USE OF GIS FOR OPTIMAL MANAGEMENT AND REDUCTION OF AIR POLLUTION LOAD FROM TRANSPORTATION NETWORK IN HYDERABAD

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ABSTRACT

Hyderabad city is experiencing rapid growth and transportation issues have assumed critical importance. Only an integrated and sustained campaign that combines the transportation planning with Land use in the longer term, development of transportation infrastructure in the medium term will able to address this issue comprehensively. The present paper highlights an integrated research designed to understand the relationship between Land use and transportation and presents how transportation related alternatives might be used in the region to accommodate the growth and the demand for travel while holding down the pollution load of transportation.

It is observed that the total number of vehicles in Hyderabad increased by 273.9% during 2003 compared to 1987. Total mile of travel (VMT) in the Hyderabad increased by 45% since1980 to 1997. The analysis showed that the compound growth rate of all vehicles in Hyderabad stands at an average value of 10%. But the relative growth of all vehicles differs widely. The highest growth rate of 24.61 percent has been shown for motorcars for the whole period of 16 years even though its share in total vehicle population has increased only 0.79 percent (from 3.9 percent in 1984 – 85 to 4.69 in 2002 – 2003).

The road network of 373 road codes and 1,907 road segments corresponding to an average of about nearly 5 road segments per road code has been established. In order to display street names, a database with road codes and street names was established based on the address database. The spreadsheet with road and traffic data included street width, travel speed and low traffic load of the various categories. The average distribution of traffic performance according to vehicle categories on the road network was calculated for passenger cars, vans, Lorries and buses. Finally pollution load from different vehicular strength for each proposed transportation alternative (ring roads, bypass road) are studied.

INTRODUCTION:

Rising incomes combined with a demand for greater personal mobility and inadequate public transport are likely to result in a pronounced increase in automobile (scooters, motorcycles, mopeds and cars) ownership and use, particularly in the metropolitan cities of India, each comprising over 1 million people.

In the context of HUDA master plan for the year 2020 amongst the strategies, managing urban growth has received attention, with transportation as a critical element in the infrastructure development[2]. The transportation management strategies include development of road network infrastructure in the form of express ways, inner and outer ring roads.

It is therefore imperative to study the impact of each proposed alternative on the nature and magnitude of air pollution emission load in the city relating to energy demand under alternative strategies. The suggested strategies are: (a) strengthening public transport to reduce urban congestion (b) intersection geometry improvement (c) Road widening (d) grade separations (e) parallel roads (f) Railway barriers RUB/ ROB' s at

major River and railway crossings and (g) promoting cleaner and alternative fuels and improved engine technologies.

METHODOLOGY:

For studying Landuse and Trasporation an extensive survey of major educational, employment, commercial and shopping centers, recreational places and residential locations were identified using GPS. The relative densities of each activity for each location were calculated for each zone. Trip attractions are estimated based on land use and employment, shopping and recreational activities within each analysis zone. For the calculation of the trip attraction weightings were assigned to each particular trip attracting activity. Preference has been given to Governmental institutions, educational centers, medical facilities and industries in different regions. Weightage were assigned after studying the relative importance of each activity. Weightage ranging from 1 to 0.25 has been given to each category, with least preference being given to recreational centers and parks.

For calculation of emission load from the transportation sector a coherent geo-coded road network with assigned road and road traffic data has been established[3]. Road network was divided into road segments using GIS platform. Road segment is uniquely defined by its road code and the road segment as shown in figure 5.12. The road network has 373 road codes and 1,907 road segments corresponding to an average of about nearly 5 road segments per road code.

In order compute the impact of new roads on the emission reduction scenario, the proposed new road segments were added to the existing road network; each particular route is identified and assigned a code.

The corresponding emission loads are calculated using emission model. The relative dispersion of carbon monoxide under different test scenarios is assessed using Caline4 model[4].

RESULTS & DISCUSSION:

Hyderabad city has witnessed a huge percentage increase in person miles traveled relative to the changes in other variables. The increase in households from 1981-1991 far exceeded the increase in percentage population. However, a significant fraction of the households size i.e. persons per house, decrease also arose from the duller source of declining birth rates. The increase in households is significant because trip rates have historically been more strongly correlated with the number of households than with the numbers of people. It can be correlated that during 1981 minimum number of person-traveled trips included nearly 103454 trips whereas during 1991 the number has increased by almost 1000 fold increase to 1678842 trips per day.

Land use – Transportation model:

An extensive study of the land use and vehicular data and an attractive index is developed. The index is computed using land use density for each category in the zone of analysis and correction attraction factors, through trial and error method. The regression studies yielded an intercept value of $y = (10755x + 15552)$ for the future projections, where x is the index value. It is observed that the present regression equation holds true for low attraction values computed. Figure 1 shows the attractive index and the observed traffic at selected locations in Hyderabad. Figure 2 shows the corresponding pollution load for the year 2020, which has shown to increase by a factor of 8 the present pollution load in Hyderabad. The worst case wind

angle carbon monoxide concentrations are shown in figure 4.

Strengthening public transport system and construction of new roadways:

The major thrust is to integrate various modes and to develop multi modal transportation system to avoid flooding private vehicles for regular commutation in the cities. The proposed road network is observed to reduce the present day emission load by nearly 12%.

Impact of brides over river Musi:

To relieve the funneling effect several new bridges at eight places over river musi has been proposed. Presently brides are available at eight places across river musi at various points. Figure 3 shows the impact of proposed bridges on emission loads. For studying the impact of bridges over river musi, the average road capacity of the road network is calculated from the existing lane width and dimensions of the road. The significance of congestion on vehicular speeds was computed. Then the corresponding pollution load for the lane was computed emission equation describe in previous chapter.

The reductions in the emission load during peak hours at Nalgonda X roads and Chaderghat areas are predicted to be more with the development of more bridge at different points across river Musi. It is observed that these developments around the river will reduce the pollution load by nearly 40 – 70% at Chaderghat area with the thickening of traffic along the link during the peak periods of the day. The peak hour pollution load from 88gm/hour is reduced to 23gm/hour at the link.

3. Intersection geometry improvements:

One of the major contributors for reducing the efficiency of free flow of traffic is the performance of intersections. This is an area of immediate intervention

that can be implemented with marginal investments and where improvement in the performance can be felt. Hyderabad has about 386 intersections, out of which 224 are manned and 162 unmanned. Based on the available intersection flow information and the observed delays about 50 intersections have been identified that need immediate attention.

4. Bus bays and pedestrian crossings:

Frequent weaving movements of buses in busy corridors have a significant effect on the speed of traffic. Further, stopping buses in the face of traffic at bus stops tends to block the traffic moving on the left lane. Figure 4 shows the major bus stoppage points in Hyderabad and recommendations for changed locations. It is observed that major bus bays at locations such as Masabtank, Sadan College, Lakdika Pool towards Koti at Dwaraka Hotel, Chaderghat stop do not have proper bus bays, the proper identification for provision of convenient stoppages for buses without inconveniencing the traffic following will be a major factor in facilitating transport problems.

6. Rescheduling of work activities:

Rescheduling of work activities will allow the sudden increments of traffic on roads, for example it has been observed that at many places in Hyderabad the closure of schools and the end of cinema shows coincides releasing more traffic to the roads causing traffic congestions. Model has been developed in to study the areas where rescheduling of work is needed under HUDA limits. The factor for rescheduling of the work schedule is calculated using road capacity and the time duration during which the traffic is released and the number of sensitive areas around the place.

Figure 5 shows the areas where rescheduling of work activities is needed for reducing the traffic and pollution potential. The relative rescheduling factor is

identified using the unity of road length, number of educational centers and cinema theaters around 1km^2 areas. Rescheduling the work activities at places such as Nampally, Abids and Narayanaguda, RTC X Roads, and Secunderabad paradise area will be highly useful to reduce the unnecessary traffic congestions.

CONCLUSION:

Present trend indicates that while rapid development is taking place along the transportation corridors in the form of ribbon development, considerable amount of growth is taking in the form of gradual increase in the interior areas of the municipalities in Hyderabad city making transportation options difficult to implement.

Simulation studies carried in the present paper will help the planners and transportation engineers and environmentalists in providing the environmental pollution burden and the means by which each proposed alternative affects.

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3. Min-Der Lin, Yung-Chang Lin, "The application of GIS to air quality analysis in Taichung City, Taiwan, ROC, Environmental Modelling & Software 17, 11–19, (2002).
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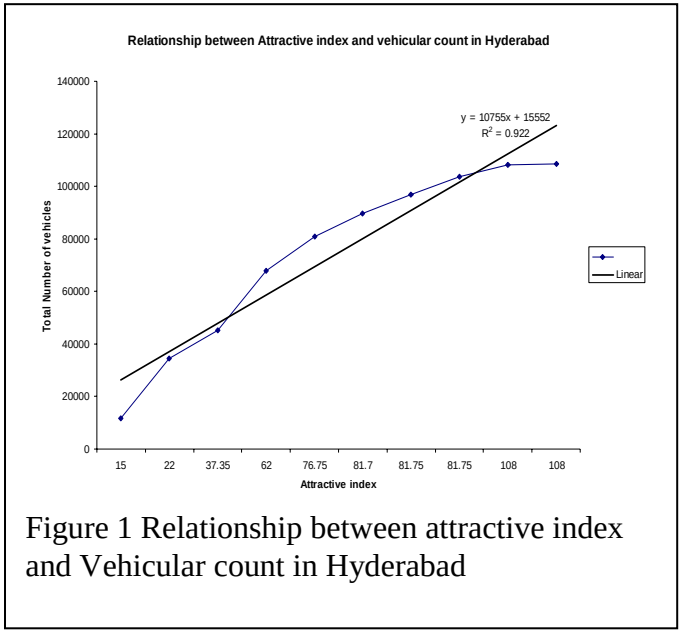

Figure 1 Relationship between attractive index and Vehicular count in Hyderabad

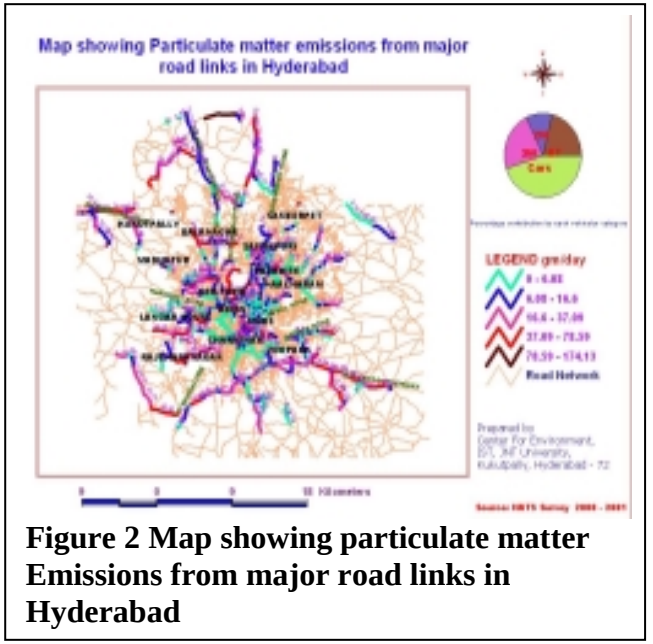

Figure 2 Map showing particulate matter Emissions from major road links in Hyderabad

Figure 3 Impact of bridges over river Musi on the pollution levels

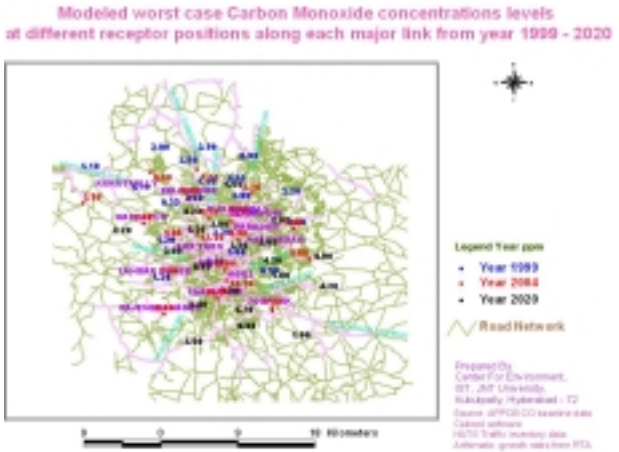

Figure 4 Modeled worst case carbon monoxide concentration levels at different receptor positions along the each major link from 1999 – 2020

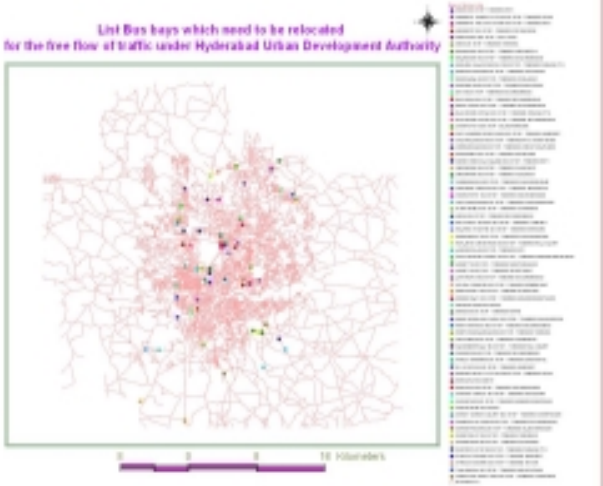

Figure 5 List of bus bays which need to be relocated for the free flow of the traffic

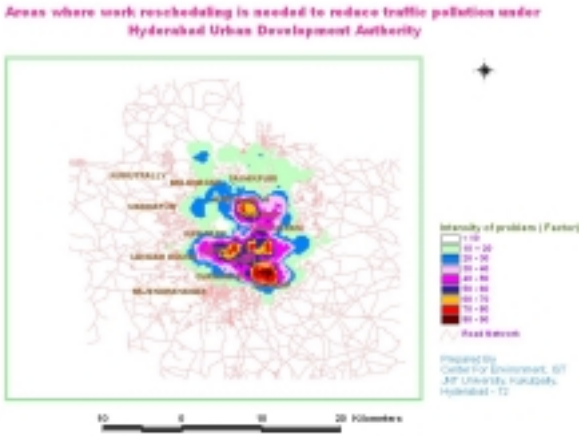

Figure 6 Areas where work rescheduling is required to reduce traffic pollution during peak hours of the day