Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 08, August - 2017

Modernizing the Transportation Infrastructure of Hyderabad using ITS in Relation to Capacity Levels and Road Accident Severity

A Breif Insight into the Opportunities for Implication of ITS in Rapidly Developing Cities

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***Abstract*— The modern transportation has rapidly transformed due to the implication of electronics and communication systems into the Transportation infrastructure. This city of Hyderabad is growing at a very rapid pace into a Metropolis but is lagging behind in the efficient transportation facilities. The reason behind this lag is that the transportation techniques and methodologies are outdated. The best way to revive the transport network in this city is to upgrade it using Intelligent Transportation Systems. This concept being a wide variety concept, involves a number of parameters and application is case specific. The traffic in India is mixed traffic involving all kinds of vehicles ranging from a bicycle to a semi-trailer utilizing the same portion of the road. This has been the main cause for severe traffic congestion and the recently increased number of road accidents all over the country. Keeping this facts in view, the current paper discusses the implication of ITS and latest urban transportation technologies in relation with the Capacity of the roads and the Road accidents that have occurred in the city. A careful study of the road capacity is conducted to understand the exact reason of road congestion in the city, parallel to which the road accidents data is also collected and analyzed for the cause of the accidents. Once, the reasons are identified, ITS and urban transport technologies have been suggested to mitigate the ill effects and improve the transportation facilities.**

Keywords—ITS;Capacity; Road Accident Severity; Badennova; Roll Crash barrier, Glow markings, TSRTC Automation

I. INTRODUCTION TO ITS

The use of advanced technologies including information and communication technologies (ICT) or telematics, data collection and storage, navigation systems and others fall under the aegis of intelligent transport systems (ITS). The main aim of using such technologies in transport is to alleviate existing concerns including traffic congestion, air and noise pollution by enhancing data collection for addressing the transport-related concerns. Over the past two decades, India has established itself as a leader in information technology (IT). However, the subsequent economic boom has also resulted in an exponential increase in motorization, urban traffic congestion and deterioration of air quality in the Indian megacities.

A Technical Note of the World Bank named "ITS for Developing Countries" addresses the condition of ITS in developing countries, and discusses the long-term, society-wide benefits that ITS can provide surface transportation more affordable, more reliable, and more efficient Interest in ITS begins as computer systems start becoming cheaper and smaller. ITS got a major boost when communication technologies became much cheaper and reliable and computation capabilities expanded enormously. A opportunity for motor vehicle industry was put forth by ITS as it provide a base to increase value to their products in terms of safety and functionality. Large projects were launched with government-industry partnership.

The potential benefits of ITS applications are enormous for all concerned including users and providers of services, the Government and the public at large. There are benefits, for instance, technologies are:

- Improved safety of the transportation system
- Reduced congestion and improved mobility
- Enhanced economic productivity
- Reduced travel time
- Less government, traveller, and operator costs
- Improved energy efficiency and reduced impacts on the environment

II. REVIEW OF PREVIOUS WORKS AND STATISTICS

A. Intelligent Transporation Systems

Although the origin of formal ITS dates back to the 1970's the first ITS world congress in Paris, in 1994, catalyzed the development and application of ITS to develop and improve the existing traffic control systems in many countries around the world. Faghri and Hamad (2002) studied the use of GPS in traffic management. In their study application of GPS was involved in collecting traffic data such as travel time, speed and delay on 64 major roads in the state of Delaware. When mean and variance of the results obtained by both the methods were compared and no significant difference was observed. GPS data was found to be 50% more efficient in terms of manpower. Pre-trip information availability enhances the self-belief of the drivers to use freeways and allows commuters to make better-informed transit choices (Campbell et al., 2003). Zhang et al. (2011) in their study developed and tested a generic multimodal transport network model for ATIS applications. First, a

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 08, August - 2017

multimodal transport networks was modeled from an abstract point of view and networks were categorized into private and public modes then a generic method was used to construct a multimodal transport network representation by using transfer links which was inspired by the super-network technique.

B. Capacity of Urban Roads

The Indian Roads Congress through its publication (IRC: 86-1983) has recommended tentative capacity factors for urban roads for various mixed traffic conditions accommodating for traffic flow conditions. Frontage access control, parking of vehicles and crossing traffic. The concerted efforts in the research project entitled 'Road user cost study in India' have evolved certain capacity norms or different rural sections with degree of road curvature for various terrains, these have been worked out on the basis of speed-flow relationships under a set of prevailing road and traffic conditions. Ministry of Surface Transport in India has sponsored a research scheme titled 'Increase of Capacity of Roads in Urban Areas by provision of Adequate Lighting'. Sarna et al. developed capacity norms by conducting a location study in Delhi and Bombay in this study they used the results of speed-flow relationship urban roads and undivided roads were categorized broadly into two groups, normally divided roads and undivided roads.

C. Road Accident Severity

Global Safety Commission report (June 2006) says that the global road deaths were between 750,000 to 880,000 in the year 1999 and estimated about 1.25 million deaths per year and the toll is increasing further. About 4,07,025 were killed in road accidents in India in the year 2011. The road accidents have been majorly observed in the seven metropolitan cities which are Mumbai, Kolkata, Delhi, Chennai, Hyderabad, Bangalore and Ahmedabad contributing to about 21.5%. In our country road accidents occur every 1.2 minutes and a person is killed in every six minutes which sums upto 235 persons dying every day and 1243 get injured. Nearly sixty percent happen during night which hardly has 15% of 24 hour volume. Fajaruddin Mustakin et al. did his study on block spot study and accident prediction model using multiple regression linear models. The study area was Federal Route 50 Batu Pahat – Ayer Hitam. The results of this analysis were that the route has larger major junction density causing accidents. Statistical method was used by Yulong PEI et al. intending to provide insight into the general safety of highway safety and systematic contribution causing accidents. Kadiyali L.R. developed an accident model based on population and motor vehicle by using regression technique. He collected accident data for 20 years, population and number of motor vehicles in India.

III. SURVEY CONDUCTED AND DATA COLLECTION

To understand the nature and reasons of the traffic congestions and road accidents happening on a daily basis in the city of Hyderabad, we have conducted surveys and collected data regarding the capacity and the road accidents. Several major junctions where the congestions occur on a regular basis occur on a have been identified and studied. The accident data has been collected from the local police stations which are in relation to the above mentioned congested road stretches and are further explained in detail.

A. Capacity and Level of Service

The concept of capacity and level of service is of paramount importance in understanding the traffic characteristics. The traffic carrying capacity of different types of roads can be a yardstick to assess the degree of utilization and to determine the present as well as the future requirements for road improvement. When a road carrying traffic equal in volume to its capacity under ideal roadway and traffic conditions, the operating conditions become poor. Speed drops down and frequency of stops mounts up. It varies under different volumes of traffic. Level of Service is defined as the qualitative measure describing the operational conditions within a traffic stream and their perception by motorists or passengers.

Hyderabad Area Transportation Studies (HATS) reports have been studied carefully to get the necessary details regarding the city network. The following corridors have been identified to have high tidal flow patterns.

1. Khairtabad – Shadan college
2. Amberpet – Sri Ramana Theatre
3. Nanal Nagar – Langer House
4. Rail Nilayam – St. Ann's
5. Bhoiguda – Musheerabad
6. NMDC –Mehidipatnam
7. Malakpet – Chaderghat
8. Somajiguda – Hyderabad Public School

These mid blocks are identified to carry a reasonable capacity in Hyderabad city roads. The objective of this study is to evolve methodology for computing congestion and surveys have been conducted using the following three methods:

i) Physical inventory studies

Before understanding any improvement program, precise information on inventory is essential. The corridor has been measured for carriage width at every 100 metres and any significant changes have been noted.

ii) Traffic volume studies

a) The floating car technique has been used in the present study for acquiring traffic volume data and the following formula has been used:

$$V_n = 60\ (M_s + O_n - P_n)/T_n + T_s$$

Where,

V_n= Volume per hour northbound (for southbound, the subscripts have been reversed

M_s= Count of opposite traffic when test vehicle travelled south

O_n= Number vehicles overtaking the test car while travelling south

P_n= Number of vehicles passed by test car while travelling south

T_n= Travel time during north travel

T_s= Travel time during south travel

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Name of the link	T_n	T_n	M_n	O_n	P_n
Khairtabad-Shadan college	6.4	6.2	1366	114	128
Amberpet-Sri Ramana	5.5	5.7	594	53	24.5
Nanal nagar-Langer house	6.3	7.2	611	112	78
Rail nilayam-St.Ann's	9.7	9.8	709	96	82
Bhoiguda-Musheerabad	6.4	6.2	592	102	73
NMDC-Mehdipatnam	4.5	3.8	531	85	69
Malakpet-Chaderghat	7.3	7.2	1599	198	114
Somajiguda-HPS	7.2	6.5	1115	137.5	27.5

Average north bound trips in peak period

b) Spot speed is instantaneous speed of a vehicle at a given point. Speed is the basic measure of traffic performance and the spot speeds have various applications. They are the fundamental in traffic regulation and control, in establishing speed limits, determining safe speeds at intersections and curves, establishing length of no parking zones, timing of traffic signals, providing useful information on the proper location of mandatory, cautionary and guide signs and establishing speed zones. Two reference points marked at a distance of thirty metres and time taken to cross the distance between the points by a vehicle is noted using a stopwatch. Speeds are noted at fifteen minute interval during peak hours for different categories of vehicles. The speeds are then converted to KMPH and average of all modes is considered

S No.	Name of the mid-block	Speed – Flow equation	Q_{max} (Veh/hr.)	R^2 value
1	Khairtabad – Shadan college	S= -0,0034Q + 44.928	6607	0.7519
2	Amberpet – Sri Ramana Theatre	S= -0.0036Q + 43.471	6037	0.8872
3	Nanal nagar – Langer house	S= - 0.0032Q + 42.064	6572	0.8886
4	Rail Nilayam – St. Ann's	S= -0.0029Q + 45.811	7898	0.9021
5	Bhoiguda - Musheerabad	S= -0.0031Q + 43.407	7001	0.8378
6	NMDC - Mehdipatnam	S= -0.003Q + 44.953	7492	0.8923
7	Malakpet - Chaderghat	S= 0.0028Q + 44.89	8016	0.6970
8	Somajiguda - HPS	S= -0.0019Q + 36.466	9596	0.8601

Speed – Flow equations

B. Equations

The accident data was collected from the records kept by the state police department, national crime records bureau. Further accident data for north, east, west, south and central zones were collected. The data includes time, number of vehicles involved, severity, hourly and pedestrian involvement, etc. The zonal description and station limits are obtained through the police department along with the population details. Accidents which are located on any leg within 50 metres of a junction are considered as junction accidents. The nature of road environment is known to have a major influence on the occurrence of accidents. The starting point for the collection of road feature data was to produce list of various parameters which had been found to have significant influence on road safety from existing research, the following data points were collected:

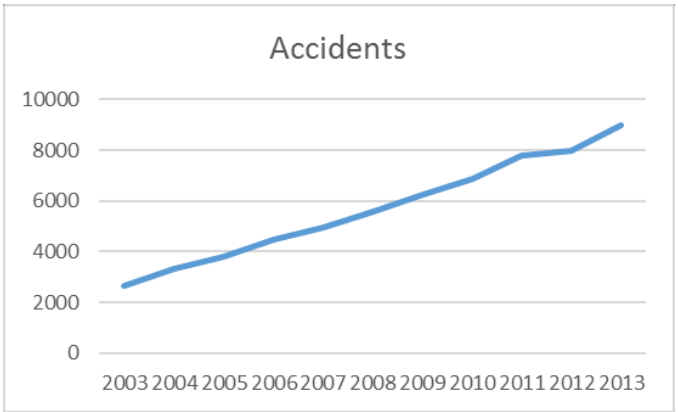
a) Road reference
b) Median type and presence of gaps in the median
c) Carriageway and surface condition
d) Number of lanes and width
e) Presence of road signs and road markings
f) Presence and quality of footpath

Year	Population	Vehicles	Fatalities	Injuries	Total
2003	3829753	930841	720	1950	2670
2004	4251025	995999	805	2515	3320
2005	4718693	1070700	902	2918	3820
2006	5284875	1151002	989	3481	4470
2007	5813834	1243082	1020	3950	4970
2008	6453356	1345015	1295	4295	5590
2009	7163225	1459341	1540	4700	6240
2010	7951180	1600120	1790	5076	6866
2011	8915692	1634600	1937	5523	7780
2012	9021481	1742834	2189	6289	7998
2013	10056160	1792139	2371	6854	8962

Road accident data for Hyderabad for the years 2003-2013

Month	2012		2013		Total		Total
	F	NF	F	NF	F	NF	
January	1	239	2	221	3	460	463
February	3	188	4	197	7	385	392
March	2	212	3	210	5	422	427
April	2	237	2	209	4	446	450
May	1	204	5	201	6	405	411
June	2	260	3	234	5	494	499
July	1	309	3	303	4	612	616
August	2	180	2	214	4	394	398
September	5	271	5	194	10	465	475
October	3	171	3	208	6	379	385
November	2	180	4	231	6	411	417
December	3	192	3	215	6	407	413

Accidents distribution in months



Type of Area	No. of Accidents
Near Educational Institutions	170
On Arterial Roads	1870
Near an Industry	200
Near a Religious place	40
In Bazaar	105
Residential Area	98
Office Complex	95
Bus stop	19
Encroached areas	23
Recreational places	33

Accidents distribution depending on location in year 2012 and 2013

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 08, August - 2017

Driver Age	No. of Accidents
0-10	0
10-20	7
20-30	492
30-40	750
40-50	457
50-60	159
60-70	44
>70	3

Accidents distribution depending on age in year 2012 and 2013

IV. ANALYSIS

The following inferences were absorbed after collected the above data depending on which the defects were identified to improve the transportation infrastructure of Hyderabad city.

A. Capacity and Level of Service

Surveys are conducted to evaluate the traffic parameters like speed and volume and selected peak volume for each mid-block. From the collected data capacity curves are drawn between speed and volume. From this curve the maximum capacity and free flow speed of each mid-block is obtained. It is observed that road width is proportional to capacity is as follows:

- For road width of 7-8 metres, capacity is 6721 vehicles/hr.
- For road width of 10-11 metres, capacity is 7890 vehicles/hr.
- For road width of 11-12 metres, capacity is 10140 vehicles/hr.

It is observed that for every one meter increase in road width, there is an increase in capacity of 850-900 vehicles/hr. The following are the salient features of the analyzed data collected through the field surveys:

a) The capacity of a road is definitely influenced by the width of the road, width of parking, percentage of trucks, buses, cars, two wheelers and other type of vehicles.
b) In the mid-blocks that have been studied through these surveys, the following had the highest of flows:
   i) Khairtabad - Shadan college
   ii) Malakpet - Chaderghat
   iii) Somajiguda – Hyderabad Public School
c) All these three mid-blocks had a common point, i.e. the nature of the traffic was mixed at all times of the day unlike only during particular times of day as in other mid-blocks
d) These sections had buses plying in heavy volumes, passenger cars, two wheelers and auto rickshaws are very constantly seen as these roads are joining a lot of trip attraction and trip generation places like Dilsukhnagar, Begumpet, Nampally, etc which are highly commercial centres.

B. Road Accident Severity

A total of 650 sq. kilometers area was studied for road accidents severity in this project and found that there were a total of 5672 accidents that occurred out of which 84 were fatal and 5588 were non-fatal during the years 2011-2013. After closely analyzing the accident data collected from the various police stations in the city, it was inferred that the, maximum number of accidents in the years 2011-2013 occurred in the west zone police stations. The west zones includes the regions of Banjara Hills, Gosha Mahal, Panjagutta and Asif nagar. All these are very highly populated areas of the city, but the infrastructure facilities are limited due to technical constraints like the maximum width of roads, very heavy and erratic order of mixed traffic, high violation of traffic regulations, insufficient parking facilities in all the areas in this zone.

The month wise accident distribution shows that the months of June and July had the highest accidents registered in a year. This is due to the fact that the monsoon season sets in during these months and there are sudden showers in the city. This decreases the visibility on the roads and improper geometric, drainage conditions worsen the situation even more. The mixed traffic utilizing the road is another cause as the two wheeler owners susceptible to getting drenched in rain, and so begin riding faster or take rash turns ultimately involving themselves in accidents.

Location wise accident distribution shows that the maximum accidents occurred on arterial roads, the number of which is more than the sum of accidents that have occurred in all other locations. The fact behind this scenario is that the capacity of the roads in the city vary very widely all over the city. The arterial road width usually changes every one kilometer in the city due to which the psychological perception of the road user needs to constantly adjust and may cause taking improper decisions in using the road. The arterial roads have bus stops included directly on the road due to which the congestions occurs very frequently and needs to be regulated.

Observing the data of age wise distribution, it is clear that the age group between 20 and 40 years have been involved in the highest number of accidents. The reason behind this scenario is that most of this age group involves in violation of many traffic rules and end up involving in an accident.

V. CONCLUSIONS

As the above study has clearly shown that the capacity of roads is insufficient to the number of vehicles plying on them and therefore the Level of Service is not acceptable. The traffic congestions happening on a daily basis on the city roads is a clear evidence of the failure of capacity. The foremost reason for this failure is the fact that, there was a population boom in the last decade which in parallel, increased the number of vehicles on city roads. The multiple modes of transportation that is in practice by the population of Hyderabad needs to be regulated in order to reduce these congestions.

During the study it has been observed that most of the congestions happen only during the peak hours i.e. morning and evening hours during which people commute to their location of business. The peak hour traffic can be regulated by utilizing automated signal control systems. This involves a central command center which analyzes real time traffic data and controls the traffic signals accordingly. The amount of traffic flowing into a junction is picked up by a sensor installed on the road which feeds the count to the command center. A powerful computer analyzes the data as to how much volume is flowing in and what should be signal cycle times to ensure a free flow. It also sets the timer on the next signals where the traffic is approaching in accordance with the previous signal

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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time and traffic volume at that junction. If necessary the traffic zone can be isolated in case of any mishaps or emergencies.

Parking facilities are scarcely seen in heavy traffic locations due to which the road user parks the vehicle on the pavement adding to the existing congestion. Hence the parking facilities information needs to ne dynamically available to vehicle user so that they can utilize the available facilities. This can be achieved by automation of parking facilities and zones. This involves a dedicated information system that integrates all the parking facilities available and provides data to the user. This involves a sensors that sense occupancy of a defined parking location which a user can check and if available can be used by the vehicle owner. A mobile application is a best way to communicate information to the user.

The most utilized public transportation facility is the Bus service run by TSRTC, abbreviation for Telangana State Road Transport Corporation. There are a lot of buses that run round the clock but still lack in service to the customer. We usually encounter scenarios wherein the bus is sometimes overly filled and sometimes very empty, due to which the corporation is running itself into losses. Optimizing the number of buses required based on the projected occupancy of a bus in a particular route can dramatically change the face of this public transportation. This process involves digitization and automation of TSRTC services. A mobile app needs to be developed which can facilitate purchase of tickets, real time location of the desired bus. This helps the user in tracking which bus would come at what particular time exactly and will plan his travel accordingly. This can be achieved by using the GPS service on the smartphone of the bus driver. The location of the smartphone obviously indicates the bus that a driver is driving and this signal information is fed to the server on a minutely basis. The server is pre-fed with the service number of that bus, the route that it travels in. The user enters the desired bus route or number into the mobile application which then provides the exact location of the bus and he can plan the journey accordingly. Since, ticketing system is also integrated into application, the user can purchase it hassle free. Depending on the number of tickets through the application projected occupancy can be forecasted and number of buses in that particular route can be optimized.

The road accidents have been observed to happen at the junctions and due to over-speeding. The enforcement methodologies need to be up scaled and ITS needs to be implemented to effectively curb the violations thereby reducing the accidents on the city roads. ITS has helped improve the road user safety all over the western countries and will be a very rational solutions for this city's goodwill. Use of speed tag cameras is the primary and most effective method enforcing any violation on the roads.

Badennova is a speed control device that could be very effective and functional in curbing them. The Badennova speed bump consists of a gel filled in a heavy duty plastic material which can be laid or affixed onto the pavement. The gel has a special property which hardens upon impact and then relaxes back. The molecules in the gel stiffen out if loaded suddenly and if loaded normally, reacts as any other random gel i.e. displaces slowly and regains. Using this property, if a vehicle tire interacts with the speed bump slowly, it displaces the liquid under the contact area and feels as if the vehicle did not travel over any bump. At the same time if the tire suddenly impacts onto the bump, the liquid in the bump hardens and behaves like a regular speed bump thereby regulating over-speeding vehicles.

Self-illuminating road marking paint is a smart innovation where the paint used to mark the boundary and control lines of a pavement, glows in the dark all by itself. This is a useful technology for implying in rural and low volume roads as they need to be constructed with the lowest possible cost of construction and give maximum durability. These markings when painted with the glow paint won't need a light source to reflect or shine. This feature helps in increasing the safety of that particular road, both for vehicular and pedestrian traffic. Low volume roads are usually not lit well or sometimes not lit at all which makes travelling on these roads almost impossible during night times or when the natural light fails. With the lights mounted on the vehicle, a person can see only upto a certain distance after which it is very dark, hence can't predict what is the geometry of the road unless very close to the actual spot. This has become a major reason for accidents in villages and towns across India and needs to be curbed at the earliest. The glow paint proves to be a logical solution for this condition.

Rolling crash barrier is an improvement to the conventional barriers used on the road boundaries as a safety measure. The conventional crash barriers lack in strength and safety mechanism as it is unable to reduce the number of deaths occurring even the vehicle is being stopped. Keeping this fact in mind, the rolling crash barrier has been developed, which not only saves lives but also reduces the vehicle damage comparatively. In case of a conventional crash barrier the vehicle either comes to a sudden stop or breaks through the barrier and goes across it. When a vehicle stops suddenly, the momentum of the vehicle becomes zero but the occupants momentum is still the same due to which they get hit in the vehicle itself and face severe injuries leading to death. However, the rolling crash barrier, in contradiction diverts the vehicle in such a manner that the momentum is carried on while the vehicle travels along the barrier and gets scraped to it until it stops. This feature protects the occupants of the vehicle getting hurt severely and prevents the vehicle from collapsing, thereby reducing the number of deaths.

REFERENCES

[1] Mulay, S. A., Dhekne, C. S., Bapat, R. M., Budukh, T. U., & Gadgil, S. D. (2013). *Intelligent City Traffic Management and Public Transportation System.* International Journal of Computer Science Issues, 10(3), 46-50.

[2] Winnett M A & Wheeler A H (2002) Vehicle-activated signs – a large-scale evaluation, TRL Report 548.

[3] M A Chowdhary and A Sadek. Fundamentals of Intelligent Transportation systems planning. Artech House Inc., US, 2003.

[4] Bishop R. (2000) Intelligent vehicle applications worldwide. IEEE Intelligent Systems And Their Applications. **15**, 78-81. [A review of vehicle based systems in use and future prospects]

[5] Ramesh, R., Ezhilarasu, Y., Ravichandran, P., & Prathibha, S. (2012). *Regulating Bus Management System Using Cloud Platform.* International Journal of e-Education, e-Business, e-Management and e-Learning,

[6] Balaji, P. G., & Srinivasan D. (2011). Type-2 Fuzzy Logic Based Urban Traffic Management. Engineering Applications of Artificial Intelligence, 24, 12–22.

[7] The Future is now - ITS technologies to ease congestion and improve safety Japan Auto Trends September 1999