

Exclusive Median Bus Lane Network

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1. Policy Implementation Period

Buses have been serving citizens for decades as one of the most typical public transport modes along with subways; however, irregular service intervals due to traffic congestion have caused inconveniences and led to citizens gradually avoiding bus use. As a consequence, the exclusive median bus lane system was first introduced in the second half of 1986 as part of the bus priority policy, one of the ways to induce the transition from private cars to public transport modes in the wake of a vicious cycle of increasing the use of private cars and increasing traffic congestion.

Since the first exclusive median bus lane system was implemented by installing roadside exclusive bus lanes on Wangsan Road in 1986, the total length of exclusive bus lanes reached 224.5km in 1999. The exclusive median bus lane system designating the median lanes of road as the exclusive median bus lanes was first introduced to Cheonho-daero in 1996, and it has been regularized since the time of reorganizing the popular transportation system by Seoul Metropolitan Government in 2004.

Since its introduction in July 2004 to Dobong-Mia-ro, Susaek- Seongsan-ro and Gangnam-daero, it has been expanded on average by 15km per year mainly on roads with heavy traffic congestion. By the end of 2014, 117.5km of exclusive median bus lanes have been built and operated thus providing fast and safe bus services by connecting major arterial roads without clogging.

As of 2016, 119.3 km of lanes designed for the exclusive use of buses, in an effort to increase efficiency and customer satisfaction, are operated throughout the city of Seoul.

¹ Translation by ESL®

2. Background Implementation

Until the 1960s, bus transportation served as a central role in public transportation. However, its role had gradually declined due to the increase in private cars following the continuous economic growth since the 1970s and the development of other public transportation systems resulting from the expansion of urban areas. The rapid increase in private cars caused traffic congestion problem in large cities. Among the traffic system management techniques that appeared to solve this problem, the exclusive median bus lane system reaffirmed the importance of the bus.

The Traffic System Management Act, which has been enforced since the early 1970s, was a short-term low-investment method designed to curb traffic demand and to optimize the use of existing traffic facilities, while the existing method was a long-term high-investment method focused on increasing traffic facilities. The exclusive median bus lane system is one of these traffic system management techniques, and is a way predicted to anticipate the transition from the demand for private cars to that of buses through the improvement of bus and its services, in particular, as a method of simultaneously reducing the demand and supply of traffic.

Such an exclusive median bus lane system enables the same transportation capacity as light rail transit at a much lower investment cost than a subway system; moreover, it can be easily improved or restored during operation. Most of all, it is effective in encouraging the conversion from the demand for private cars to that of buses.

In South Korea, since the exclusive median bus lane system was implemented for the first time by installing a roadside exclusive bus lane on Wangsan Road in 1986, a total of 218.5km exclusive bus lanes have been installed in 59 sections.

- Full-time - 23 sections, 46.1km (07: 00-21: 00)
- Part-time - 18 sections, 44.6 km (07: 00-10: 00, 17: 00-21: 00)
- Exclusive median lane - 12 Corridors, 119.3km

3. The Importance of the Policy

The importance of exclusive median bus lane policies had previously been theoretically emphasized by US and UK traffic scholars (Downs 1977; Mogridge and Williams 1985). In other words, according to the theory, if a road is expanded or newly established to mitigate traffic congestion, it will have a short-term effect on improving the travel speed first. However, the capacity of the expanded road will encourage new traffic and the speed will increase again in the long-term while the policy that increases only the travel speed of public transportation can have a positive effect on relieving traffic congestion by increasing the travel speed of both public transport modes and private cars through attracting traffic users to public transportation. In fact, it was observed that not only bus travel time but also the speed of the normal lane was improved in the exclusive median bus lane system which was carried out at the time of reorganization of public transportation in Seoul. In other words, this policy is an example of exemplary policy implementation that realized the theoretically proven effect of increasing public transport speeds. It has thus been seen as one of the main policies that has enabled

movement among the various means of transportation, which was at the time very difficult due to an ever increasing use of private cars. It is difficult to separate the effects of individual policies because public transport reorganization is being achieved as an overall blend of diverse policies, but in the absence of such a series of popular public transport policies, automobile owners would have continued to use their cars, then as in other cities confronted with similar situations, the car-centered culture would have persisted as ownership and use of cars continued to rise. Such a dependence on cars would have continued, making the conversion of the transportation means extremely difficult. This is an important policy that has contributed greatly to the Seoul-style flexibility in the modes of transport where the car owners do not solely rely on their cars but also on public transportation depending on situations as a mixed result of the overall policies that have increased the competitiveness of the bus when compared to car – such as the integration of bus routes, integration of fares and automation of traffic information.

4. Relevance with Other Policies

The establishment of exclusive median bus lanes in Seoul has made the most remarkable progress within the larger framework of the transition level of public transport system reform, as is widely known. Therefore, it is closely related to major policy factors that constitute the public transportation system – such as the integration of bus service routes, integration of fares, transfer center, traffic information integration and planning. In particular, the exclusive median bus lanes that were installed together with these means of 'integration' were able to have a clearer effect compared to the previous roadside exclusive median bus lanes partly because of the physical difference between the median lane and the roadside bus lane, naturally. But this policy was related to a series of policies that enhance the competitiveness of buses in general in that a single policy that strengthens the competitiveness of buses when compared to cars has limited effects and users are able to detect the effect only when it was generated in combination with other policies. This policy is most closely and directly related to the policy measures that can shorten bus travel times.

The direct policy objective of exclusive median bus lanes is to shorten these travel times. This is the ultimate goal of car users when switching from a car to a bus. However, bus travel times from a user's point of view also includes the time getting to the bus stop, bus waiting time and bus stop departure time as well as the time spent on the bus. It may also include the time while the bus itself waits to comply with bus timetables after boarding. In addition, exclusive median bus lanes (with the aim of maintaining relatively higher bus running speeds than those of other vehicles) are only effective in overcoming a drop in driving speed due to congestion; however, they cannot control other factors such as signaling systems and accident vehicles. Therefore, this policy is closely related to overall policy measures that can reduce the total travel time of the buses such as the integration of charges mobilized in public transportation integration and, in particular, electronic freight payment means, service linkage with other public transport modes, bus stop connections and the automation of public transport information as well as having a close complementary relation with a series of TSM (Transport System Management)

such as signaling system synchronization, bus priority signal system, control and management of bus stops and surveillance of illegal parking and illegal use of exclusive median bus lanes.

5. Policy Objectives and Processes

The policy objective of the exclusive median bus lane system is to secure lanes that can only be used by buses in the regions where the average travel speed is habitually low due to traffic congestion, thereby allowing the bus to maintain a superior travel speed when compared to cars using the remaining lanes as well as to actively encourage the people who use cars to switch to buses.

The following conceptual flow chart shows well how the installation of exclusive median bus lanes can lead to the transition from cars to public transportation and contribute to the improvement of overall road conditions.

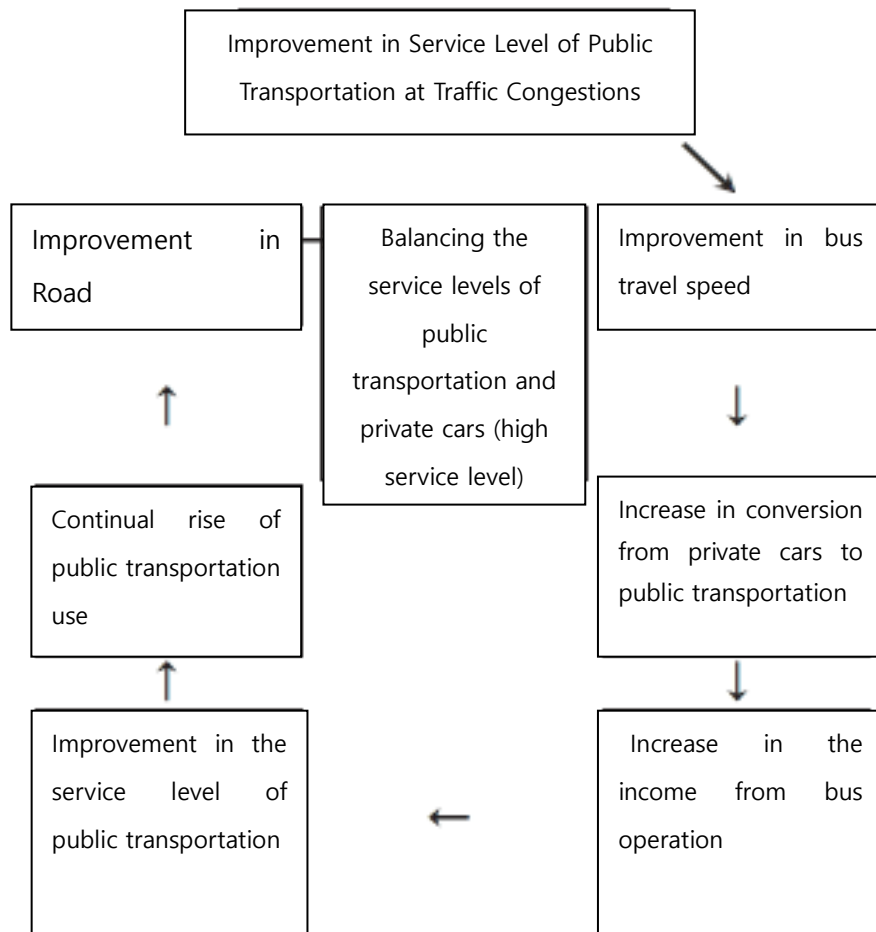


Figure 1. Improvement in Congestion by the Introduction of Exclusive Median Bus Lanes

Source: Han, Sang-Jin (2007) Opinion

Installation Process of Exclusive Median Bus Lane by Year

The following three figures show the gradual expansion and distribution of exclusive median bus lanes

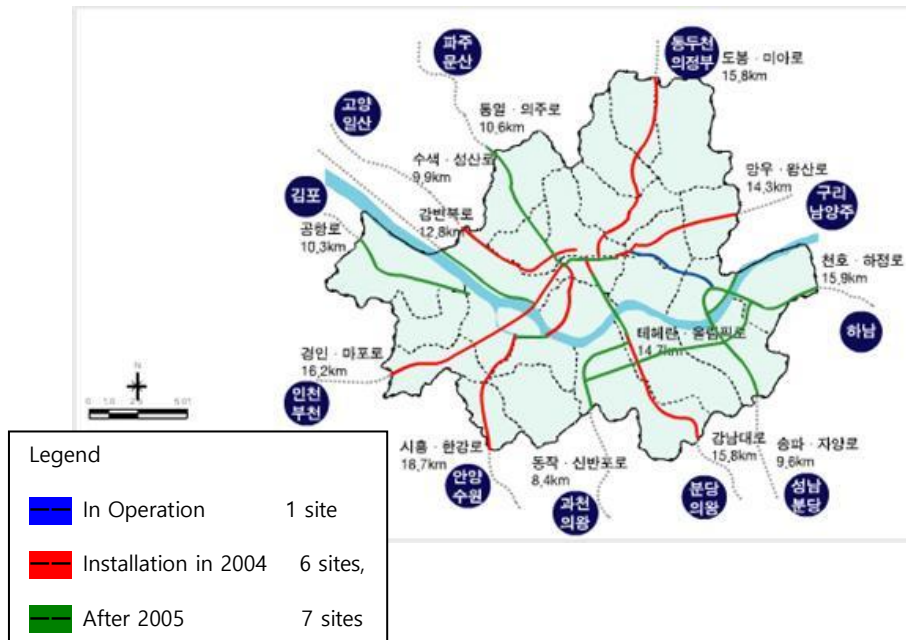


Figure 2: Installation Planning Map of Exclusive Median Bus Lanes in Seoul Metropolitan Government, Ministry of Land, Transport and Maritime Affairs, 2004



Figure 3: Installation Planning Map of Exclusive Median Bus Lanes in Seoul Metropolitan Government, Ministry of Land, Transport and Maritime Affairs, 2008

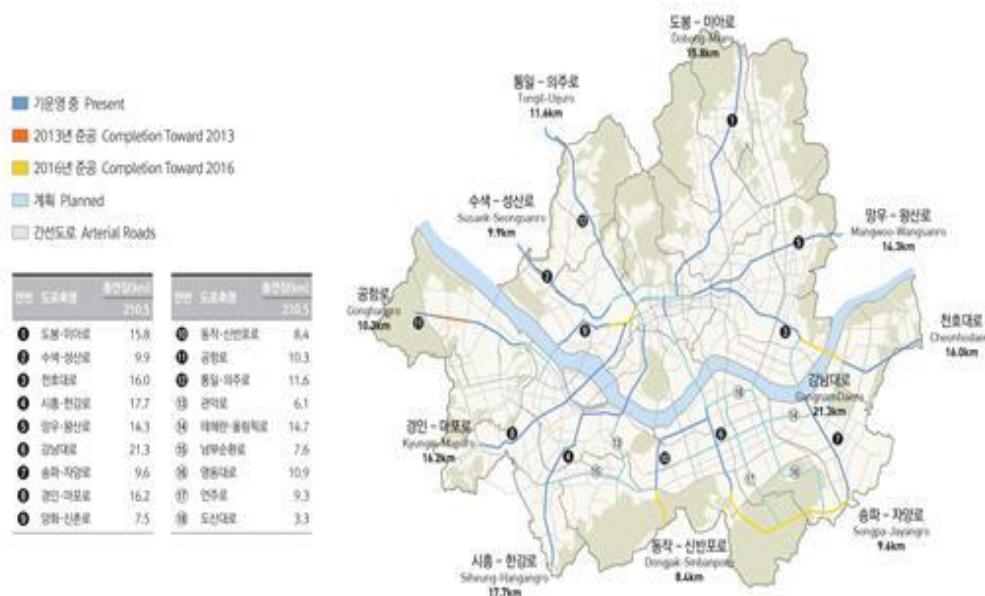


Figure 4: Installation Planning Map of Exclusive Median Bus Lanes in Seoul Metropolitan Government, Ministry of Land, Transport and Maritime Affairs, 2013

6. Main Policy Contents

The exclusive median bus lane system in Seoul was first introduced in 1986 based on the Road Traffic Act, and a total of 218.5km exclusive bus lanes have been installed in 59 sections since first appearing on Wangsan Road and Han River-daero.

As for exclusive median bus lanes, there are roadside exclusive bus lanes and exclusive median bus lanes. For the roadside exclusive bus lanes, the length of the exclusive bus lanes decreased from 224.5km in 1999 to 89.3km in 2011, while the number of exclusive median bus lanes increased from 4.5km in 1999 to 121.1km in 2011, which is more than 30 times increase. The roadside exclusive bus lanes are installed on the roadway on the roadside, divided into full time (07:00 to 21:00 on weekdays) and part time periods (07:00 to 10:00 and 17:00 to 21:00 on weekdays), and are not in operation on Saturdays, Sundays and public holidays.

The exclusive median bus lanes provide exclusive lanes to the median lane of existing roads and may also be equipped with protective fences to prevent the entry of other vehicles. While the smooth driving on the roadside exclusive lanes is often interrupted by parked vehicles or vehicles turning right, there is no need to reduce the speed while driving on the exclusive median bus lanes because of far fewer interventions from other vehicles. Therefore, there has been a tendency to reduce the number of roadside exclusive bus lanes and to increase the number of exclusive median buses because achieving the primary purpose of maintaining a superior driving speed is more certain. The first 24-hour exclusive median bus lane on the

common road was opened on Cheonho-daero, and in 2004, the exclusive median bus lanes were put into full operation in Gangnam-daero and so on along with the Seoul Metropolitan bus reorganization.

The exclusive median bus lane was introduced as part of the public transport system reorganization project in 2004 and has been continuously expanded for more than 10 years.

The Seoul Metropolitan Government has already been building radial median exclusive median bus lanes with its center downtown, and will further establish an east-west connection system linking the sub-downtown areas (see Figure 4).

Currently, the Seoul Metropolitan Government is working toward increasing the current distance of median exclusive median bus lanes in operation in 12 corridors from 115.3km to 134.5km adding 19.2km by 2016. Moreover, it will also improve the connectivity of the median lanes by examining the construction of the exclusive median bus lanes on the arterial roads that connect sub-downtowns east and west.



Figure 5: Seoul Metropolitan Government Exclusive Median Bus Lanes Planning Map

Source: Traffic Operation Information Service, 2013

First, five additional sections will be installed by 2016, which will increase the efficiency of the existing exclusive median bus lanes by linking the disconnected sections among the already existing sections or by being built on the visual sections and other areas linking the metropolitan BRT (arterial bus express system) routes that are being pursued by the central government.

For the first time, all sections of the exclusive median bus lanes on Gonghang-ro that connect Gimpo Airport to Yanghwa Bridge were connected.

In 2013, 1.8km of exclusive median bus lanes were installed in the Magok district section

(Airport Telephone Station ~ Balsan Station), which had not been installed with exclusive median bus lanes. In addition, the connectivity of downtown section bus lanes was enhanced in 2014 by additionally installing 2.2km of exclusive median bus lanes on Yanghwa-Sinchon-ro that were installed only from the northern end of Yanghwa Grand Bridge to Ewha Womans Univ. in order to stretch them to Seodaemun Intersection (Chungjung-ro section).

- Installation of exclusive median bus lanes: Expansion by adding 4 routes of 18.4km by '17
 - By 2017: 4 routes of 18.4 km
 - (Cheonho-daero 3.3 km, Hyeong-ro 9.7 km, Jong-ro 4.0 km, and Namdaemun-ro 1.4 km)

In addition to these additional connecting sections, the Seoul Metropolitan Government plans to expand the exclusive median bus lanes for the corridors that link sub-downtown areas east and west. In the meantime, the system has been configured with radial exclusive median bus lanes consisting of 12 road corridors stretching to all directions with its center in the downtown area in which the 'Sadaemuns' are located. However, an examination of the feasibility of installing exclusive median lanes to connect the sub-downtown areas such as Gwanak-ro and South Circular Road is scheduled to take place.

Table 1: Exclusive Median Bus Lane Promotion and Planning

Year	Name of Route	Extension (km)	Promotion & Planning	Remark
2013	Extension of Gonghang-ro (Magok District)	1.8km	Dec. 2013 Opening plan	In connection with Magok district businesses
2014	Chungjeong-ro	2.2km	In connection with the dismantling of the elevated highway	dismantling of the elevated highway in 2014
2015	Cheonho-daero Extension	3.3km	In connection with the extension of Cheonho-daero	Extension construction
2016	Dongjak-daero Extension	2.2km	Connecting Nantaeryeong~Sadang Section	
	Heonreung-ro	9.7km	Promoted in terms of Wirye New City project progress status	
Total	-	19.2km	-	

Source: Traffic Operation Information Service, 2013

7. Technical Details

Seoul Metropolitan Government is currently taking the volume of bus traffic and the number of bus transportation passengers as criteria for the types of new installation and the operation of exclusive lanes. The installation criteria are as follows:

For one-way three-lane roads

- Roadside exclusive lanes considered if:
 - 60 cars per hour or more and 1,800 people per hour or more
 - Roadside exclusive lanes considered if 100 cars per hour or more and 3,000 people per hour or more, it is possible to provide contra-flow exclusive lanes
 - It is possible to provide median exclusive lanes if 150 cars per hour or more and 4,500 people per hour or more, overtaking lanes at the bus stops provided.

For one-way four-lane roads:

- Roadside exclusive lanes and overtaking lanes at the bus stops offered if 100 cars per hour or more and 3,000 persons per hour or more.
- It is possible to offer median lanes and overtaking lanes at bus stops when 150 cars per hour or more and 4,500 people per hour or more

8. Policy Effects

Bus travel speeds increased by about 30% compared to pre-construction time of the exclusive median bus lanes, while the average number of passengers increased by 4 - 7%

According to the results from the analysis of the effects of installing median bus lanes in Seoul Metropolitan Government area, the speed of bus travel has been seen to be slightly different for each road. However, the installation was analyzed to be effective in enhancing the convenience of citizens using public transportation because of an approximately 30% improvement in the average speed of travel at peak times.

The average speed of buses was improved by about 30% from about 15km / h before the opening to about 20km / h.

Particularly, in the case of Dobong-Mia-ro, which used to suffer from serious traffic congestion, the average speed of buses was improved by 9.0km / h (81.8%) from 11.0km / h before the installation of exclusive median bus lanes to 20.0km / h,

Table 2. Increase / Decrease Ratio of Median Bus Lane Travel Time

Opening Date	Road Name	Extension(km)	Speed before Opening (km/h)	Speed after Opening (km/h)	Increase / Decrease Ratio of Travel Time
'04.07	Dobong-Mia-ro	15.8	11.0	20.0	81.8%
	Susaek-Seongsan-ro	6.8	13.1	19.9	51.9%
	Gangnam-daero	4.8	13.0	17.3	33.1%
'05.07	Mangwu-ro	4.8	17.6	20.9	18.8%
	Kyeongin-ro	6.8	14.3	19.3	35.0%
'05.12	Siheung-Daebang-ro	9.4	15.5	20.7	33.5%
'06.12	Hangang-ro	5.5	17.4	21.9	25.9%
	Mapo-ro	5.3	14.5	19.1	31.7%
'08.01	Songpa-daero	5.6	17.1	20.3	18.7%
'09.04	Gonghang-ro (Level 1)	2.5	16.5	18.5	12.1%
'09.05	Noryangjin-ro	2.8	16.4	21.6	31.7%
'09.06	Sinbanpo-ro	3.5	18.4	20.9	13.6%
'09.11	Dongjak-daero	2.6	17.2	21.0	22.1%
'09.12	Yanghwa, Shinchon Road	5.2	16.2	18.6	14.8%
'10.08	Gonghang-ro (Level 2)	2.3	14.8	19.6	32.4%
	Mangwu-roExtension	2.2	18.7	21.2	13.4%
'10.12	Tongil-Uiju-ro, (Level 1)	3.3	18.6	20.9	12.4%
'11.03	Cheonho-daero (BRT)	5.1 (excluding Hanam-si Section)	17.9	18.7	3.9%
'11.12	Tongil-Uiju-ro, (Level 2)	5.4	12.3	19.0	55.1%
	Wangsan-ro	3.4	15.8	18.7	18.4%

Source: Traffic Operation Information Service, 2013

Secondly, it was shown that the exclusive median bus lanes contributed greatly to securing the accuracy of the arrival time of buses. The travel time deviation of the buses passing through the exclusive median bus lanes turned out to be at the level of $\pm 1 \sim 2$ minutes, which means that there was much less deviation when compared to vehicles traveling the same distance

using regular lanes. For example, in the case of Dobong-Mia Road (15.8km), where the average travel time for buses is 44.3 minutes, the buses have a deviation in travel time of ± 2.7 minutes, while the level of private cars is at ± 15.3 minutes.

As a result, the buses of the same route did not move around in groups, they were properly arranged according to the bus stops, and the jagged arrival intervals were eliminated. It thus became possible to provide citizens with more convenient public transportation services at regular time intervals.

Table 3. Travel Time Deviations of Bus Median Lanes

Road Name	Extension (km)	Average Travel Time of Vehicle (min)	Deviation of Travel Time (min)	
			Bus	General Vehicles
Dobong-Mia-ro	15.8	44.3	± 2.7	± 15.3
Susaek-Seongsan-ro	6.8	18.1	± 1.2	± 15.6
Gangnam-daero	4.8	16.7	± 1.3	± 4.6
Mangwu-ro	4.8	14.8	± 1.4	± 4.9
Kyeongin-ro	6.8	16.9	± 3.1	± 9.2
Siheung-Daebang-ro	9.4	22.7	± 1.2	± 4.6
Hangang-ro	5.5	15.1	± 1.1	± 5.4
Mapo-ro	5.3	16.4	± 1.0	± 5.6
Songpa-daero	5.6	15.7	± 1.6	± 4.1
Gonghang-ro (Level 1)	2.5	5.8	± 0.4	± 0.7
Noryangjin-ro	2.8	6.8	± 1.2	± 3.0
Sinbanpo-ro	3.5	9.0	± 3.0	± 6.2
Dongjak-daero	2.6	7.7	± 0.9	± 1.8
Yanghwa, Shinchon Road	5.2	13.4	± 1.8	± 3.4

Gonghang-ro (Level 2)	2.3	15.1	± 1.4	± 1.8
Mangwu-roExtension	2.2	6.3	± 0.9	± 1.0
Tongil-Uiju-ro, (Level 1)	3.3	10.9	± 1.0	± 1.6
Cheonho-daero (BRT)	5.1 (excluding Hanam-si Section)	30.2 (including Hanam-si Section)	± 2.1	± 1.0
Tongil-Uiju-ro, (Level 2)	5.4	15.3	± 2.8	± 5.4
Wangsan-ro	3.4	10.3	± 0.4	± 1.4

Source: Traffic Operation Information Service, 2013

The number of bus passengers increased by 4-7% on average compared to the pre-construction time of exclusive median bus lanes even if there were still slight differences depending on the road.

Table 4. Transition Trend of the Bus Passengers on the Exclusive Median Bus Lanes by Road Opened Since 2009

(Unit: thousand persons / month)

Name of Road	Extension (km)	Before Opening	After Opening	Increasing Rate of Passengers
Dongjak-daero	2.6	2,491	2,679	7.0%
Yanghwa-Sinchon-ro	5.2	16,228	16,342	0.7%
Gonghang-ro (Level 2)	2.3	11,072	13,743	24.1%
Mangwu-ro Extension	2.2	11,023	11,501	4.3%

Source: Traffic Operation Information Service, 2013

In particular, as a result of comparing the numbers of bus passengers in Tongil-ro (Eunpyeong New Town –Seodaemun-intersection, 11.1km), which was fully opened in December, 2011, the number after the opening was analyzed to have increased by about 15% compared to that of before the opening.

Table 5. Transition Trend of Bus Passengers on Tongil-ro Exclusive Median Bus Lanes

(based on weekdays, unit: persons)

Before Opening ('10. 4)[A]	After Opening ('12. 4)[B]	Variation [B-A]
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78,218	89,304	11,086(15.1%)
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※ Average daily passengers on five routes (701,703,704,706,720) from Gupabal to Seoul Station

Source: Traffic Operation Information Service, 2013

The daily total number of bus users in Seoul was 4.78 million in 2004 during the early stage of the introduction of the exclusive median bus lanes; however, it increased to approximately 5.8 million (an average 21% increase on a daily basis) in 2011. Therefore, Seoul Metropolitan Government regards the establishment of exclusive median bus lanes as having been effective in the activation of public transportation use.

9. Challenges and Solutions

Transient Increase in Traffic Accidents

In the early days of the implementation of the exclusive median bus lane system, traffic accidents tended to increase temporarily due to the unauthorized crossing of pedestrians and public transportation users who were as yet adjusted to the newly changed traffic system and speed of buses. However, the number of accidents has been decreasing every year along with the continuous expansion of exclusive median buses as a result of the increase in citizen awareness and the settlement of orderly traffic culture due to the continuous promotion of the exclusive median bus lane system.

In addition, in order to reduce traffic accidents, the installation of safety fences around the exclusive median stops and crosswalks, shock absorbers at road junctions, photovoltaic rechargeable raised pavement markers for guiding the lanes and speeding prevention facilities at the stops were carried out along with regular safety education programs for bus transportation service workers.

Insufficient Capacity of Exclusive Median Bus Stops

For some bus stops and general traffic congestion points where build up occurs due to the concentration of passengers getting on and off after the operation of the exclusive median bus lanes, Seoul Metropolitan Government will strive to resolve the inconvenience of the citizens using buses as well as general vehicles by carrying out various projects to enhance the capacity of bus stops as well as traffic improvement projects to relieve traffic congestion. It will also continue to complement the factors of traffic safety inhibition and communication obstacles by observing traffic situations in sections within the exclusive median bus lanes.

Measures to Overcome Problems and Implementation Status

In its early days, the traffic accidents on the exclusive median bus lanes tended to increase

temporarily due to the unauthorized crossing of pedestrians and public transportation users who were as yet adjusted to the newly changed traffic system and speed of buses. In the meantime, the number of accidents has been decreasing every year along with the continuous expansion of exclusive median buses as a result of the increase in citizen awareness and the settlement of orderly traffic culture due to the continuous promotion of the exclusive median bus lane system.

Since 2009, the Seoul Metropolitan Government has been improving 40 exclusive median bus lanes in the city – including the expansion of exclusive median stops (11 places) on Gangnam-daero– by promoting the 'Improvement Project for Exclusive Median Bus Lanes'.

In 2011, the exclusive median stops (11 places) on Gangnam-daero with high air-density due to a small stop compared to the citizens using it was extended (stopping lane 4 → 5, the platform width 3m → 4m), and last year, a bus stop was newly established in front of Suyu Station on Dobong-Mia-ro to enhance the convenience of the transfer with Subway Line 4.

In the future, Seoul Metropolitan Government will continue to improve the operation of the exclusive median bus lanes efficiently in accordance with the changes in the local environments and traffic conditions by promoting improvement measures such as optimizing the intersection signal times and promoting bypass routes in order to alleviate the congestion in the exclusive median bus lane on Wonsan-ro, which runs from Shinseol-dong to Cheongyang-ri. It will also look toward expanding the stop of the exclusive median bus lane in front of Gyeongin Road dome stadium following the opening of the dome stadium in southwestern region.

In order to reduce traffic accidents in other sections, the installation of safety fences around the exclusive median stops and crosswalks, shock absorbers at road junctions, photovoltaic rechargeable raised pavement markers for lane guidance and speed prevention facilities at the stops were carried out along with the regular safety education programs for bus transportation service workers. In addition, for some bus stops and general traffic congestion points where build up occurs due to the concentration of passengers getting on and off after the operation of the exclusive median bus lanes, Seoul Metropolitan Government will strive to resolve the inconvenience of the citizens using buses as well as general vehicles by carrying out various projects to enhance the capacity of bus stops and traffic improvement projects to relieve traffic congestion. It will also continue to complement the factors of traffic safety inhibition and communication obstacles by observing the traffic situations of the sections within the exclusive median bus lanes.

In the future, Seoul Metropolitan Government plans not just to construct exclusive median bus lanes, but even to improve the function of exclusive median bus lanes by continuing to find out the points from the existing sections which are in operation where traffic congestion occurs and inconveniences in using the buses incur.

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