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ANALYSIS OF ACCESSIBILITY AND CONNECTIVITY FOR THE PROPOSED ROAD NETWORK IN MATHUGAMA

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ABSTRACT - Accessibility is a critical factor in evaluating the urbanity of a particular location. As a result, transportation networks play a vital role in urban planning and design. The aim of this research is to compare the accessibility and impact of the proposed transportation network to the current transportation network in the Mathugama core centre. Mathugama town in Kaluthara district of Sri Lanka was chosen as the case study. The core's troublesome issues have been detected, and as a response, this suggested road network has been brought. The study discussed the impact of the proposed road network on commuters and citizens of the core. To this end, space syntax analysis was conducted to identify accessibility, and further network centrality analysis was done to identify the connectivity of the road network. The core has the highest closeness and betweenness values, which indicate its potential to become an urbanized and highly accessible place. This is due to the proposed network, which increases bypass trips, level of urbanity and reduces the traffic that may cause to increase the wellbeing of the public. The study's findings can be used to make cities more resilient through transportation and urban development plans.

Keywords: Road Network; Accessibility; Urbanity; Network Analysis; Urban Planning

1. INTRODUCTION

Traffic and transportation planning is critical in a city since it influences public well-being. Mathugama is a rural town with a monocentric urban form. The town's main issue is the loss of its unique agricultural character. The primary objective of developing the selected area as the core centre of Mathugama is to preserve the agrarian character of the Mathugama region to safeguard the agrarian area without suburbanizing. To remedy this, a transportation plan for the city centre has been developed, which includes the installation of a road network. First it evaluates the accessibility of proposed & current situation. Then network analysis has done to determine the connectivity. Finally, the degree of the suggested scenario has been determined by analysing the circumstance.

2. MATERIALS AND METHODS

Mathugama has a unique structure due to its rural character and its formed road network. To analyse the level of transportation and success of the proposed transportation network, accessibility of the area has to be measured (Al-Mohannadi et al., 2023 & Lerman et al., 2014). Accessibility involves in layout & designing the land uses, building types, density distribution, public spaces & transportation systems to spread through it with useable to people & disables (Al-Mohannadi et al., 2023). To address this, space syntax analysis has been used to analyse the context of the existing & proposed situation. QGIS software has been used to measure closeness and betweenness centrality. Node analysis has also been used to measure the X & T ratios to identify the layout structure of the transportation network (Batty, 2022).

3. RESULTS AND DISCUSSION

The proposed new road network was created through fieldwork, observation, and analysis of potential connections that could connect existing roads. With the aim of creating alleyways and improving connectivity as more connections lead to higher integration. Figure 1 and 2 shows the existing and the proposed road network.

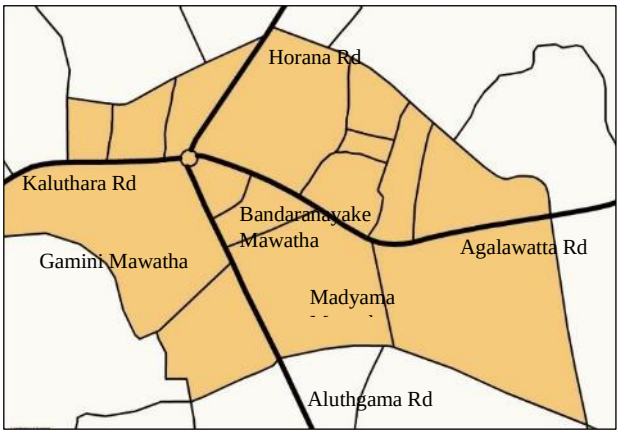

Figure 1. Existing road network

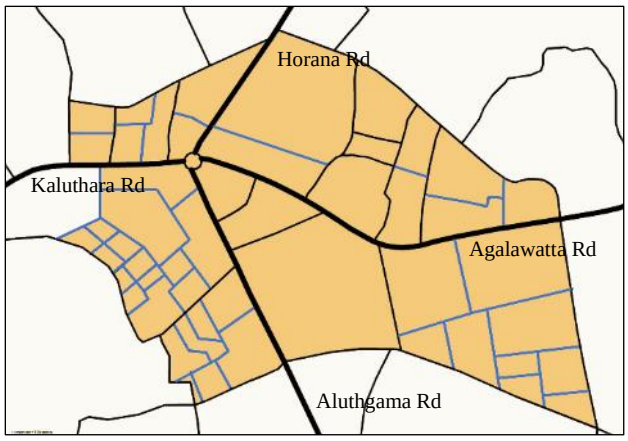

Figure 2. Proposed road network

The existing road network has a closeness centrality (angulr-2000) of 0.005494 in Aluthgama-Mathugama road and few other bypass roads connecting to Agalawatta road. The proposed road network has a closeness centrality of 0.37896, which is 6797.71% higher than the existing situation. This is due to greener & yellow colour visible in the map.

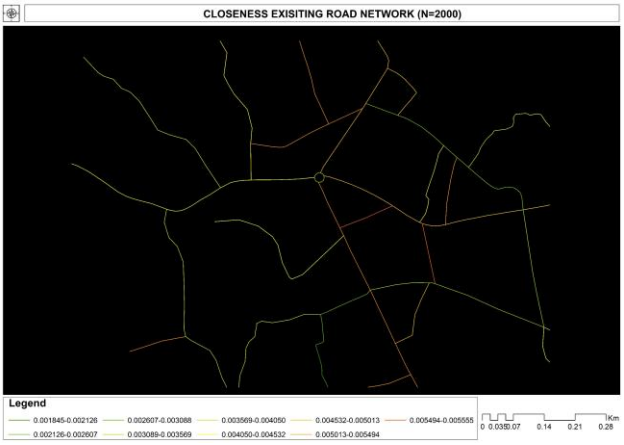

Figure 3. Closeness centrality – existing network

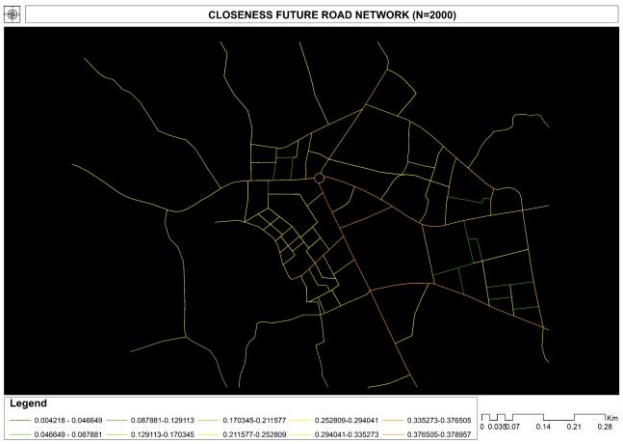

Figure 4. Closeness centrality – proposed

The Aluthgama and Agalawatta roads are the most centrally located. The lowest number is 0.004218, which is seen on a few fragile side roads. When compared to the current situation, the lowest number of offered scenarios grew by 128.62%. In addition, an additional medium level may be seen by looking at the map. (More yellow and orange colours may be seen) When the betweenness centrality (2000) is examined, it is seen that the suggested scenario is superior to the present situation. Bandaranayake Mawatha and Madyama Mawatha have the largest betweenness in the current scenario, which is 0.45761, and the lowest, which is 0.062418. When the proposed scenario is analysed, the maximum value of betweenness is 5796.39 in the portion of Aluthgama road & Gamini Mawatha, representing a 1266565.94% increase over the existing situation. Only a few lower levels are available, and the lowest figure is 0.33333, representing a 434.03% rise over the current condition.

As the closeness centrality increases, those areas will create high O-D trips and betweenness centrality-increased paths act as bypass roads. When comparing the existing situation and the proposed situation, the proposed road network has increased the closeness and betweenness in high numbers, and it also causes the whole road network of the area to increase the closeness and betweenness. This will increase the urban density of the area as well as its accessibility. A significant

factor that can be observed is that both the highest levels of betweenness and closeness are shown from Aluthgama Road. The proposed road network connecting Aluthgama Road and Kaluthara Road has the highest betweenness and closeness values. As these roads can act as bypass roads, they also create high O-D trips. So, the core of Mathugama will increase the level of urbanity in the area and also control the traffic.

Table 1. node analysis – Existing Street network

No of three-way junctions	31
No of four-way junctions	5
Total no of junctions	36
T ratio	0.86
X ratio	0.13
Type	T ratio is close to 1
	Tree

Table 2. node analysis – Proposed Street network

No of three-way junctions	93
No of four-way junctions	8
Total no of junctions	101
T ratio	0.92
X ratio	0.07
Type	T ratio is close to 1
	Tree

4. CONCLUSION

The research examined the impact of the proposed transportation network in Mathugama's core, aiming to improve accessibility and urbanity. The goal of this initiative is to draw individuals to Mathugama's inner centre, which has the highest closeness & betweenness values. This indicates that the region has the potential to become urbanized and suitably accessible. This study outlines & examines a procedure for measure network centrality of a certain road network, which will be important as a source of information for future planning strategies for resilient urban planning and transportation development strategies.

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