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Traffic Asset Management and Development : A Case Study OF Jyoti Talkies Bus Stop To Roshanpura Intersection, Bhopal City (M.P.) India

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Abstract— Systematic deployment, operation, maintenance, upgradation and disposal of assets is termed as asset management. In broad manner, it can be referred to any system that monitors and maintains the values of things for a entity or group. Asset management is a process of deploying, operation Asset management principles are used by several agencies as a business tool to model their goals and prioritize their resources for efficient decision making. Management of road assets focuses on bridges, traffic signs, pavement markings, culverts. The development of traffic signs and traffic asset management system is focused in this dissertation work. The objective is met by conducting a visual night time inspection to observe the Retro-reflectivity of a signs. These surveys are conducted at regular night time intervals with minimum vehicle distances and high beam light of vehicle. Some of the traffic signs failed the test as they were not visible to the driver and some signs needs to be maintained for better visuality. The findings of the study concluded that by making this asset management, a business case the management program can be more effective. 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.

Keywords— Asset management, traffic signs, management methods, Retro-reflectivity

I. INTRODUCTION

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.

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.

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.

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.

II. OBJECTIVE OF STUDY

- 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.

III. BASIC CONCEPTS OF TRAFFIC SIGN ASSET MANAGEMENT

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.

A. 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.

- **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
- **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.
- **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.

  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.
- **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.

B. 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.

C. 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. This should be applies to the signs situated on the movement roundabouts and islands.

D. 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. 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.

E. 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.

IV. LITERATURE REVIEW

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.

. 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.

V. METHODOLOGY

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)

A. 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.

B. 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.

C. 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.

D. 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.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 allocation (eg. Budget breakdown) Variation in unit prices Deviations between out-turns and estimated costs Maintenance costs of assets Total cost and Budget

VI. STUDY AREA

Bhopal is centrally located in the Indian state of Madhya Pradesh. It is the also known as City of Lakes for its various natural as well as artificial lakes and is one of the greenest cities in India. It is the 17th largest city in the country and 131st in the world. A X-class city, Bhopal houses various educational and research institutions and installations of national importance, including ISRO's Master Control Facility, BHEL, and AMPRI. Bhopal is home to the largest number of Institutes of National Importance in India, namely IISER, MANIT, SPA, AIIMS and NLIU.

The city attracted international attention in December 1984 after the Bhopal disaster, when a Union Carbide India Limited (UCIL) pesticide manufacturing plant (now owned by Dow Chemical Company) leaked a mixture of deadly gases composed mainly of methyl isocyanate, leading to one of the worst industrial disasters in the world's history. The Bhopal disaster continues to be a part of the socio-political debate and a logistical challenge for the people of Bhopal.

Bhopal was selected as one of the first twenty Indian cities (the first Phase) to be developed as a smart city under PM Narendra Modi's flagship Smart Cities Mission.

National Highway No.12 passes through Bhopal which connects it to Jabalpur in the East and Jaipur in the West. National Highway 86 connects Bhopal to Sagar in the East to Dewas & Ujjain in the West. State Highway 17 connects the city with Indore. An interstate bus terminus is located near the Habibganj railway station, called the Kushabhau Thakre Inter State Bus Terminal which was inaugurated in 2011.

The data collection is done on the link road - 4, which is a providing land connectivity between jyoti Talkies Square, Maharana Pratap Nagar to Roshanpura Sqaure, Tatya Tope Nagar. Jyoti Talkies square is the busiest square with traffic handling capacity of around 2000 light motor vehicles during peak hours. Data collection of the signs and signals on the road by using inspection methods and using cameras. The road stretch taken under consideration is 4.1 km and there were 6 traffic singals in between, as shown in Fig..1. with the following latitudes and longitudes:

A - 23.237613 ; 77.400997
B - 23.234117 ; 77.401515
C - 23.233338 ; 77.401569
D - 23.230883 ; 77.427715
E - 23.231326 ; 77.432596
F - 23.233288 ; 77.434646

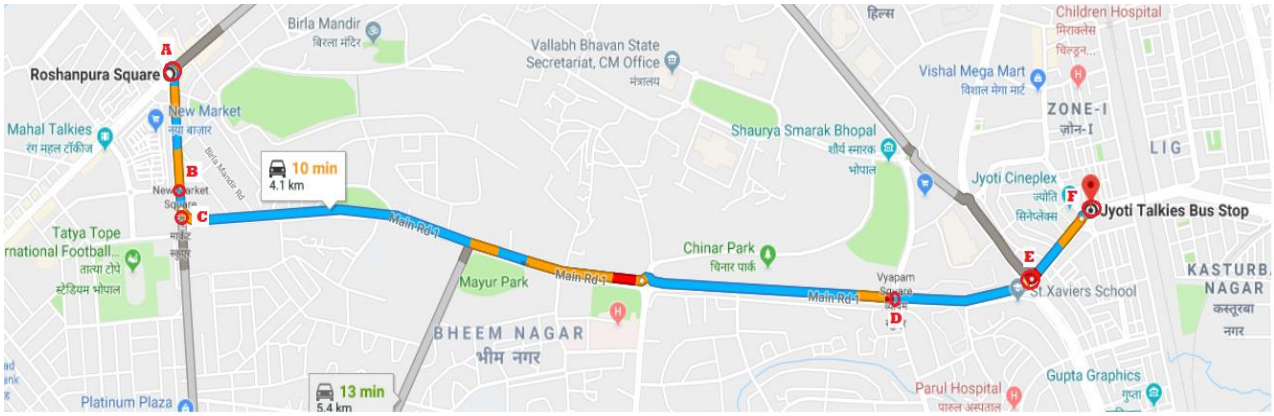

Fig..1: Study Area Map

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.

VII. RESULT

A. Minimum Distances for Sign Visibility and Legibility:

Table.2. 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 (m2). 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 m sign height is 2.0 m. Vehicle headlight distance from the road 0.65m driver sight distance is 1.2m.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.

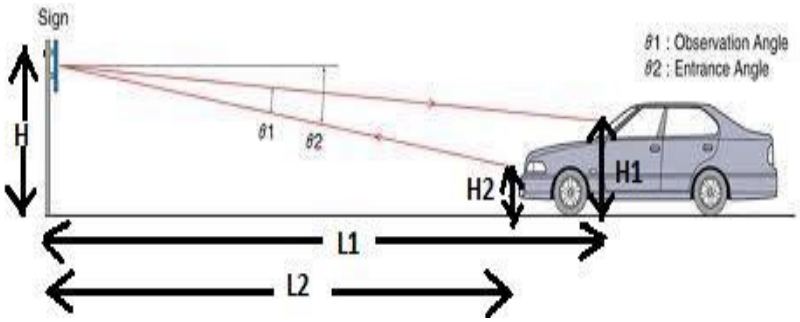

Fig. 2. Visibility distances and angles

B. 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 θ1, θ2 are calculated as follows.

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

$\text{Tan}(\phi) = \frac{(H-H1)}{L1}$; $\phi = \tan\text{-}1(\frac{(H-H1)}{L1})$

$\theta 1 = \theta 2 - \phi$

Where, (θ1) = observation angle & (θ2) = entrance angle

Height of the sign H = 2 m.

Height of the driver from the ground level H_1=1.2 m

Height of the vehicle headlight from the ground level H_2 = 0. 65m.

Length of the distance between sign to the observer L_1 = 100 m

Length of the distance between vehicle head lights to sign L_2 = 98.5 m.

Tan (θ2) = 2 - 0.65/98

θ 2 = tan-1 (1.35/98)

Entrance angle θ2 = 0.789

Tan ϕ = (2-1.2)/100

ϕ = tan-1(0.8/100)

ϕ = 0.45

Observation angle θ1 = θ2 - ϕ

= 0.789 – 0.45 = 0.339.

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

Tan (θ2) = (2-0.65)/88

θ 2 = tan-1 (1.35/88)

Entrance angle θ2 = 0.87

Tan ϕ = (2-1.2)/90

ϕ = tan-1(0.8/90)

ϕ = 0.50

Observation angle θ1 = θ2 - ϕ

= 0.87 – 0.50 = 0.37

The distance is 150 m speed 60kmph

Tan (θ2) = (2-0.65)/148

θ 2 = tan-1 (1.35/148)

Entrance angle θ2 = 0.52

Tan ϕ = (2-1.2)/150

ϕ = tan-1(0.8/150)

ϕ = 0.30

Observation angle θ1 = θ2 - ϕ

= 0.52 – 0.30 = 0.22

Distance 170 m, speed 70kpmh

Tan (θ2) = (2-0.65)/168

θ 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 θ1 = θ2 - ϕ

= 0.46 – 0.26 = 0.20.

Distance 185m, speed 80kmph

Tan (θ2) =(2-0.65)/183

θ 2 = 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 θ1 = θ2 - ϕ

= 0.42 – 0.24 = 0.18

Table 3.Observation angle and entrance angle for visibility distance

Speed (kmph)	Distance (m)	Observation Angle (Θ1)	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 90m.

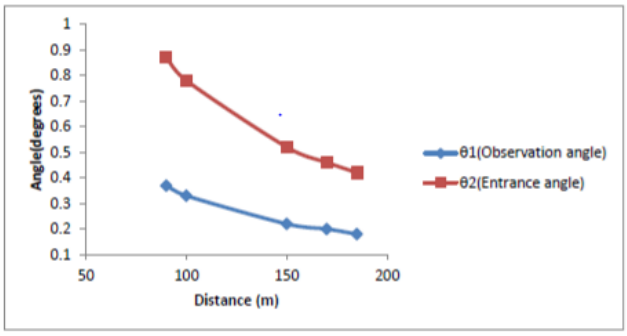

Fig .4. observation angles and entrance angles variation for visibility distance

C. 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 θ1 = 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 θ1 = θ2- ϕ
= 1.137 – 0.65= 0.487

Table.4. Observation angle and entrance angle for legibility distance

Speed (kmph)	Distance (m)	Observation Angle (Θ1)	Entrance Angle (Θ2)
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

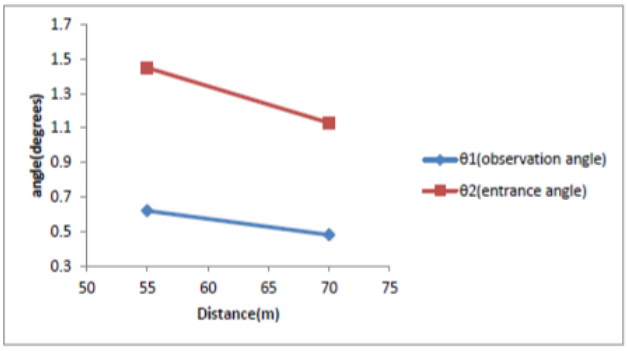

Fig .5. Observation angles and Entrance angles variation for legibility distance

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 90m.

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

Table.5. coefficient of retro-reflectivity of each sheet type colours as per AASHTO specifications

Observation Angle (deg.)	Entrance Angle (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	-0.4	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

D. Retro-reflectivity performance standards:

Table.6. 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
Tested	10	23	3
Passes	8	15	3
Failed	2	8	0
% Failed	20 %	35 %	0 %

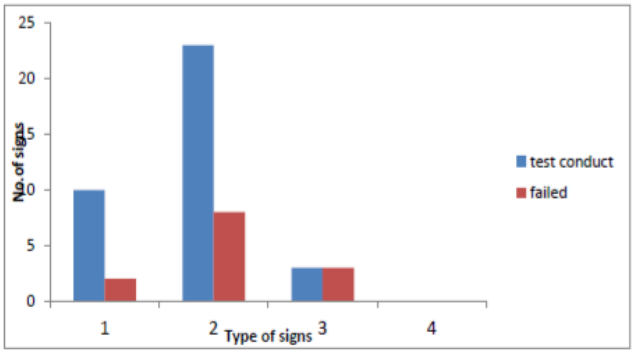

Fig 6. Total signs and failed signs in each type of sign

VIII. CONCLUSION

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.

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