

ISSN 2348 - 8034 Impact Factor- 5.070

GLOBAL JOURNAL OF **E**NGINEERING **S**CIENCE AND **R**ESEARCHES APPLICATION OF GEOSPATIAL TECHNOLOGY TO FREEWAY MANAGEMENT SYSTEM

Megharaj Magdum & Dr. Sumedh Mhaske

Post Graduate Student, Civil and Environmental engineering department, Veermata Jijabai Technological Institute, Mumbai 400019, Maharashtra, India.

Associate Professor, Civil and Environmental engineering department, Veermata Jijabai Technological Institute, Mumbai 400019, Maharashtra, India

ABSTRACT

Corresponding with the increase in development in Freeway constructions in India, it requires intensifying standard and highly effective Freeway management system. The study entailed review of literature outlining the available lane management techniques (LMT) for freeways to apply these techniques to manage the lane traffic of newly constructed Freeways. Also, literature recommends the speed criteria's depends on the basic principles of speed limit includes safety, economic and constant for the vehicles on the freeways to avoid accidents on the freeways. This study aims to study various operations of Freeway Management System (FMS) such as Lane use control, Ramp Control, Incident management etc. An application strategy of Geographic Information System (GIS) in Freeway Management System is proposed specially for Incident management on the freeways. This strategy includes collection of the previous accidental data on the freeway, analysis of the data according to various parameters such as type of vehicle incurred in the accident, speed of that vehicle at the time of accident, cause of accident; according to above information defining the black spots on the freeways, providing some accident prevention measures on that spots, indicating the nearest available hospitals and closest path to that hospital from the accident spot using Gram++ software according to available time, traffic and road conditions. It fully utilizes the advantage of computer and GIS technology to modernize the management of freeway.

Keywords : ArcGIS, Basic principle, Gram++, Freeway, Lane management, System.

I. INTRODUCTION

According to, The Highway Capacity Manual defines a freeway as a divided highway with full control of access and two lanes use for two opposite directional traffic which are continuously separated by raised barrier or by planting trees which provides uninterrupted flow of traffic. Freeways were generally planned and designed to provide continuous, free flow to vehicles, high speed functioning of vehicular traffic on roads. For control of speed of vehicle on freeway, type of pavement to be used for construction of freeway, safety precautions of public as well as vehicle on freeways it is required to maintain a good management system for freeway.

Freeway management requires maintaining balance between goals and objectives of freeways. Freeway Management system (FMS) is defined as set of components which are come together to facilitate the overall objectives or goals of the management system. Freeway management system consists of management about traffic on freeways, freeway infrastructure safety and emergency management, ramp management and control, incident management, performance management, accident prevention.

Now, It is requires to build highly efficient and standard freeway management system so that application scheme of Geographic Information System (GIS) In Freeway Management System (FMS) is proposed which contains dynamic segmental technology. GIS offers evidence of assistant decision-making in routine management business. Hence the purpose of application of GIS in Freeway Management system is to expands and strengthen efficiency of management. This FMS realized the integration management of spatial data and attribute data.





ISSN 2348 - 8034 Impact Factor- 5.070

II. VARIOUS OPERATIONS OF FREEWAY MANAGEMENT SYSTEM

Freeway Management System includes all the personnel, operational scenarios and mechanisms. FMS combines all above parameters to control and manage the traffic flow on the freeways more impressively.

Following are the various operations performed by the FMS:

Lane Use Control

The main purpose to control the lane use of freeway is to boost the efficient use of the available existing pavement within right-of-way of the road. Some examples which are used for lane use control includes Large truck restrictions, mainline metering, Temporary shoulder utilization, reversible lane operations.

Ramp Control

For Freeway traffic control the Entrance Ramp Control method is mostly used method. The main objective of this method is to control of vehicles entering freeway so that demand does not exceed the capacity of freeway.

Ramp Metering is the strategy used for ramp control. It limits the rate of the entering traffic to freeway in such a way that the capacity of the freeway does not exceed downstream of on-ramp.

High-Occupancy Vehicle (HOV) Priority Treatment

Next operation of the Freeway Management System is to furnish preferential treatment to Carpools, Vanpools, Buses and other HOV on the Freeway to develop travel time asset for the vehicle occupants and review the number of vehicles on the freeway. These treatments include special lanes, priority access ramp controls for HOV vehicles.

Incident Management

Out of all the Freeway Management operations, incident management gives the considerable potential operational and safety advantage to freeway motorists. Incident Management system needs the operation and pre-planned use of human and technological resources to use the freeway to full capacity quickly and effectively after an accident occurs. It includes other freeway management functions such as the following:

- Surveillance.
- Control center operation.
- Freeway service patrols.

Freeway Mainline Control

Freeway mainline control meant for the regulation, warning, and instruction to the freeway traffic in order to maintain more uniform and more stable traffic flow on the freeways to reduce the potential of rear-end collisions, if congestion develops, facilitate accident management and recovery from congestion, divert freeway traffic to alternate routes to utilize corridor capacity, and change the directional capacity of the freeway by use of reversible lanes.

III. LANE MANAGEMENT TECHNIQUES (LMT) FOR MULTILANE FREEWAYS

Reference [4], presents the various lane management techniques in order to control traffic flow on freeways by means of restricting lane use by vehicle type and limiting speed by lane by vehicle type. Based on the practical experience on eight-lane freeway and the literature reviews five lane management techniques are established. These are as follows:

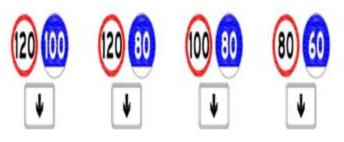
Limit speed by lane

In this method speed of the various types of vehicles on every lane of freeways is restricted within both maximum and minimum in such a way that vehicles can't exceed maximum speed and can't be less than the minimum.





ISSN 2348 - 8034 Impact Factor- 5.070



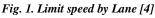




Fig. 2. Limit speed by Vehicle Type [4]

Fig.1.shows that Maximum speed for first lane from left is 120 km/h and minimum speed is 100 km/h; same for second lane Maximum and minimum speed are 120 km/h and 80 km/h and so on.

Limit speed by vehicle type

In this technique, various speeds are given to different types of vehicles. Vehicles are classified according to their size, weighing capacity, their weight when moving on freeways.

As shown in Fig.2, in this method, maximum speed for small vehicles such as car is 120 km/h and minimum speed is 80 km/h and for large vehicles such as trucks, containers, trailers maximum speed is 100 km/h and minimum speed is 60 km/h.

Limit speed both by lane and vehicle type

In this method first two lanes from left are set for small vehicles and their maximum and minimum speeds are different from other lanes and other vehicles. Next two lanes are set for large vehicles and their speeds are also different on these lanes.

According to Fig.3 First and second lanes are for small vehicles and their maximum and minimum speeds are 120 km/h and 80 km/hr respectively and same for the next two lanes which





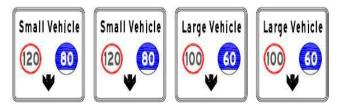


Fig.3. Limit speed both by lane and vehicle type [4]

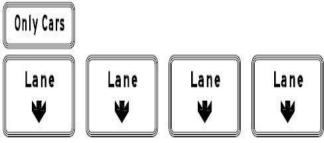


Fig. 4. Lane only for cars [4]

are set for large vehicles with maximum speed 100 km/hr and minimum speed 60 km/hr Small and large vehicles are discriminated by the size and speed of vehicles, according to which the lane can be restricted in different maximum and minimum speed limits.

Car only Lanes

In this method, the first lane of every freeway from the left is used only for small cars and it is marked "Only Cars" and the other lanes have no limits. Fig.4 above shows 'Car only lanes' method in which first lane from left is available only for carpools.

Truck-restricted lanes

In this method, first lane from the left is used only for small passenger cars and the second lane for the bus. Trucks and big containers are restricted only in the third and fourth lane and they are not allowed in first two lanes, but buses are also allowed in truck restricted lanes. With respect to different vehicle types, different maximum and minimum speed limits are set for different lanes.

From Fig.5, the first lane have the maximum speed is 120 km and the minimum speed is 100 km which is for only cars; the second lane have the maximum speed is 120 km and the minimum speed of 80 km which is for only buses; for the third and fourth lane the maximum speed of 100 km and the minimum speed of 60 km set on which trucks and buses are allowed.

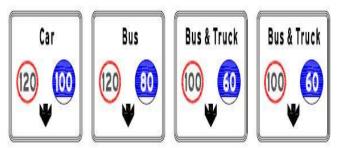


Fig.5. Truck-restricted lanes [4]





ISSN 2348 - 8034 Impact Factor- 5.070

IV. APPLICATION OF GEOSPATIAL TECHNOLOGY TO FMS

This paper mainly depends on the application of Geospatial technology to Freeway Management System. Specifically, GIS technology is applied in the Incident Management Operation out of the various operations described in above paragraphs of FMS. Incident Management includes providing the Ambulance facility at the accident point as early as possible in minimum time after the incident using the Geospatial Technology. To carry out this work Gram++ software is used. Using an eight-lane freeway in Mumbai City of Maharashtra i.e. Eastern Freeway we developed incident management model using GIS technology.

Methodology

Methodology used for the Application of Geospatial technology is shown in the format of flow diagram in below Fig.6. It includes Finalization of study area, Database creations, collection of accidental data and their multicriteria analysis using ArcGIS software.

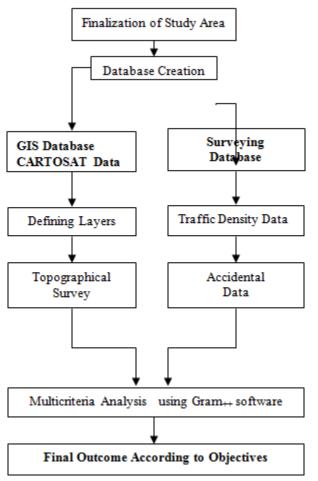


Fig.6 Flow Diagram of Methodology adopted

Study Area

Study area selected to this project work is Eastern Freeway, Mumbai. The authority of MMRDA has grouped to built important 16.9 km long Eastern Freeway project considering the present situation of traffic, Future traffic and other transportation demands. This Freeway is divided into 3 parts:





ISSN 2348 - 8034 Impact Factor- 5.070

Part 1: Eastern Freeway - Chhatrapati Shivaji Maharaj Vastu Sangrahalay to Anik Junction. It includes Elevated corridor of 9.29 km long Eastern Freeway 17.2 m wide, 2+2 lanes.

Part 2: Anik-Panjarpol Link Road - It includes 5 bridges, 3 underpasses, 2 tunnels, 1 foot over bridge, 4.3 km, 4+4 lanes.

Part 3: Panjarpol-Ghatkopar Link Road. It includes 3 km long, 17.2 m wide, 2+2 lanes.

Database Creation

There are two databases created for this work namely GIS database and the surveying database. GIS database also known as CATOSAT data. It includes defining various layers and digitizing it in the ArcGIS software. Database such as Road layer included all the roads major roads, minor roads, highways exist in Mumbai Region. Next layer is of Hospital building layer present in the Mumbai city.

Surveying database includes the data that we get from surveying on the Freeways (in case of this project). For the project of Application of Geospatial Technology to Freeway Management System various surveying databases are required such as accidental data for the particular freeways, traffic data. Accidental data includes information about the accident happened on the freeway. This information about accident may contain particular location of the accident, number of deaths if any, reason for happening of that accident. It may be helpful to maintain the speed of the vehicle at that particular accidental spot and to take some precautionary measures to stop such accidents.

Accident data collection

Study area selected to this project work is Eastern Freeway, Mumbai. The authority of MMRDA has grouped to built important 16.9 km long Eastern Freeway project considering the present situation of traffic, Future traffic and other transportation demands. This Freeway is divided into 3 parts:

Part 1: Eastern Freeway - Chhatrapati Shivaji Maharaj Vastu Sangrahalay to Anik Junction. It includes Elevated corridor of 9.29 km long Eastern Freeway 17.2 m wide, 2+2 lanes.

Part 2: Anik-Panjarpol Link Road - It includes 5 bridges, 3 underpasses, 2 tunnels, 1 foot over bridge, 4.3 km, 4+4 lanes.

Part 3: Panjarpol-Ghatkopar Link Road. It includes 3 km long, 17.2 m wide, 2+2 lanes.

Database Creation

There are two databases created for this work namely GIS database and the surveying database. GIS database also known as CATOSAT data. It includes defining various layers and digitizing it in the ArcGIS software. Database such as Road layer included all the roads major roads, minor roads, highways exist in Mumbai Region. Next layer is of Hospital building layer present in the Mumbai city.

Surveying database includes the data that we get from surveying on the Freeways (in case of this project). For the project of Application of Geospatial Technology to Freeway Management System various surveying databases are required such as accidental data for the particular freeways, traffic data. Accidental data includes information about the accident happened on the freeway. This information about accident may contain particular location of the accident, number of deaths if any, reason for happening of that accident. It may be helpful to maintain the speed of the vehicle at that particular accidental spot and to take some precautionary measures to stop such accidents.

Accident data collection

		<i>ubic. no.</i> 1 1 u	si acciaentai aato	i joi Lusien	i Treeway, II	umou	1
Sr.	Black spots on EFM	No. of	Date	No. of	Injured	Reason	Type Of
No.		accidents		deaths	Persons		Vehicle
1	Panjarpol-end of	1	10/10/2017	1	2	High speed of	Two-wheeler
	highway					vehicle	
2	Exit near nawab tank	1	6/12/2015	2	1	Driving on wrong	Four
	road and dockyard (near					side of freeway	Wheeler
	Anderson house)						(Audi and

51

Table. no. 1 Past accidental data for Eastern Freeway, Mumbai





ISSN 2348 – 8034 Impact Factor- 5.070

						k	
							taxi)
3	Stretch near Chembur	1	7/10/2016	3	2	High speeding and	SUV
						lost control over the	
						vehicle.	
4	Jijamata Nagar Entry	1	7/19/2016	3	2	Head on collision	SUV and
							Taxi
5	Near Chembur Exit	1	12/27/2017	3	0	Slippery road	Four
							Wheeler
6	Sewri exit	1	11/5/2016	3	2	Lost control over	Four
						vehicle	Wheeler
7	Near Wadala (pole 264)	1	8/25/2016	0	3	Lost control over	Four
	on the southbound lane					vehicle	Wheeler
	towards Chembur						

Table. no. 2 Name of Hospitals in the Mumbai city & Mumbai sub-urban areas and their Information(Sample)

Sr.	Name of Hospital	Latitude,	Time to	Distance from		Nature		Emergency
no.		Longitude	Travel	black spot	Facility		No.	
			(min.)	(km.)				
1	Holy Spirit							
	Hospital, Guru							
	Gobind Singh							
	Marg, Takshila,							
	K/E Ward, Zone 3,						022-	
	Mumbai, Greater						28248500/1	
	Bombay, Mumbai	19.1295546,	60	32.5	YES	PRIVATE	/2	YES
	Suburban,	72.8657412					/3	
	Maharashtra,						/4	
	400093, India							

Table no.1 shows the past accident data for the Eastern Freeway, Mumbai. It shows information regarding number of accidents happened on that particular point, date of that accident, number of deaths in that accident, number of injured persons, reasons for the accident and the type of vehicle. This data helps to locate the black spots on the freeway.

There are 7 black spots found on the Eastern Freeway, Mumbai. These are Panjarpol-end of highway, Exit near nawab tank road and dockyard (near Anderson house), Stretch near Chembur, Jijamata Nagar Entry, Near Chembur Exit, Sewri exit and Near Wadala (pole 264) on the south bound lane towards Chembur.

Hospital Data

Table no.2 shows the sample of data collected with respect to available 55 hospitals in the Mumbai city and Mumbai sub-urban areas. The data includes the hospital name, their address, the location co-ordinates of the particular hospital in the form of Latitude and Longitude, time of travel from Black spot to the hospital, Distance of that





ISSN 2348 - 8034 Impact Factor- 5.070

Certain cont ill - U - NA 2 16 Dr 3 15 Di 4 13 Ji) 4 13 Ji) 4 13 Ji) 4 13 Ji) 7 9 Ar 8 8 Gr 9 7 Hi 10 6 M 7 9 Ar 8 8 Gr 9 7 Hi 10 6 M 11 3 Gc 12 2 Ni 13 1 Ni 3 1 Ni 13 1 A 15 5 Pe 16 33 8 C	ame_of_Hi - Am oly spirit hosy isha Hospital van vikas Hos wari Hospital luktabai Hospital luktabai Hospital luktabai Hospital odrej Memor new Life Hospi odrej Memor new Life Hospital owai Hospital owai Hospital	Font Font thas been disable abulance • Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø	Private · · · · · · · · · · · · · · · · · · ·	Covernment -	Work hours • 24 24 24 24 9 9 11 24 24 24 24 24 24 24 24 24 24	Y Y 	ng X↓ Tilter	Ƴ Toggle Filter F & Filter	Address Address Guru Gobind Singh M Dr L H Hiranandani Ik J V Kendra Road, Aza 90 Feet Road, Jarima R B Kadam Road, Aza Krishna alankar, Teip	Select * Find Contact_no a 022-28248500/1/2// w 022 5763322 / 3323 a 022 2578 1090 c 022 2684 45775 a 022 25781012 x 23 25781012	
Copy Format Paints Certain cond 11 U V V 2 16 Or 3 15 Di 4 13 Jin 5 12 Tir 6 10 M 7 9 Ar 8 8 Gr 9 7 Hi 10 6 M 11 3 Gr 11 3 Gr 11 3 Gr 11 3 Ni 11 3 Ni 11 3 Ni 11 3 Ni 11 3 Ni 11 3 Ni 11 3 Si 5 Di 7 Tir 11 5 Si 11 5 Si 12 Si 13 Si 5 Di 7 Tir 11 5 Si 13 Si 5 Di 7 Tir 13 Si 5 Di 7 Tir 14 Si 5 Di 7 Tir 15 Si 7 Si 7 Si 7 Si 7 Si 7 Si 7 Si 7 Si 7	er Tr U u u u u u u u u u u u u u u u u u u	► • A • A • A • A • A • A • A • A • A •	d Options Private • • • • • • • • • • • • • • • • • • •	Covernment -	Work hours • 24 24 24 24 9 9 11 24 24 24 24 24 24 24 24 24 24	Save ** Spelli Delete - *** More Records	ng X Filter Filter Time_to_Travel 6 68 41 55 51 58 52 42 52	Advanced - V Toggle Filter Distance_KM - 33 33 18 21 19 19 21	Address Window Window Guru Gobind Singh M Dr L H Hiranandani H Sant Shitolebaba Ma J V Kendra Road, Aza 90 Feet Road, Jarima R B Kadam Road, Aza Kanjur Village Road,	→ Go To - ↓ Select - Find Contact_no 022-28248500/1/2/3 022 25763322 / 3323 022 25763322 / 3323 022 25781092 022 2654 3777 1082968 46275 022 25781012 23 25781012	/4
Format Painte Certain cont 1 U 1 1 2 16 0 3 2 16 0 3 5 12 16 10 7 9 8 6 9 7 10 6 11 3 10 6 11 1 12 1 13 1 14 14 15 5 16 33 16 33 17 2	ame_of_H· Amo oly spirit hosy r. L.H. Hiranne isha Hospital van vikas Hos wari Hospital luktabai Hospital luktabai Hospital lukkand Hospit odrej Memor new Life Hospi odrej Memor new Life Hospital owai Hospital owai Hospital	Font Font that been disable	d Options V V V V V V V V V V V V V V V	C C Rich Text	All - X Work_hours - 24 24 24 24 8 9 9 11 24 24 24 24 24 24 24	Emergency_ *	- 2 Filter Sort i Time_to_Travel - 68 41 55 51 58 52 42 52	Toggle Filter Filter Distance_KM - 33 - 33 - 18 - 19 - 19 -	It Form Windows * Window Guru Gobind Singh M Dr L H Hiranandani H Sant Shitolebaba Ma J V Kendra Road, Aza 90 Feet Road, Jarima R B Kadam Road, Aza Kanjur Village Road,	Select * Find Contact_no a 022-28248500/1/2// w 022 5763322 / 3323 a 022 2578 1090 c 022 2684 45775 a 022 25781012 x 23 25781012	/4
Certain cont ill - U - NA 2 16 Dr 3 15 Di 4 13 Ji) 4 13 Ji) 4 13 Ji) 4 13 Ji) 7 9 Ar 8 8 Gr 9 7 Hi 10 6 M 7 9 Ar 8 8 Gr 9 7 Hi 10 6 M 11 3 Gc 12 2 Ni 13 1 Ni 3 1 Ni 13 1 A 15 5 Pe 16 33 8 C	ame_of_H · Amo oly spirit hos; r. L.H. Hiranne isha Hospital van Vikas Hos iwari Hospital tuktabai Hospi tuktabai Hospi induhridaysai tuktaba Hospi induhridaysai odrej Memor lew Life Hospi idan Hospital oowai Hospital oowai Hospital	has been disable has been disable v v v v v v v v v v v v v	Private · · · · · · · · · · · · · · · · · · ·	Government -	24 24 8 9 9 11 24 24 24 24 24	Emergency_ •	Time_to_Travel + 68 41 55 51 58 52 42 52	 Distance_KM - 33 33 18 21 19 19 21 	Window Guru Gobind Singh M Dr L H Hiranandani H J V Kendra Road, Aza 90 Feet Road, Jarima R B Kadam Road, Aza Kanjur Village Road,	Contact_no a 022-28248500/1/2// s 022 25763322 / 3323 h 022 2578 1090 c 022 2578 1090 c 022 2578 1090 c 022 25781012 h 23 25781012	/4
II V Na 1 17 He 2 16 Dr 3 15 Di 4 13 Jix 5 12 Tim 6 10 M 7 9 Ar 8 8 Gr 9 7 H 10 6 M 11 3 Gr 12 2 Nx 13 1 NI 14 4 Pc 15 5 Pe 16 33 BC 16 33 Sc 17 32 Sc	ame_of_Hi - Am oly spirit hosp rr. LH. Hirannet isha Hospital van Vikas Hos wari Hospital tuktabai Hosp nkit Nursing I reat Smile De induhridaysai tukund Hospit dorej Memor ew Life Hospi tidan Hospital owai Hospital owai Hospital	bulance_ <	Private · · · · · · · · · · · · · · · · · · ·	Government -	24 24 8 9 9 11 24 24 24 24 24	Y Y 	68 41 55 51 58 52 42 52	33 33 18 21 19 19 21	Guru Gobind Singh M Dr L H Hiranandani Ho Sant Shitolebaba Ma J V Kendra Road, Aza 90 Feet Road, Jarima R B Kadam Road, Aza Kanjur Village Road,	a 022-28248500/1/2/3 s 022 25763322 / 3323 h 022 2578 1090 c 022 2684 3772 n 082968 46275 c 022 25781012 N 23 25781012	/4
1 17 Hc 2 16 07 3 15 01 4 13 13 5 12 Th 6 10 M 7 9 Ar 8 67 9 10 6 M 11 3 Gc 12 N N1 13 1 N1 14 4 Pc 15 Pe 63 16 3 X 17 2 Sa	oly spirit hos r. L.H. Hirannc isha Hospital van vikas Hos iwari Hospital luktabai Hospi nkit Nursing H reat Smile De induhridaysai tukund Hospit odrej Memor lew Life Hospi idan Hospital owai Hospital owai Hospital	× • • • • • • • • • • • • • • • • • • •	Y Y Y Y Y Y Y		24 24 8 9 9 11 24 24 24 24 24	Y Y 	68 41 55 51 58 52 42 52	33 33 18 21 19 19 21	Guru Gobind Singh M Dr L H Hiranandani Ho Sant Shitolebaba Ma J V Kendra Road, Aza 90 Feet Road, Jarima R B Kadam Road, Aza Kanjur Village Road,	a 022-28248500/1/2/3 s 022 25763322 / 3323 h 022 2578 1090 c 022 2684 3772 n 082968 46275 c 022 25781012 N 23 25781012	/4
1 17 Hc 2 16 07 3 15 01 4 13 13 5 12 Th 6 10 M 7 9 Ar 8 67 9 10 6 M 11 3 Gc 12 N N1 13 1 N1 14 4 Pc 15 Pe 63 16 3 X 17 2 Sa	oly spirit hos r. L.H. Hirannc isha Hospital van vikas Hos iwari Hospital luktabai Hospi nkit Nursing H reat Smile De induhridaysai tukund Hospit odrej Memor lew Life Hospi idan Hospital owai Hospital owai Hospital	× • • • • • • • • • • • • • • • • • • •	Y Y Y Y Y Y Y		24 24 8 9 9 11 24 24 24 24 24	Y Y 	68 41 55 51 58 52 42 52	33 33 18 21 19 19 21	Guru Gobind Singh M Dr L H Hiranandani Ho Sant Shitolebaba Ma J V Kendra Road, Aza 90 Feet Road, Jarima R B Kadam Road, Aza Kanjur Village Road,	a 022-28248500/1/2/3 s 022 25763322 / 3323 h 022 2578 1090 c 022 2684 3772 n 082968 46275 c 022 25781012 N 23 25781012	/4
2 16 Dr 3 15 Di 4 13 Jiv 5 12 Tr 6 10 M 7 9 Ar 8 8 Gr 9 7 Hi 10 6 M 11 3 Ni 11 3 Ni 12 2 No 13 1 Ni 14 4 Pc 15 5 Pe 16 33 Re 17 32 Sa	r. L.H. Hiranne isha Hospital wan Vikas Hos iwari Hospital tuktabai Hosp induhridaysai nduhridaysai uduhridaysai odrej Memor elew Life Hospi idan Hospital oowai Hospital eoples Mobili- ombay Hospital	Y 	Y Y Y Y Y Y Y		24 24 8 9 11 24 24 24 24 24	Y 	41 55 51 58 52 42 52 52	33 18 21 19 19 21	Dr L H Hiranandani Ho Sant Shitolebaba Ma J V Kendra Road, Aza 90 Feet Road, Jarima R B Kadam Road, Aza Kanjur Village Road,	2 022 25763322 / 332 022 2578 1090 022 2684 3772 082968 46275 022 25781012 23 25781012	
4 13 Jiv 5 12 Tiv 6 10 M 7 9 Ar 8 G 9 7 Hi 10 6 M 11 3 G 12 2 Ni 13 1 Ni 14 4 Pc 15 5 Pc 16 33 Bc 17 32 Sa	van vikas Hos iwari Hospital Iuktabai Hosp nkit Nursing I reat Smile De induhridaysai Iukund Hospit Iukund Hospit Idan Hospital owai Hospital owai Aospital ombay Hospit	· · · · · · · · · · · · · · · · · · ·	Y Y Y Y Y Y		8 9 11 24 24 24 24 24		51 58 52 42 52	21 19 19 21	J V Kendra Road, Aza 90 Feet Road, Jarima R B Kadam Road, Aza Kanjur Village Road,	d 022 2684 3772 n 082968 46275 d 022 25781012 N 23 25781012	
5 12 Tri 6 10 M 7 9 Ar 8 8 Gr 9 7 Hi 10 6 M 11 3 Gr 12 2 N 13 1 N 14 4 Pr 15 5 Pr 16 33 Br 17 32 Sa	iwari Hospital Iuktabai Hosp nkit Nursing I reat Smile De Induhridaysa Iukund Hospita odrej Memor idan Hospital owai Hospital ooples Mobili oombay Hospit	· · · · · · · · · · · · · · · · · · ·	V V V V V V V V		9 9 11 24 24 24 24 24 24		58 52 42 52	19 19 21	90 Feet Road, Jarima R B Kadam Road, Aza Kanjur Village Road,	ri 082968 46275 d 022 25781012 N 23 25781012	
6 10 M 7 9 Ar 8 8 Gr 9 7 Hi 10 6 M 11 3 Gr 12 2 N 13 1 N 14 4 Por 15 5 Pe 16 33 Br	luktabai Hosp nkit Nursing F reat Smile De induhridaysai lukund Hospi odrej Memor ew Life Hospi idan Hospital owai Hospital eoples Mobili ombay Hospit	Y	Y Y V Y Y		9 11 24 24 24 24 24 24		52 42 52	19 21	R B Kadam Road, Aza Kanjur Village Road,	d 022 25781012 N 23 25781012	
7 9 Ar 8 8 Gr 9 7 Hi 10 6 M 11 3 Go 12 2 No 13 1 Ni 14 4 Po 15 5 Pe 16 33 Bo 17 32 Sa	nkit Nursing F reat Smile De Induhridaysa Iukund Hospi odrej Memor lew Life Hospi idan Hospital owai Hospital eoples Mobile ombay Hospit		Y Y Y		11 24 24 24 24 24		42 52	21	Kanjur Village Road,	23 25781012	
8 8 Gr 9 7 Hi 10 6 M 11 3 Go 12 2 No 13 1 Ni 14 4 Po 15 5 Pe 16 33 Bo 17 32 Sa	reat Smile De induhridaysa lukund Hospi odrej Memor iew Life Hospi idan Hospital owai Hospital eoples Mobili ombay Hospit		Y V V V		24 24 24 24	\ V V	52				
10 6 M 11 3 Go 12 2 No 13 1 Ni 14 4 Po 15 5 Pe 16 33 Bo 17 32 Sa	lukund Hospi odrej Memor lew Life Hospi idan Hospital owal Hospital eoples Mobili ombay Hospit	V 	> > >		24 24	✓	67			a 098920 00000	
11 3 Go 12 2 No 13 1 Ni 14 4 Poo 15 5 Peo 16 33 Boo 17 32 Same	odrej Memor lew Life Hospi idan Hospital owai Hospital eoples Mobili ombay Hospit		V V V		24			22	Balasaheb Thackeray		
12 2 No 13 1 Ni 14 4 Po 15 5 Pe 16 33 Bo 17 32 Sa	ew Life Hospi idan Hospital owai Hospital eoples Mobili ombay Hospit		▼ ▼				58	21	Mathuradas Vasanji I		
13 1 Ni 14 4 Po 15 5 Pe 16 33 Bo 17 32 Sa	idan Hospital owai Hospital eoples Mobili ombay Hospit		✓		8		38 70	21 60	Godrej Memorial Hos Azad Nagar, N Ward,		
14 4 Po 15 5 Pe 16 33 Bo 17 32 Sa	owai Hospital eoples Mobili ombay Hospit				8		56	30	Lal Bahadur Shastri M		
15 5 Pe 16 33 Bo 17 32 Sa	eoples Mobile ombay Hospit	-		~	24	✓	46	26	Adi Sankaracharya M		
17 32 Sa			✓		12	✓	26	8	Dr Annie Besant Roa	d 022 2493 3759	
		•	✓		24	✓	21	6	Bombay Hospital Ave		
10 31])	aifee Hospital		✓	Image: A state of the state	24 24	✓	22	7	SaifeeQueen's Road,		
19 30 Bo	J Hospital ombay Hospit	✓	✓	•	24	✓	20	6	Ramchandra Bhatt Ma Vithaldas Thackersey		
	erabai Wadia I			~	24	 ✓ 	15	4	Dr Ernest Borges Mar		
			✓		24	~	26	10			
		•	•		24	•	15	4			
								6			
				4	24	Z	19	0	samt xavier street, S	022 2417 7000	
										N	um Lock 🔚
<u> </u>											
or			~	~ ~~	_				h_c.mdb		
te m					3 ~~~~		sin fu	ID [N-	me of Hospital Ambulance	Ser Private	Governm
c				Ä			18 5	7 BF	PT Hospital No	No	Yes
а.				5		4	19 5i 50 51	6 SF 5 Ma	RM KP Cardia Yes	Yes Yes	No No
51				n fith			51 5	4 Ac	worth Leper A No	No	Yes
* I				I "BI			52 53 53 53	o Pił 2 Sh	kale Hospital No		
									nivam Nursing No	Yes Yes	No No
							54 5	1 Hi	nduja Clinic Yes	Yes Yes	No No
					for se	\sim	5 5 5 5 2 4	1 Hi 0 Dł 9 La	nduja Clinic Yes naravi Hospital No ilta Hospital Yes	Yes Yes Yes Yes	No No No
						γ	04 5 35 51 32 44 33 44 34 4	1 Hii 0 Dł 9 La 8 S.I	nduja Clinic Yes naravi Hospital No ilta Hospital Yes L. Raheja Hos Yes	Yes Yes Yes Yes Yes	No No No No
						7	44 5 55 55 32 42 33 44 34 4 35 41 50 41	1 Hii 0 Dł 9 La 8 S.I 7 Ho 6 No	nduja Clinic Yes naravi Hospital No ilita Hospital Yes L.Raheja Hos Yes aly Family Hos Yes pathoote Nursi No	Yes Yes Yes Yes No Yes No	No No No No Yes No
							44 5 55 55 32 44 33 44 33 44 34 4 35 44 36 44 37 44	1 Hii 0 DH 9 La 8 S.I 7 Ho 6 No 5 Hii 4 Lii	nduja Clinic Yes haravi Hospital No lita Hospital Yes L.Raheja Hos Yes oly Family Hos Yes	Yes Yes Yes Yes Yes No	No No No No Yes
							14 5 55 51 52 42 33 41 34 4 35 41 35 41 36 42 37 4. 38 4. 39 9	1 Hii 0 DH 9 La 8 S.I 7 Ho 6 No 5 Hii 4 Lii	nduja Clinic Yes naravi Hospital No lita Hospital Yes L. Raheja Hos Yes oly Family Hos Yes stheote Nursi No nduja Hospital Yes	Yes Yes Yes Yes Yes No Yes Yes	No No No Yes No No No No
							14 5 55 51 32 41 33 41 34 4 35 41 36 41 37 4 38 4 39 41	1 Hii 0 DH 9 La 8 S.I 7 Ho 6 No 5 Hii 4 Lii	nduja Clinic Yes naravi Hospital No lita Hospital Yes Li Raheja Hos Yes aly Family Hos Yes athcote Nursi No nduja Hospital Yes avati Hospital Yes	Yes Yes Yes Yes No Yes Yes Yes	No No No No Yes No No No
							94 5 55 55 32 42 33 44 45 44 455 44 36 42 37 44 38 44 50 5 51 5 52 41 53 44 54 5 55 44 56 42 57 44 56 45 56 45 56 45 57 5 58 44 59 5 59 5 50 5 50 5 50 5 50 5 50 5 50 5 50 5 50 5 50 5 50 5 50 5 </td <td>1 Hi 0 DF 9 La 8 S.I 7 Ho 6 No 5 Hi 4 Lil 3 Pa 2 C</td> <td>nduja Clinic Yes naravi Hospital No lita Hospital Yes Li Raheja Hos Yes aly Family Hos Yes athcote Nursi No nduja Hospital Yes avati Hospital Yes</td> <td>Yes Yes Yes Yes No Yes Yes Yes</td> <td>No No No Yes No No No No</td>	1 Hi 0 DF 9 La 8 S.I 7 Ho 6 No 5 Hi 4 Lil 3 Pa 2 C	nduja Clinic Yes naravi Hospital No lita Hospital Yes Li Raheja Hos Yes aly Family Hos Yes athcote Nursi No nduja Hospital Yes avati Hospital Yes	Yes Yes Yes Yes No Yes Yes Yes	No No No Yes No No No No
								1 Hi 0 DF 9 La 8 S.I 7 Ho 6 No 5 Hi 4 Lil 3 Pa 2 C	nduja Clinic Yes anavi Hospital No itta Hospital Yes L.Raheja Hos Yes ayt Family Hos Yes atthoctor Nurat No nduja Hospital Yes avai Hospital Yes avai Hospital Yes	Yes Yes Yes Yes No Yes Yes Yes Yes	No No No No Yes No No No No
	22 27 G 23 26 Ja 24 25 Tr dd H 4 3 0 dd H 4 3 0 er Operatii	22 27 Gloabal Hospit 23 26 Jaslok Hospital 24 25 Tata Memorial d: K 4 3 of 55 P H P 7 F er Operations Help C C C C C C C C C C C C C C C C C C C	22 27 Gloabal Hospit 23 26 Jastok Hospit 24 25 Tata Memorial ⊄ H 4 3 of 55 ▶ H № K No Filter Sea Fig.7 Im. er Operations Help € € € € € € € 1 € € € € € €	22 27 Gloabal Hospit V 23 26 Jaslok Hospital V 24 25 Tata Memorial V dt H 4 3 of 55 P P P K No Filter Search Fig.7 Image sho r Operations Help V V P Fig.7 Image sho	22 27 Gloabal Hospit 23 26 Jaslok Hospit 24 25 Taslok Hospital dt H	22 27 Gloabal Hospit 23 26 Jashok Hospit 24 23 26 Jashok Hospital 24 24 24 24 24 24 24 24 24 24 24 24 24 2	22 27 Global Hospit	22 27 Gloabal Hospit ♥ ♥ 0 24 ♥ 15 23 26 Jaskok Hospital ♥ ♥ 24 ♥ 15 24 ♥ 19 dt H 4 3 of 55 ▶ H + ₩ K Horitler Search 4 ♥ 19 <i>G</i> I I I I I I I I I I I I I I I I I I I	22 27 Global Hospit V V 24 V 15 4 23 26 Jashok Hospital V 24 25 da kemorial V 24 25 da kemorial V 24 25 da kemorial V 24 29 da kemorial V 24 20 da kemorial V 24 20 da kemorial V 24 20 da kemorial V 24 24 25 da kemorial V 24 24 25 da kemorial V 24 24 24 25 da kemorial V 24 24 25 da kemorial V 24 24 24 25 da kemorial V 24 24 24 25 da kemorial V 24 24 24 25 da kemorial V 24 24 24 25 da kemorial V 24 24 24 25 da kemorial V 24 24 25 da kemorial V 24	22 27 Gloabal Hospit Image: Source of the source of t	22 27 Gloabal Hospit V V 24 V 15 4 Dr Emest Borges Marg 022 6767 0101 23 26 Jaslok Hospital V 24 V 25 6 Dr Gopalrao Deshmuk 022 6657 3014 24 V 19 6 Saint Xavier Street, Sh 022 2417 7000 C V 3 of 55 V H X No Filter Search V Se

Fig.8 Image shows digitized Mumbai city map with boundary, roads, hospital locations and their information table.

hospital from black spot, ambulance facility, Nature of the hospital (Government or Private), Contact number, Timings etc. The data of the hospital required for the database creation is added in MS access 2007 to create MS access database file which is required to run queries in Gram++.





Fig.7 above shows the database created in MS access software for black spot no. 2.

Find the Hospital from the point of accident on freeway according to various parameters

The Vector analysis tool of Gram++ allows us to make the Database required to locate the closest hospital according to the various parameters as shown in the Table no. 2 such as travel time, ambulance service etc.

To add field data to table in database MS Access is used. The database file of Mumbai city map is used in vector GIS. Fig.8 shows digitized Mumbai city map with boundary, roads, hospital locations and their information table. The vector GIS contain vector query module, tin module, network module. Vector query module basically used for running query and find out best solution. Vector query is very important to Mumbai city map vector file. By running query find the more alternatives of hospitals and that will helpful for hospital selection process. By this query find out nearby hospitals, time of travel to hospital from black spot in very few time. Also it is used to compare with other hospitals with respect to their nature, facilities available and evaluate of each hospital. Let us see, 1 query about black spot 2.

Query:

Find out the Hospital having Private nature with available ambulance facility, within the area of maximum 20 kilometers from accident spot and having working hours of less than 24 hours.

If Freeway system manager wants to know the information about hospitals having Private nature with available ambulance facility, within the area of maximum 20 kilometers from accident spot and having working hours of less than 24 hours in Mumbai then, he easily get the related information within minutes just by running the query in GIS vector analysis.

Procedure:

- ✓ Open GRAM++ → vector analysis → vector query → open vector file of GIS_Map_Mumbai.
- ✓ Click on tools → open query option → select simple query
- ✓ Then enter the condition of query Fig. 9 i.e. Private= "Yes", Ambulance_Service="Yes", Distance_KM< "20" and Work_hours< "24.

54

 \checkmark Then click on \overline{OK} button to get result of query.





ISSN 2348 - 8034

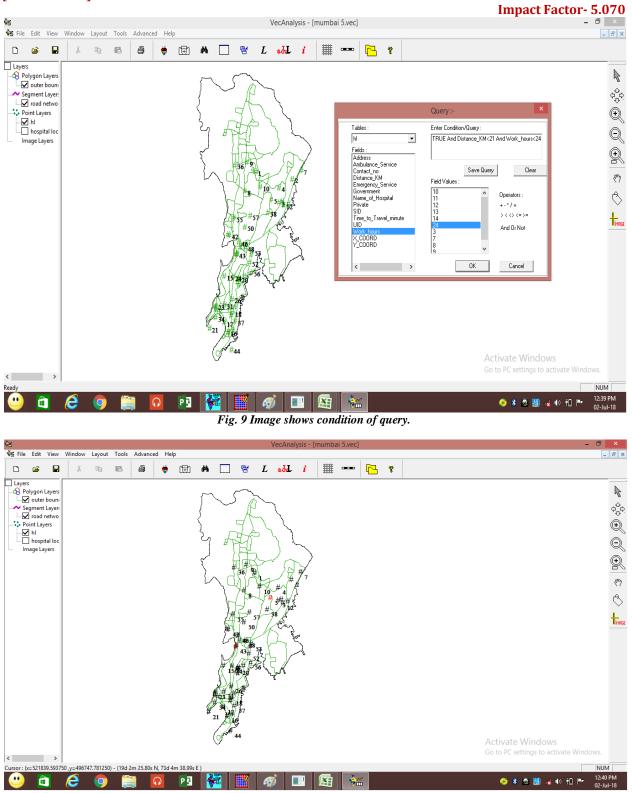


Fig. 10 Image shows result i.e. hospital location having query condition.





ISSN 2348 - 8034 Impact Factor- 5.070

Result of Query:

Fig. 10 shows the result of this query, is 2 out of 57 hospitals of private nature, available ambulance facility, within the area of maximum 20 kilometers from accident spot and having working hours of less than 24 hours in Mumbai.

Ho		Page Lay	rout For	mulas (Data Re	view Vi	ew nova	PDF											0.	-
							📑 Wrap			*						Σ AutoS	ium * A			
🦪 F	ormat Painter		<u>ı</u> •	<u> - A</u> -	E B					• • • • • • • • • • • • • • • • • • •			t Cell • • Styles •	Insert D	elete Format	2 Clear	* Filter *	Find & Select *		
Clipbo		<u></u>		5		Align	iment	G	Nur	nber 🕞		Styles			ells		Editing			
K			f_{x}	-		-								-		- 1		-		_
	BUID	C Name_of		E	F Work hou			Contect r		K Y_COORD	L	М	N	0	P	Q	R	S	Т	
	15 5	Peoples N		TRUE	12				3 501882.4											
	34 47	Ruxmani l		TRUE	3				496783.7											
																Activet	e Windo	214/5		
																	settinas to			
н.	Sheet1 🥠 😏	/														GO TO PC I	settings to	activate	vindows.	
																		100% 😑		
	<u>e</u>	1 🥏				-	3 /				And	_							10	:43
	i (9 🧕		i 🕠	P 3			- 1 🌮		61	1 🔶 👘 👘					- 🤨 🎙	🕴 🧕 😫 .	- 😵 🗣 🔛	02	

Fig. 11 Shows the all the information about the hospitals having the query criteria.

Utility of Query:

This query helps to give idea about the Hospitals having Private nature with available ambulance facility, within the area of maximum 20 kilometers from accident spot and having working hours of less than 24 hours in Mumbai.

- □ It is very easy to find out best hospital with having Private Nature with available ambulance facility, within the area of maximum 20 kilometers from accident spot and having working hours of less than 24 hours in Mumbai.
- \Box And hence it helps to saving the time.

V. CONCLUSIONS

In this research paper five lane-management techniques are studied namely limit speed by Lane type, by vehicle type, by combination of lane and vehicle type, car only lanes and truck restricted lanes according to status of traffic flow, traffic volume and number of lanes of freeway. The conclusions are summarized as follows:

- 1. Lanes of the freeways should be designated build on traffic volume and traffic characteristics
- 2. Minimization of the conflict between large and small vehicles can decline lane change frequency and hence reduce average speed difference in multilane.

This paper studies various methods of speed limit of vehicles on the freeways to avoid accidents based on design speed, operation speed environmental factors and road alignments.





ISSN 2348 - 8034 Impact Factor- 5.070

The Geospatial technology is applied for the Freeway Management System. This paper introduced the main concepts of the FMS specifically for the Incident Management of FMS. GIS queries play an important in emergency requirements of ambulance. GIS network gives the information of shortest route between accident location and the available hospital according to the requirements.

REFERENCES

- Date C.J., "Introduction to Database Systems (7th Edition)", 2000.
 Kang C., "Introduction to Geographic Information Systems.", 2006.
- "Determination method of Freeway speed limitation for accident 3. LI Xinwei and WANG XiaoFei, prevention",ICTE, pp. 2388-2395, 2013.
- 4. Man-juan YANG, Ke-man WU and Lian-de ZHONG, "Lane Management Techniques For Multilane Freeways", ICCTP, pp. 994-1006, 2011.
- 5. Minli Ge, Lu Sun, Yiyong Pan, Yifeng Li, "Design and Implementation of Freeway Infrastructure safety and emergency management system", COTA International Conference of Transportation Professionals, pp. 728-740, 2013.
- 6. S. Akhtar Ali Shah, Hojung Kim, Seungkirl Baek, Hyunho Chang, Byung Ha Ahn, "System architecture of a decision support system for freeway incident management in Republic of Korea", Transportation Research Part A 42, pp. 799-810, 2008
- 7. Samir A. Ahmed, M. ASCE, "Urban Freeway Traffic Management Technology", J. Transp. Eng. 1986.112, pp. 369-379, 2015.
- 8. Tian Xiaoge, "Application of GIS to Freeway Management System" GeoHunan International Conference, pp. 133-137, 2009.

