

Road Transport Network Analysis of Hinthada District, Ayeyarwady Region

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Abstract

“Transportation is a measure of relations between areas and therefore an essential part of geography” (Ullman, 1954). Transport network development is considered to be one of the keys to rapid modernization and development, especially for better traffic efficiency. Other than the dense network of roads in cities, roads are often built in suburban areas to accelerate the development and economic growth of these areas. The study of the network includes an analysis of intersections (nodes), density of roads, and accessibility. The laying of roads is usually decided by political, social and economic factors, and it is not well-balanced by natural conditions. As a consequence, problems are often faced from rain, flood, etc. The aim and objective of this paper is to study transport network of roads in Hinthada District of Ayeyarwady Region. The density of roads nodes and connectivity were compared with relief and drainage. Township boundaries superimposed over the map and relative position of each township with reference to network of roads are studied to develop the transportation network in the region. From the analysis, it is found that the lowland area is well-connected with road network and the western hilly region has low connectivity and accessibility. Relief and drainage play as dominant role in the road network development in the district.

Key words: road transport network, nodes, arcs, connectivity

Introduction

“Any one making a journey has a number of decisions to take. All kinds of things have to be considered before it is decided to make a journey, or one journey is chosen in preference to another.” (Robinson, 1976). The factors mentioned above include the purpose of journey, mode of transport, the route if a number of routes are available, type of vehicle, etc.

There are a number of planners, researchers, engineers and others who have some different parts of the country and the world to analyse the behaviour of transportation in different contexts using different methodologies. Some of the works are Ullman (1954), Kansky (1963), B. Rajagopal (1976), G. Ramaswami (1976), etc.

“Transportation is a measure of relations between areas and therefore an essential part of geography” (Ullman, 1954). Transport network development is considered to be one of the keys to rapid modernization and development. Transportation is the factor, which determines the speed of growth and development of a place. Transportation literally means to carry some thing from one place to another. Roads and its network only are considered in this research paper. The settlements in Hinthada District are found along the roads as linear / ribbon pattern. The pattern gives an additional emphasis on the roads. It is an observed fact that road junctions in Hinthada District are centre of development. The number of road junctions is the sole criteria for the development of the region.

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Aim and Objective

Geographer studies transportation as an aspect of the organization of area and focuses his attention on the spatial structures formed by different modes of transportation and attempts to understand the processes that have created them because of its pervasive effects on any region studied. Organization of every region is reflected in its transportation network as well as in the less visible networks of trade, communications, political ties, and social orientation. This research paper aimed to study road network in Hinthada District of Ayeyarwady Region. Districtwise study has been made to analyse the characteristics of road transport network in Hinthada.

Study Area

The area selected for this study is Hinthada District in Ayeyarwady Region. It is the northern most district in Ayeyarwady Region. It extends between 17°20' N and 18°31' N latitudes and 94°47' E and 95°48' E longitudes. The district is located far away from the administrative capital of the region and this is one of the major factors for the backwardness of the district in developmental activities. The district consists of six townships, namely, Kyangin, Myanaung, Ingapu, Laymyethna, Hinthada and Zalun. Hinthada District is bounded on the north by Padaung Township, while on the east the Ayeyarwady River serves as a boundary between Monyo and Shwedaung Townships. On the southeast the boundary is marked by Taikkyi Township (Yangon Division) and on the south by Danuphyu Township (Maubin District), Kyonpyaw and Ngathaingyaung Townships (Patheingyi District). The western boundary follows the water divide of the Rakhine Yoma (the Rakhine Mountain Range) throughout its whole length. On the other side of the Yoma lies Gwa Township (Thandwe District).

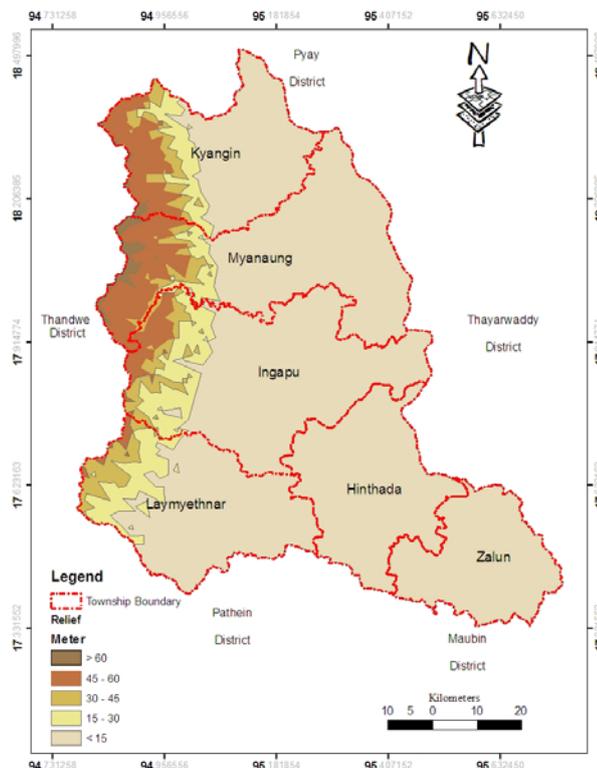


Figure 1. Relief of Hinthada District.

Source: Myanmar Land Survey Department (Yangon)

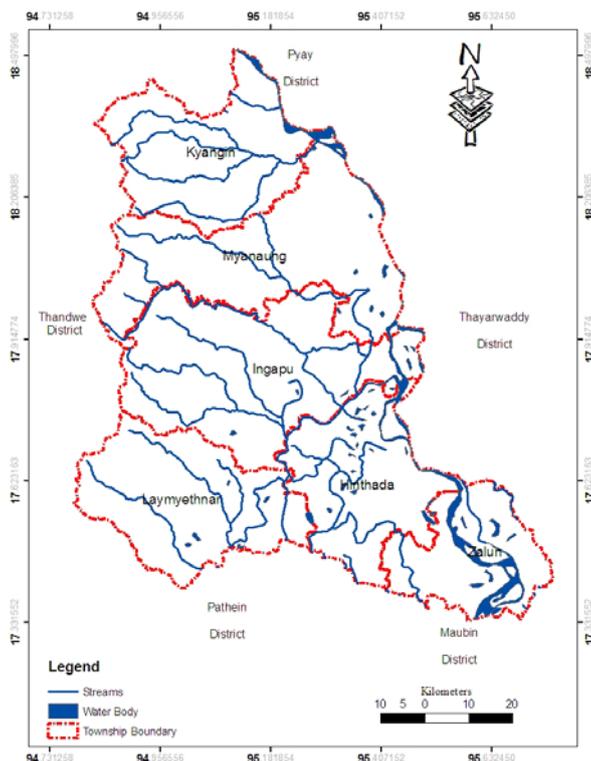


Figure 2. Drainage of Hinthada District.

Source: Myanmar Land Survey Department (Yangon)

Physically, the township is composed of eastern flood plain in the east, the central low land in the middle and western spur region in the west. The western spur region is the eastern part of the Rakhine Mountain Range which is 76 to 760 meter (250 to 2500 feet) high (Figure 1). Apart from the western spur region, the rest are low-lying areas with an altitude of 15.24 meter (50 feet) above sea level. The Ayeyarwady River is the major river in the district. Above Nyaungyo Village, the first distributaries of the Ayeyarwady, Ngawun flows the southwest into the sea near Patheingyi Town. Ngawun river in the south is the well known as Patheingyi River. Mamyia, Kanyin and Nankathu streams join the Ngawun river in the south. These tributaries take their source on the Rakhine Mountain Range and flows through the oxbow lakes in the east-central part of the district. The average temperature is about 29°C (86.7°F) and the annual rainfall is about 2,032 mm (80 inches). Generally relative humidity is high. Hinthada District is located in the north of Ayeyarwady Region, generally falls within the tropics and experiences the Tropical Monsoon Climate (Am), according to the Koppen's system of climate classification. But in some years, it has the climatic conditions likely to be tropical savanna (Aw).

Demographic conditions shows Hinthada as a highly inhabited district, with a total population was 1,569,503 persons in 2002, with an average density of 581 persons per square mile. Hinthada Township has the highest density with 1190 persons per square mile. The eastern slope of the Rakhine Mountain Range and the swampy areas are sparsely populated. The population of the Hinthada District is 1,709,876 in 2009 (Hinthada District General Administration Department, 2009).

Methodology

All the roads are digitised from the Survey of Myanmar's topographic map of scale 1 inch. The roads are updated with the help of Google Earth satellite imagery. The road junctions are taken as nodes. The nodes are connected by straight lines to form arcs (edges) (Figure 3). The alpha, beta and gamma indices for connectivity are derived using the formula developed by K.J. Kansky (1963).

Cyclomatic number indicates for branching networks and disconnected graphs and which can be derived from the formula

$$\mu = \text{nodes} - \text{arcs} + 1$$

Beta index (β) for connectivity is a simple measure of connectivity which can be derived from the formula

$$\beta = \text{arcs}/\text{nodes}$$

Here nodes are road junctions and arcs are connections between the nodes as straight lines. Beta index ranges from 0.0 for network, which consists just of nodes without any arcs, through 1.0 and greater where networks are well-connected.

For instance, very simple networks and trees possess values less than 1.0, a connected network involving a single circuit has a value of 1.0, while networks of greater complexity, which include several circuits, have values higher than 1.0. It is most useful in very simple networks where no circuits are involved.

Another index, the gamma index, (γ) is a simple ratio of the actual number of edges in the network to the maximum possible number of edges, which describes in numerical terms the connectivity of a network given by the formula

$$\gamma = \text{arcs}/3(\text{nodes}-2)$$

The value 1 will be applied to any completely connected network and 0 is given to poor connectivity.

The alpha index (α) for connectivity is the ratio of the number of fundamental circuits to the maximum possible number of circuits, which may exist in a network, given by the formula

$$\alpha = \text{a}-\text{n}+1/ (2\text{n}-5)$$

Where **a** is the number of arcs, and **n** is the number of nodes. The Alpha index gives the range values possible from 0 to 1. The higher the index, the degree of connectivity in the network is greater. Simple networks, such as trees, have nil values. A value of 1 is indicative of a highly integrated network in which every possible link exists between the various nodes.

Analysis and Results

According to Table 1, the region shows backwardness in the case of road network. The road density is comparatively low in relation to the total area of each township.

The alpha and beta indices show a low level of connectivity in the region (Table 1). The low connectivity is mainly due to the drainage pattern with very few north south connections. This was mainly due to the non-availability of bridges. The roads are in east west direction and are parallel to the drainage. (Figure 2, 3)

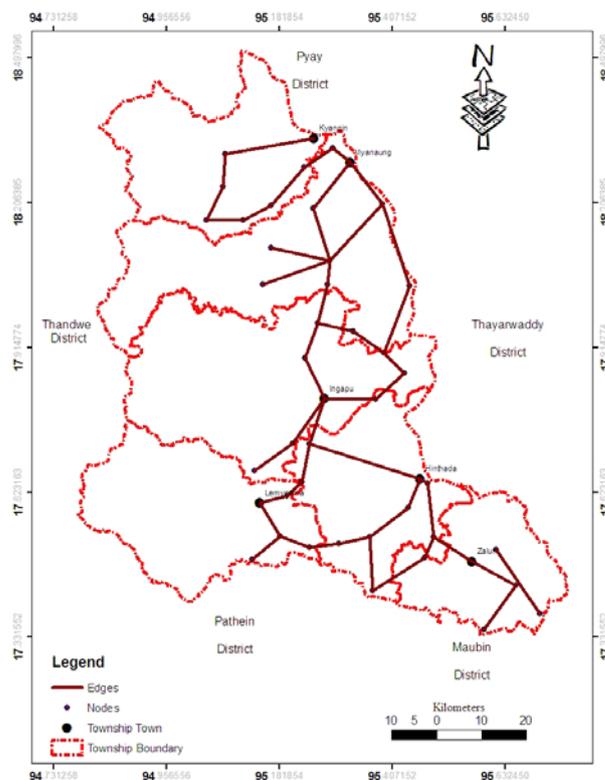


Figure 3. Road Transport Network Topology of Hinthada District.

Source: Myanmar Land Survey Department (Yangon)

Table 1. Road transport network analysis in Hinthada District.

No.	Name of Township	Area (Km ²)	Road Length (Km)	Density of Roads	No. of Edges	No. of Nodes	Cyclomatic Number	Beta Index	Gamma Index	Alpha Index
1	Kyangin	11514.8	48.46	0.0042	6	7	0	0.86	0.40	0.00
2	Myanaung	15522.2	116.92	0.0075	11	10	10	1.10	0.46	0.13
3	Ingapu	16270.3	54.62	0.0034	7	8	8	0.88	0.39	0.00
4	Laymyethna	10335.2	19.23	0.0019	4	5	5	0.80	0.44	0.00
5	Hinthada	9808.2	70.00	0.0071	7	8	8	0.88	0.39	0.00
6	Zalun	6408.8	59.23	0.0092	5	6	6	0.83	0.42	0.00

Bridges have been constructed recently for connecting north and south. Still at many places the streams are a hindrance to the movement of the people.

According to Taaffe and Gauthier (1973), when the gamma index is close to 0, it indicates incomplete connectivity. The calculation carried out in this study clearly shows low connectivity.

Cyclomatic number indicates for branching networks and disconnected graphs. Cyclomatic number Index signifies that out of 6 townships, 5 townships show branching

networks. Consequently, Myanaung Township shows fairly good connectivity and has circuits.

Beta index differentiates simple topological structures (with low Beta values) from complicated structures (with high values). Lower portion of the Beta scale (from zero to one) differentiates between different types of branching networks. Value of one and above differentiate Circuit networks, but for planner graphs the maximum value is 3.00 (Kansky, 1963). The more greater value reflects the more connection. The beta index signifies that out of 6 townships, 5 townships show minimum connectivity. Myanaung Township shows fairly good connectivity.

Gamma index indicates simple topological structure from complicated structures. The more gamma value is the more connection. So, Myanaung Township shows fairly good conditions. Other 5 Townships show poorer connectivity than Myanaung Township.

Alpha index gives a sensitive measure of connectivity. Value of Zero indicates a branching network in which, conversely value of one indicates completely connected graph. The alpha index in this study shows most negative values and abnormal values. This is because of the poor connectivity of roads in the region. But among them, Myanaung Township shows circuits and remaining township shows branching.

The roads run parallel to the stream to join the Pathein-Monywa highway running north-south. In many places, the roads are abruptly ending near a stream or river.

Conclusion

Ayeyarwady Region is a very fertile delta region and it is the most important granary of the country. Hinthada District, is also an important economic division of the country. Hinthada district is located in the northern part of the division and lies between the Rakhine Mountain Range in the west and the Ayeyarwady river on the east.

Population density and distribution in this district is varied. The average density of Hinthada district is more than that of Ayeyarwady Region. With the growth of population this district has to promote agricultural products, fishery products and forest products. Construction of roads and transport systems, have been practiced in this district. Because of the development of transport system, it is easy to connect rural and urban area within district.

After 1989, the economic and social conditions of the district has steady improvement, agricultural, fishery and industrial products are sent to the capital of the district and Yangon Region. Complementarity occurs due to better transport. Pathein-Monywa Highway passes through the district and the road along the western bank of the Ayeyarwady River connects Hinthada District with former capital city, Yangon within four hours. Because of these roads, even the interior parts of the district are accessible. Perishable goods and bulky commodities are sent to the markets within a day. Before the opening of Bo Myat Htun Bridge in November 1999, the local people had to cross the Ayeyarwady River by Z crafts at Nyaungdone. It took a very long time to cross the river at a ferry-port near Satkawt. During the rainy season, because of wind and rain, travellers had to wait over night, which causes great difficulties.

However, the study reveals that Hinthada District is fairly good in transportation facilities. The major problem in the development of road network in the region is that the roads run parallel to the streams. The people in the region have to travel many kilometers in circuitous route to reach their destination. The effective interconnections of roads are needed.

This will contribute to the overall development of the district as well as townships in the region.

The construction of Hinthada-Zalun-Danuphyu Rail Road, 77.25 km (48 miles) started in 2009-2010 financial year. Therefore, the growth in the volume of passengers and goods transport by rail and motor road indicate that it continues to be an important mode of transport in the region.

The state has laid the 24 Special Regions Plan and the Rural Region Development Tasks for ensuring equitable development for all the regions of the Union and the growth of socio-economic status of the local people. The plans are being implemented for enhancement of agriculture, meat and fish, forestry, industrial, transport, communication, electric power and energy sectors for improvement of all the regions of the nation. Hinthada District is also included in the 24 Special Regions Development Plan. In this regard, some roads and bridges were built as a network for ensuring better transportation especially for the future.

Acknowledgements

We are grateful to Dr. Tin Tun Myint, Acting Rector, Hinthada University, and Dr. San Lin, Pro-Rectors of Hinthada University, for their constructive suggestions for the manuscript. We would like to express our sincere gratitude to the editors of the Hinthada University's Research Journal, for their critical reading that greatly helps in improving the draft manuscript. We are also deeply indebted to the authorized personnel from Directorate of Road Transport for their invaluable information and facts to do this work.

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