

Analysis of Batik Solo Trans Service Area to Schools and Settlements in Surakarta City

Jay She Syaharini^{1*}, Arwan Putra Wijaya², & Yudo Prasetyo³
Departemen Teknik Geodesi, Fakultas Teknik, Universitas Diponegoro^{1,2,3}
Corresponding e-mail: jayshe.syaha@gmail.com

ABSTRACT

Surakarta city has public transportation called Batik Solo Trans (BST). Batik Solo Trans has a system of going up or down at certain locations called bus stops. However, the problems that arise are in the form of service and availability of BST stops for schools and settlements. It is necessary to analyze the BST bus stop service areas for schools and settlements in Surakarta City. This research is carry out using the Network Analysis method with a distance of 400 meters to determine the service coverage area from the Batik Solo Trans bus stop to schools and residential areas in Surakarta City. The results of the service area processing show that the service area at the existing BST bus stop can reach 126 elementary schools, 47 middle schools and 21 high schools in the city of Surakarta. Meanwhile, in settlements there are 43 urban villages that can already be served with existing BST bus stops. Then a recommendation is made for the potential of the BST bus stop so that it can serve schools and settlements in Surakarta city. The recommended BST bus stops are 11 stops spread across several locations.

Keywords: Batik Solo Trans, Network Analysis, School, Service Area, Settlement

ABSTRAK

Kota Surakarta memiliki transportasi umum bernama Batik Solo Trans (BST). Batik Solo Trans memiliki sistem naik atau turun pada lokasi tertentu atau yang disebut halte. Namun, permasalahan yang muncul berupa pelayanan dan ketersediaan halte BST untuk sekolah dan permukiman. Berdasarkan hal tersebut, perlu dilakukan analisis wilayah pelayanan halte BST untuk sekolah dan permukiman di Kota Surakarta. Penelitian ini dilaksanakan dengan menggunakan metode Service Area dengan jarak 400 meter untuk mengetahui cakupan area pelayanan dari halte Batik Solo Trans menuju sekolah dan permukiman yang ada di Kota Surakarta. Hasil pengolahan wilayah pelayanan menunjukkan bahwa wilayah pelayanan di halte BST eksisting dapat menjangkau 126 SD, 47 SMP dan 21 SMA di Kota Surakarta. Sementara itu, pada wilayah permukiman terdapat 43 kelurahan yang sudah bisa terlayani dengan halte BST yang sudah ada. Kemudian dilakukan rekomendasi potensi halte BST agar dapat melayani sekolah dan permukiman di kota Surakarta. Halte BST yang direkomendasikan adalah 11 halte yang tersebar pada beberapa lokasi.

Kata Kunci: Batik Solo Trans, Network Analysis, Permukiman, Sekolah, Service Area

1. INTRODUCTION

The transportation system has a very important role in a city. This important role can be felt by people who need public transportation to support their activities in everyday life. An area with a good public transportation system is able to increase city mobility, so it is necessary to have a public transportation system taking into account the accessibility to the stopping location (Cheng and Chen, 2015). People who do not know how to drive private vehicles and school children who are not old enough to drive private vehicles make public transportation one of the modes of transportation they use. Meanwhile, based on (Kemenhub, 2022) using public transportation as a mode of transportation can reduce air pollution, reduce congestion, and can reduce the level of traffic accidents that often occur in private vehicles.

Surakarta City is one of the cities that has a Bus Rapid Transit (BRT) or commonly known as the Batik Solo Trans (BST) Bus as a mode of public transportation. BST buses themselves can be used in congestion management programs as a mode of public transportation for the general public (Arif Nugroho et al., 2019). Based on the results of research (Mulyono et al., 2016) showed that BST bus passengers were dominated by students with a percentage of 28%, private employees 27%, students 14%, Civil Servants (PNS) 13%, Entrepreneurs 12%, and Housewives by 6%. Meanwhile, based on research results (Rachma et al., 2013) showed that BST buses on corridor I of the Kartasura to Palur route had the majority of passengers consisting of students.

Based on research (Ridwan et al., 2023) which conducted research using Network Analysis on QGIS software by analyzing the coverage area of the Trans Mamminasata bus service for housing facilities, government infrastructure and education with a distance of 400 meters for pedestrians and 2000 meters for cyclists. Based on the existing problems and facts, the problem that arises is the availability of BST shelters for schools and settlements. Therefore, this research was conducted to analyze the availability of BST shelters for schools and settlements by using Network Analysis in the form of Service Areas. This research, which was only conducted on the object of the BST bus stop, aims to determine the distribution and pattern of BST bus stops to schools and settlements.

2. METHODOLOGY

2.1.1 Study Area

The research location was carried out in the Surakarta City area. The city of Surakarta consists of 51 Urban Village (Diskominfo, 2022). Surakarta city itself is located between 110°

45' 15" - 110° 45' 35" E and 70° 36" - 70° 56" S. The administrative area of Surakarta City borders directly with Karanganyar Regency and Boyolali Regency to the north, Karanganyar Regency to the east, Sukoharjo Regency to the west, and Sukoharjo Regency to the south (Pemkot Surakarta, 2022). The administrative area of Surakarta City can be seen in **Figure 1** below.

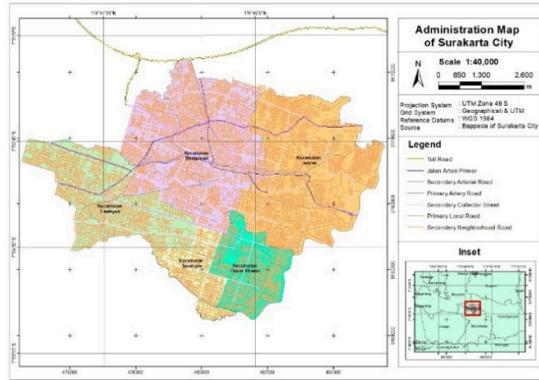


Figure 1. *The administrative area of Surakarta City*
 Source: Researcher, 2023

2.2 Research data

The data used in the research is shown in Table 1 below.

Table 1. *Research data*

Data	Information
Surakarta City Road Network	Surakarta City road network is obtained through the Surakarta City Bappeda
Surakarta City Administrative Boundaries	Surakarta City Administrative Boundaries are obtained through the Surakarta City Bappeda
BST Stop Coordinates	The coordinates of the BST stop are obtained by digitizing onscreen via Google Earth
Coordinating Schools in Surakarta City	School coordinates and data were obtained via the Dapodik website.
BST route	The BST route is carried out by digitizing onscreen based on existing data in the "Teman Bus" software.

2.3 Plotting School Positions

The stage of plotting school positions is a simple one. This stage consists of collecting coordinates from school data in the city of Surakarta where the data is obtained through the Reference Data website of the Ministry of Education, Culture, Research and Technology. The coordinate data that has been obtained through this site is then checked again regarding the school's position via Google Maps.

2.4 Plotting BST Bus Stop Positions and Routes

The stages for plotting bus stop locations are not much different from the stages for plotting school positions. Plotting bus stop locations is carried out in the form of collecting coordinates of Batik Solo Trans bus stops where the coordinates of the stops are obtained by on-screen digitization via Google Earth. The coordinate data obtained is in the form of coordinate data for the Solo Trans Batik Bus stop in corridors I–VI in the Surakarta City area. Meanwhile, the BST bus stop route is also carried out on-screen digitization, where the route is digitized by paying attention to the route in the Teman Bus software. The results of digitizing the on-screen location of the bus stop point are then carried out data quality control using Avenza software on a smartphone. Data quality control is carried out as much as 10% of the total number of bus stops, as many as 24 location points.

2.5 Topology Checking

Topology is a systematic definition by explaining the relative relationship between one object and another object (Saefurrohman, 2005). Topology rules can regulate the relationship between features in a given feature class and other features, regulate the relationship between features in two different feature classes or subtypes (Wicaksono, 2020). Topology checks are carry out on the road network and BST routes. This topology check aims to find out errors in the road network. The parameters used to check the topology of the Surakarta city road network are must not overlap, must not intersect, must not have dangles, and must be a single part. While the parameters used to perform topology checks on BST network routes are must not overlap, must not intersect, must not have dangles, and must not have pseudo nodes.

2.6 bus stop service area process

The process to determine the area coverage of bus stops for schools and settlements is carried out using Service Area in QGIS software. The use of Service Area in QGIS was chosen because this method can cover the bus stop area using a distance of 400 m based on the road network. The distance of 400 meters is a distance that can still be walked (Rahmawati, 2009). Based on this, this study uses the service area method in QGIS software with a distance parameter of 400 meters.

3. RESULT AND DISCUSSION

3.1 Distribution of BST Bus Stops

Based on the data from the data processing carried out, the distribution and pattern of the existing BST bus stops have spread across various sub-districts in Surakarta City. However,

it has not yet spread thoroughly in Surakarta City. This map of the distribution of bus stops at each BST stop can be seen in the following figure, where the distribution of BST bus stops in Banjarsari sub-district is shown in **Figure 2**, the distribution of BST bus stops in Jebres sub-district is shown in **Figure 3**, the distribution of BST bus stops in Laweyan sub-district is shown in **Figure 4**, the distribution of BST bus stops in Pasar Kliwon sub-district is shown in **Figure 5**, and the distribution of BST bus stops in Serengan sub-district is shown in **Figure 6** below.

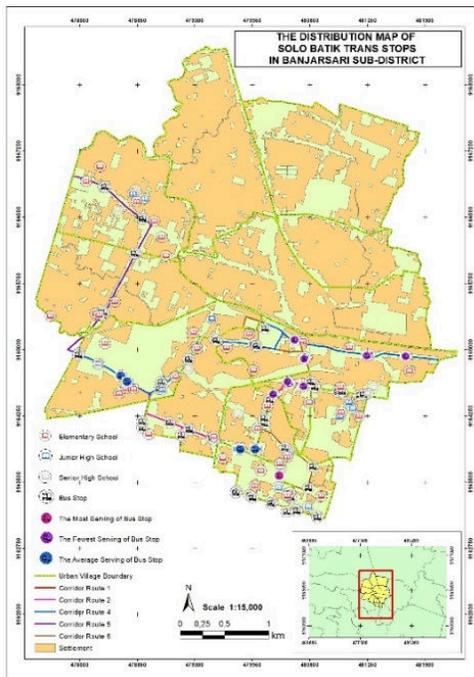


Figure 2. The distribution of BST bus stops in Banjarsari sub-district

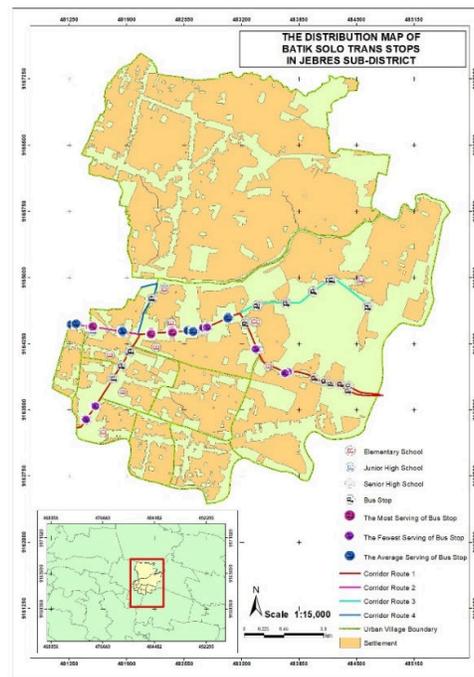


Figure 3. The distribution of BST bus stops in Jebres sub-district

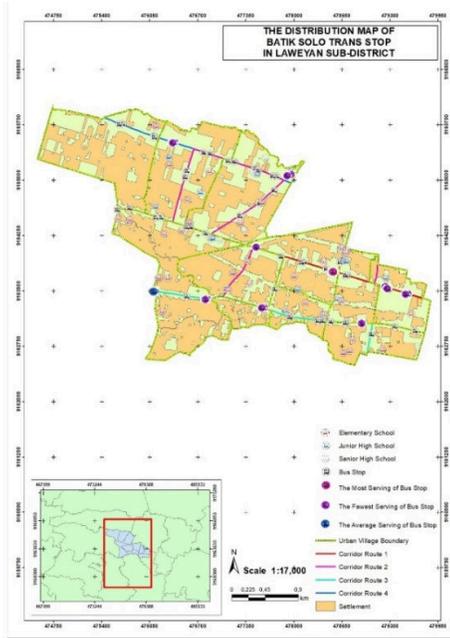


Figure 4. The distribution of BST bus stops in Laweyan sub-district

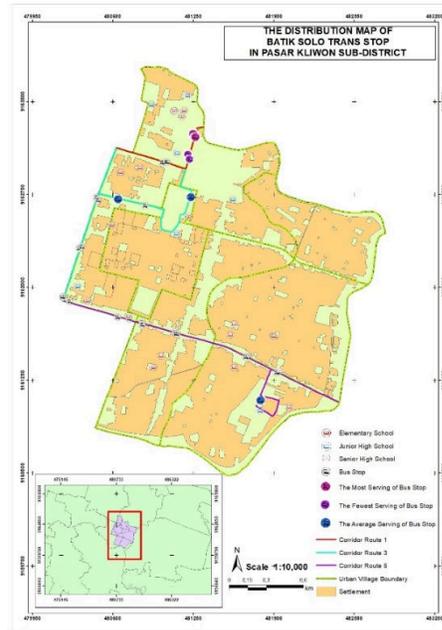


Figure 5. The distribution of BST bus stops in Pasar Kliwon sub-district

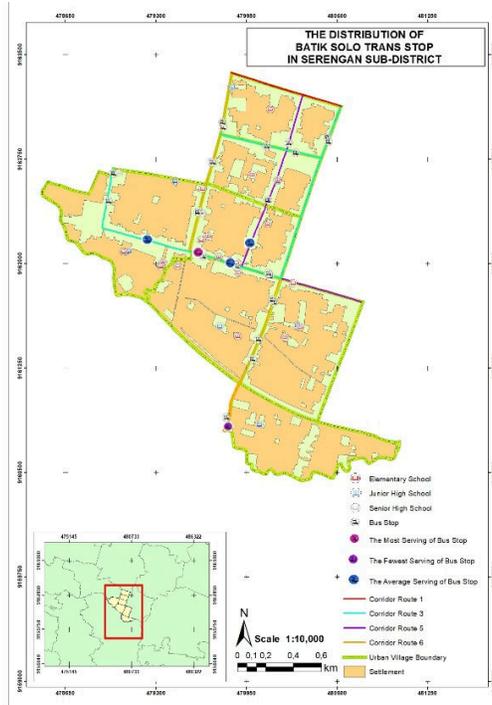


Figure 6. The distribution of BST bus stops in Serengan sub-district

The BST bus stop as the object of this research has 6 corridors with a total of 239 BST stops. Serengan sub-district has 28 bus stops, laweyan sub-district has 63 bus stops, jebres sub-district has 50 bus stops, pasar kliwon sub-district has 26 bus stops, and banjarsari sub-district has 73 bus stops. Based on the distribution of existing BST bus stops, it can serve 126

elementary schools, 45 middle schools and 21 high schools in the city of Surakarta. Apart from that, this bus stop can also serve 43 residential sub-districts in Surakarta City. Based on the data from the data processing carried out, the distribution existing BST bus stops that have been spread in various sub-districts in the city Surakarta. However, it has not been spread thoroughly in Surakarta City, because there are still several settlements that have not been served by BST Bus stops.

3.2 Recommendations for Potential Placement of New Bus Stops

There are several settlements or schools that cannot be served by existing BST bus stops using service areas, so recommendations for potential BST bus stops at 11 location points have been made. Recommendations for potential placement of new bus stops can be seen in **Table 2** below.

Table 2. *Recommendations for Potential New Bus Stop Locations*

<i>Potential Bus Stop</i>	<i>Easting (X)</i>	<i>Northing (Y)</i>
Potential 1	479130.873	9165338.754
Potential 2	479000.769	9166051.296
Potential 3	479480.480	9166252.874
Potential 4	480176.873	9166215.024
Potential 5	480542.315	9166541.911
Potential 6	480040.791	9167370.088
Potential 7	482381.238	9166144.724
Potential 8	483342.558	9166501.466
Potential 9	484254.511	9166371.212
Potential 10	480842.600	9165601.404
Potential 11	481213.689	9165176.034

Based on the potential placement of the new bus stops, there are three bus stops that already have bus stops but are not used for BST bus stops but for feeder public transportation stops. The three potential points are at potentials 8, 9, and 11. Meanwhile, the 6 potential points are passed by Transjateng public transportation.

3.3 Validation of Placement of Potential New Bus Stops

There is a potential for new bus stops to be able to serve several schools and settlements which previously could not be served by existing bus stops. There are 28 schools that can be served by the potential for new bus stops based on using the service area. However, after validation using Google Maps, there are 3 schools that cannot be reached by the bus stop 400 meters away. This is due to differences in the existing road network database on Google Maps

and the data used by research where research uses more recent data. Whereas in settlements that previously could not be served, they are able to be served with the potential for new bus stops.

4. CONCLUSIONS AND SUGGESTION

4.1 Conclusion

1. The distribution of the existing BST bus stops has spread in various sub-districts in Surakarta City. However, it has not yet spread thoroughly in Surakarta City. BST shelters have 6 corridors with a total of 239 units of BST shelters.
2. Based on the results of the distribution of existing BST bus stops with a coverage area of 400 meters, they are able to serve 126 elementary schools, 45 junior high schools and 21 high schools. While the settlements that can be served are 43 sub-districts in Surakarta City.
3. There are 11 recommended locations for potential new bus stops, with three stops being in the same location as the feeder public transport stops and one stop that is passed by the Transjateng public transportation route.
4. The results show that 11 potential new bus stop locations can serve 28 schools that were not previously served. However, based on suitability based on Google Maps there are 3 schools of which have different distances. This is due to the acquisition of different map databases. While the map database used is the latest map database.

4.2 Suggestion

1. The object of research is not only BST buses, but other public transportation in Surakarta City such as feeder public transportation.
2. The target coverage area for bus stops is not only schools and settlements, but can include offices, markets or other public facilities. This is to find out the proper function designation at each existing bus stop.
3. The schools used in the research target are not only public and private schools, but can also include schools under the auspices of the Ministry of Religion.

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