DEVELOPMENT OF TRAFFIC SIGN ASSET MANAGEMENT SYSTEM IN INDIAN CONTEXT

Department of Civil Engineering

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DEVELOPMENT OF TRAFFIC SIGN ASSET MANAGEMENT SYSTEM IN INDIAN CONTEXT

Thesis

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In

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By

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Under the guidance of

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CERTIFICATE

*This is to certify that the Thesis Report entitled "**DEVELOPMENT OF TRAFFIC SIGN ASSET MANAGEMENT SYSTEM IN INDIAN CONTEXT**", submitted by **Mr. Throvaguntla Khaja Hussain bearing Roll no. 212CE3058** in partial fulfillment of the requirements for the award of **Master of Technology in Civil Engineering** with specialization in "**Transportation Engineering**" during session 2012-2014 at National Institute of Technology, Rourkela is an authentic work carried out by him under my supervision and guidance.*

To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other university/institute for the award of any Degree or Diploma.

Place: Rourkela

Date: -

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Abstract

Asset management is a systematic process of maintaining, upgrading and operating assets. Several agencies are applying asset management principles as a business tool and model to help them define goals and prioritize agency resources in decision making. Road asset management is focused on bridges, traffic signs, pavement markings, culverts.

This project focuses on the development of traffic sign asset management system. For this we have to conduct a visual night time inspection method to find the Retro-reflectivity of a sign. This survey will be conducted at regular night time intervals. This survey will be conducted at minimum vehicle distances with vehicle high beam lights. And some of traffic signs should be failed the test they should not visible to the driver. And some signs need for maintenance.

The study findings indicate that making a business case for formal asset management programs. In the management study, we have to take manufacture cost of each sign and maintenance cost of the signs. For this we need to replace the some signs and maintenance should be required for some signs. And should note the latitude and longitude of the sign and create a file in the arc GIS and should plot a position of the each sign.

Key words: Asset management, traffic signs, management methods, arc GIS, cost analysis, Retro-reflectivity.

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Chapter 1
Introduction

Introduction

1.1 General

Asset management is defined as " A systematic process of maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing tools to facilitate a more coordinated and flexible access to preparing the decisions necessary to reach the public's expectations".

Assets of the road network as

1) Physical information such as roads and bridges.
2) Equipment and the resources.
3) Data, computer systems, methods and technology.

1.1.1 Requirements of asset management system:

Asset management systems is generally consists of

- Include the asset inventory, information and condition measures.
- Include the values of a condition of the asset.
- Include the performance of prediction capability.
- It also ensure that data integrity, enhance data accessibility and provide data compatibility.
- Include all the relevant components in the life-cycle cost analyses.
- Enable the removal of an out dated systems and unproductive assets also.
- Reports were useful information on periodic basis, ideally in a real time.
- Facilitate iterative analysis is a processes that can be performed on regular basis.

Integration is key aspect of asset management. This system delivers a integrated approach to all the costs, road user, works, administration, environmental and also public costs and the current data sources. This system integrates the current management system for single assets. This merger provides the road administrations with a consistent system-wide data, allowing the allocation of an available fund across competing pavements, structure and other infrastructure.

1.1.2 Components of an Asset Management System:

An asset management system holds all processes, tools, data and also policies necessary to achieve the goal effectively managing the assets. Although the concept of "system" does not usually focused on data requirements, an effective approach to a managing the assets as an integrated system should include the data required to meet the asset management objectives. This implies that in general, an AMS will consist of the following components:

- Goals and plans of organization.
- Data
- Resources and also budget details.
- Performance model for another strategies and program development.
- Project selection criteria
- Implementation of program.

1.2 Problem statement:

The road network creates one in each of the most important community assets and this predominately government closely-held. The agencies are liable for the transport infrastructure, maintain, operating, improve, replace and preserve this asset. At identical time the economic and human resources needed to achieve the performance objective of the road network and may be managed fastidiously. All carefully accomplished below the shut study of the final public World Health Organization get this a district of the transport system, area unit regular users of this place and increasingly demand improved levels of quality, in terms of safety, reliability and luxury, from the road network.

Roads and highways offer the dominant mode of land transportation. They kind the backbone of the economy, typically carrying over eighty per cent of passengers and over fifty per cent of freight in a very country, and providing essential links to large rural road networks. Roads square measure among the foremost necessary public assets in several countries. Enhancements to roads bring immediate and typically dramatic edges to communities through higher access to hospitals, schools, and markets, bigger comfort, speed, and safety; and lower vehicle in operation prices Governments is placing greater pressure on road administrations to improve the efficiency of roads and accountability for the management of community assets. In some of the countries like Canada, the United States and Australia face formal accountability and reporting requirements on how they manage their assets.

1.3 Objectives and scope:

- To provide ready access to the database system
- To develop the decision support system using the acquired data set for the asset management
- To develop a support system to optimize use of assets.
- To utilize the principles of economics, accounting and customer service models.

1.4 Organization and Report:

This report has been done in total five chapters. In the first chapter general introduction of topic, problem statement and objectives and scope of the topic. In the second chapter general information on basic concepts of traffic sign asset management and in the third chapter review of literature and background of the study. In the fourth chapter asset data used in various analysis data administration, data collection, data storage, data analysis process. in the fifth chapter study area and data collection and in sixth sign inspection results and analysis chapter and conclusions and summary are in seventh chapter.

Chapter 2

Basic concepts of traffic sign asset management

Basic concepts of traffic sign asset management

2.1 General Principles of Traffic Signs:

Traffic signs are an essential a half of the road system, and a road with poor signing or by poorly maintained signs are an insufficient road. Road users depend on traffic signing for information and guidance, and route authorities depend on signing for the economical operation of the route network, the group action of traffic rules, traffic control and facilitate to road safety.

Signs should offer road users their message clearly and at the right time. The message should be clear and quickly understood. A pattern normal sign assist in their quick recognition, as can regularity of form, colour and writing for every type. Induce the fullest advantages of uniformity there mustn't only be regularity of signs, however additionally regularity in their use, positioning and lighting.

Signs are provided to manage and guide traffic and to market road safety. They should only be used where they'll usefully serve these functions. On the other hand their omission where steering, and control or danger warrants a utilization of a sign isn't at the intervals the road users are best interest. A balance should be able achieved between too many and too few signs.

Signs are only effective if:

- Signs should have visibility properties.
- Signs should have legibility properties.
- Signs should not be un understandable.
- The road users to know what they mean.
- The road users is interested to behave correctly.

Visible and legible properties ought to be relies on upon the upkeep and area of the signs. And recognize of the sign ought to be relies on upon the configuration of the signs and images. A picture or sign could be significantly more viable than words, and effortlessly can see by the individuals who can't read. Where there is no option then Use worded signs. The symbols on signs must be not difficult to speak read. This must to be taken in the outline of the images, lettering, shades, and so on., however the extent of the sign is again of most imperativeness as drivers the individuals who going with high velocity for more separation.

For this, the images and lettering ought to be extensive and noticeable to drivers to peruse the signs.

Movement signs must be unmistakably unmistakable around evening time. And It is not sufficient to depends on the light by Vehicle headlights, and it is unequivocally favoured that signs ought to be reflectorized either only or to a limited extent.

2.2 Types of Traffic Signs:

The three main functions of traffic signs are to regulate warn and inform. There is a different group of signs for each function, and the signs in each group have a uniform shape to help drivers recognize them quickly.

2.2.1 Regulatory Signs: This signs give requests. They tell to the drivers what they should not do (prohibitory), or what they must to do (required). The greater part of them take the manifestation of a round plate, albeit two signs, the Stop sign and the Give Way sign, have different individual shapes

2.2.1.1 Size of Regulatory Signs:

The sizes of the regulatory signs should be based on the type of the roads.as per for the national highways the minimum diameter of the sign should be the 600mm and this should be also for rural roads. If any additional impact is required in national highways, rural roads the size of the diameter is 750mm.for town And urban roads the size of sign is 600mm.when signs attached to traffic signal at that areas the size of sign is 300mm.high prismatic sheet type used in the national highways. And engineering grade sheet of signs should be used in the rural and urban and towns.

2.3.2 Warning Signs: These caution drivers of some threat or trouble out and about ahead. The greater part of them take the type of an equilateral triangle with its summit highest.

2.3.2.1 Size and siting of Warning Signs:

The sizes of the warning signs should be based on the type of the roads.as per for the national highways the minimum diameter of the sign should be the 700mm .If any additional impact is required in national highways, rural roads the size of the diameter is 900 mm.For town And urban roads the size of sign is 600mm.when signs attached to traffic signal at that areas the size of sign is 750mm. high prismatic sheet type used in the national highways. And engineering grade sheet of signs should be used in the rural and urban and towns.

2.3.3 Information Signs: The majority of this signs give the drivers data to empower them to discover the route to their objective. This is a differed gathering signs; however they are all also square or rectangular appropriate as a shape.

2.4 Positioning of Signs:

- Sign siting in connection to the intersection, risk, Rotary and so on.
- Sign position in connection to the edge of the carriageway.
- General guidance on sign situating out and about.
- The signs must be clearly visible.
- No disarray about Signs which street they allude to.
- The signs don't hinder the perspective of drivers.

2.5 Position relative to the edge of the carriageway:

Signs must to be put the sign is closer than 600 mm from the outside edge of the shoulder, or carriageway, - see Figure 2.1 This should be applies to the signs situated on the movement roundabouts and islands.

2.6 Height and angle of the sign plate:

Signs must to regularly be mounted so the easier edge of the sign plate is 2,000 mm over the level of the carriageway - see Figure 2.1 This serves to demoralize vandals and Bill publications from the damaging the sign plate.

Signs must to never be mounted short of what 1000 mm over the ground level, signs that mounted at this tallness get filthy all the more rapidly from the drizzle sprinkle and vehicle shower. Where two cautioning signs are to be mounted on the same post, that sign that identifies with the closest risk must to be at the top.

Temporary road signs must be on an edge which keeps the sign over the ground by no less than 300mm. the Signs raised over footways and in urban ranges must be sufficiently high to empower walkers to stroll underneath them. The more level edge of the sign spot ought to be about 2.0 meters over the surface.

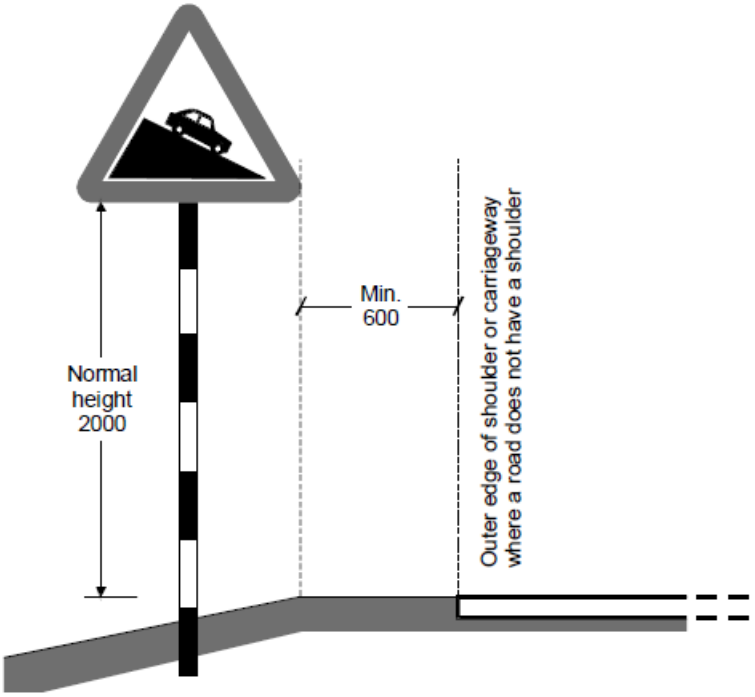

Fig 2.1 height of sign plate source from traffic signal manual HIS majesty's government of Nepal

2.7 Maintenance of Signs:

An exclusive requirement of upkeep of movement signs, activity lights is fundamental on the off chance they are to satisfy their motivation. It should be a waste of cash to give the signs and afterward to permit them to lose viability and liability consequent weakening.

All traffic signs ought to be assessed at customary and regular interims step by step. And for reflectance purpose inspected at night timings. Signs must be renewed as necessary. Signs turn into a more modest sum powerful when characters of signs colouring devalue, as well as when overcast or ruined or relocated as an aftereffect of or decimation. Harmed or grimy signs diminish way clients. Continuous inspection of the signs should be made to ensure their early repair or replacement when necessary, and after night inspections should be made of reflectorized signs. Regular cleaning of all the signs is essential.

2.8 Maintenance rules:

The way to great upkeep is fitting recordkeeping and normal investigation. A stock of signs and other way gear is useful. What's more a portrayal of the thing and its area.it can

conveniently incorporate establishment and review dates and other repair subtle elements. The stock number ought to be painted on the cover of the sign plate.

- Signs that are disappeared or placed in the wrong area.
- Signs are laid in the incorrect way or are broken.
- Signs are protected by trees.
- sign posts that are detached in their establishments
- Sign plates are detached.
- Corrosion of the sign plates and posts.
- Accident or other harm.
- flaking or blurred the sign confronts and painted surfaces
- poorly reflecting the sign confronts

2.8.1 Cleaning:

Signs must to be prepared at any rate twice in a year. Necessity ought to be given to low-mounted signs. Decrease some of long grass, shrubberies or tree extensions which conceal the sign face. Utilization of the water and a gentle cleanser to wash the sign and take cautious note to begin to expose what's underneath. Wash the sign in clean water to uproot all hints of cleanser. Street tar might be cleaned off with petrol or white soul, yet be mindful so as not to break down by the paint, and flush well subsequently.

2.8.2 Repairs:

Minor repairs and repainting is the possible on a location. Repainting must to do just be carried out in a dry Weather and after legitimate arrangement of the surface. Don't matter paint to reflective sheeting, in light of the fact that this will make it non-reflective.

2.8.3 Assessment of Effectiveness of Signs:

As a major aspect of the support program in the area and recurrence of accidents must to be rerecord. From this registers it might be built where mischances out and about system most regularly happen. Often the most cost effective ways of developing the safety on a section of road is to develop traffic signing. Accident sites they should be looked at in more detail to found whether improved signing or road marking would develop safety and decrease accidents.

2.9 Introduction about Geographic Information System:

Geographic Information System (GIS) is a system for mapping and analysing the any object on earth. This should be gathering, storing, and managing any type of data with spatial data components. GIS data is usually kept in above one layer. This is the fundamental aspect of GIS, and working with layers of geographic information system is generally known as data integration. GIS technology integrates powerful database capabilities with a unique visual perspective of a good old fashioned-map. This makes GIS unique among various information collection systems.

Basically, this system utilizes hardware, software, user, and effective management to collect, store, analyse and present the related information of a given area on the earth. Even more, it has the capability to overlap map and provide an information inquiry facility that can indirectly create a whole new set of information. Here, data output can be obtained in the form of tables, maps, graph or combination of these three. The other powerful aspect of GIS is its flexibility in modelling spatial objects to suit the particular needs of the user or application. GIS provides a set of tools or computer programs that allow user to perform specific operations on the map, assisted by a set of attribute data.

2.10 GIS Capabilities:

GIS consists of four subsystems, namely data acquisition, data management, analysis of data and information output. Some of the GIS advantages are listed as follows:

- Consists of a central database storing all data related, available and usable to users when required.
- Promotes data sharing culture and enhances team spirit.
- Improves data currency, accuracy and consistency of data maintained.
- Minimizes data duplication.
- Performs analyses of spatial and non-spatial components.
- Has a more effective presentation of data.
- Data is managed more efficiently.
- Increases work productivity, particularly in planning and managing infrastructures, to produce results from numerous combinations of data sets.

Chapter 3

Review of Literature

Review of literature

3.1 General

To the study of many literatures some of them describing that the maintaining of the assets and management methods. And how to maintain the pavement marking assets, signs, culvert asset management, bridge asset management, road infrastructure management.

3.2 Background of Study on Asset Management:

Harris, E.A., Rasdorf et al. Describes the minimum traffic sign reflectivity standards. This paper was presented analysis of several traffic signs reflectivity maintenance methods using sign asset management. This method based on inspection and data collection process. The simulation part should be done. They should take 30 scenarios in the annual maintenance cost per sign and percentage of traffic signs. The simulation results should be higher cost per higher sign maintenance generally the resulted in a lower percentage of signs. For some signs using night time inspection method.

Petri Jusi et al. Describe the road network of Papua and New Guinea. This country the total road network of 8258km of national classified roads and other 19937km low-traffic roads. The total cost of roads us 1billion dollars. In this country department of works (DOW) were maintaining the road assets. And this department doesn't give the sufficient attention to maintaining the road networks. And this should effect on the economic growth and gross domestic product. In this country to be able to provide a basic service to access, to markets, administrative, health and education. The poor maintenance of road network limits access to the rural population of basic services. Dow collects the funds and guidance by Asian development bank and with the assistance of Finland consultant and developed Road asset management system. This is a stirring and presenting road data information, short term and long term maintenance, budgets made for road networks.

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Michael J. Markow (2008) was describing the asset management practices on pavement markings. They told that the principles and asset management by pavements and bridges. They should divide the six classes of non-pavement infrastructure assets from the NCHRP synthesis topic 37-03. Traffic signals, signing, lighting, pavement markings, culverts,

sidewalks are the classes of asset management. They should review some of the aspects to approaching the asset maintenance, budgeting methods, measuring the asset performance, asset service life, material usage, technology. This study indicates the basic knowledge on pavement markings, management, and site conditions service life for different materials. And for some of the processes using the reflect meter for reliability, asset management approach.

Curtis Berthelot (2009) et al. Was describing the asset management to evaluate the road substructure drainage system. They said that many areas in western Canada have increased volumes of heavy commercial vehicles. They related to resource based economic development this changing moisture conditions and marginal granular materials and heavy loadings should affect the road structure distress, failure. In some of the cases like slow moving and turning truck traffic increases stress and moisture pumping effect within the road structure. Their impacts on structural rigidity is difficult with the empirical models and mechanistic models. in these three case studies summarized falling weight, deflect meter and ground penetrating radar, effective mechanistic models.

Joseph Perrin (2006) et al. Through the governmental standards board and the department of transportation are required to track their infrastructure costs and conditions through asset management practices. They should be applied to the roads and bridges, to access and inspection of the infrastructure. Culverts are critical components in asset management. This is the more important to consider the underground assets for inventory and inspection process. The many states of DOTS were sent to the survey for the concerning the culvert management issues. The total 28 responses are planning to develop the inventory database and planning for the inspection program. Several agencies did identify the failure reason for identifying and inspection process.

Pannapa Herabat was describing the rural road development they undergo major structural reforms account to the national economic and social development plan. They divided the rural to the sub district levels. The objective of sub district levels to improve the quality of life and economic and social development in rural areas. A web based technology used for easy linking to the between the remote areas for network and project levels. They developed process tools and technology. This system developed the regards on pavement, bridge, drainage system, traffic sign, pavement marking and vegetation problems. The benefits are measured profitability and rural road user effects.

Odd J. stalebrink was told that the management methods of the assets. This method is the enterprise based financial reporting method in the public transportation infrastructure. This method was used for profitability analysis. it should be generated satisfactory system input values because the market price is not generated in this environment. They did the two approaches for this analysis benefit cost analysis and economic study of productivity impacts on infrastructure. These methods are done for system input values.

Charles d.larson was done the inventory and condition assessment system project. This was designed for inventory, condition and location information for assets. And it should store the information. They should use the global positioning satellites for accurate position of the asset. Asset condition (damaged or blocked). This project was done for all roadway assets within the highway boundary lanes. For this contractor and sub-contractors are collecting the data and development. This total process was made in the November 2012.they should collect finally compete inventory highway assets in three countries measuring asset conditions and state wide process for managing asset information.

Omar smadi was describing the asset management of civil infrastructure facilities and systems. And improve in practice and academics growth and development in the aged infrastructures. For this some of the agencies should adopt and develop their assets. And more academic institutions conducting education programmes. This paper focused in the civil engineering and transportation planning students. The overview of this active and engagement based learning techniques are presented.

Zongwei tao was described that the system integration for asset management. Transportation asset management is an integrated set of practices and systems. it should be a cost effective investment. And used for transportation assets. This method was difficult to complete the asset management goal. This is used for basic goals, strategies, principles and analysis m ethos. This approach should be done for business integration, system requirements, integration and local design integration and implemental integration. Each phase should carry particular integration objective and developments.

Mohammed Najafi (2010) et al. Was describing the development of highway current asset management of road infrastructures. They should give more importance to highway embankments, pavements, bridges and neglect the maintenance of culverts. Culverts are

defined storm sewers and drainage structures crossing roads, rail roads and highways. These culverts consist of concrete, metal, plastic. Many culverts are at the end of service life. The department of transportation need to some maintenance. The main goal is to assess the status of culvert asset management in the USA and develop the culvert inventory and inspection.

Sue McNeil et al. Was described that the asset management and it should be generated activity in the organization, agencies and supporting organizations. The status of some this some activities divided into the level of activity. This result of survey of AASTHO member states that questions with management tools, asset valuation, and decision making tools are reported. The survey results should be there is no awareness and activity level focussed on the topic of asset management.

3.3 Literature on Road Asset Management with GIS Application:

Mohd Zulkifli et al was describing the road maintenance using the GIS applications and they should do a case study on Penang, Malaysia. In this paper they mainly considered development and economic process of a nation is closely associated with its available transportation system. Road transport infrastructure facilities can promote industrial and economic development. To provide safety and comfort to road users, road maintenance schedule must be formulated and adopted to ensure these roads are in good condition at all times. Preventive road maintenance works, like road rehabilitation will facilitate to reduce the main road repairs. Prior to this, a good database, gathered through GIS will be necessary in order to ensure maintenance is completed effectively. Geographic information system (GIS) is said to be one of the useful tools that can be utilized to manage information in road maintenance engineering. GIS system is capable of storing, managing, analyzing, computing and displaying all forms of geographical information for road maintenance works. In this study, they should adopt GIS application software – ArcView, and have reviewed and analyzed its effectiveness in managing road data. This data are then used to assist the management to confirm effective and systematic road maintenance.

Bheshem Ramlal was described in this paper asset management in the Trinidad and Tobago by using geographic information system. In the last two decades, Trinidad and Tobago has invested in the development of infrastructure across the country. In this city new building to houses, schools, libraries, hospitals, police stations, universities, government offices and sporting facilities have been constructed. And also roads and bridges have been

reconstructed. It is envisaged that even more will be added to the existing infrastructure in the next few years. The author signifies A major problem faces the country at managing and maintaining the assets. They have some planning to develop the assets, these planning successfully utilized. A nascent technology that may be employed in asset management and maintenance is Geographic Information Systems (GIS). GIS may be providing effective solutions. This paper reviews existing applications of GIS for this purpose and proposes strategies for the development of GIS for asset management in Trinidad and Tobago.

Chapter 4

Study Methodology

Study Methodology

4.1 General

An asset management system in use by a road administration will utilize the following data:

- definition of the system
- definition of the benefits on the system
- Location of the advantages on the system.
- Condition of the assets.
- Levels of utilization
- Policies and measures (e.g. Support models and medication plans and additionally observing data, for example, execution measures).
- Budget data (*e.g.* Broken down by asset type, program level)

4.2 Sign asset management method:

- **Visual night time inspection method**
- **Measured Retro reflectivity Method**

The visual night time method uses human observers visually judge at a night time weather and observers should have some judgement on the reflectivity of signs. Generally it should be conducted at regular highway speeds from the travel lane using the low beam headlights.

To measure Retroflectivity method uses a retroreflecto meter to measure all signs. At least four retro reflectivity readings are taken during the daytime and the average retroreflectivity value of the sign is compared to the established minimums for that particular sign.

4.3 Management methods:

- **Expected sign life method**
- **Blanket replace method**
- **Control sign method**

The expected sign life method calculates a sign life from the signs.it should be combination of sheet colour and sheet type.it should requires the tracking age of signs eighter by using the sign installation date labels on the back of each sign.

The blanket replacement method replaces all signs along the corridor within an area. Replacement should be based on the manufacturer warranty.

The control sign method uses signs either in a controlled study yard or a sample of signs from the field to determine sign life. The control sample of signs is used to represent all of the signs in an agency.

4.4 Data administration

For all advantage administration frameworks, the vitality of compelling information organization can't be over accentuated. The association between the information, the responsibility for information and a point by point depiction of the information must be effectively settled and characterized at the beginning and kept up for the duration of the life of the framework. It is the obligation of the administration inside an association to advertise the imperativeness of powerful information organization and to guarantee that staff is generally prepared and have a proper order for the acknowledgment of this assignment. Specific consideration is obliged where information hails from sources outside the association. Administration must make clear what data is needed, which associations are mindful and what information are to be supplied. The appropriation of an organized methodology will distinguish any crevices in the data and will highlight any information that are of deficient quality.

4.5 Data analysis:

Asset management systems generally carry out the following data analyses:

- Interpretation of the condition information gathered on the individual holdings.
- Identification of "ideal" medicines..
- prioritisation of upkeep medicines against plan
- Prioritisation of maintenance treatments against budgets.

Holding administration for the most part looks at such components as venture levels, support norms and budgetary vitality. Regarding base administration, these variables may be interpreted into different measures of execution of the advantage, including level of utilization, wellbeing and ecological effect. Possession administration will hence be affected by topographical and socio-monetary circumstances in the association and the business methods received.

The estimation of the benefits will be ascertained utilizing perceived and acknowledged bookkeeping practices. The calculation of the value of the asset is not generally included in management systems for individual assets.

Information investigation could be of a specialized, budgetary, or general nature and not every kind of dissection will be utilized similarly as a part of all levels of an association. All in all, distinctive parts of an association will complete information investigates at diverse levels of subtle element. The shows underneath cases of the sorts of information investigates did by a street organization and which may profit from the utilization of an advantage administration framework.

Table 4.1 Type of analysis of assets.

Type of analysis	Analysis
Technical	Condition of asset Causes of maintenance Age and degradation of asset. Use of network
Economic	The budget required Budget allocations (*e.g.* Budget breakdown) Variations in unit prices Deviations between out-turns and estimated costs Maintenance costs of assets Total costs and budget

Chapter 5

Study Area and Data Collection

Study area and data collection

5.1 Study Area:

Rourkela is located in the north-western border of Odisha. It is the third largest city of Odisha after Bhubaneswar and Cuttack. Situated about 340 kilometres (211 mi) north of state capital Bhubaneswar, the city is surrounded by a range of hills and encircled by rivers. One of the largest steel plants of the Steel authority of India (SAIL) is situated here. Rourkela has a good connection to the other towns in the State with an average frequency through Road. Rourkela city is connected with National Highways NH-23 and SH-10 to the towns and cities of Odisha. And the Rourkela has the 23 kilometre ring road and it's connecting 19 sectors and some other parts of Rourkela City.

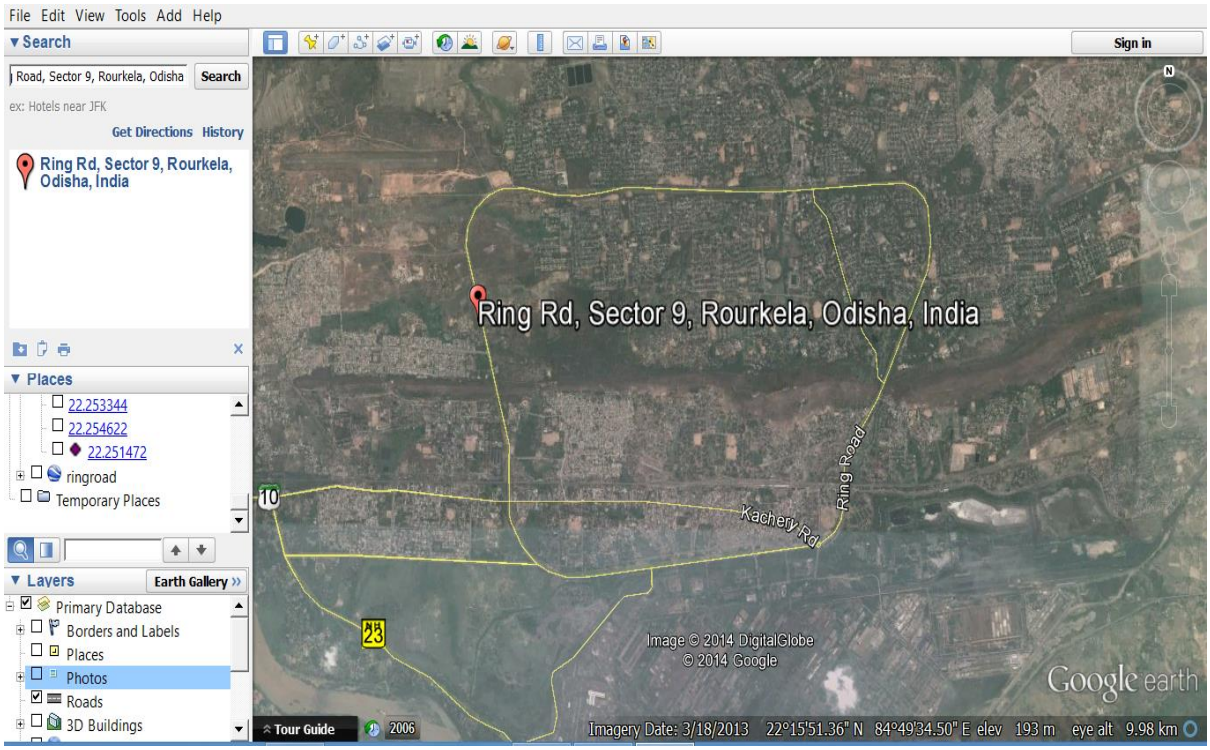


Fig 5.1 study area of data collection

5.2 Data Collection:

The data collection should be taken on the ring road of the Rourkela. This data should be taken from Ig Park to Ispat market. Data collection of the signs and signals on the road by using inspection methods and using cameras**.**

The sign asset data was collected on the ring road from sail chock to ispat market. This data was collected by using visual night time inspection method. This method was a visually judge the retro reflectivity of a sign. Retro reflectivity is the physical ability of the material to reflect the light back in the direction of the original light source (e.g. Vehicle headlight) normally at night. This test was conducted during night hours 7pm-9pm. The vehicle speed is the 40kmph and the visual inspection from the 100m distance from the sign. The vehicle head light was focused on the sign and it is reflecting light back is in the direction of the original light source. Some of the signs were not clearly visible and this type of signs should be replaced.

5.3 Data storage:

The information utilized by an AMS has high money related worth to a street organization. Along these lines, once the gathered information has been supplied, they will for the most part go under the control of the organization work inside the street organization. The organization will have obligation regarding controlling the Quality of both new and put away information. Ordinarily, information quality control techniques ought to incorporate.

- Data confirmation (i.e. Information ought to be checked for trustworthiness, area, time, culmination and precision).
- Application of both approaching information and existing put away information.

Chapter 6

Sign Inspected and Results

6. Sign Inspected and Results

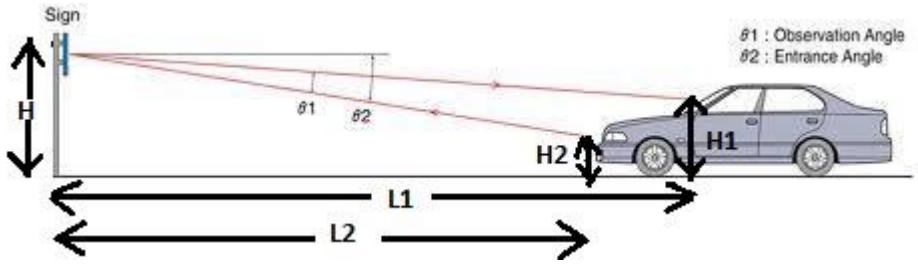
6.1 Minimum Distances for Sign Visibility and Legibility:

Table 6.1 minimum distances for sign visibility and legibility

Speed (Km/hour)	Visibility (m)	Legibility (m)
40	90	55
50	100	55
60	150	70
70	170	70
80	185	70

To find the coefficient of retroflection (Ra) values for each sign. The coefficient of retro reflection (Ra) is the ratio of the light which the sign reflects to a driver (cd) to the light which illuminates the sign (lx) per unit area (m^2). By getting the Ra values we can find the observation angle, entrance angle. From these two angles we can find the coefficient of retroflection (Ra).

Vehicle to sign distance is 100 mts sign height is 2.0 mts. Vehicle headlight distance from the road 0.65mts driver sight distance is 1.2mts**.**from these distances can find the observation angles and entrance angles. First can find the observation angle and entrance angle for the visibility distance. These distances are based on the type of roadways and cities.



Source from Nippon carbide industries

6.2 Observation Angle And Entrance Angle For Each Sign for visibility distance:

Using the right angle triangle method the observation angle and the entrance angle is found by using the lengths and heights measured during observations the angles are measured. The height of the sign under consideration taken as H, H1 is the height of the observer in the car from the ground, L1 is the distance between the observer and the traffic sign, H2 is the height

of the headlights of the car from the ground, L2 is the distance between head lights of the car and the traffic sign.

From the above observations the values of θ_1, $\theta 2$ are calculated as follows.

Tan ($\theta 2$) = $\frac{(H-H2)}{L2}$

$\theta 2 = \tan^{-1}(\frac{(H-H2)}{L2})$

Tan (ϕ) = $\frac{(H-H1)}{L1}$

$\phi = \tan^{-1}(\frac{H-H1}{L1})$,

$\theta_1 = \theta 2 - \phi$

Height of the sign H=2 mts.

Height of the driver from the ground level H1=1.2 mts

Height of the vehicle headlight from the ground level H2=0. 65mts.

Length of the distance between sign to the observer L1= 90 mts

Length of the distance between vehicle head lights to sign L2= 88.5 mts.

(θ_1) = observation angle.

(θ_2) = entrance angle

Tan ($\theta 2$) =2-0.65/98

$\theta 2 = \tan^{-1}$ (1.35/98)

Entrance angle $\theta 2$= 0.789

Tan ϕ = (2-1.2)/100

$\phi = \tan^{-1}$(0.8/100)

ϕ = 0.45

Observation angle $\theta_1 = \theta 2 - \phi$

= 0.789 – 0.45 = 0.339.

And now from the distance of 90 mts with vehicle speed is 50kmph.

Tan (θ2) =2-0.65/88

$\theta 2 = \tan^{-1}(1.35/88)$

Entrance angle θ2= 0.87

Tan ϕ = (2-1.2)/90

$\phi = \tan^{-1}(0.8/90)$

ϕ = 0.50

Observation angle $\theta_1 = \theta 2 - \phi$

= 0.87 – 0.50 = 0.37

The distance is 150 mts speed 60kmph

Tan (θ2) =2-0.65/148

$\theta 2 = \tan^{-1}(1.35/148)$

Entrance angle θ2= 0.52

Tan ϕ = (2-1.2)/150

$\phi = \tan^{-1}(0.8/150)$

ϕ = 0.30

Observation angle $\theta_1 = \theta 2 - \phi$

= 0.52 – 0.30 = 0.22

Distance 170 mts, speed 70kpmh

Tan (θ2) =2-0.65/168

$\theta 2 = \tan^{-1}(1.35/168)$

Entrance angle θ2= 0.46

Tan ϕ = (2-1.2)/170

ϕ = $\tan^{-1}$(0.8/170)

ϕ = 0.26

Observation angle $\theta_1 = \theta 2 - \phi$

= 0.46 – 0.26 = 0.20.

Distance 185mts, speed 80kmph

Tan (θ2) =2-0.65/183

θ2 = $\tan^{-1}$ (1.35/183)

Entrance angle θ2= 0.42

Tan ϕ = (2-1.2)/185

ϕ = $\tan^{-1}$(0.8/185)

ϕ = 0.24

Observation angle $\theta_1 = \theta 2 - \phi$

= 0.42 – 0.24 = 0.18

Table 6.2 observation angle and entrance angle for visibility distance

Speed (kmph)	Distance(mts)	Observation angle (θ_1)	Entrance angle (θ2)
40	90	0.37	0.87
50	100	0.33	0.78
60	150	0.22	0.52
70	170	0.20	0.46
80	185	0.18	0.42

The below figure 6.1 shows the variation in the observation and entrance angles. These angles should be depends on the speed of the vehicle and distance of vehicle from the sign.

The speed and distance increases then the angles will be decreased.in this area of study using for night time inspection method speed is 40kmph and distance is 90mts.

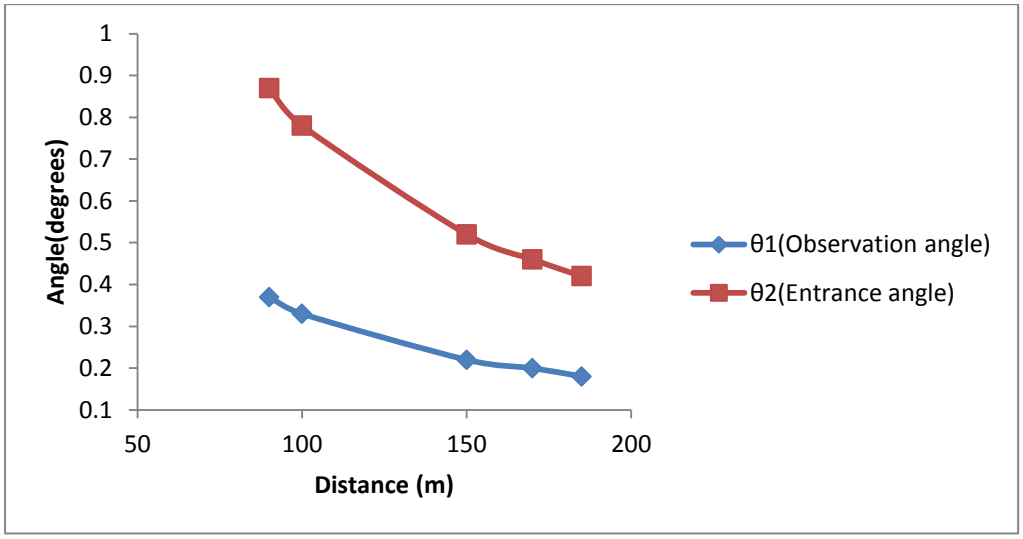


FIG 6.1 observation angles and entrance angles variation for visibility distance

6.3 Observation and Entrance Angle For Legibility Distance:

Tan (θ2) =2-0.65/53

θ2 = $\tan^{-1}$ (1.35/53)

Entrance angle θ2= 1.45

Tan ϕ = (2-1.2)/55

ϕ = $\tan^{-1}$(0.8/55)

ϕ = 0.83

Observation angle θ_1 = θ2-ϕ

= 1.45 – 0.83 = 0.62

Tan (θ2) =2-0.65/68

θ2 = $\tan^{-1}$ (1.35/68)

Entrance angle θ2= 1.137

Tan ϕ = (2-1.2)/70

ϕ = $\tan^{-1}$(0.8/70)

ϕ = 0.65

Observation angle $\theta_1 = \theta 2 - \phi$

= 1.137 – 0.65= 0.487

Table 6.3 observation angle and entrance angle for legibility distance

Speed	Distance	Observation angle	Entrance angle
40	55	0.62	1.45
50	55	0.62	1.45
60	70	0.48	1.13
70	70	0.48	1.13
80	70	0.48	1.13

This is the legibility distance is the enable to read the sign. These distances are also depends on the speed and distance of vehicle from the sign. These values must be comparing with the AASHTO specification sign retro-reflectivity method. in this area of study using for night time inspection method speed is 40kmph and distance is 90mts.

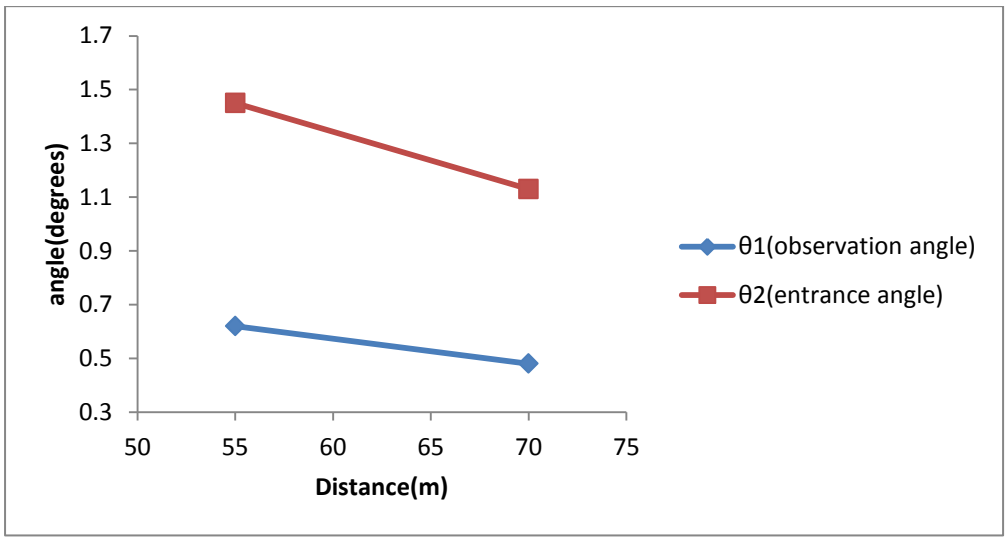


Fig 6.2 Observation angles and Entrance angles variation for legibility distance

Based on their observation and entrance angles we can find the coefficient of retro flection (Ra) values. This should be based on their sign sheeting reflection and types of sheets and colours. For each different colour types of Ra values. These values are taken from AASHTO specifications.

Observation angles (deg.)	Entrance angles (deg.)	White.	Yellow.	Orange.	Red.	Green	Blue.	Brown.
0.2	-0.4	335	250	125	50	35	17	10
0.2	30	120	85	45	17	12	6.0	3.5
0.5	-0.4	135	100	50	20	14	6.5	4.0
0.5	30	45	35	17	7.0	4.5	2.5	1.5
1	-4	15	12.5	6.5	2.5	1.5	1.0	0.5
1	30	5.5	4.5	2.5	1.0	0.5	0.3	0.2

Table 6.4 coefficient of retro-reflectivity of each sheet type colours as per AASHTO specifications

6.4 Retro-reflectivity performance standards:

Table 6.5 Retro-reflectivity performance standards

White	A=342 R=307
Yellow	A=238 R=212
Red	A=67 R=60
Blue	A=17

	R=15

A= annual tests conducted if below, these values.

R= replacement considered below, these values.

As per based on that standards some signs having the less retro-reflectivity standards. For that signs we can need replaced or maintenance the signs. The sign inspected and compare these with the retro-reflective standards. The signs failed at the night time inspection methods using the legibility and visibility sight distances. These observations are compared with the AASHTO specifications and there is a minor percentage of error, so these values are reliable for the further analysis of the study.

Table 6.6 sign inspected data

	Regulatory Signs	Informatory signs	Warning signs
Tested	10	23	3
Passed	8	15	3
Failed	2	8	0
% failed	20%	35%	0%

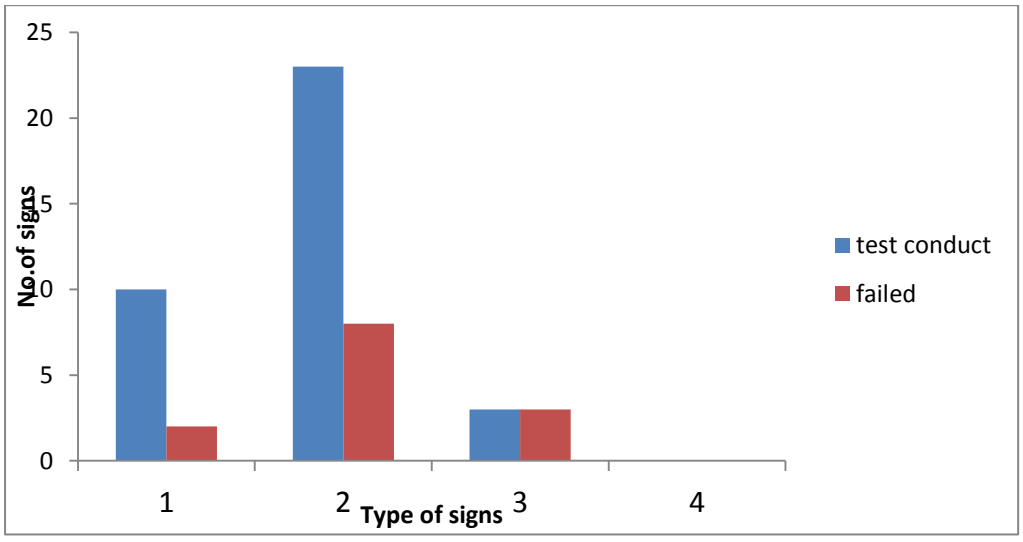


Fig 6.3 total signs and failed signs in each type of sign

6.5 Asset data mapping in a geographic information system (GIS):

The collected signs will be plotted in a geographic information system. First, we should take a position of the each sign and then noted the longitude and latitude of the each sign. And this should be plotted in the arc GIS we should create a file. Data from various sources can be integrated into the road safety database and displayed all together in Google Earth. This makes it easier to find out the contributing factors that influences the safety performance of the road. Figure 1 below shows an example of integrated use of road sign and asset data in a safety study. Latitude and longitude points will be shown in the table no. 6.7

Table 6.7 latitude and longitude of the each sign

Latitude	Longitude
$22^0$14’46.56	$84^0$52'46.41"
$22^0$14'46.00"	$84^0$52'44.69"
$22^0$14'35.29"	$84^0$52'41.05"
$22^0$14'27.94"	$84^0$52'37.18"
$22^0$14'22.44"	$84^0$52'34.35"
$22^0$13'54.35"	$84^0$52'17.10"
$22^0$13'51.72"	$84^0$52'14.18"
$22^0$13'49.47"	$84^0$52'13.37"
$22^0$13'49.47"	$84^0$52'13.37"
$22^0$13'23.67"	$84^0$52'03.88"
$22^0$13'24.21"	$84^0$52'05.17"
$22^0$13'21.41"	$84^0$51'56.64"

22^{0}13'21.61"	84^{0}51'52.61"
22^{0}13'21.60"	84^{0}51'47.24"
22^{0}13'21.60"	84^{0}51'47.24"
22^{0}13'18.68"	84^{0}51'31.20"
22^{0}14'52.27"	84^{0}51'52.56"
22^{0}15'02.57"	84^{0}52'48.61"
22^{0}15'12.04"	84^{0}52'46.18"
22^{0}15'16.64"	84^{0}52'37.35"
22^{0}1505.30"	84^{0}52'42.48"

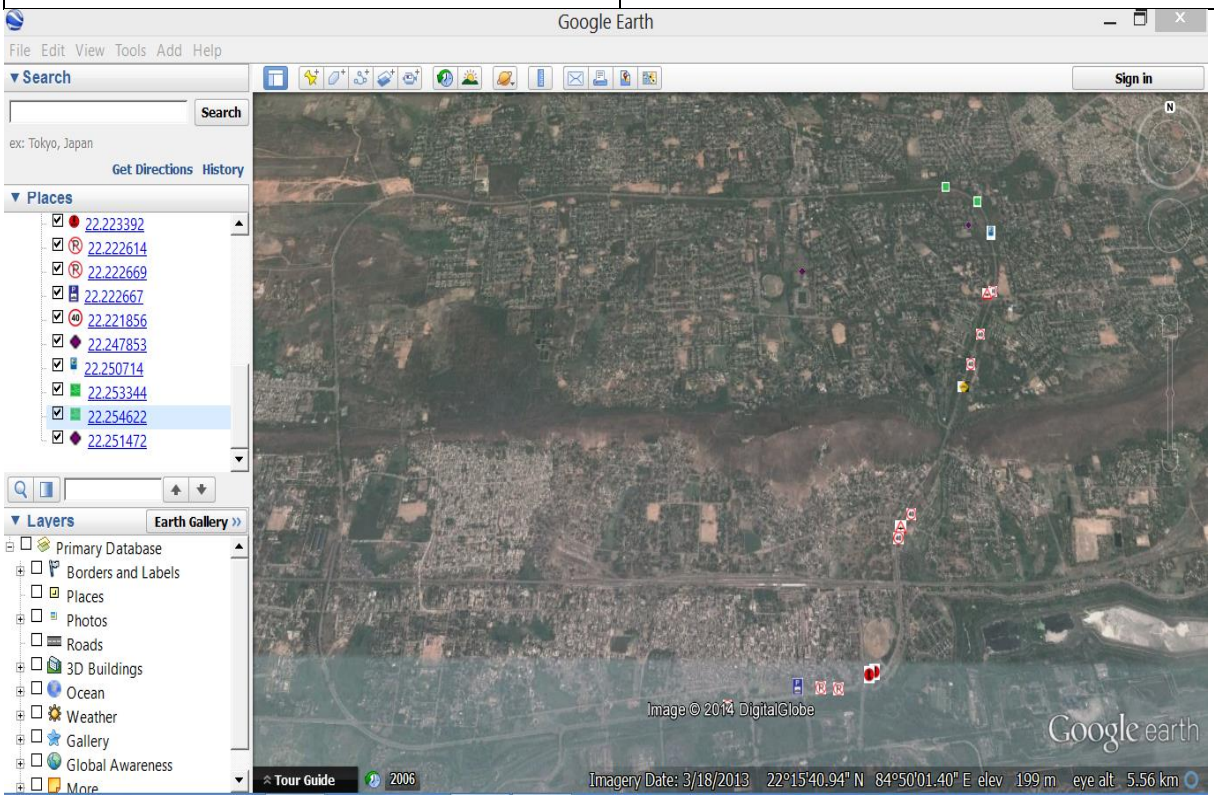


Fig 6.4 sign asset data in GIS

6.6 Steps followed in arc GIS:

- Get the latitude and longitude in an excel sheet
- Import the excel sheet to arc GIS
- Define the x and y values in arc GIS

- Then the point of features opened in the arc GIS
- Convert the point features into a layer feature using the arc GIS tool
- Then convert the layer to (. kml) format for viewing the layer file in Google earth
- Open Google earth and import the (. kml) file to open in Google earth

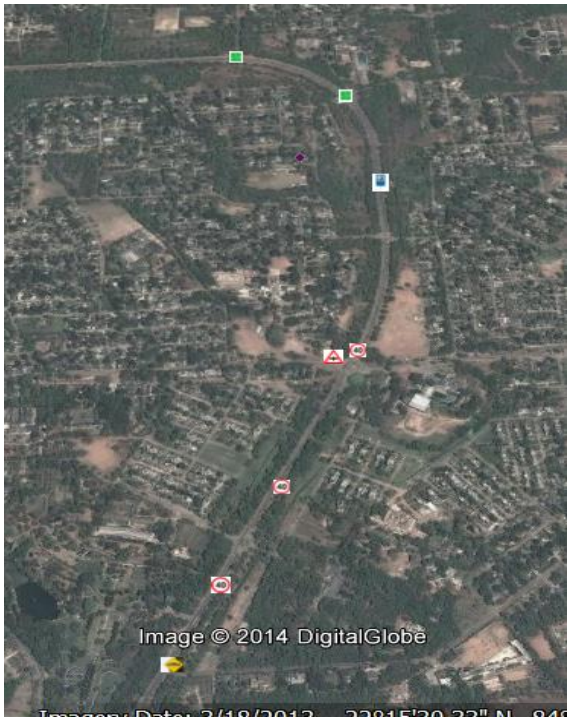


Fig 6.5 and fig 6.6 shows the each sign in a particular area.

6.7 Management data:

Table 6.8 sizes of collected signs data

S.no	Sign type	No of signs	Diameter of sign (mm)	Sheet type
1	Maximum speed 40kmph	05	600mm	Engineering grade
2	Speed beaker sign	01	600mm	Engineering grade
3	Major road ahead sign	02	600mm	Engineering grade
4	No parking sign	03	600mm	Engineering grade

5	Informatory signs	23	450mm	Engineering grade

6.7.1 Cost of each sign:

Table 6.8.1 approximate manufacture costs of signs

S.no	Sign type	Manufacture cost (INR)	Maintenance cost (INR)	Total cost (INR)
1	Maximum speed 40kmph	1010*5	Individual sign crew worker wage/total No.of signs.	5050
2	Speed beaker sign	510		510
3	Major road ahead sign	2*510		1020
4	No parking sign	3*1140		3420
5	Informatory signs	23*760		17480

The cost of the regulatory sign is the INR 1010 and no of signs should be 5 and speed beaker sign cost INR 510 and two major road ahead signs with the cost of 510. No parking sign should be INR 1140inr total 3 signs. And 23 more number of informatory signs each sign cost is 760. Then the total manufacture cost of the total signs is INR 27480. And the maintenance cost should be included in the management methods (daily wages, paintings, repairs) for all this the minimum maintained cost per year INR 250 per sign approximately. We have to maintain 33 signs the total cost should be 8250 per year. The maintain should be twice in a year. The total cost of the signs was INR 35730.these values are based on the population and traffic volume and market prices. These costs are changes year by year.

Chapter 7

Conclusions

Conclusions

The goal of analysing the asset management of traffic signs. Can minimize sign asset costs while maintaining a high level of safety on local and state roads. These observations are compared with the AASHTO specifications and there is a minor percentage of error, so these values are reliable for the further analysis of the study. In my study around 75% of the signs are visibility and legibility properties are according to the standards.

- Some of the regulatory signs need to be changed because the reflectivity of signs is less and maintenance should be required for 3 signs.
- Some of The informatory signs should be re replaced because the directions of the signs not visible from a certain distance.
- Parking signs should be visible from the all the distances and angles.
- Manufacture cost and maintenance cost for all the signs is estimated.
- These costs should be changed year by year and this should be based on the population, traffic volume and market prices.

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Chapter 8

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