2. PRE-FEASIBILITY STUDY ON BUSWAY EXTENSION PROJECT

2.1 GENERAL

2.1.1 Background

Commuting trips into the central area of Jakarta has been increasing by almost 10 times over the period from 1985 to 2002. Major part of the current trips consists of private mode of transport, though a share of public transport is also high at present. Traffic jam is a familiar phenomenon these days in the center and fringe area of Jakarta. The Study on Integrated Transportation Master Plan in Jabodetabek (SITRAMP) revealed that enhancement of public transportation was a policy agenda to cope with amplification of motorization because it seems very difficult to develop road facility in a short time due to shortage of necessary budget of road sector in the central government as well as the local governments.

On the other hand, the current bus transportation system has many constraints and problems. Some are caused by bus operation system itself and the others are attributed to insufficient road network. Many people are commuting for long hours from their home to offices. In some cases, it is reported that they wake up at 5 o'clock every morning and it takes more than two hours from their houses to their offices by bus. These facts indicate that development of rapid and reliable bus system is one of key issues to solve the current transportation problems without huge investment. DKI Jakarta started a busway system on 15 January 2004 as a first step to challenge this subject.

2.1.2 Study Route

The study routes for the pre-feasibility study are shown in Figure 2.1.1. These four routes were proposed in SITRAMP as components in the short-term implementation program.

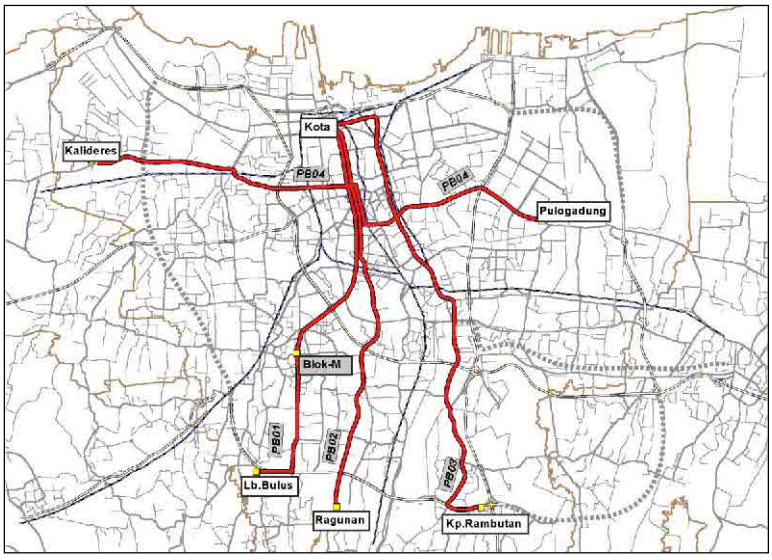


Figure 2.1.1 Busway Route for Short-Term Plan

2.2 EXISTING CONDITION OF PLANNED BUSWAY ROUTES

2.2.1 Location of Current Bus Stops

Figure 2.2.1 shows the location of current bus stops for existing large and medium buses, though all passengers are not always boarding and alighting at the bus stops; in other words, buses often stop to pick up their passengers here and there depending on requests by passengers.

The bus stops are broadly distributed with an interval of 300 m to 400 m on average. The bus stops are categorized mainly into two types; a shelter type and non-shelter type.

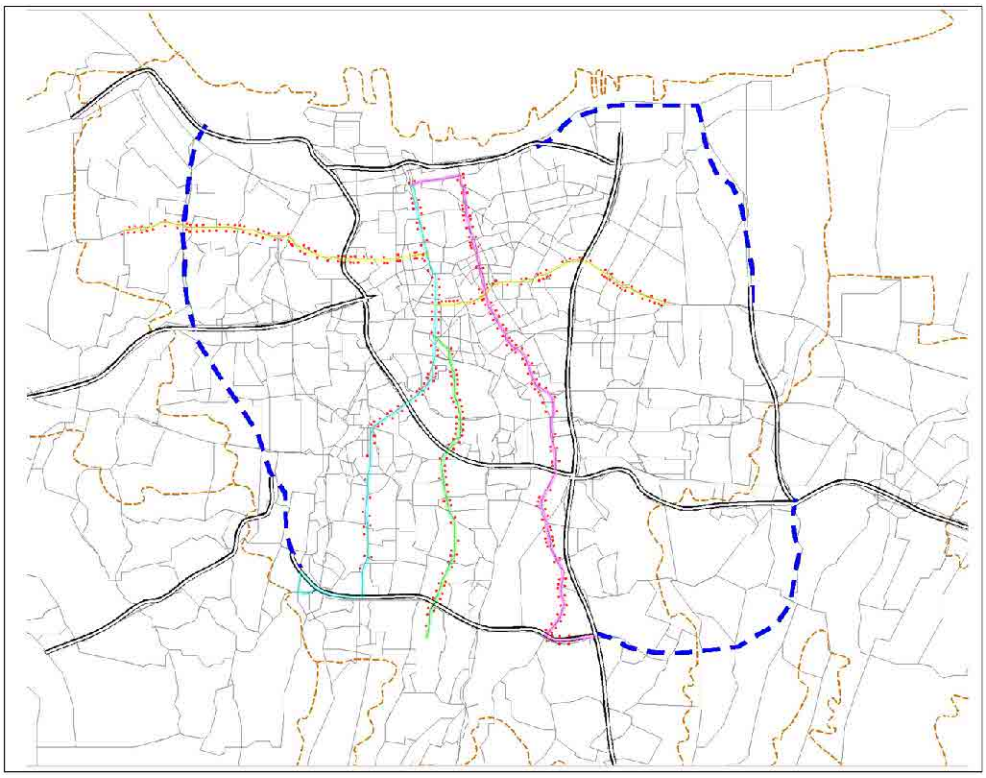


Figure 2.2.1 Location of Current Bus Stops

2.2.2 Route Characteristics

(1) Planned Route of Busway

There are four routes in planned busway in the study as follows (see Figure 2.1.1):

Table 2.2.1 Planned Busway Route

Route	Origin	Destination	Length (km)	Major Street	Remarks
PB01*	Kota (Blok M)	Lebak Bulus	21.8	Jl. Fatmawati	Extension of DKI Jakarta's first busway route from Kota to Blok M
PB02	Kota	Ragunan	19.8	Jl. Rasuna Said	The section from H.I. to Kota is identical to PB01
PB03	Kota	Kampung Rambutan	24.9	Jl. Gunung Sahari / Bogor Raya	
PB04	Kalideres	Pulogadung	25.9	Daan Mogot / Bekasi Raya	East-west route

Note: Extension is 11.1 km and the total is 21.8 km including some marginal length.

(2) Bus Passengers and Traffic Condition

The number of passengers and traffic volume on the planned busway routes is tabulated in Table 2.2.2.

Table 2.2.2 Bus Passengers and Traffic Volume (2002)

Route	Max. Passengers / (passengers/morning peak hour)	Hourly Traffic Volume (pcu/hour /direction)
PB01	11,480	7,070
PB02	5,850	5,510
PB03	5,240	3,780
PB04	6,660	4,410

Note: 1) Bus maximum passengers are those passing across a line on a section by all types of buses.
2) Traffic volume indicates representative traffic volume in all types of traffic counted in 2000 and 2002.

PB01, from Blok M to Lebak Bulus, has the largest number of passengers of 11,000 per hour and the other three routes have almost equal number of passengers of around 6,000 per hour.

2.2.3 Busway Development Plan by DKI Jakarta (Trans – Jakarta Busway)

(1) Service Route

Busway Development Plan by DKI Jakarta (Trans – Jakarta Busway) is a busway on Jl. Thamrin and Jl. Sudirman between Kota and Blok M with a length of around 13 km.

(2) Implementation Schedule

Trans –Jakarta Busway started its service from the middle of January 2004. DKI Jakarta allocated a total of Rp. 118 billion in the 2002 and 2003 budget and another Rp.120 billion will be allocated in 2004 budget.

DKI Jakarta plans to introduce the feeder services for 14 lanes in the future.

(3) Bus Coaches and Related Facilities

1) Coaches

The bus coaches have two side doors for boarding and alighting. The main door is installed at the center of the side doors and the step is adjusted to the same height of platforms at the bus shelters. Major dimensions of bus coaches are as follows:

[Major Dimensions]

- Seating Capacity: 30
- Standing Capacity: 55
- Total Length: 11.38 m
- Total Width: 2.5 m

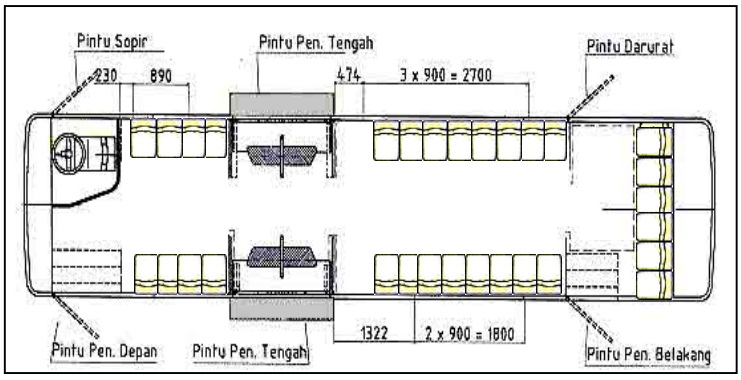


Figure 2.2.2 Major Dimensions of Bus Coach

2) Bus Lane

Exclusive bus lanes are provided along median strips physically separated by concrete blocks from the other lanes for general traffic. The width of the exclusive bus lane is 3.0 m. Since bus shelters for the BRT are located in the median and buses run with general traffic flows, boarding and alighting should be made through the righthand-side doors.

3) Operation Time

Bus operation is scheduled for 17 hours from 5 a.m. to 10 p.m. Forty (40) buses per hour are planned for maximum bus frequency. Headway varies from 1.5 minutes in the peak period to 5.0 minutes in off-peak hours.

(4) Relocation of Bus Terminals

DKI Jakarta has a relocation plan for the Pulogadung and Senen bus terminals, although the location of new terminals and the schedule for relocation have not yet been decided.

(5) Management

PT. Jakarta Express Trans (JET), a consortium of five transportation companies consisting of three private bus operators and two public owned transportation companies, was established as an operation body of busway. DKI Jakarta contracts JET for the operation services and currently payment of fees of the operation based on the running distance of bus is being considered.

The tariff of busway is fixed at Rp. 2,500 per trip. Besides the ticket of busway, two kinds of bus feeder tickets are also considered by DKI Jakarta: a ticket for the inner city zone at Rp. 2,900 and a ticket for outer city zone at Rp. 3,800.

2.3 BUSWAY DEVELOPMENT PLAN IN THE STUDY

2.3.1 Projected Demand

Future passenger demand on the Jabodetabek busway system for the years 2007, 2010 and 2020 are shown in Figures 2.3.1, 2.3.2 and 2.3.3 respectively.

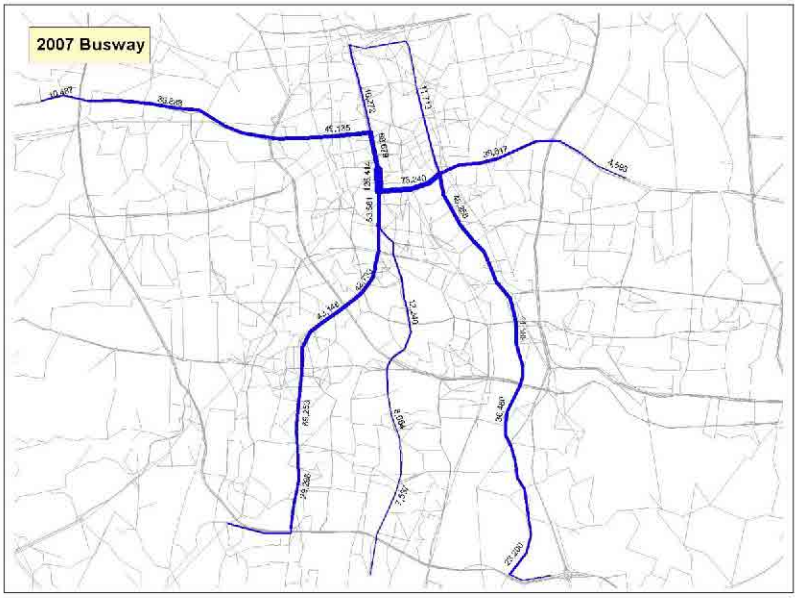


Figure 2.3.1 Busway Passenger Demand - 2007

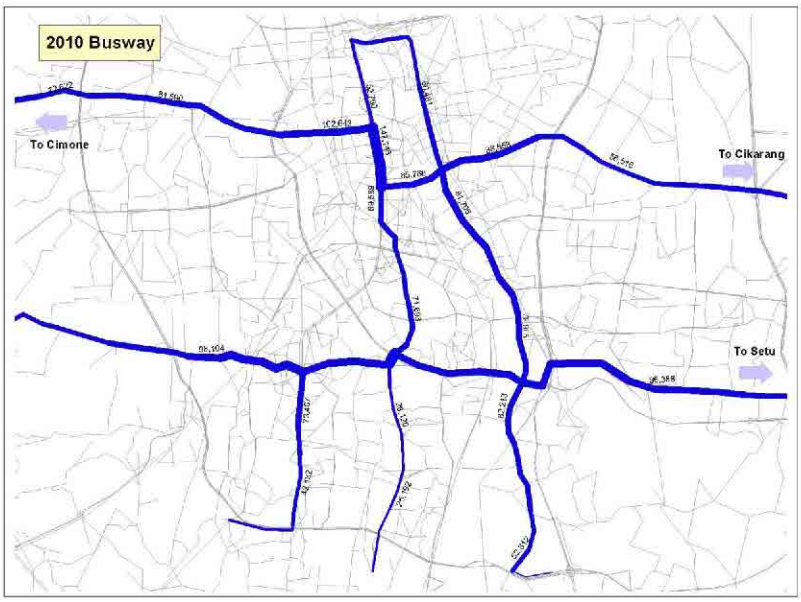


Figure 2.3.2 Busway Passenger Demand - 2010

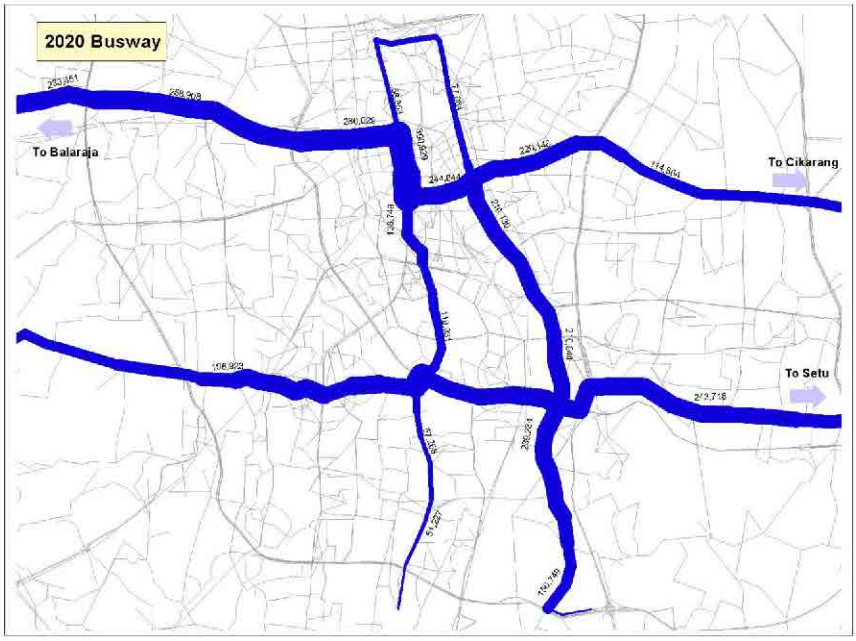


Figure 2.3.3 Busway Passenger Demand – 2020

The section around Monas will become an important interchange point as it serves for both east-west as well as north-south busway routes. Passenger volume on this particular section in the 2007 would be around 125,000 per day (both directions) and is projected to grow more than double by the 2020. The maximum line loading for each busway route is summarized in Table 2.3.1.

Table 2.3.1 Maximum Line Loading By Route Section

No	Route	Max Line Loading (pax/day/dir)		
		2007	2010	2020
1	Kota – Lebak Bulus	23,631	-	-
	Lebak Bulus – Kota	19,875	-	-
2	Kota – Ragunan	7,261	36,423	71,530
	Ragunan – Kota	8,862	44,282	79,962
3	Kota – Kampung Rambutan	23,895	41,833	128,970
	Kampung Rambutan – Kota	22,769	50,181	124,784
4	Kalideres – Pulogadung	34,974	54,593	131,771
	Pulogadung – Kalideres	38,433	55,576	157,585
5	Ciledug– Setu	-	63,343	127,991
	Setu – Ciledug	-	58,295	131,806

In the context of Jabodetabek public transport services, busway system is expected to play an essential role in the long run, particularly in serving the east-west movements complementing the services provided by Jakarta MRT and Jabotabek railway (see Figure 2.3.4).

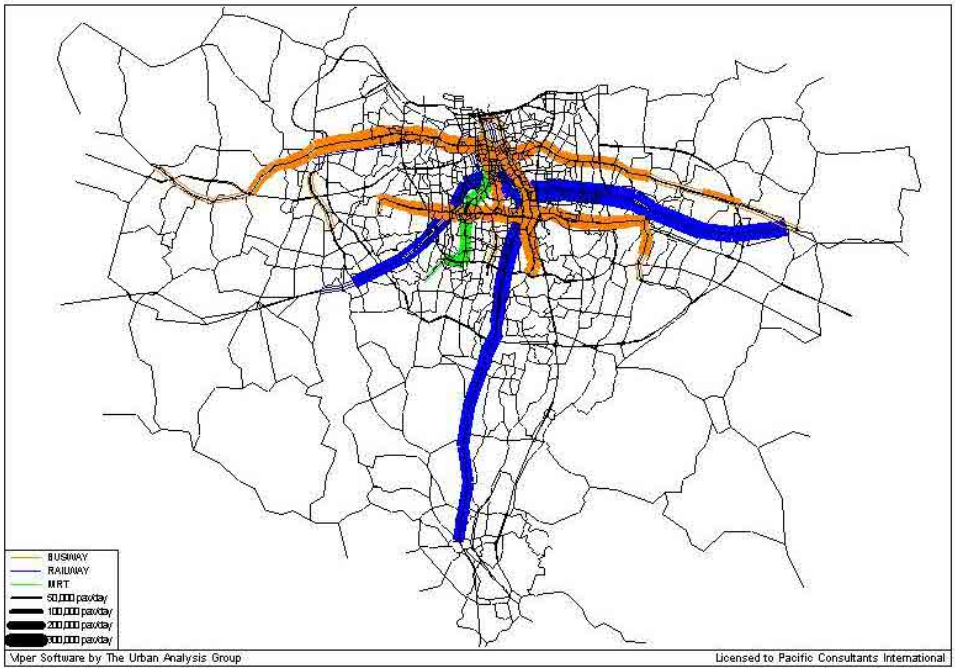


Figure 2.3.4 Jabodetabek Public Transport Demand, 2020

2.3.2 Operation Plan

(1) Basic Operational Conditions

1) Location of Bus Lane

Exclusive bus lanes for the busway system proposed in the study will be basically installed at the right side of traveled lane consistent with those of DKI Jakarta's plan. The exclusive bus lanes will be installed beside median strips.

2) Specification of Bus Coach

Loading capacity of bus coaches and the total number of bus coaches are important factor to determine the busway operation plan. As mentioned in the previous section, the bus coach which DKI Jakarta is about to procure is 11.38 m long. The same size of bus coaches would be utilized for the extension of busway system in the study. Articulated type of bus coaches, of which loading capacity is larger than single type, could be installed for the route with high passenger demand. The articulated bus coach is superior to the single type in terms of turning capability and larger passenger loading capacity. This results in reduction of the total operating cost, although the initial investment cost is higher than that of single type.

[Major Dimensions]

- Capacity: 140-150
- Total Length: 18 m
- Total Width: 2.6 m

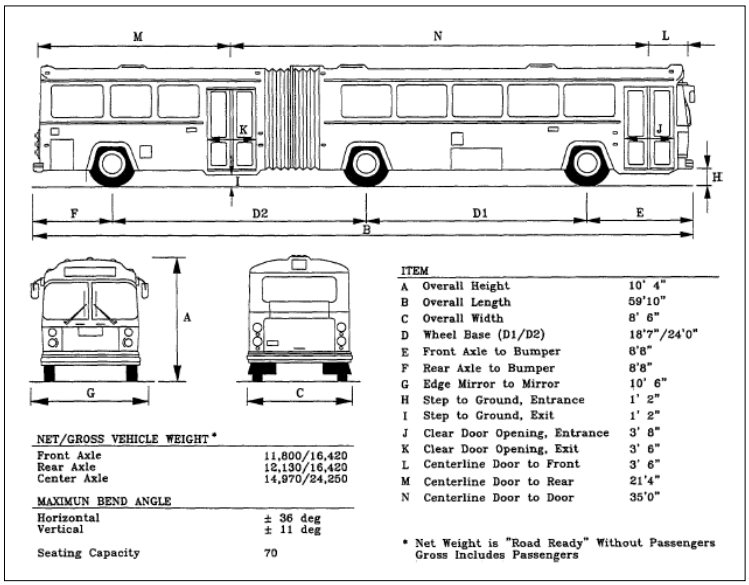


Figure 2.3.5 Specification of Articulated Bus Coach (18 m type)

Source: "TCRP Report 19, Guidelines for the Location and Design of Bus Stop," Transportation Research Board National Research Council, USA (1996).

3) Interval of Bus Stops

Intervals between bus stops are decided within the range of 0.8 – 1.2 km as a standard for ensuring high and stable running speed.

(2) Frequency Service

1) Demand-Based Frequencies

Demand-based frequencies can be obtained by two factors; passenger demand and bus loading capacity. Moreover, headway is calculated by the following formula:

Headway (second) = 3,600 / bus frequencies (/ hour / direction)

2) Minimum Frequencies

In off-peak periods, frequency determined based on passenger demand might be longer than tolerable range of bus passengers. In such a case, it might be better to design the minimum frequency at lower than some 20 minutes to avoid too long waiting time and to secure minimum level of service.

(3) Capacity of Bus Lane

Capacity of bus lane is an important factor for the busway operation planning. As the bus operation on the exclusive lane is rather simple, a standard in the U.S.A. is applicable even in Indonesia despite some differences on traffic characteristics between the two countries. According to "Transit Capacity and Quality of Service Manual" by Transportation Research Board, USA, the capacity of bus lane is suggested as shown in Table 2.3.2. The level of "Forced Flow,

Poor Operation" should be avoided from planning point of view. The bus lane for the busway in the Study is determined to be capable of accommodating 90-110 buses per hour per direction considering the current situation of bus transportation in Jakarta as well as the suggestions of the service manual in Table 2.3.2.

Table 2.3.2 Suggested Bus Service Volume for Planning Purpose

(Flow Rates for Exclusive or Near-Exclusive Lane)

Description	Service Volume bus/lane/h	Average bus/lane/h
Arterial Road		
Free Flow	25 or less	15
Stable Flow, Unconstrained	26 to 45	35
Stable Flow, Interference	46 to 75	60
Stable Flow, Some Platooning	76 to 105	90
Unstable Flow, Queuing	106 to 135	120
Forced Flow, Poor Operation	over 135*	150*
CBD Streets		
Free Flow	20 or less	15
Stable Flow, Unconstrained	21 to 40	30
Stable Flow, Interference	41 to 60	50
Stable Flow, Some Platooning	61 to 80	70
Unstable Flow, Queuing	81 to 100	90
Forced Flow, Poor Operation	over 110*	110*

* Results in more than on-lane operation
Note: *) Results in more than one-lane operation.
Source: "Transit Capacity and Quality of Service Manual", Transportation Research Board National Research Council, USA (1999).

(4) Bus Operation Plan

1) Passenger Demand

The passenger demand was obtained as follows:

Table 2.3.3 Passenger Demand by Route

Unit: Passengers

Route	Direction	No. of Passengers			
		Daily		Peak 1 Hour	
		2007	2010	2007	2010
PB01	North Bound	19,900	32,600	1,990	3,260
	South Bound	23,600	40,800	2,360	4,080
PB02	North Bound	8,900	44,300	890	4,430
	South Bound	7,300	36,400	730	3,640
PB03	North Bound	22,800	50,200	2,280	5,020
	South Bound	23,900	41,800	2,390	4,180
PB04	East Bound	35,000	54,600	3,500	5,460
	West Bound	38,400	55,600	3,840	5,560

Source: SITRAMP

2) Operation Plan

According to the basic operational conditions including the projected passenger demand, bus operation was planned as follows:

Table 2.3.4 Bus Operation Plan (2007)

Unit: Buses / hour/direction

Section		Bus Type	PB01	PB02	PB03	PB04	Total (Bus/Hour)
PB01	Kota - Harmoni	Articulated	16	6	-	-	22
	Harmoni - K.Sirih		16	6	-	27	49
	K.Sirih - H.I.		16	6	-	-	22
	H.I. - Blok M		16	-	-	-	16
	Blok M – Lebak Bulus		16	-	-	-	16
PB02	Kota - Tendean	Articulated	-	6	-	-	6
	Tendean - Ragunan		-	4	-	-	4
PB03	Kota - Senen	Single	-	-	15	-	15
	Senen - KP.Rambutan		-	-	30	-	30
PB04	Kalideres - Pulogadung	Articulated	-	-	-	27	27

SITRAMP estimates.

Major features of the operation plan tabulated above are as follows:

- After the completion of MRT, competing busway will be removed;
- Six buses on PB02 are overlapping with PB01 between Kota and H.I. Roundabout;
- Twenty-seven (27) buses on PB04 are overlapping with PB01 between Daan Mogot and K. Sirih;
- Six buses on PB02 are operated between Kota and Tendean and four are operated between Tendean and Ragunan;
- Fifteen (15) buses on PB03 are operated between Kota and Senen and 30 are operated between Senen and KP. Rambutan; and

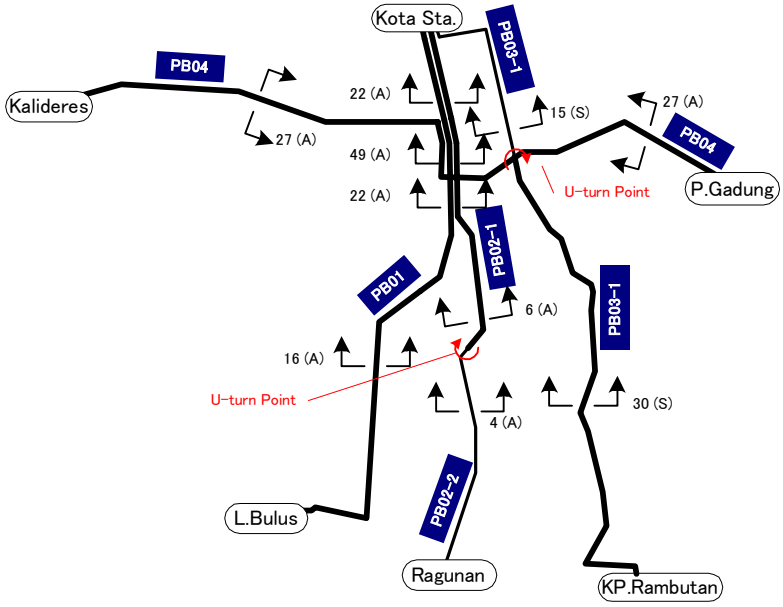
To change the bus traffic volume (e.g. PB02 and PB03), U-turn movement will be operated passing the Tendean and Intra-Urban for PB02, and passing along the Senen Transfer Center for PB03.

This operation plan is interpreted into the following operation frequencies between origin and destination by route.

Table 2.3.5 Route Operation

Route	Origin - Destination	Frequency (buses/peak hour/direction)	Type of Bus
PB01	Kota – Lebak Bulus	16	Articulated
PB02	Kota - Ragunan	6	Articulated
	Kota - Tendean	4	
PB03	Kota - Rambutan	15	Single
	Senen - Rambutan	30	
PB04	Kalideres - Pulogadung	27	Articulated

The bus frequency in peak hour by major section is shown in Figure 2.3.6.



Note: (S, A) indicates single and articulated type of bus

Figure 2.3.6 Bus Operation Concept

2.3.3 Facility Plan for Busway

(1) Basic Policy

1) Installation of Bus Exclusive Lane

As mentioned in the previous section, the exclusive bus lanes will be installed beside median strips like that of DKI Jakarta. The exclusive bus lanes with a 3-meter width are designed segregating the bus operation from the general traffic.

Platform width of bus stops was designed at around 5 meters in DKI Jakarta's plan. It is, however, difficult to provide a 5-meter platform all the way of the routes proposed in the study, taking the current road condition of the routes into account. A width of 3.5-meter was adopted as design standard for the platform, while a 2.5-meter width was adopted in case the space is narrow.

2) Measures to Ensure Bus Operation

(a) Easy Transferring

Easy transferring is one of key issues to support the busway. Transferring facilities with busway itself and from/to railway stations or existing bus terminal have to be strengthened.

(b) Improvement of Other Bus System

Feeder bus system development and restructuring of existing bus system are required to provide better bus services as a whole in association with proposed busway.

(2) Bus Lane Arrangement

Most of exclusive bus lanes will be installed in the road stretches, of which width is three lanes and more in one direction at present.

Typical exclusive bus-lane arrangement for roads with six lanes and more is shown in Figure 2.3.7.

The road width at the bus stops is kept as same as those of general sections. In case the width of median strips is narrow, the width of bus stops is adjusted by reduction of width of traveled lanes, stopping lanes and green/tree planting space. The width of traveled lanes is, however, kept at 3 meters in minimum.

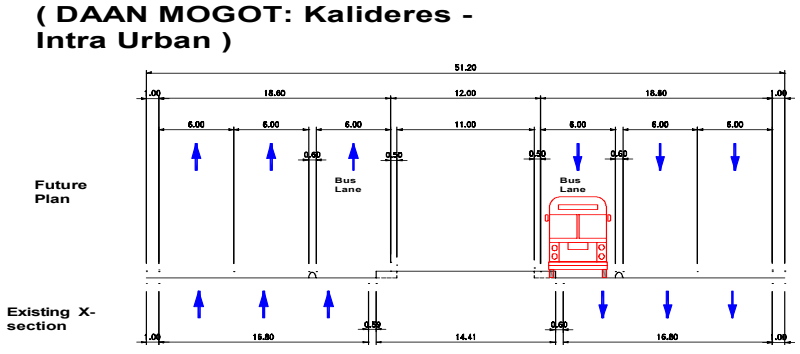


Figure 2.3.7 Bus Exclusive Lane Arrangement

On the other hand, the lane arrangement for roads with four lanes is shown in Figure 2.3.8. Basically, road widening is required for this type of road.

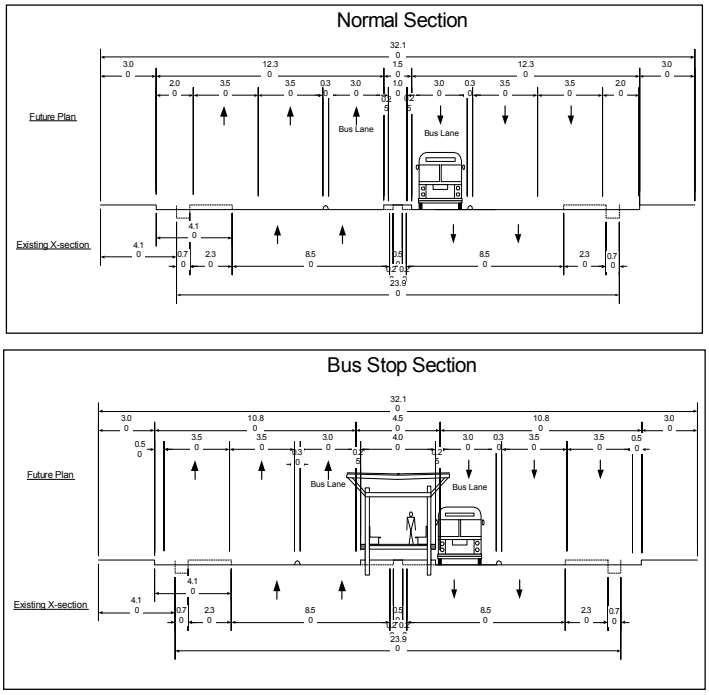


Figure 2.3.8 Example of Bus Lane in Case of Road Widening

It is proposed that the exclusive bus lanes be basically designed on all the routes of busway except some sections along the JORR and Jl. Cokroaminoto/Jl. Imam Bonjol in the CBD. In case the number of lanes of existing roads is two in one direction, widening is immediately required. In the event of deferment of widening, busway may be operated together with general traffic on two-lane roads in a mix-traffic condition for the time being.

The stretches of road requiring widening are shown in Figure 2.3.9.

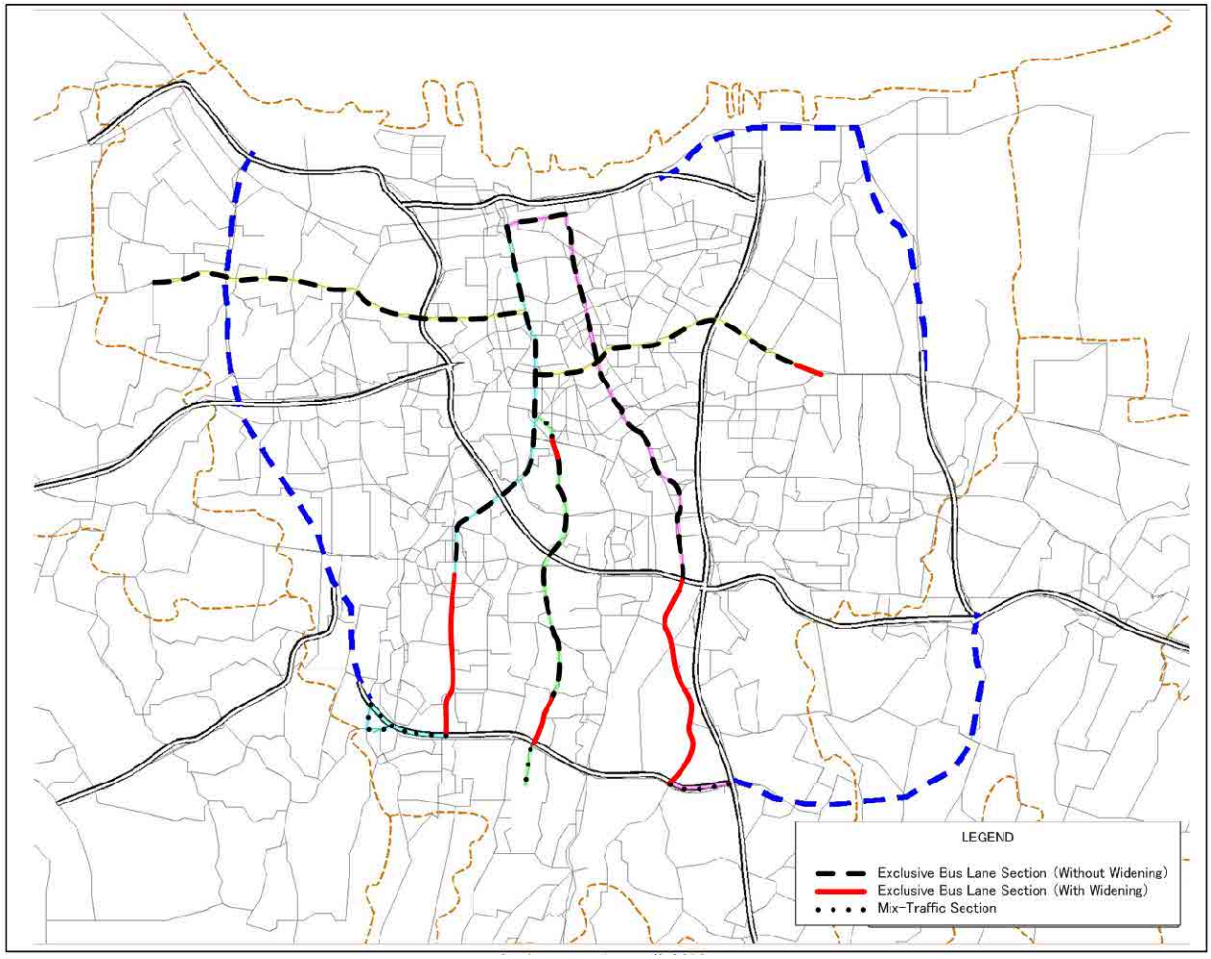


Figure 2.3.9 Location of Road Widening and Installation of Exclusive Bus Lane

(3) Loading Facilities for Busway

1) Bus Terminals

All the busway routes proposed in the study are connected to the existing bus terminal facilities at the origins and destinations. These facilities play an important role to connect the existing bus or other means of public transportation such as angkot, taxies, ojeks and bajajs. Smooth transferring among these means of transportation is the key to the success for busway development.

Bus terminals for Busway would be set up at the sites of existing bus terminals, and five more terminals (Lebak Bulus, Ragunan, KP.Rambutan, Kalideres, Pulogadung) were planned for 2007.

2) Other Bus Terminals on the Route between Terminus

The busway passes the four existing bus terminals, Blok M, Kampung Melayu, Grogol and Senen. However, it is proposed that the buses of busway system do not enter the bus terminals due to the following reasons:

- Many turns are required to enter the bus terminals and this will result in longer operating time;

- It is often very congested near and inside bus terminals and it will also disturb steady operation; and
- Installation of bus shelters on roads near the bus terminals could minimize inconvenience for bus passengers in transferring from conventional bus services to BRT system.

3) Transfer Center

One of key issues for successful busway development is to establish busway service network to cover the area as much as possible. In addition, interchange-facility development between busway routes is another important development component to cater for passenger's convenience. Smooth transferring will promote passengers ridership and this is a tool for accomplishment of initial objective of busway development. Concept of interchange-facility development is shown in Figure 2.3.10. The projected numbers of transfer passengers of busway are illustrated in Figure 2.3.11.

The following Transfer Centers were planned as interchange facilities in 2007.

- Monas: Interchange between PB01/PB02/PB04
- Harmoni: Interchange between PB01/PB02/PB04
- Senen: Interchange between PB03 and PB04

4) Bus Stops

Around 80 bus stops were selected and the locations of bus stops were decided based on the following:

- Results of the Bus Passenger Interview Survey, which was conducted as a transportation survey program in SITRAMP;
- Existing major bus stops where many passengers can be observed; and
- Average intervals of bus stops are 0.8 – 1.2 km, to ensure smooth and rapid operating speed.

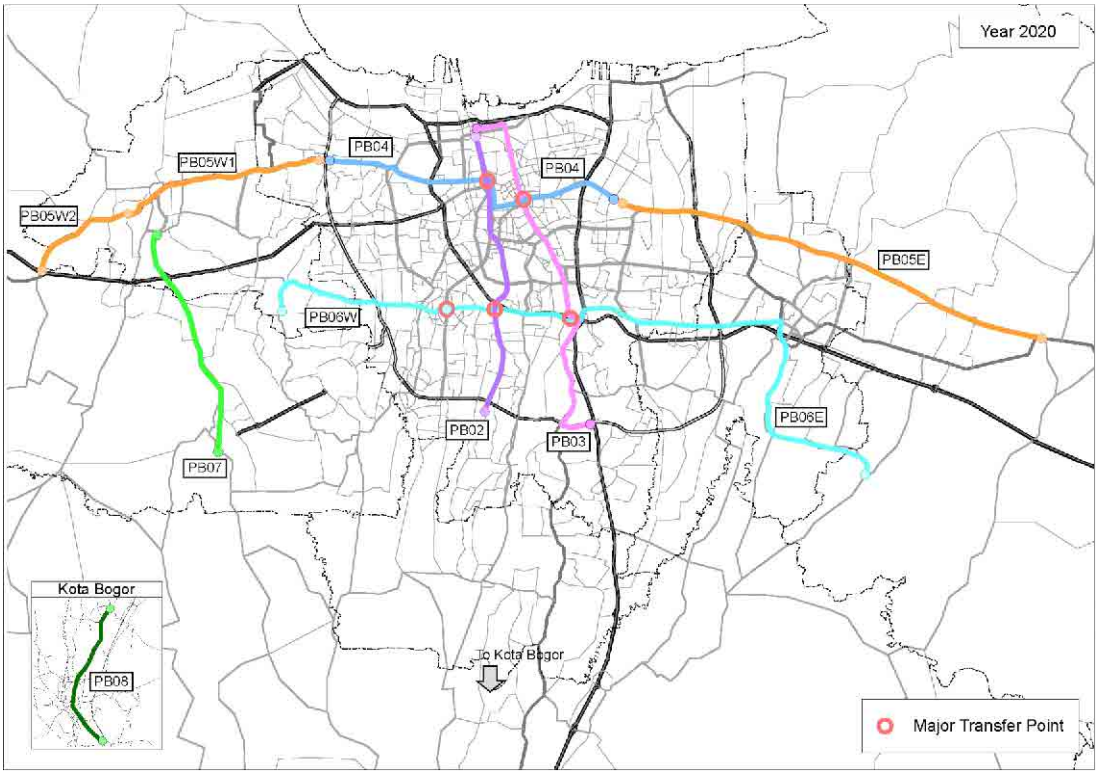


Figure 2.3.10 Interchange-Facility Development

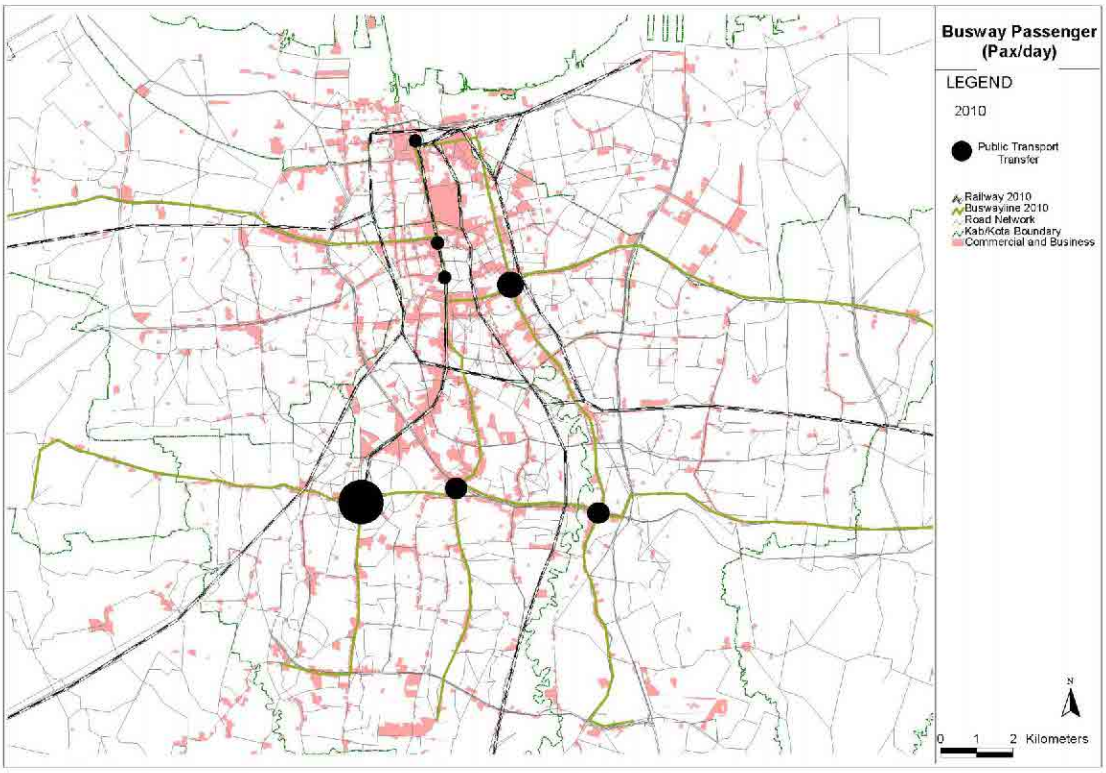


Figure 2.3.11 Number of Transfer Passengers (2010)

5) Transferring Facility to Railway

Special attention should be paid to transferring both at Sudirman railway station (former Dukuh Atas) and new Rasuna Said railway station, of which many passengers are expected. Furthermore, an MRT station is also planned near Sudirman railway station. Well-designed and elaborated transferring facilities will offer convenient services to the passengers and this will contribute to increase of public transportation demand as a whole. Figure 2.3.12 shows one of additional transferring facilities proposed in the Study between the busway PB01 route and Sudirman railway station. The details are the following:

- Installation of new busway stop on Jl. Sudirman at nearby Sudirman railway station;
- Installation of small square for short-distance feeder services; and
- Direct pedestrian gangway from the busway shelter to the ground.

(4) Bus Shelter Design

1) Bus Terminal

For the five bus terminals to be added in 2007, berths with shelters were planned for passenger comfort in alighting and boarding, as well as for buses that have to have idling time to adjust operation time to meet the schedule.

Shelters' locations were decided not to change substantially the existing usage of facilities and the existing movement of the buses. Consequently, liner type shelters were installed (see Figure 2.3.13 (1) to (3)). Decision Procedure of the Bus Shelter's Dimension is discussed in Appendix 1.

2) Bus Transfer Center

Sawtooth type berths were planned for the two bus transfer centers of Monas and Senen as shown in Figure 2.3.14, since passenger demands were forecast to be relatively high. Three berths were allocated for each direction and pedestrian bridges were to be built to access the transfer centers.

On the other hand, Harmoni transfer center was planned using liner type berth, like the common new bus stop, because the passenger demand forecast was not so high. The difference between this transfer center and the common bus stop was that the passageway would be installed to connect two shelters on Hayam Wuruk and Gaja Mada.

Decision Procedure of the Bus Shelter's Dimension is discussed in Appendix 1.

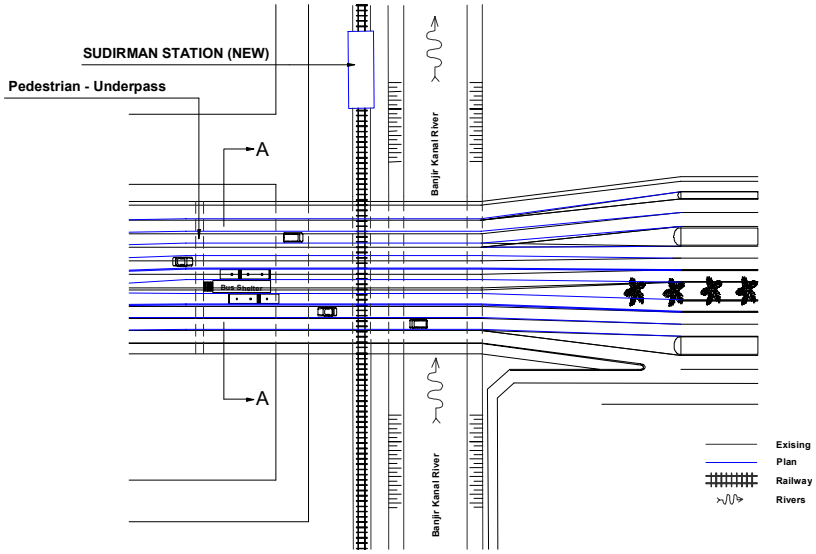
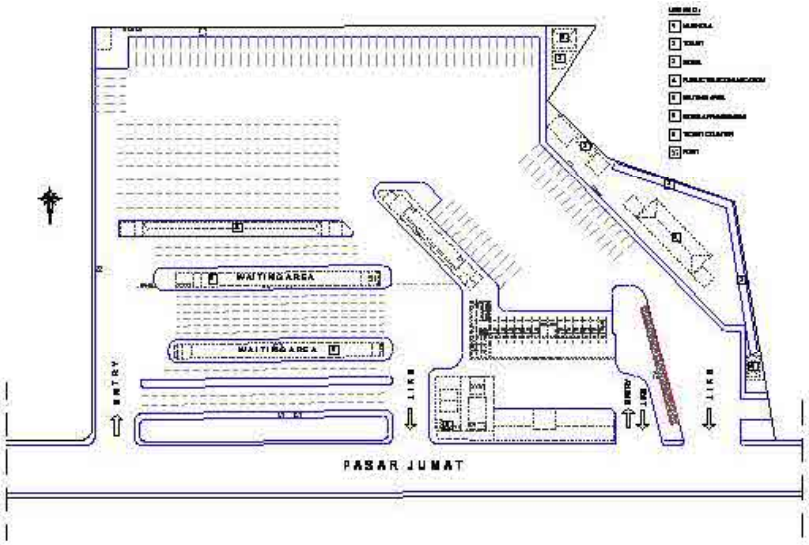
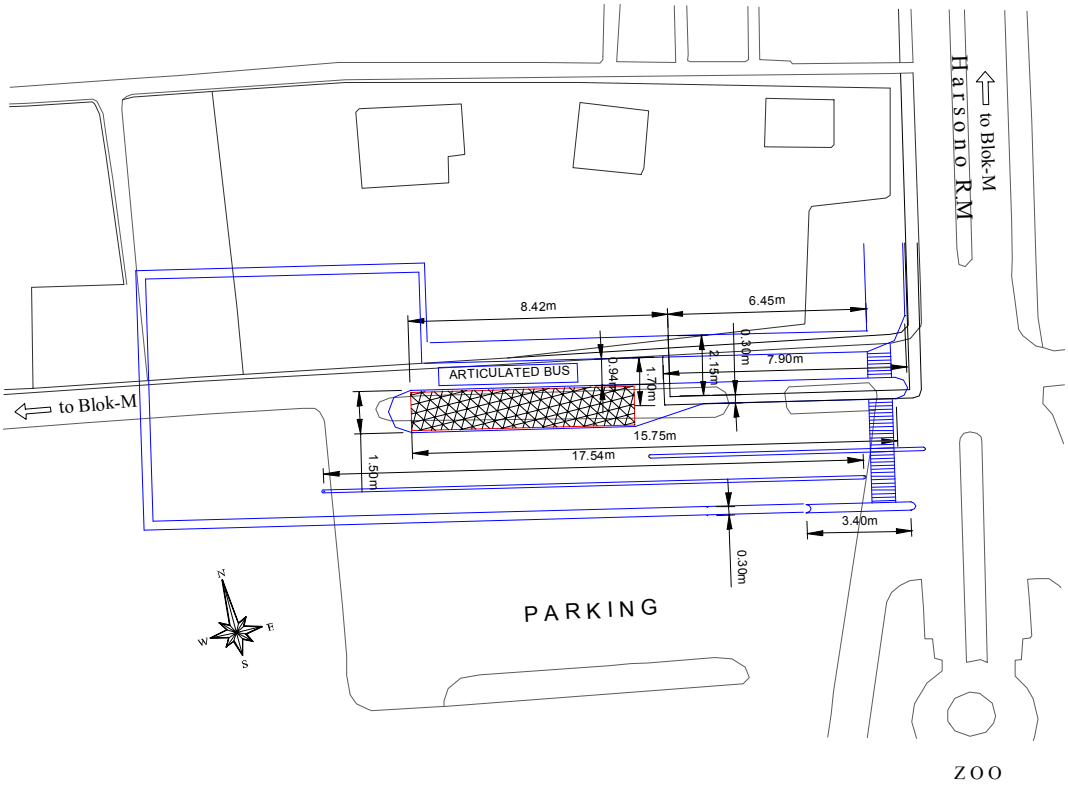


Figure 2.3.12 Square Development at New Sudirman Bus Stop

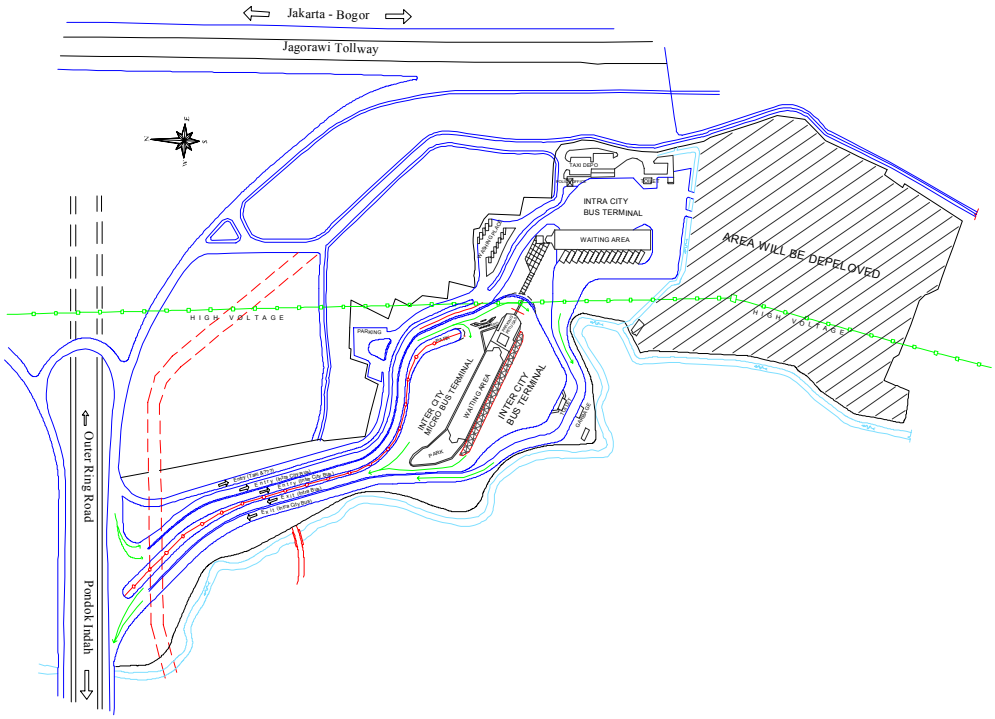


Lebak Bulus

Figure 2.3.13 (1) Bus Terminal Improvement Plan

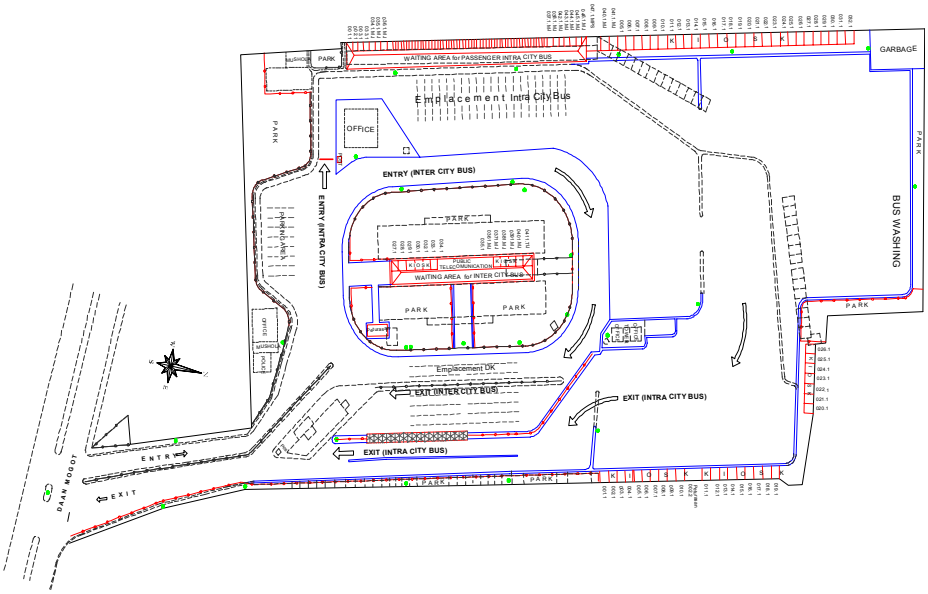


Ragunan

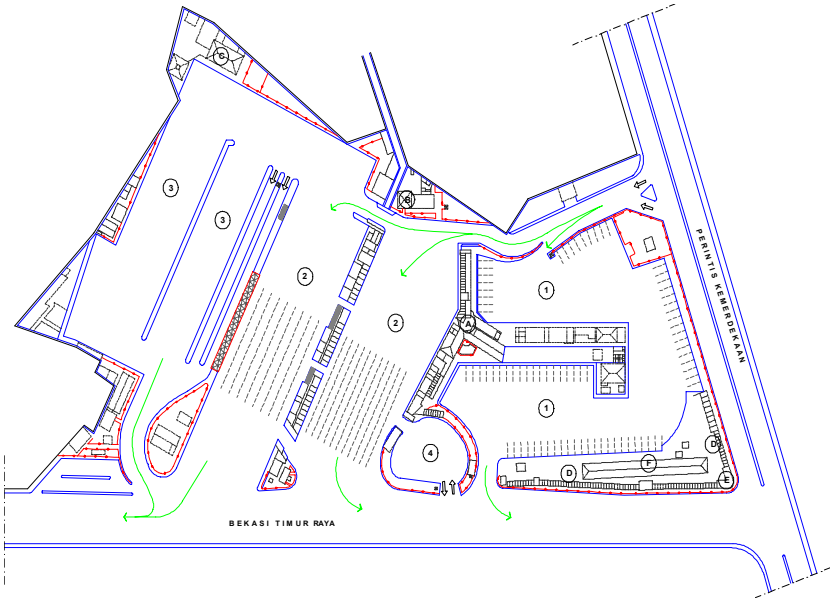


Kampung Rambutan

Figure 2.3.13 (2) Bus Terminal Improvement Plan



Kalideres



Pulogadung

Figure 2.3.13 (3) Bus Terminal Improvement Plan

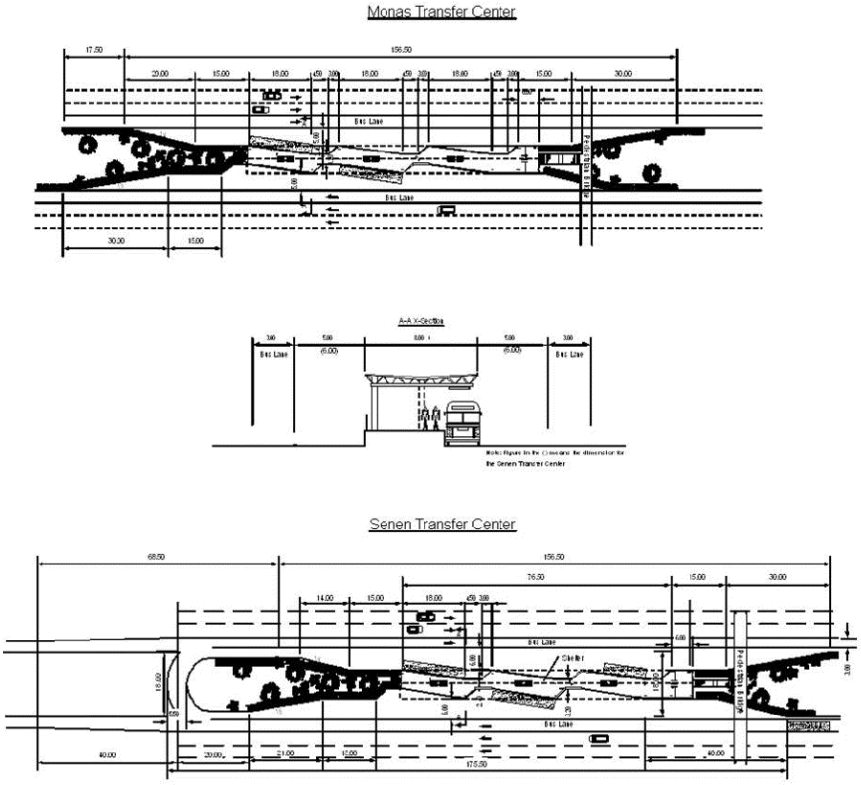


Figure 2.3.14 Transferring Center at Monas and Senen

3) Bus Stop

a. Approach to Bus Shelters

Existing or newly constructed pedestrian bridges will be provided for boarding and alighting passengers to cross the roads from sidewalk to bus shelters in principle, in case general traffic is heavy. On the other hand, pedestrian crossing will also be provided with traffic signals at the bus shelters on mid-section of roads where general traffic is moderate and road is not so wide.

b. Dimensions

The size of bus shelters depends on passenger demand and type of bus coaches. In the study, shelters of 12 types that are tabulated in Table 2.3.6 were planned. And typical configurations are shown in Figure 2.3.15.

Decision Procedure of the Bus Shelter's Dimension is discussed in Appendix 1.