcement cameras positioned at desired locations across the city in selected area network which would be taping and beaming the violations to the Traffic management centres. The law enforcement team should have to transfer the violations and then handover the data to the automatic enforcement system unit.

3.15 Wireless Communication Network

The decision thus made after the Traffic management centre (TMC) will be communicating to the officer's present on the field and for operating this the wireless devices are available with the Police will be made use of to control the situation.

3.16 Measures Should be Taken Care During DMS Installation

1. Graphic messages are significantly more effective and better than text messages in terms of road users reaction time and correctness and must be used as much as possible.
2. The colour Red is not usually recommended for Dynamic Message sign messages.
3. More Aged driver's performances were expressively improved by using graphic-aided messages.
4. Graphic-aided DMS messages improved message understanding time for non- native or outside English speakers.
5. More study is essential to find out the proper specifications and design rules of such graphical images to be used in DMS messages.
6. The required number of lines on DMS should be set to a minimum.
7. Bilingual signs would only be used when it is unquestionably necessary.
8. If we use the bilingual signs, the different colours or type fonts should be taken care to separate the languages.
9. The adequate number of information units should be correlated to DMS reading time duration than the number of lines that is to be displayed.
10. A blank "off-screen" with small duration may improve information processing when consecutive DMS frames are cast-off.
11. The Right-justified text on DMS should not be used to display.
12. Abbreviations can obstruct understanding of DMS if they are not very regularly known.
13. The Luminance of class L3 is better for symbols on Dynamic Message Sign.
14. Three-diode symbol width leads to well legibility compare to one or two diodes thickness.

3.17 Dynamic Message Sign Cost Analysis

TABLE: 3.15 Cost Analysis of Dynamic Message Sign

Unit Cost Component	Unit Cost Module	Description	Cost Type	Reported Units	Capital Cost/Unit in INR	Total Cost in INR
Dynamic Message Sign-Permanent	Dynamic Message Sign	Permanent Dynamic Message Sign, Full Overhead LED panel (21*4 ft.)	Estimated	9	422500	3802500
Dynamic Message Sign-Permanent	Dynamic Message Sign	Permanent Dynamic Message Sign, Half Overhead LED panel (10*4 ft.)	Estimated	14	260000	3640000
						TOTAL
						7442500

TABLE:3.17 Cost Analysis of Dynamic Message Sign Tower

Unit Cost Component	Unit Cost Module	Description	Cost Type	Reported Units	Capital Cost/Unit in INR	Total Cost in INR
Dynamic Message Sign Tower	Dynamic Message Sign Support Structure	Dynamic Message Sign Support Structure, Furnish &Install. Span 51-100 ft.	Estimated	9	136500	1228500
Dynamic Message Sign Tower	Dynamic Message Sign Cantilever Overhead	Dynamic Message Sign Support Structure, Furnish &Install. Span 51-100 ft.	Estimated	14	120250	1683500
						TOTAL
						2912000

The dynamic message sign cost analysis includes the initial cost i.e. the cost of the equipment and after installation in contains the operation cost as well as maintenance cost which includes the power consumption and its upkeep cost. The above cost analysis show the Equipment cost per unit and DMS tower cost per unit. The approximated gross amount of Dynamic Message Sign with its tower cost is coming out to be ₹ 10354500 approximately.

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