

**ROUTE INTEGRATION OF SEMARANG TRANS FEEDER FOR
THE CITY OF SEMARANG AND SURROUNDINGS****Anita Ratnasari Rakhmatulloh, Diah Intan Kusumo Dewi, Titin Andini**

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E-mail: anita.ratnasari.r@gmail.com**ABSTRACT**

Inadequate service of Bus Rapid Transit in all zones in an urban area encourages integrated transport management system which can allow transport lines that connect more neighbourhoods which are far from BRT corridor route. Feeder services in Semarang aims at improving accessibility to BRT, reducing traffic congestion caused by the use of private cars and enhancing public transport services in Semarang urban areas and its surrounding. Moreover, Trans Semarang feeder is expected to become a public transport which is representative, safe, convenient, and affordable as well as its lines can be integrated with other transport modes. The purpose of the study is to analyse the integration of feeder route serving more trips in Semarang urban areas and its surrounding by using superimpose analysis and quantitative descriptive analysis. This study reveals that service routes of feeder are not likely to be an optimal, the presence of bus stops amenities has not constituted the minimum requirements of convenience standard, its infrastructure has not integrated yet and the shelter cannot provide easy access to public transport users.

Key words: feeders; Bus Transit, route integration; public transport.

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INTRODUCTION

Bus Rapid Transit services are not sufficient to serve all zones in an urban area (Chien, 2001). The increase in transportation needs is in line with the increase in the number of residents in a city (Rosidah, 2018). The success of the bus rapid transit (BRT) project is largely determined by the strong coordinating relationship between land use strategies, road network planning and other transportation systems (Satiennam, 2006). In addition, the use of public transport remains lower than desired and national transport passengers have decreased by 7% over the last decade (Mallett, 2018). Responding to this, transportation system management is needed through the integration of public transportation systems (Solecka & Zak, 2014). Integration between modes is considered important to realize an affordable mass transportation in terms of services, including easy access to bus stops and pedestrian paths. In terms of services that must be considered, namely bus operating time, comfort on the bus, security officers, handrails and access to get on and off with disabilities (Savitri, A., Murtejo, T., & Rulhendri, 2020). The basic principle of integration is the placement of shelter locations that are directly connected between modes and pedestrian accessibility within a radius of 300-500 meters, besides that, integration between modes is seen from the location, time and frequency of movement. (ITDP Indonesia, 2019).

The existence of the feeder phenomenon is a new mode of public transportation in the city of Semarang which was introduced to serve residential pockets that have not been reached by the Trans Semarang Bus. Feeder connections not only increase the capacity of the BRT but also increase the accessibility of the community around the BRT stops (Satiennam, 2006). In addition, the feeder route is also intended to solve the problem of overlapping routes, improve public transportation services in the city of Semarang and its surroundings and reduce congestion due to the use of private vehicles. The feeder is directed to be a representative, safe, comfortable, affordable, and integrated public transportation option with other means of transportation. There are 3 feeder routes that have been operating in Semarang City in Semarang City, namely route 1: Jl. Raya Ngaliyan- Ngalian Market, Route 2: Pasar Banget Ayu (PP), Route 3: Penggaron Terminal-Sumur Jurang T-junction, Route 4: BSB (PP). BLU Trans Semarang stated that within 1 year of operating the feeder, there was a target of 22 thousand passengers using this transportation.

According to the UPTD BLU Trans Semarang which states that the condition of feeder services is still very low. This is evidenced by the number of passengers per day in 1 mode in one way only carrying a maximum of 5 passengers. Based on these conditions, it shows that the feeder service has not met the expectations of the community, so it is necessary to identify the characteristics and conditions of the Semarang feeder service. This study aims to analyse the integration of public transportation in Semarang and its surroundings. Based on the explanation above, it is necessary to have a clear hierarchy for public transportation, namely Trans Semarang Buses and feeders that are connected to each other through the transit system as a mode of transfer using the concept of integration of public transportation in Semarang City and its surroundings.

RESEARCH METHODS

The study location is in a residential area traversed by 3 feeder routes. The data used in this study are primary and secondary data. Methods of obtaining primary data include observation, shooting, and brief interviews with passengers and feeder officers. Meanwhile, secondary data were obtained from BLU Trans Semarang and the Semarang City Transportation Service regarding BRT corridor routes. The analysis used in this research is Superimpose Analysis and Quantitative Descriptive Analysis.

Superimpose Analysis Method (Overlapping Method)

This method aimed at analysing the existing public transportation routes, namely the feeder route and the Semarang City BRT route. The two routes are overlapped so that it can be seen which routes experience overlap between the feeder route and the Semarang City BRT route with an overlapping map technique that considers:

- 1) Feeder Route Map in Semarang City.
- 2) Map of Feeder Shelter Locations in Semarang City.
- 3) Trans Semarang Feeder and Bus Route Integration Map

This method uses GIS (Geographical Information System) tools to map public transport routes in the city of Bandung that overlap or intersect.

Descriptive method

The method of integrating public transport is done by descriptive analysis method. This method is an analytical method by describing the state of a symptom by means of direct observation or observation at several feeder stops. This method is used to explain the suitability of service characteristics with several indicators supporting the integration of transportation modes including travel time, travel costs, waiting time, availability of transit locations, frequency of public transportation, operating hours, service information, arrival time information, information on bus stops to be passed, accuracy and certainty of schedules and tickets. Travel time and travel costs (Tamin, 2000; Tfl, 2008) is one of the main factors and can be an attraction in choosing the mode used by a trip (human or goods). Affordable travel costs can increase the number of passengers from various groups such as children, people with disabilities and the middle class (Susilo and Cats, 2014). To reduce transportation costs, both for the movement of passengers and goods in an integrated intermodal transportation system, the thing that needs to be considered is the effort to save transit costs from one mode to another. Therefore, it is necessary to build facilities and infrastructure at the place of movement of goods or passengers or the transfer of routes of one of the modes so that movement becomes fast, safe, cheap, and comfortable so that transit costs can be reduced as little as possible (Kresnanto and Tamin, 2008). While the increase in travel time in a mode will reduce the number of uses of that mode and by itself will reduce the level of income or service. Lu et al. (2016) stated that the total travel time of each bus can be minimized with a flexible transfer system and feeder bus routes so as to increase the accessibility of the transit system in urban areas. Availability of transit locations (Solecka & Zak, 2014) a shelter or a temporary stop is an important component in the concept of integration. The existence of a container can facilitate the process of changing modes, getting on and off passengers, and supporting the smooth integration process. In addition, convenience at transit locations (stop amenities) can increase the number of

passengers, reduce the feeling of waiting too long and create a feeling of security for passengers through clear service information, tickets, arrival times and operating hours (Fan, 2016; Lagune-Reutler, 2016, Miao, 2019; Shi, 2021). Also, schedule accuracy and certainty of departure times such as the Real-Time Information System, transit stops information and frequency of public transport can influence the perception of waiting time can be more fun and convenient as well as increasing passengers satisfaction (Dziekhan and Vermeulen, 2006; Shi, 2020).

RESULTS AND DISCUSSION

Overview of Semarang's Feeder and Bus Rapid Transit System Integration

The city of Semarang has developed a public transportation system based on Bus Rapid Transit (BRT) called BRT Trans Semarang. The Trans Semarang BRT is connected based on the road network hierarchy, namely the BRT corridor route that serves movement generation on the main road, the Trans Semarang feeder route which serves residential pockets on local roads and the sub feeder route that serves residential neighbourhood roads. In this study, we will discuss the integration of the Trans Semarang feeder route and its services. The Trans Semarang feeder service route is visualized on the map in Figure 1 below.

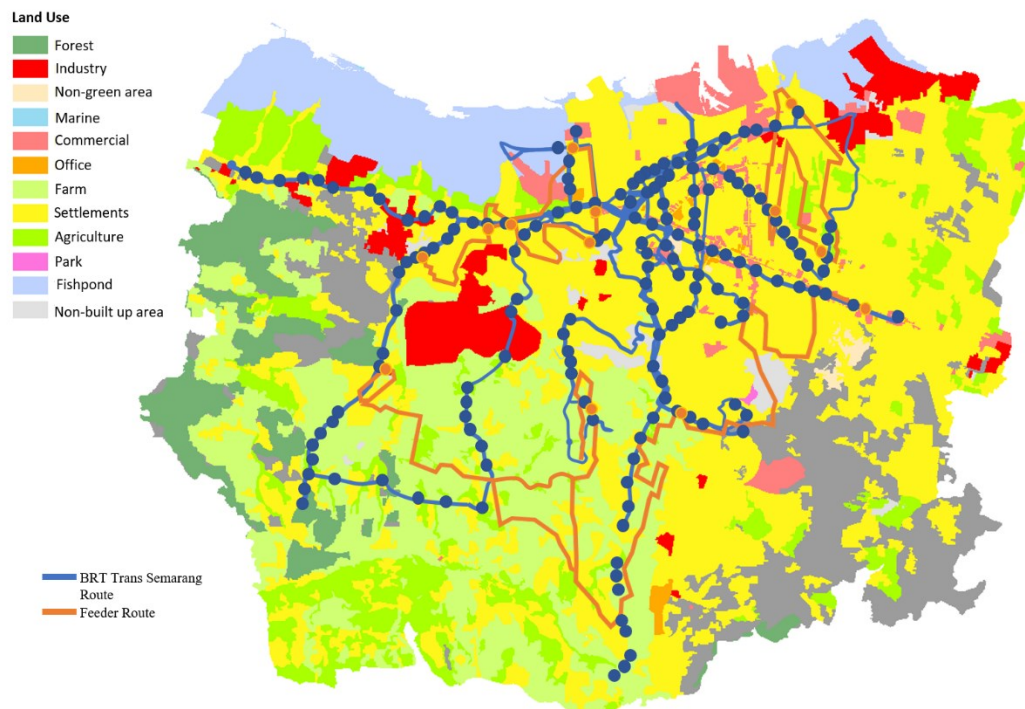


Figure 1. Integration of Feeder and Trans Semarang Bus Routes Source: Processed Results, 2021

Based on Figure 1 above, the feeder route has been integrated with several bus stops, both terminal stops, Bus Transits, and stops with details on the integration of the feeder route with the Trans Semarang BRT route:

1. Feeder Route 1 (F1) : Route length of 44.3 Km and integrated with BRT Corridors 1, 4, 5, and 8
- Last Stop : Junior High School 16
- Bus Transit : Open Space of Tugu, Muradi, Aneka Jaya (Ngaliyan), Simpang Muradi, Kesatrian.
- Bus Stop : Junior High School 16

This feeder 1 (F1) route operates to serve the Ngaliyan area which is slightly to the outskirts of the city (sub-urban towards Kendal Regency) dominated by land use which is a large-scale residential area, a bustling service trade area and an educational area from the elementary, junior high, and high school levels to universities which have very high demand and trip generation. The area also has a main line for the Trans Semarang BRT corridor service so that feeder 1 (F1) can facilitate access to BRT in the area.

2. Feeder Route 2 (F2) : Route length 47 Km and integrated with BRT
 Corridors of 2, 3a, 3b, 5, and 7
 Last Stop : Banget Ayu Traditional Market
 Bus Transit : Sidodadi, Pengampon, Raden Patah, Pasar Banget Ayu, Palebon, UPGRIS, Kompol Maksum, ADA Majapahit, Superindo Kedung Mundu
 Bus Stop : Banget Ayu Traditional Market

This feeder 2 (F2) route serves areas with very high movement generation because this area is dominated by residential areas, education and trade services that serve the entire city of Semarang so that it becomes a very busy movement route, especially during peak hours. In addition, this area is also passed by a strategic route that connects the suburbs (towards Demak Regency) with the center of Semarang City. In addition, in this area there are also public infrastructure facilities on a city and provincial scale that require access via local roads and educational areas that need to be served by feeders.

3. Feeder Route 4 (F4) : Route Length 120 Km and Integrated with BRT
 Corridors of 4, 6, and 8
 Last Stop : BSB, Penggaron Terminal
 Bus Transit : BNI UNNES, Gunung Pati Terminal, BSB City
 Bus Stop : BSB, Penggaron Terminal

Feeder route 2 (F2) serves suburban areas with a new city concept consisting of education, settlement and service trade areas. Several areas in this region have local roads that cannot be reached by the BRT corridor route due to the width of the road and the quite extreme terrain. Based on Figure 1, the integration also shows that there is still overlapping of the Feeder route and the Trans Semarang BRT corridor route with the following details:

Table 1. Overlapping Trans Semarang public bus routes in Semarang City

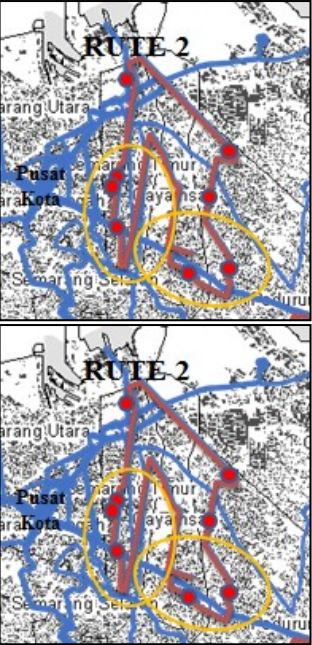

No.	Trans Semarang BRT Route	
	Feeder Route	BRT Corridor Route
1	• Banget Ayu Market - Banget Ayu Park (2A)	• Jl. Pengappon - Jl. Broken Raden (Corridor 3A)
	• Banget Ayu Market - Banget Ayu Park (2B)	• Jl. Pattimura - Jl. Dr. Cipto (Corridor 3A)
2	• Banget Ayu Market - Banget Ayu Park (2A)	• Bundaran Simpang Lima - Jl. Gen. Ahmad Yani (Corridor 1)
	• Ngaliyan Market - Panembahan Senopati (1A)	• Jl. Majapahit - Penggaron Terminal (Corridor 1)
		• Jl. Walisongo - Jl. Siliwangi (Corridor 1)

Source: Survey Results, 2021

Route overlapping analysis was carried out to identify Feeder routes and Trans Semarang BRT corridor routes which have overlapping routes, especially in the main corridors of public transportation in Semarang City. As for more details, it has been described in Table 1, where from the description of the table there is an overlap between the Feeder route and the Trans Semarang BRT corridor route, occurring on routes 1A, 2A, and 2B with corridors 1 and 3A. These three routes

experience a lot of overlap, this is because the route they take is the main corridor with the dominance of land use for trade and services, housing and connecting to the center of Semarang City.

Table 2. The existing condition of the Trans Semarang feeder

Physical Aspect	Existing Condition	Documentation
Route	<ul style="list-style-type: none"> Route overlapping commonly happened in the main corridor leading to the city center Feeder has 2 Routes (a few roads only) that overlap the main corridor of the Trans Semarang Bus There are still many areas that have not been served by feeders, especially route 4 	
Fashion Transfer Place (Stop/Shelter)	<ul style="list-style-type: none"> The location of the bus stop/shelter is still on a road that can be passed by main transportation, not in a residential area. There is no separated door at the bus stop/shelter that has been integrated into the main corridor (passengers must leave the bus stop) The distance of the feeder shelter/shelter is too far because it is not adjusted to the distance for pedestrians in Indonesia, which is 400-600 meters and is not adapted to residential pockets. 	

Source: Survey Results, 2021

The description in Table 2 shows that there are problems in the service system that affect the integration of the Feeder route and the Trans Semarang BRT corridor route. So far, the existing Bus Rapid Transit (BRT) routes in cities in Southeast Asian countries such as Jakarta, Bangkok, Manila and Hanoi tend to consider strategic land uses such as residential areas, trade/services, schools and transit stations (Satiennam, 2006; Park, 2007). 2019) which apparently makes the service system less than optimal and overlaps occur. In addition, these developing cities have weak land use control and result in the formation of urban sprawl that cannot be reached by Bus Rapid Transit (BRT) routes. Therefore, with feeder routes such as in the city of Seoul, South Korea, can improve access for BRT passengers and suggest that this feeder bus route considers the taxi movement pattern

during rush hour (rush hour). This consideration is because taxis are an alternative to four-wheeled modes commonly used by passengers when they cannot reach mass transportation in residential pockets (Park, 2019). In addition, the feeder route is too long, causing the travel time to exceed the standard set by the Decree of the Director General of Land Transportation No. 687 of 2002. Usually external factors such as settlement density and demographic characteristics of local potential users affect the control of the transit system and its service routes (Shi, 2021). Travel time and route length also affect mode waiting time. This happens on route 2 where the waiting time can reach >15-30 minutes. In fact, if the feeder bus network is well designed and reasonable, it can encourage the level of service, efficiency and competitiveness of public transport and increase the preferences of the community or commuters to choose bus transportation modes (Deng et al, 2013; Roy, 2020).

The bus stop/shelter is also one of the causes of the less than optimal integration system, this is because the integrated stops do not provide special doors for changing modes. The mode change is carried out at the same stop, but the boarding and alighting gates are still not distinguished (not yet available for the feeder) so that passengers who will change modes, especially from BRT Trans Semarang to Feeder, have to leave the stop because of the difference in height of the bus stop door and transportation mode.



(a)



(b)



(c)



(d)



(e)

Figure 2. Physical Condition of Feeder and Stop, (a) Bus Condition, (b) Condition of Feeder Room, (c) Condition of Bus Transit Sign, (d) Condition of Feeder Stop/Shelter, (e) Condition of BRT Bus Transit/Shelter and Feeder Source: Survey Results, 2021

The physical condition of the Trans Semarang feeder is still relatively new and the condition of the feeder vehicle still looks very good, this affects the comfort for passengers. The condition of facilities such as seats, floors, cooling devices, and circulation on the bus are still functioning very well. The Trans Semarang Feeder has also implemented a health protocol, namely there is a seat separator sign to carry out social distancing. Studies have shown that the comfort level of a bus stop can affect many aspects of transit use experienced by passengers including security, accessibility, thermal and visual comfort (Zhang, 2012).

The condition of the special stop for the Trans Semarang feeder itself is still the same as the condition of the mode of transportation, which is still relatively new, because the City of Semarang has only launched this transportation for one year. However, of the many special Trans Semarang feeder shelters that have been built, there are still stops that do not have physical buildings, these stops only have a bus stop sign as shown in Figure 2 (c). Please note that passengers are very sensitive to the bus stop environment, a place where they spend a lot of time waiting (transit time) which will then affect passenger satisfaction (Susilo and Cats, 2014; Abenoza et al., 2019) and proximity between facilities also affect user comfort (Dewi, 2018). In a transportation study in the Salt Lake City, United States, there was an average 141% increase in passenger activity at the bus stop along with the increase in comfort facilities compared to bus stops that were not equipped with convenient facilities (Kim et al, 2020).

The lack of facilities at the Trans Semarang feeder stop will be a problem for users who do not know the feeder stop point because the markers are not clearly visible. This is because the bus stop facilities also affect the perception of time spent waiting during transit and the perception of feelings of security, especially the sense of security against crimes that may occur within a radius of 100 meters from the stop. Fan et al., 2016; Moudon et al., 2018; Shi, 2021).

Characteristics and Conditions of Trans Semarang Feeder Services

The characteristics of the availability of Trans Semarang feeder services include the performance of bus frequency services, waiting time, travel time, operating hours, availability of information, tickets, the presence of feeder lines, and condition of facilities. The performance and characteristics of Trans Semarang feeder services in Semarang City can be seen in Table 3 as follows.

Table 3. Compatibility of service characteristics with standards

Indicator	Standard	Existing	Analysis
Traveling time	Average between 60-90 minutes	route 1: 60-90 minutes	corresponds
		route 2: 90-120 minutes	it is not in accordance with
		route 4: > 2 hours	it is not in accordance with
Waiting time	Average between 5-20 minutes	Average 15-20 minutes (Palebon stop)	corresponds
		Average >15-30 minutes (Anneka Jaya Stop, Ngaliyan)	it is not in accordance with
Fee/tariff	general IDR.3500 student/student/elderly IDR. 1000	IDR 3500 for public and IDR 1000 for students/students/elderly/toddlers (intermodal change is free of charge)	corresponds
Frequency of public transport	>6 vehicles/hour	± 3 vehicles/hour	it is not in accordance with
Operational hour	service hours at 06.00-21.00 06.00-18.00 (during the pandemic)	all routes 06.00-18.00	corresponds
Service information	information containing the name of the bus stop, arrival and departure schedules, routes, corridors, fares, and maps	there is no service information at the bus stop or in the feeder	it is not in accordance with
Arrival time information	information at the bus stop regarding the estimated waiting time for the arrival of public transportation	there is no information on the arrival time of the mode at the stop	it is not in accordance with
Information on the stop to be passed	information in Bus Transits that are being and will be passed	there is no information (written/digital) of the bus stop to be skipped	it is not in accordance with
Schedule accuracy and certainty	5 minutes delay (from the BRT pull), and 10 minutes (from the bus stop) against the set schedule	no mode arrival schedule	it is not in accordance with
Ticket	manual and/or smart card for transit system	manual	it is not in accordance with

Source: Survey Results, 2021

According to the performance of the Trans Semarang feeder service above, there are many indicators that are not in accordance with the standards set by the Perwal Kota Semarang Number 2 of 2017 concerning Minimum Standards for Public Transport Services, it will definitely have an impact on the low quality of service received by passengers and will affect the performance of other

transportation systems. So far, passengers' assessment of the Trans Semarang BRT is considered adequate, due to unsatisfactory BRT Trans Semarang services such as punctuality and waiting times, traffic jams that make their travel time longer and Trans Semarang BRT infrastructure not yet integrated with other public transportation (Dwiryanti, AE, & Rakhmatulloh, 2013) so that the feeder service route can provide a good balance between maximizing the coverage area of public transportation services and minimizing overall travel time (Ciaffi, 2012; Deng et al, 2013). In addition, transportation research in cities in China shows that the distribution of passenger demand has a significant influence on the development of the feeder bus network. Therefore, passenger distribution should be taken into consideration when designing a feeder bus network (Deng et al, 2013).

The City government's plan continue to reduce congestion problems through an integrated system of public transportation modes still has to be evaluated, this is due to increasing public interest in switching private cars to public transportation modes. The evaluation related to the intermodal integration system was carried out with the aim of being time efficient, cheap, representative, and able to meet the needs of movement. Infrastructure supporting the intermodal integration system is also an important part that must be improved such as pedestrian paths, bus stop connectivity, feeder paths and other Trans Semarang BRT supports which can only be found in the city center (Dewi, 2018; Park, 2019; Rakhmatulloh, 2021). Finally, awareness, familiarity and the level of popularity of feeder mode among of citizen especially young people can be main driving factors to increase potential public transportation system in the future (Zgheib, 2020)

CONCLUSION

Based on the results of the analysis described previously, it can be seen that the Trans Semarang feeder service route serves areas close to the outskirts of Semarang (suburban area) with the dominance of large-scale residential areas and trade services which have very high movement generation. However, the existing Trans Semarang feeder route is still too long, resulting in a less than optimal integration system and affects the mode travel time, waiting time, and vehicle frequency. In addition, feeder service routes are overlapping because the service routes pass through areas that connect to the city center and service trade areas. This is because public transportation service routes in Asian countries mostly only consider proximity to the city center, land use services trade, schools and busy activity centers (Park, 2019). In addition, supporting infrastructure such as the existence of integrated shelters/ shelters has not been able to provide convenience for passengers, this is due to the unavailability of doors for feeder transportation. Hence, passengers have to leave the stop because of the difference in height of the bus stop door and the mode of transportation.

The existence of the shelter/shelter is still too far away and is on the main road not in or near residential pockets, so passengers have to walk > 600 meters. In addition, the lack of an adequate transit system in residential enclaves and not all local roads near settlements can be traversed by feeder vehicles, causing feeder routes to overlap due to the absence of other alternative route options in these residential enclaves. Therefore, this can then be considered in the development of the public transportation network system in the future to make it more comprehensive, reliable and comfortable. In addition, the indicators of the characteristics of feeder services in the city of Semarang are not in accordance with the standards of public transport services that have been set.

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