

ROAD NETWORK CHARACTERISTICS AND ORIENTATION – DESIGN LEADS IN URBAN AREAS

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ABSTRACT

Road network in the urban areas constitutes one of the essential infrastructures for the development of the city and also to meet the demands of the people. In the current scenario of the traffic in many parts of the world the road users are facing problems of mobility, accessibility and connectivity within a road network. With the rise in population and advancement of technology, an increase in the travel demand has been observed and subsequently the facilities pertaining to transportation have also increased.

As the cities are growing at a rapid rate with reference to Business, Commercial, Educational and technological aspects, the land use pattern is also getting promoted to decentralized activities of business, educational and residential. Due to this the functionality of the road is changing but then the geometrical condition remains same which leads to many urban traffic issues. In short the traffic has become dynamic but the network characteristics have become static.

As there is a rapid increase in traffic volumes which are almost all equal to or sometimes exceeding the capacity of the road the level of service is falling down. With regard to the twin cities i.e. Hyderabad and Secunderabad of the Telangana state in India the geometrical conditions are according to the standards providing all the facilities, they are being mis-used by the roadside business activities.

To improve the existing infrastructure it is required that the network be analyzed on different parameters – Accessibility, Mobility, Connectivity, Self –Similarity (Visualizing the fractal view) and etc. By keeping these points in view an attempt is made in this paper to analyze the different characteristics of Urban Road Network.

As part of the present study, existing road network of different study areas were captured and orientation of each link is studied and subsequently Transverse Corridors and Longitudinal Corridors as the case may along with the feeder roads to increase the functionality of the sub-arterial roads are proposed.

Keywords: Fractal View, Feeder Roads, Network Characteristics, Network Orientation, Transverse corridors, Road Network

I. INTRODUCTION

Transportation occupies a high place in modern life. Advancement in all spheres of life has been to a large extent influenced by transportation. Road Transport plays a vital role in the social and economic development of any country. Transportation is very essential for the economic development of any region since every

commodity which is produced and every service that is rendered produces warrants for transport at production & distribution stages, the inadequacy of which retails the socio-economic development of the country. This transportation is carried out on a specific guided path known as network.

Utilization of land by different activities is promoting complex interactions, which are non-uniform in a time frame over a specified space occupation. The citizens are facing the problems of overcrowding which is the result of high intensity of the residential land uses which is reflected in the density of houses, households, populations etc. In most of the Indian cities people try to live as close to the city centre which is modified by other factor such as accessibility and different social economic status and so forth.

One of the most serious deficiencies of India's Urbanization is having important bearing on social economic progress relates to excessive concentration of economic activities in few urban centers. This results in urban disharmony, disarray leading to inefficient working of the entire transportation system. Urbanization provides the necessary infrastructure for trade, commerce and industry. Urbanization attracts the surplus labour force from the rural areas and utilizes it in the running the various service which are vital to the existence of town. In advanced countries and at abroad, the level of urbanization is rather high.

1.1 Need of the study

In an efficient road network, configuration is an essential ingredient for any region to promote the economic development of the country. As the traffic is increasing day by day in the cities, but the geometrical conditions and the network of existing road are not given due consideration to improve the traffic flow condition. Due to the increased traffic, speeds are falling down. The space provided for specified purpose is not utilized for that. In this context if the existing road conditions are improved like widening of the roads, restricting the road side business activities, providing on street parking facilities and footpath facilities for pedestrians etc, traffic flow conditions can be improved.

1.2 Objective of the Study

The Scope and Objective of the present study is as follows:

- Visualize the Fractal View
- What should be done to promote accessibility in the network?
- What should be done to promote moderate connectivity among the number of gateway?
- What should be done to promote access for mobility in the study area

II. METHODOLOGY

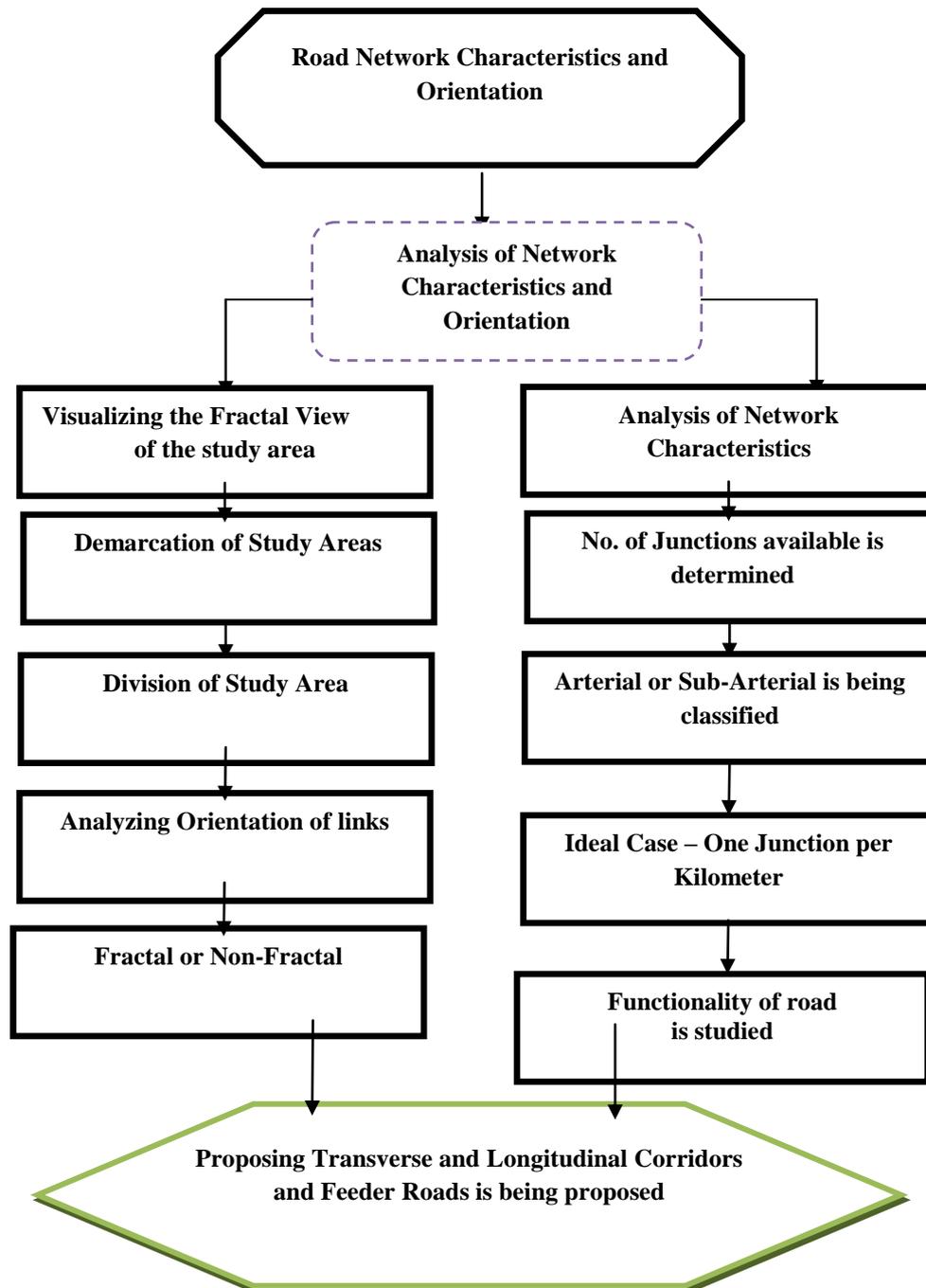


Fig 1. proposed structure of research methodology

III. LITERATURE REVIEW

- Road networks can be defined as series of nodes and links which represents spatial locations and connections exhibiting geometric variations and topological variations. As part of research many researchers have done contribution by making base of these two factors and then introducing higher attributes such as spacing, shape , orientation and geometric patterns.

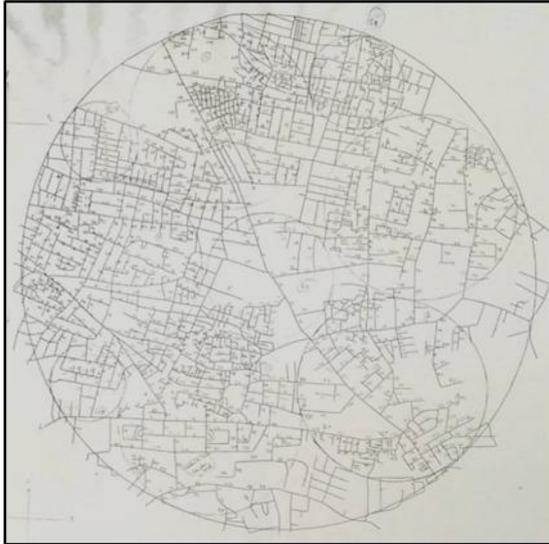
- In the past i.e. early 1960s network characteristics and structure were measured by geographers and transportation researchers (Garrison 1960, Marble 1962 and Kansy 1963) by using graph theoretic network analysis constrained by limited data.
- Attempts have been made in the past for implementing the concepts of fractal dimension in road network by Hausdrauff 1919 and Richardson 1961. Subsequently these concepts were more developed and made firm by Mandelbrot in the year 1967 who stated that if a straight line or a plane is absolute with Euclidean dimension having fractal dimension 1 or 2, then the spatial objects such as sea shore which bends in the plane will have a fractal dimension between 1 and 2.
- With the introduction of various travel demands models researchers (Newel 1980 and Vaughan 1987) have explored about how the traffic flows and travel pattern are affected by various geometric network structures.
- Later in 1987, Batty and Longley attempted an analysis on Urban Road Networks and then Batty and Xie in the year 1996 have analyzed fractal dimensions of urban form and growth. They calculated three types of urban fractal dimensions based on city size, shape, and scale. Batty and Xie (1999) further examined the fractal space filling process by using the concept of self-organized criticality of road network.
- In late 1990's and early 2000's many researchers have contributed something in correlation of before in which Garreau, et al. (1991) Edge city suggested that suburbanization has gone so far to form new points of concentration outside the downtown both in developed and developing countries such as India.
- Harris 2001, Braun, et al 2005, and Dong et al 2006; El-Geneidy and Levinson, 2006 all these have formulated accessibility based evaluation models with the combination of mobility and landuse factors. In the same year El-Geneidy and Levinson 2006 have defined the Access to Destinations study using detailed data on land use, travel behavior, and population demographics to evaluate accessibility in a particular situation.
- These studies have focus more on the fractal nature of a specific element of urban transportation network which have given formulations and empirical results revealing the fractal nature of urban road network, they are not systematic in the sense that cities were not selected according to population, size or extent. In view of this we can say that the results are not complete and less useful in urban networks and it is evident that the fractal dimension has been an integral part of fractal geometry in particular to the distribution of road network.

IV. DATA COLLECTION AND DATA PROCESSING

Hyderabad is the capital and largest city of the southern Indian state of Telangana located at 17.3667° N, 78.4667° E. It occupies 650 square kilometers (250 sq mi) on the banks of the Musi River. Its population is 6.8 million, and its metropolitan area increases that number to 7.75 million people, making it India's fourth most populous city and sixth most populous urban agglomeration.

Three National Highways pass through the city: NH-7, NH-9 and NH-202. Five state highways, SH-1, SH-2, SH-4, SH-5 and SH-6, either begin at or pass through Hyderabad. As of 2010, maximum speed limits within the city are 50 km/h (31 mph) for two-wheelers and cars, 35 km/h (22 mph) for auto rickshaws and 40 km/h (25 mph) for light commercial vehicles and buses.

Ameerpet



Nizampet

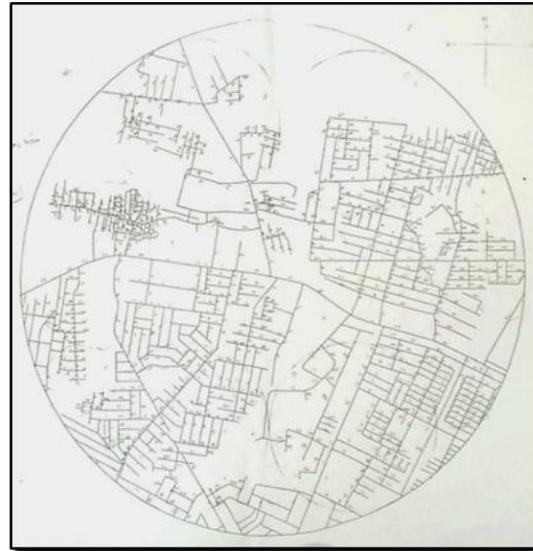


Fig – 2 Study Areas : Ameerpet and Nizampet

4.1 Study Area – 1 Ameerpet

- An area of radius 1.25 Km from the Ameerpet Junction constitutes the study area.
- It extends from LIGH Park near ESI Balkampet Road in NORTH to Banjara Hills Road No 3 near Muffakham Jah College of Engineering & Technology in SOUTH.
- It extends from Yousuf Guda Check Post ESI in WEST and Begumpet Post Office at Begumpet in SOUTH
- It includes many commercial business districts, Education Institutes and Residential Colonies apart from the recreational centers and many Government Offices like HUDA, BSNL, Electricity office etc in its vicinity.
- Many traffic generation and attraction centers exist in the area like Government offices. Apart from this the arterial roads feeds the thorough traffic from Khairtabad, Errum Manzil, Punjagutta, Ameerpet, S.R Nagar, ESI and Kukatpally via public and private transport systems.
- Arterial and Sub-Arterial Roads in the study area are Non-Functional because junctions are located at shorter intervals resulting into the formation of many mid-blocks. Absence of feeder road at many places is leading the arterial & sub-arterial roads non-functional.

4.2 Study Area – 2 Nizampet

- An area of radius 1.25 Km from the Nizampet Junction constitutes the study area.
- It extends from Metro fireworks near CBCID colony main road in WEST and Dharma Reddy colony in EAST
- It extends to Nizampet Road Amber Cheruvu in NORTH and MIG in SOUTH
- It includes many commercial business districts, Education Institutes and Residential Colonies apart from the recreational centers.
- Many traffic generation and attraction centers exist in the area like JNTU, Shopping centers etc. Apart from this through traffic flow on the Nizampet X Roads converging from Ram Naresh Colony, Brindhavan

Colony, Vasantha Nagar, Aditya Nagar, Pragathi Nagar, Tulasi Nagar towards Hitec City Roads exist in the study area.

- The type of traffic in the study area is mixed type which includes public as well as private transport systems.
- Arterial and Sub-Arterial Roads in the study area are Non-Functional because junctions are located at shorter intervals resulting into the formation of many mid-blocks. Absence of feeder road at many places is leading the arterial & sub-arterial roads non-functional.

4.3 Fractal View of Study Area – I (Ameerpet) and Fractal View of Study Area – II (Nizampet)

The complete study area - I is divided into following nine circles: The complete study area is divided into following ten circles:

Table 1. – fractal data of the study areas

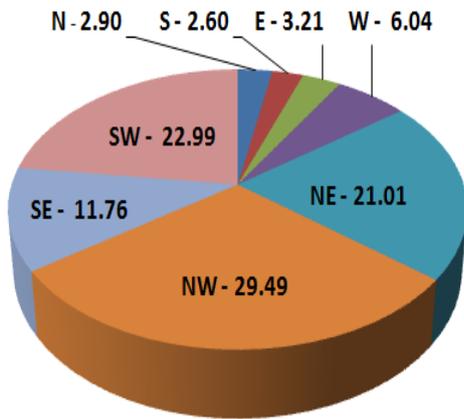
Ameerpet				Nizampet		
S.No	Circle No	Diameter (KM)	Area (Sq KM)	Circle No	Diameter(Km)	Area (Sq KM)
1	Circle 1	0.87	0.60	Circle 1	0.78	0.48
2	Circle 2	0.87	0.60	Circle 2	0.34	0.09
3	Circle 3	0.87	0.60	Circle 3	0.78	0.48
4	Circle 4	0.87	0.60	Circle 4	0.34	0.09
5	Circle 5	0.87	0.60	Circle 5	0.78	0.48
6	Circle 6	0.38	0.11	Circle 6	0.78	0.48
7	Circle 7	0.38	0.11	Circle 7	0.78	0.48
8	Circle 8	0.60	0.28	Circle 8	0.78	0.48
9	Circle 9	0.43	0.15	Circle 9	0.78	0.48
10	-	-	-	Circle 10	0.34	0.09

4.4 Analysis

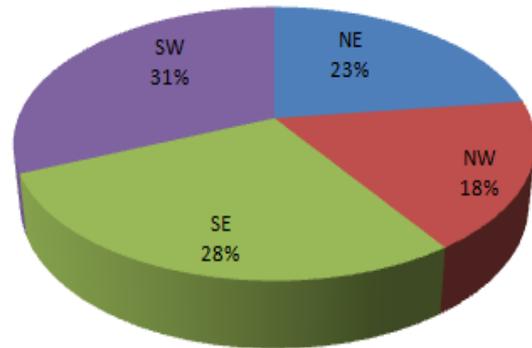
Table 2. – fractal analysis of the study areas

Fractal Analysis of Ameerpet				Fractal Analysis of Nizampet			
S.No	Direction	Counts	Percentage	S.No	Direction	Counts	Percentage
1	N	38	2.90	1	NE	201	22.95
2	S	34	2.60				
3	E	42	3.21				
4	W	79	6.04	2	NW	147	17.55
5	NE	275	21.01	3	SE	233	28.12
6	NW	386	29.49				

7	SE	154	11.76	4	SW	252	31.38
8	SW	301	22.99				



Study Area – Ameerpet



Study Area - Nizampet

V. CONCLUSION

Urban road networks are being concentrated mainly a present for the analysis of their characteristics. Recently it has been observed that number of interdisciplinary approaches and fast developments of new analytical methods. Certain pockets of the urban areas cannot be planned geometrically using the concepts of Euclidean geometry unless an entire network is considered on a large scale. The main reason behind this is that the Urban Road Networks have got distinct characteristics of fractals which include irregularity, Scale-Independence and self-similarity. Hence it can be stated that the urban road network can be considered as fractals and can be analyzed in fractal geometry.

The measurement of the structure of the urban road network which includes topologic, geometric and large scale statistic attributes needs to be given more attention.

5.1 Study Area – 1 (Ameerpet)

1. The Land Use patterns of the Study Area – I (Ameerpet) comprises of Commercial Zones, Residential Zones, Industrial Zones and other recreational Centers apart from many Public buildings which serves as main attraction centers attracting traffic from many parts of the city. The Density of road in these area is 20 Km/ 1 Sq Km
2. Orientation of the links in different direction are as given in Table 2 which illustrates that the orientation in a particular direction is uniform and Fractal but, if it is considered on overall basis the network is Non – Fractal.
3. The functionality of the existing network is poor due to the presence of many junctions at irregular intervals which has resulted the sub-arterial and arterial roads non functional. Feeder roads are proposed to enhance the functionality of the road network in the study areas. These feeder roads will not only carry huge volume

of vehicular traffic but also reduce the no of junctions to 1 per kilometer stretch. (Considering that the present study area comes under urban corridors one junction per one kilometer may assume to be suitable.)

4. Proposed Transverse corridors are uniformly spaced at an interval of 1 KM.
5. Colonies or the residential areas are established in to the vicinities which are rich in their past that is “The Heritage” hence the road network have originated from these areas. With the advancement of technology and the rise of industrialization & increase in population many “Industrial Areas” have developed which has seriously influenced the orientation of the Road Network. Ultimately, these changes have resulted in to formation of heavy Central Business District in a span of time frame (may be 20 to 30 years) which has again altered the orientation of the Road Network

5.2 Study Area – 1 (Nizampet)

1. The Land Use patterns of the Study Area – I (Ameerpet) comprises of Commercial Zones and Residential Zones, which serves as main attraction centers attracting traffic from many parts of the city. The Density of road in these area is 20 Km/ 1 Sq Km
2. Orientation of the links in different direction are as given in Table 2 which illustrates that the orientation in a particular direction is uniform and Fractal but, if it is considered on overall basis the network is Non – Fractal.
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4. Proposed Transverse corridors are uniformly spaced at an interval of 1 KM.
5. Colonies or the residential areas are established in to the vicinities which are rich in their past that is “The Heritage” hence the road network have originated from these areas. Within a span of time frame (may be 20 to 30 years) development of many residential apartments, shopping centers have altered orientation of the Road Network

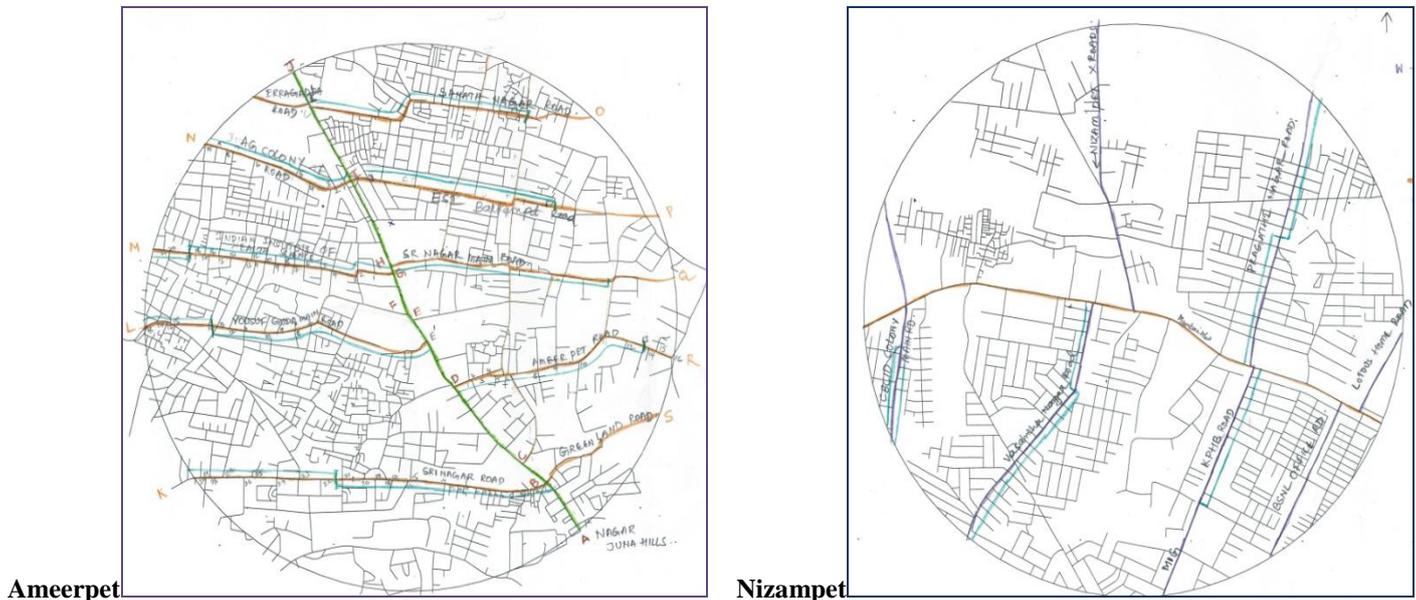


Fig – 3 Proposed Transverse and Longitudinal Corridors

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