ISSUE 10

KOTI Knowledge Sharing Report

Korea's Best Practices in the Transport Sector

Road Transport Policy in Korea

by Nak Moon SUNG et al.

THE KOREA TRANSPORT INSTITUTE

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KOTI Knowledge Sharing Report: Korea's Best Practices in the Transport Sector
Issue 10: Road Transport Policy in Korea

by Nak Moon SUNG, Jae Kyung LIM, Jun Seok PARK, Young Ho KIM, Han Sun CHO, Hee Kyung KIM, Ji Hyung PARK, Hun Ki LEE

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• Preface

During the previous half century, Korea has achieved phenomenal economic growth at a rapid, unprecedented rate. As a result, the international community is paying attention to Korea's economic development experience, expecting the nation to play the role of a middleman between advanced and developing countries.

Furthermore, there is a growing demand in the international community for knowledge sharing concerning Korea's experience in the transport sector, which served as the cornerstone of the nation's economic growth.

Korea's transport policy has been successful in terms of facilitating economic growth as well as promoting a sustainable transport system. In this regard, Korea is qualified to be a role model for developing countries trying to develop their own successful transport policies.

Beginning in 1950, the Korean War devastated the country destroying most of the industrial facilities. When the war ended in 1953, the total nationwide length of paved roads was only 687 km. The Korean government put a priority on restoration of war damaged facilities to rebuild the desolate country.

With the Five-Year Economic Development Plan initiated in 1960, huge investment on transportation was made marking a major turning point in the modernization of the country. In the 1970s, transport service for underdeveloped regions was enhanced by constructing the Gyeongbu Expressway, national highway, and local roads, and thereby access to industrial and logistics complex was enhanced.

We were motivated to publish this book series against this backdrop. These books deal extensively in the fields of Korea's transportation, such as road construction history, Intelligent Transport Systems (ITS) based on Information & Communication Technology (ICT), fundraising, private investment projects, expressway rest areas, and fare collection methods.

The Korea Transport Institute (KOTI) is a comprehensive research institute specializing in national transport policies. As such, it has carried out numerous studies on transport policies and technologies for the Korean government.

Based on this experience and related expertise, KOTI has launched a research and publication series entitled "Knowledge Sharing Report: Korea's Best Practices in the Transport Sector." The project is designed to share with developing countries lessons learned and implications experienced by Korea in implementing its transport policies. The 10th output of this project deals with the theme of "Road Transport Policy in Korea."

We hope that this publication will help facilitate the process of establishing transport policies in developing countries through sharing Korea's development expertise and experience.

Gyeng Chul Kim
President
The Korea Transport Institute

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CHAPTER 1

General Understanding

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01
Road Classification

Administrative Classification of Roads

The Road Act in Korea divides the road types into seven categories in accordance with their locations and functions. This classification system aims to establish administrative authorities that should assume the responsibilities for the management of the roads. As for the expressways and national roads, the primary responsibility for their management lies with the state. Of these roads, the expressways are managed and operated by the Korea Expressway Corporation (KEC), to which the state has delegated its relevant administrative authority. This practice is based on the understanding that given their special status, the expressways need to be operated by an organization with expertise in road construction and management in order to maintain their functions properly.

- National expressway
- National road

- Special metropolitan city road/Metropolitan city road
- Provincial road
- Municipal (si) road
- County (gun) road
- District (gu) road

The road administrative authorities can be divided into two categories: construction and management. Detailed information is shown in the table below.

Table 1.1. Road administrative authorities

Classification	Administrative authorities	Competent agencies	
		Construction	Maintenance & management
National expressway	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport (Authority delegated to: President of Korea Expressway Corp.) (Private operator)	Minister of Land, Infrastructure and Transport (Authority delegated to: President of Korea Expressway Corp.) (Private operator)
National road	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport
	Mayor (city areas)	Mayor (city areas)	Mayor (city areas)
Special metropolitan city road / Metropolitan city road	Special metropolitan city mayor / Metropolitan city mayor	Special metropolitan city mayor / Metropolitan city mayor	Special metropolitan city mayor / Metropolitan city mayor
Provincial road	Provincial governor	Provincial governor	Provincial governor
	Mayor (city areas)	Mayor (city areas)	Mayor (city areas)
Municipal (si) road	Mayor	Mayor	Mayor
County (gun) road	County head	County head	County head
District (gu) road	District head	District head	District head

Functional Classification of Roads

Road functions can be explained in terms of access and mobility. Mobility refers to the road's role in ensuring fast transport from origin to destination, while access signifies the ease with which people approach their homes and offices. Mobility-oriented roads are built and managed from long-term perspectives for national or regional development. In contrast, access-oriented roads, which are directly linked to desired facilities, are constructed in association with plans to use nearby land. Mobility-oriented roads are generally wide and have good alignment as they have to secure a certain level of speed and capacity. In comparison, access-oriented roads are focused on matters related to traffic convenience such as movement routes to and from parking lots, platforms and other related facilities.

By function, roads can be categorized as arterial roads, minor arterial roads, collector·distributor roads, and city roads. Expressways can be broadly classified as arterial roads. However, because of their unique status (exit-entry restrictions, highest-hierarchical design standards, etc.), they are usually classified separately.

Figure 1.1 Functional classification of roads

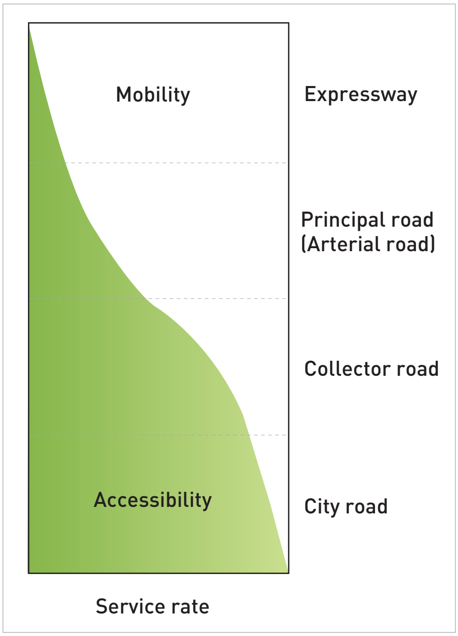


Table 1.2 shows a broad outline of the relations between functionally and administratively classified roads. Principal arterial roads refer to those that play pivotal roles in promoting national or urban development. The roads that belong to this category include national expressways, national roads, and special metropolitan city/metropolitan city roads. However, this does not necessarily mean that all the

Table 1.2. Relations between functionally and administratively classified roads

Classification	Functional classification of roads	Administrative classification of roads
Expressways	Principal arterial roads	National expressways
General roads	Principal arterial roads	National roads, Special metropolitan city·Metropolitan city roads
	Minor arterial roads	National roads, Special metropolitan city·Metropolitan city roads, Provincial roads, Municipal (si) roads
	Collector/distributor roads	Provincial roads, Municipal (si) roads, County (gun) roads, District (gu) roads
	Local roads	County (gun) roads, District (gu) roads

national roads and special metropolitan city/metropolitan city roads belong to this category.

Types of National Roads

Along with the national expressways, national roads serve as arterial roads that handle long-haul, large-volume traffic demand between principal cities and regions. Because of such significance, they are divided into four grades, which are subject to separate design speed and facility regulations.

- National road I
- National road II
- National road III
- National road IV

Table 1.3. Design speeds and facility standards of national roads

Classification		National road I	National road II	National road III	National road IV
Design speed	Flatland	80 km or higher	80 km	70 km	60 km
	Rolling areas		70 km	60 km	50 km
	Mountainous areas		60 km	50 km	40 km
Appurtenance maintenance standards	Median strips	Installation required for all sections	To be installed, if possible	To be installed, if possible	Pavement markings
	Intersection method	Interchange	Interchange/ At-grade intersection	At-grade intersection	Existing methods of intersection

02 Road Statistics

Road Length

Table 1.4 shows the growth trend of road length in Korea. As of 2011, the total road length amounted to 105,930 km, which represented a 2.3-fold increase from 46,951 km in 1980. During the same period, the expressways expanded 3.2 times their original length of 1,225 km to 3,913 km.

Table 1.4. Trends in road length

Classification	Total	National Expressways	National roads	Special metropolitan city/Metropolitan city roads	Provincial roads	Municipal/ County roads
1980 (A)	46,951	1,225	8,232	7,939	11,021	18,535
1990	56,715	1,551	12,161	12,298	10,672	20,033
2000	88,775	2,131	12,413	17,839	17,151	39,240
2010	105,565	3,859	13,812	18,878	18,180	50,835
2011 (B)	105,930	3,913	13,797	19,073	18,196	50,952
Growth (B/A)	2.3	3.2	1.7	2.4	1.7	2.7

Table 1.5 shows the results of comparative analysis of road statistics among major nations as of 2009. Korea was found to have a road density (km/km^2) of 1.05, which was higher than the United States' 0.67, but much lower than Japan's 3.20. In terms of road length per 1,000 people (km/1,000 people), Korea recorded 2.15, which is far below the average of other advanced countries. Land·population coefficient ($km/\sqrt{\text{land area}\cdot 1{,}000\ \text{people}}$) stood at 1.05, which also fell far short of the average of the major countries.

Table 1.5. Comparison of road statistics among major advanced countries

Classification	Land area ($1{,}000\ km^2$)	Population (thousand)	Road length (km)	Road density (km/km^2)	Road length per 1,000 people (km/1,000 people)	Land·Population coefficient ($km/\sqrt{\text{land area}\cdot 1{,}000\ \text{people}}$)
Korea	99.8	48,747	104,983	1.05	2.15	1.50
United States	9,831.5	307,687	6,545,839	0.67	21.27	3.76
United Kingdom	243.6	61,652	419,665	1.72	6.81	3.42
France	549.2	62,445	951,260	1.73	15.23	5.14
Germany	357.1	82,405	643,969	1.80	7.81	3.75
Japan	377.9	126,552	1,207,867	3.20	9.54	5.52
Average of 5 nations	-	-	-	1.82	12.13	4.32

• Note: Based on 2009 statistics, Road Services Manual (2012, Ministry of Land, Infrastructure and Transport (MOLIT))

Road Transport Performance

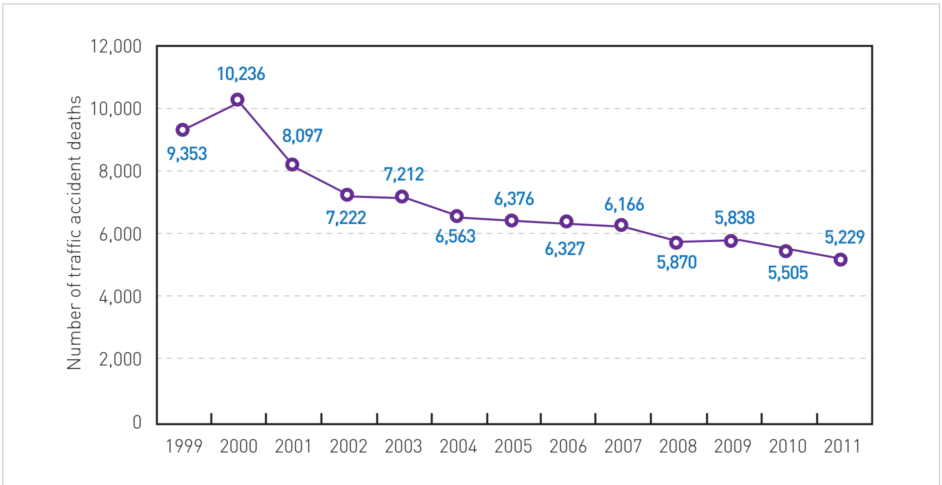
Table 1.6 presents domestic passenger transport statistics by mode. As of 2011, the number of passengers transported in the nation reached 69,582 million. The road sector accounted for 95%, or 66,136 million, showing that the absolute majority of domestic passengers traveled by road. During the 10-year period between 2001 and 2011, the performance of passenger transport increased by 1.7 times. By mode, the road sector measured to have the highest growth rate.

Table 1.6. Transport performance by mode (domestic passengers)

Classification	2001 (A) (million passengers, %)	2011 (B) (million passengers, %)	Growth (B/A)
Road	38,474 (91.9)	66,136 (95.0)	1.7
Rail	3,378 (8.1)	3,409 (4.9)	1.0
Maritime	9 (0.0)	15 (0.0)	1.7
Aviation	22 (0.1)	21 (0.0)	1.0
Total	41,883 (100)	69,582 (100)	1.7

Table 1.7. shows domestic freight transport statistics by mode. As of 2011, the amount of freight transported in Korea reached 3,851 million tons. The road sector accounted for 95.9%, or 3,693 million tons. During the 10-year period

Figure 1.2. Trend in traffic accident deaths



between 2001 and 2011, the performance of freight transport increased by about 10%, thanks mainly to growth in the road sector. Other sectors – rail, maritime and aviation – showed downward trends in their freight transport performance.

Table 1.7. Transport performance by mode (domestic freight)

Classification	2001 (A) (million tons, %)	2011 (B) (million tons, %)	Growth (B/A)
Road	3,314 (94.7)	3,693 (95.9)	1.1
Rail	45 (1.3)	38 (1.0)	0.8
Maritime	141 (4.0)	119 (3.1)	0.8
Aviation	0.4 (0.0)	0.0 (0.0)	0.0
Total	3,501 (100)	3,851 (100)	1.1

Road Traffic Accidents

In 2011, about 222,000 road traffic accidents recorded in Korea, killing 5,229 people and injuring 341,000. The government's efforts to reduce traffic accidents measured to be effective during the 10-year period between 2001 and 2011. The total number of traffic accidents reduced by 15%, including decreases in traffic accident deaths and injuries by 35% and 12%, respectively.

Table 1.8. Traffic accident trends

Classification	No. of Occurrences	No. of Deaths	No. of Injuries
2001 (A)	260,579	8,097	386,539
2002	231,026	7,222	348,149
2003	240,832	7,212	376,503
2004	220,755	6,563	346,987
2005	214,171	6,376	342,233
2006	213,745	6,327	340,229
2007	211,662	6,266	335,906
2008	215,822	5,870	338,962
2009	231,990	5,838	361,875
2010	226,878	5,505	352,458
2011 (B)	221,711	5,229	341,391
Growth (B/A)	0.85	0.65	0.88

03

Road-Related Legal System

The roads in Korea are constructed and operated on the basis of six laws, the brief overviews of which are outlined in the following table.

Table 1.9. Road-related legal system

Classification	Main contents	Description
Road Act	• Road types, designation of management agencies • Road construction procedures, criteria and management	Basic law on public roads
Expressway Act	• Designation of road routes, intersection methods, road access areas, passage limitations • Delegation of authority (Minister→Korea Expressway Corporation President)	Provisions on expressways
Toll Road Act	• Establishment criteria • Toll collection, etc.	Provisions on matters related to toll roads
Private Road Act	• Criteria for private roads • Banning passage of general public, collection of tolls, etc.	Provisions on criteria for construction and management of private roads
Korea Expressway Corporation Act	• Role of Korea Expressway Corporation • Corporation's registration, accounting, etc.	Provisions on establishment and operation of Korea Expressway Corporation, an organization entrusted with the authority to manage expressways
Road Traffic Act	• Traffic rules, enforcement criteria, etc.	Provisions on the operation of roads

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CHAPTER 2

Road History

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01

Road Policy Before and After the Korean War

Before the Korean War (-1950)

Korea had a road network of just 24,031 km when it regained its independence from Japanese colonial rule at the end of World War II. The roads were mostly in poor conditions, with paved ones accounting for a mere 0.026% of the total length of roads. The road policy under the U.S military government was focused on repairing the roads devastated during the Korean War period (1950-1953), and the relevant repair works were implemented as part of unemployment relief projects.

The first road project under the U.S. military government was devoted to repairing and paving the Seoul-Busan national highway. Due to the lack of Korean road engineers at that time, the U.S. military had to provide on-site technical guidance on road pavement. The project was interrupted due to outbreak of the Korean War in 1950.

After formal establishment of the Republic of Korea, the Korean government in November 1948 launched the Construction Bureau for the construction and management of roads. In May the subsequent year, the government set up regional construction bureaus in Seoul, Busan and Iri after enacting relevant provisions.

After the Korean War (1953-1962)

The Korean War ended in 1953, and Korea began to receive foreign aid, mainly from the countries that participated in the war. The U.S. International Cooperation Administration (ICA) and United Nations Korean Reconstruction Agency (UNKRA) played crucial role in aiding the nation to implement recovery projects until 1962.

The road projects were focused on repairing damaged roads and bridges as well as expanding and paving national roads connecting major cities (Seoul, Busan, Daegu, Daejeon, etc.). In addition, road networks centering on coal mines throughout the nation were planned and constructed during this period, helping to lay the foundations for industrial development.

Immediately after the Korean War, the nation had a shortage of road experts and relevant technologies. In response, the government in 1954 launched a project to foster road engineers sponsored by the U.S. aid. Under this project, people were sent to the United States and Germany to learn technologies necessary for road construction and maintenance. The Korean road engineers fostered through this project later played leading roles in developing the nation's road industry.

02

Economic Development and Road Policy

Five-Year Economic Development Plan and Road Policy (1962-1996)

For systematic economic growth, President Park Chung Hee launched an economic development plan that would be renewed every five years. The scheme lasted 35 years, during which 1st to 7th Five-Year Economic Development Plans were implemented. The plans were basically aimed at promoting the nation's industrial development. As such, they included various action programs to build roads, railways and ports, thus facilitating the overall SOC projects.

1) 1st Five-Year Economic Development Plan (1962-1966)

The nation had no industrial basis at this period, hence the government's road policy was focused on building industrial roads. In particular, the top priority was given to the construction of roads in coal mine areas in order to support coal mining industry.

The road projects during this period were carried out with active participation of Korean and U.S. military engineers. Also worthy of note is that the nation's first ever transport survey was conducted. The survey, implemented from 1965 to 1966 with financial support from the IBRD, generated the following policy suggestions:

- Urgent need to repair the road networks;
- Need to give priority to roads over railways in improving infrastructure for economic development; and,
- Need to integrate the transport-related organizations.

2) 2nd Five-Year Economic Development Plan (1967-1971)

The nation's road policy during this period was still directed towards building industrial roads. It, however, differed from the previous one in that it was aimed to expand the network of roads to cover all other industrial sectors than just the mining sector. The government actively promoted road projects based on its declaration that roads would be the nation's chief mode of transport, replacing the railroads which had played a crucial role in transport since the Japanese colonial period. This move was in agreement with the findings of the IBRD-financed survey that suggested giving priority to roads over railroads in infrastructure investment.

To secure financial resources for road projects, the government enacted the Act on Special Accounts for Road Construction. The law allowed for the operation of special accounts based on gasoline tax and toll revenues. The legislation was considered a critical turning point in terms of securing a stable supply of funds for road projects.

3) 3rd Five-Year Economic Development Plan (1972-1976)

The road policy during this period was marked by emphasis on building expressways. The most prominent expressways promoted during this period were the Honam Expressway connecting the capital region and the Honam area, the Yeongdong Expressway linking the capital region and Gangwon Province, and the Namhae Expressway between the Yeongnam and Honam areas. Not only did the government build expressways, it carried out projects to pave the major existing road networks. These projects were funded by loans from the IBRD and the ADB. To ensure the efficiency of the road projects funded by the loans, the government even launched an independent investigation team headed by the head of the Road Bureau (February 1972).

4) 4th Five-Year Economic Development Plan (1977-1981)

Since 1962, the government had built large industrial complexes in strategic locations to promote the nation's industrial development. The foremost road policy priority during the 4th Five-Year Economic Development plan period was given to expanding the road networks around the industrial complexes and ensuring the complexes' connections to expressways. This policy was an attempt to secure the complexes' competitiveness through efficient logistics.

5) 5th Five-Year Economic Development Plan (1982-1986)

All the previous road policies had been focused on expanding the road networks. However, in order for the transport system to operate properly, the roadworks needed to be effectively linked to other modes of transport such as railroads and public transport. From this perspective, the concept of a total traffic control system began to be discussed in this period. For the development and implementation of road policies, it is essential to secure the reliability of transport data. As part of efforts to achieve such reliability of the traffic data, the nation's first ever electronic traffic data collection system was introduced during this period.

6) 6th Five-Year Economic Development Plan (1987-1991)

The Act on Special Accounts for Road Projects was enacted in 1988, initiating the operation of special accounts funded by revenues from gasoline taxes and special consumption taxes imposed on alternative oil products. The scope of road projects, which had previously been confined to the construction and expansion of expressways, was extended to cover national, local and county roads.

7) 7th Five-Year Economic Development Plan (1992-1996)

The Act on Special Accounts for Road Projects, which had contributed to stable implementation of road policies, was replaced with the Act on Special Accounts for Transport Projects in 1993. This period also saw the introduction of a new national arterial road network scheme based on the 7(S-N)×9(W-E) concept, which is still effective and constitutes the framework of the nation's road policies.

Table 2.1. Five-Year Economic Development Plans and road policies

Classification	Road policy characteristics
1st (1962-1966)	• Industrial road construction (coal mining areas, in particular) • Construction implemented with support from the Defense Ministry and the 8th U.S. Army • Implementation of the nation's first ever transport survey (IBRD, 1965~1966)
2nd (1967-1971)	• Industrial road construction (entire industry) • Shift in the chief mode of transport from rail to roads • Establishment of a 10-year expressway construction plan (1967) • Full opening of the Gyeongbu Expressway (1970) - 420.4 km - 1968.2-1970.7 (Construction period: 29 months) • Enactment of the Act on Road Maintenance Promotion, the Act on Special Accounts for Road Maintenance (1968) - Gasoline tax and toll revenues invested in road projects
3rd (1972-1976)	• Promotion of the Honam, Yeongdong and Namhae expressways • Construction of roads with loans and investigation of road projects - Introduction of IBRD loans - Initiation of projects to pave the existing road networks
4th (1977-1981)	• Establishment of arterial road networks connecting expressways and major industrial complexes • Road projects linking expressways and industrial complexes - Heavy and chemical industrial complexes
5th (1982-1986)	• Efforts to ensure mutual connectivity of roads, and to establish a comprehensive highway transport system • Road maintenance projects launched in earnest • Electronic traffic survey - Targeting expressways, national roads and major local roads
6th (1987-1991)	• Road maintenance: expressways, national roads • Enactment of the Act on Special Accounts for Road Projects (1988) - Gasoline tax, 90% special consumption tax on alternative oil products
7th (1992-1996)	• Development of a grid-type 7(S-N)×9(W-E) network of arterial roads • Enactment of the Act on Special Accounts for Transport Projects (1993)

Road Policy After Five-Year Economic Development Plans

1) 1st Road Improvement Plan (1999-2011)

The Five-Year Economic Development Plan continued up to the seventh stage (1992-1996). Consequently, the road policy also changed, with the government deciding to implement a road improvement plan. The improvement plan would be renewed every 10 years, aiming to construct roads and ensure their proper maintenance. The first plan was focused on steady promotion of the 7(S-N)×9(W-E) policy, alleviation of road congestion problems, and installation and expansion of the Intelligent Transport Systems.

2) 2nd Road Improvement Plan (2011-2020)

Currently underway, the 2nd upgrade plan is focused on the traffic congestion problem in urban areas, based on the understanding that interregional trunk road networks have been sufficiently constructed. In this context, substantial efforts are being injected into building circular road networks in metropolitan areas and advancing the Intelligent Transport Systems.

Table 2.2. Road policy after the Five-Year Plan period

Classification	Characteristics of road policies
1st Road Improvement Plan (1999-2011)	• Promotion of 7(S-N)×9(W-E) policy • Repair and maintenance of trunk road networks • Reducing road congestion • ITS installation and expansion
2nd Road Improvement Plan (2011-2020)	• Addressing the urban traffic congestion problem ← Construction of trunk road networks • ITS advancement • Pursuing circular road network projects in metropolitan areas

CHAPTER 02

03
Implications

Changes in Major Indicators

Changes in Road Length and Pavement Rates

As a result of the government's continuous investments in roads, the nation's total length of roads increased approximately 3.9 times over the past 50 years. The length of expressways, which was only 551 km in 1970, rose to 3,859 km in 2010. The nation also recorded 2.4- to 4.1-fold increases in the length of national roads, local roads, and municipal and county roads.

Along with the expansion in road lengths, the road pavement rate also rose substantially. The pavement rate rapidly increased from 5.8% in 1961 to 79.8% in 2011.

Table 2.3. Growth trends in road length and pavements rates (Unit: km, %)

Classification	1961	1970	1980	1990	2000	2010	Increase (times)
National expressways	-	551 (100)	1,225 (100)	1,551 (100)	2,131 (100)	3,859 (100)	7.0
National roads	5,706 (12.6)	8,121 (23.6)	8,232 (67.3)	12,161 (89.19)	12,413 (96.5)	13,812 (97.6)	2.4
Provincial roads/ municipal and county roads	21,463 (4.0)	31,572 (4.5)	37,493 (27.6)	43,003 (65.3)	74,231 (73.5)	87,719 (76.3)	4.1
Total	27,169 (5.8)	40,244 (9.6)	46,950 (33.3)	56,715 (71.4)	88,775 (75.8)	105,565 (79.8)	3.9

Lessons derived from Korean road policies

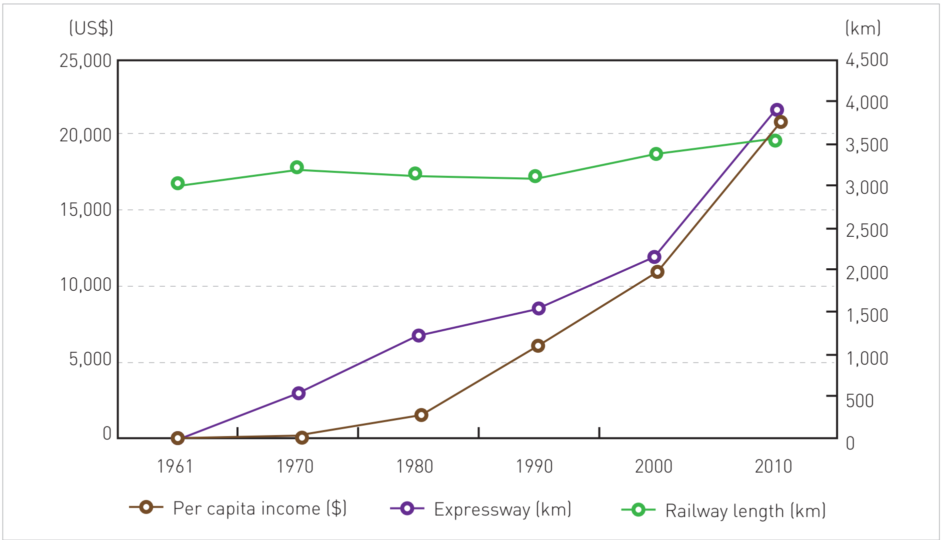
Lesson 1: Investments on Roads, Not Railways for Economic Growth

Korea's income per capita in 2010 reached US$20,562, representing a 251-fold growth from US$82 recorded in 1961. During this period, the railways expanded to 1.18 times their original length, while the network of roads increased by 3.95 times in its length. These figures indicate that the roads played a bigger role than the railways in the case of Korea's economic development model.

Table 2.4. Per capita income & road length (Unit: US$, km)

Classification	1961	1970	1980	1990	2000	2010	Increase (times)
Per capita income	82	254	1,645	6,147	10,841	20,562	251
Road	27,169	40,244	46,950	56,715	88,775	105,565	3.95
Expressway	0	551	1,225	1,551	2,131	3,859	12.3
Rail	3,02	3,193	3,135	3,091	3,371	3,559	1.18
Subway	-	7.3	165.4	274.5	423.5	537.0	73.5

Figure 2.1. Per capita income & road length



Lesson 2: Connection to National Economic Development Plan

In Korea, the road policy is closely related to the national economic development policy. The government incorporated road construction and expansion measures into the Five-Year Economic Development Plans, which were actively implemented for decades. Such an incorporation has ensured efficiency in budget and investment management.

Lesson 3: First Priority to Trunk Line

During the economic development period, the highest priority in road investments in Korea focused on securing a network of trunk lines such as expressways and major national roads. Consequently, the nation could secure a network of roads that could be used in expeditiously transporting goods manufactured at industrial complexes to large cities or export ports. These roads served as the foundation for the nation's industrial development. Korea's representative trunk lines such as the Gyeongbu, Honam and Namhae expressways were all constructed during the 1970s when the nation was exerting its all-out efforts for economic growth.

Lesson 4: Special Account for Road Construction and Maintenance

It takes many years and a lot of financial resources to build and expand roads. As a way to address this problem, Korea created a special budget account exclusively for the construction of roads as well as their maintenance and management. The government enacted laws for the special account in efforts to secure the continuity of road projects.

- Special Account Act for Road Construction & Maintenance (1968)
- Road Sector Special Account Act (1988)
- Transportation Special Account Act (1993)

Lesson 5: Demand Response Approach

Construction of a road network leads to the building of relevant facilities near the roads, which in turn generates a gradual increase in demand for transport. Increases in transport demand and facilities lead to land price hikes, which provides obstacles to future additional road projects. To address this problem, the government secured in advance a certain amount of land along the major roads. This land is used when the need arises for expansion of the existing roads because of growth in traffic demand.

- National expressway: less than 50 m
- National road: less than 20 m

Lesson 6: Strong Leadership and Devotion

The top leader's strong will is a crucial factor in expeditiously implementing road projects vitally needed for a nation's industrial development. During the early stages of expressway construction in Korea, a large number of military corps were put to work in constructing most dangerous sections. The military participation played an important role in carrying out large-scale road projects within short periods of time within a limited budget. For example, 173,588 soldiers were mobilized to work for the construction of the Gyeongbu Expressway (420.4 km), making it possible to complete the construction of the 420.4 km-long road in 29 months.

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CHAPTER 3

Road Construction and Management Organization

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01
Road Management Organizations by Road Type

In Korea, administrative organizations are in charge of the planning and maintenance of roads under their jurisdiction, based on the "beneficiary-pays principle." As for the state financed roads, however, the planning and maintenance organizations may differ.

Table 3.1. Road management organizations by road type

Classification	Administrative authorities	Competent agencies	
		Construction	Maintenance & management
National Expressway	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport (Authority delegated to: President of Korea Expressway Corp.) (Private operator)	Minister of Land, Infrastructure and Transport (Authority delegated to: President of Korea Expressway Corp.) (Private operator)
National Road	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport
	Mayor (city areas)	Mayor (city areas)	Mayor (city areas)
Special metropolitan city road/Metropolitan city road	Special metropolitan city mayor/ Metropolitan city mayor	Special metropolitan city mayor/ Metropolitan city mayor	Special metropolitan city mayor/ Metropolitan city mayor

Provincial road	Provincial governor	Provincial governor	Provincial governor
	Mayor (city areas)	Mayor (city areas)	Mayor (city areas)
Municipal (si) road	Mayor	Mayor	Mayor
County (gun) road	County head	County head	County head
District (gu) road	District head	District head	District head

02

Road Management Organization System

The central government (Ministry of Land, Infrastructure and Transport: MOLIT) is responsible for general affairs related to roads. The ministry (Road Bureau) controls five regional construction management administrations which are in charge of overall road-related affairs (planning and management) in their respective administrative zones. Specific road maintenance works are implemented by 18 national road management offices affiliated with the administrations. Local governments also manage roads under their administrative jurisdiction through such organizations as road management offices and special city/metropolitan construction headquarters.

Affairs related to the expansion and maintenance of expressways are implemented by Korea Expressway Corporation (KEC). In accordance with the Korea Expressway Corporation Act, the corporation is also responsible for land development along the expressways as well as the establishment and management of related appurtenance and convenience facilities.

In addition, there are two consultative bodies that handle metropolitan road and transport affairs - the Capital Region Development Committee and the Metropolitan Transport Association. The committee has been established to increase the competitiveness of local industries through collaboration among cities and provinces as well as the scale of economies. The association, established in accordance with the Local Autonomy Act, aims to build a transit-oriented metropolitan transport system and remove inefficiencies caused by delays in transport policy discussions among local administrative bodies.

Road Construction/Management Organization of the Central Government (MOLIT)

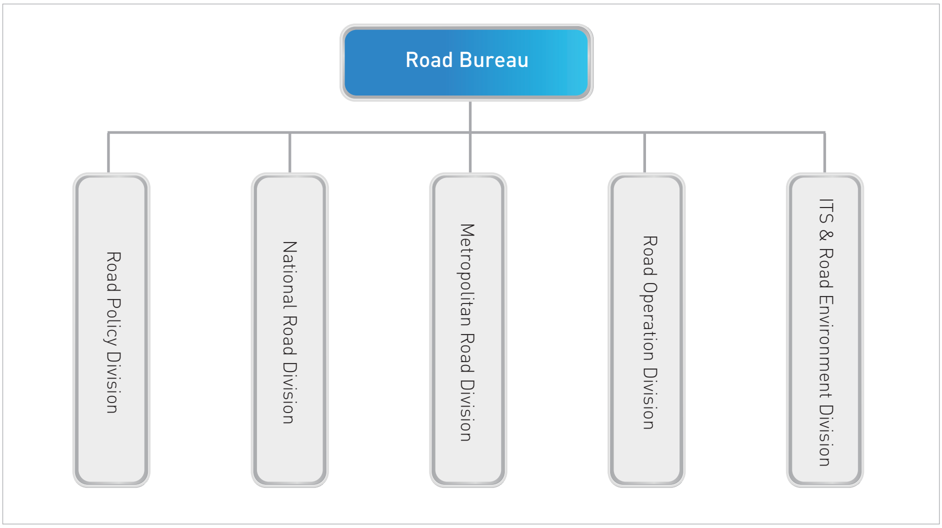
Road Bureau of the Ministry of Land, Infrastructure and Transport

The Road Policy Division is responsible for the development and adjustment of road policies, the supervision and inspection of Korea Expressway Corporation, expressway survey and design, and route appointment for expressways, national roads, provincial roads and government-funded provincial roads. The division also conducts the maintenance of Asian Highway and the development of laws related to expressways. The National Road Division is in charge of the management of road-related project expenses, affairs related to the construction of national roads, and the enactment and revision of regulations on the road structure and facility standards.

The Metropolitan Road Division is responsible for the appropriation and settlement of the budget for privately financed roads and metropolitan roads. It also deals with matters related to the provision of subsidies to local administrative bodies, congestion-reduction plans for metropolitan roads, and the construction and operation of privately funded expressways. The Road Operation Division handles affairs related to the development and implementation of national road maintenance plans, the establishment of rest areas on national roads, utilization of idle or discarded roads, the establishment of special transport measures, and traffic volume surveys.

The ITS & Road Environment Division is in charge of affairs related to the improvement and installation of disaster prevention facilities at road tunnels, the installation and operation of road safety facilities, the installation and management of overloaded truck detection facilities, and other matters concerning road traffic safety and disaster prevention. Additionally, the division deals with matters related to ITS for the road sector, the maintenance of ecological corridors, and scenic roads.

Figure 3.1. Organization of the Road Bureau of MOLIT

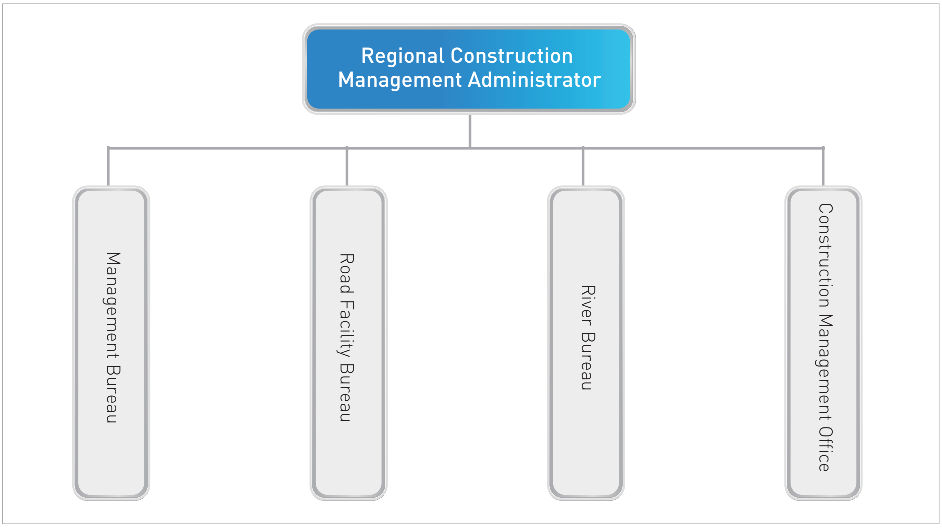


Regional Construction Management Administrations

Since their establishment in 1949, the regional construction management administrations have been responsible for the construction and upgrading of national roads, the improvement and management of rivers, regional development projects, the quality management of construction projects, and the safety management of road facilities. At present, the administrations are in five locations – Seoul, Wonju, Daejeon, Iksan and Busan. Their areas of administrative jurisdiction are the capital region for the Seoul administration, the Gangwon region for the Wonju administration, the Chungcheong region for the Daejeon administration, the Honam region for the Iksan administration, and the Yeongnam region for the Busan administration.

Each administration has three bureaus and one office. The Management Bureau handles matters related to land expropriation and compensation, and construction project and services contracts and their management. The Road Facility Bureau is responsible for the establishment of national road improvement plans (construction, supervision, design, etc.), inspection of road works (including supervision and design), and the development of plans to prevent rain- and/or snow-caused damage to roads. The River Bureau develops plans to improve rivers and prevent related

Figure 3.2. Organization of the Regional Construction Management Administration

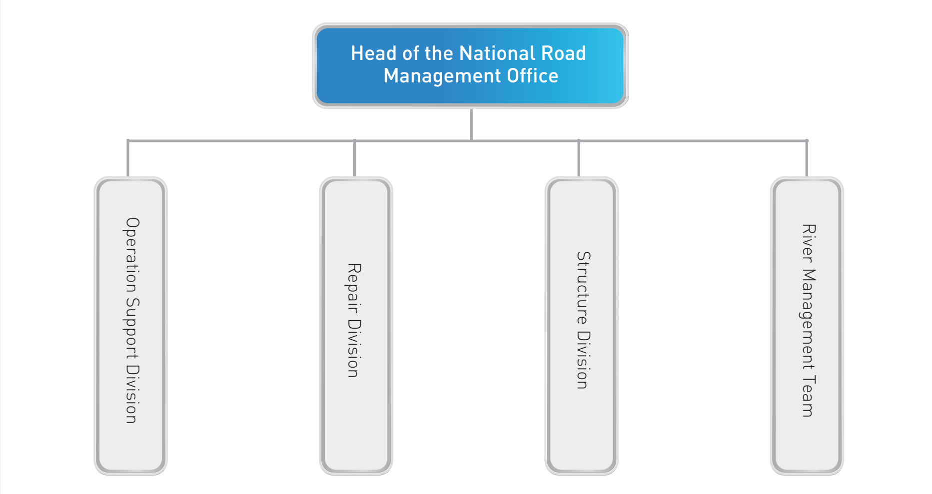


disasters. The Construction Management Office is in charge of inspection and surveys for the prevention of shoddy construction as well as the inspection of construction completion.

In addition, the regional administrations have 18 national road management offices under their administrative control. The offices scattered through the nation handle civil petitions related to the maintenance and management of roads. The Seoul administration operates two offices in Suwon and Uijeongbu, while the Wonju administration has three offices in Hongcheon, Gangneung and Jeongseon. As for the other administrations, the Daejeon administration has four offices in Nonsan, Chungju, Boeun and Yesan, the Iksan administration has four offices in Gwangju, Jeonju, Namwon and Suncheon, and the Busan administration has five offices in Daegu, Jinju, Pohang, Yeongju and Jinyeong.

The repair division under each office deals with civil petitions regarding the maintenance of national roads. The offices operate a total of 10 detachments. Figures below show the organizational structure of the Regional Construction Management Administration and the National Road Management Office.

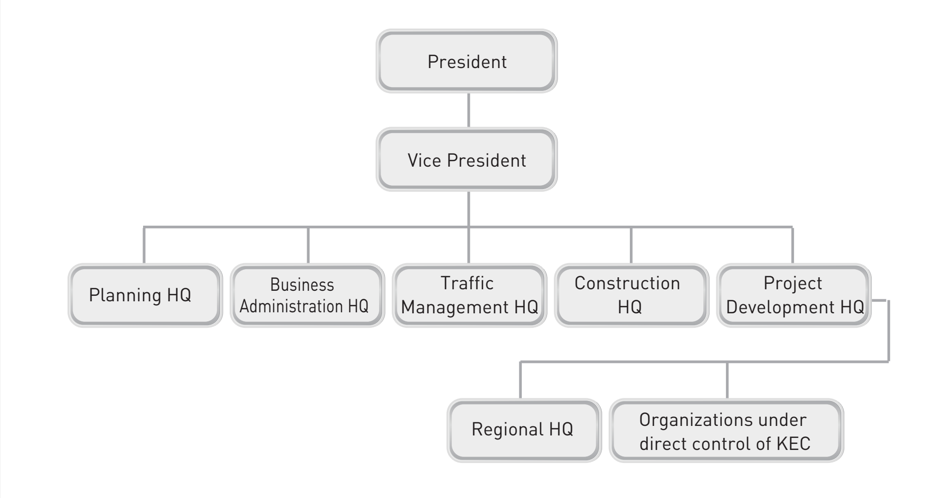
Figure 3.3. Organization of the National Road Management Office



Korea Expressway Corporation (KEC)

The Korea Expressway Corporation was established as an organization dedicated to ensuring effective and systematic implementation of affairs related to the construction, maintenance and management of expressways. The corporation has five headquarters for planning, business administration, traffic management, construction, and project management, and the headquarters operate 20 divisions under their control. Additionally, the corporation operates the regional headquarters and five organizations under its direct control – Research Institute (KECRI), Integrated Toll Revenue Clearing Center, Transport Center, Overseas Project Team, and Construction Project Team. The Road Traffic Research Institute carries out research on new road construction technologies and materials as well as standardization tasks. The Toll Revenue Clearing Center is responsible for developing revenue settlement criteria and relevant policies as well as building and managing the toll revenue clearing system. The Transport Center controls the supervision and management of affairs related to expressway traffic conditions. The Overseas Project Team is in charge of contracts and implementation of overseas projects. The Construction Project Team is responsible for supervision and inspection of road construction projects as well as affairs related to road quality and safety management.

Figure 3.4. Organization of KEC



CHAPTER 03

CHAPTER 4

Road Plans

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01
Road Planning Process

CHAPTER 04

In general, a road plan is developed through the following process: identifying the surrounding traffic conditions, defining the improvement goals, selecting alternative solutions, comparing the alternative solutions in terms of performance perspectives, evaluating the alternative solutions, and selecting the optimal solution.

Identifying the Surrounding Traffic Conditions

First of all, transportation related data should be established. For this, it is necessary to collect the data and information about higher-level land use plans, traffic conditions in the surrounding areas, spatial limitations, and changes in industrial activities.

Setting the Improvement Goals

Quantified and/or qualified goals need to be defined concerning such issues as traffic congestion, traffic accidents and environmental contamination.

Selecting Alternative Solutions

Various alternative solutions ought to be considered through brainstorming of experts. They could include proposals for introducing new transport technologies or vehicles, a diversity of road network systems, and new road operation technologies.

Comparing Alternative Solutions in Terms of Performance Measures

The alternative solutions should be subject to comparative analysis based on their present and future performance estimation in such categories as the average travel time of people or cars, the average travel distance, the vehicle occupancy rate, and the noise level or the pollution level of the air quality.

Evaluating Alternative Solutions

The alternative solutions need to be evaluated on the basis of their goal achievement prospects and their benefits and costs in terms of monetary value.

Selecting the Optimal Solution

The simplest selection of the optimal solution is often conducted based on a single factor (construction cost, minimum travel time). In general, however, the optimal solution is chosen through the Multi Criteria Decision Making (MCDM) process. Normally, the optimal solution is determined on the basis of benefit-cost analysis, the net present value, the internal revenue rate, and policy analysis.

02

Road Project Implementation Process and Planning System

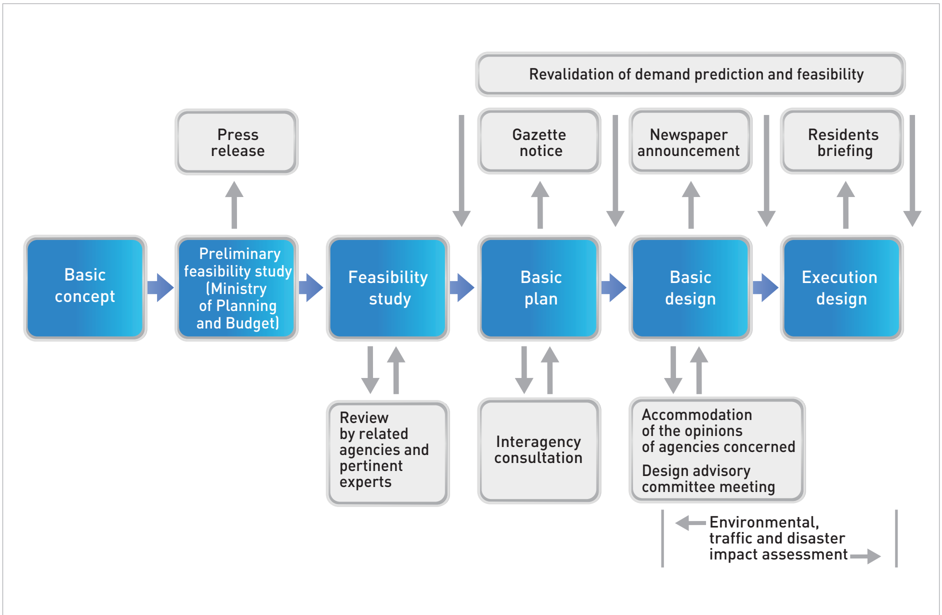
Implementation Process for Road Investment Projects

The implementation of a road investment project begins with the establishment of the basic concept, which is followed by preliminary and main feasibility studies. If the project is considered feasible through this process, it is implemented through the basic planning, basic designing and execution designing stages.

From the planning stage onwards, the feasibility study results or demand predictions undergo a revalidation process, in the cases where questions arise about their validity, according to the "Management Guidelines on Total Project Cost."

The road investment system involves four stages: conception, assessment, planning, and construction and post-management. The conception stage is focused

Figure 4.1. Implementation process for road and construction projects



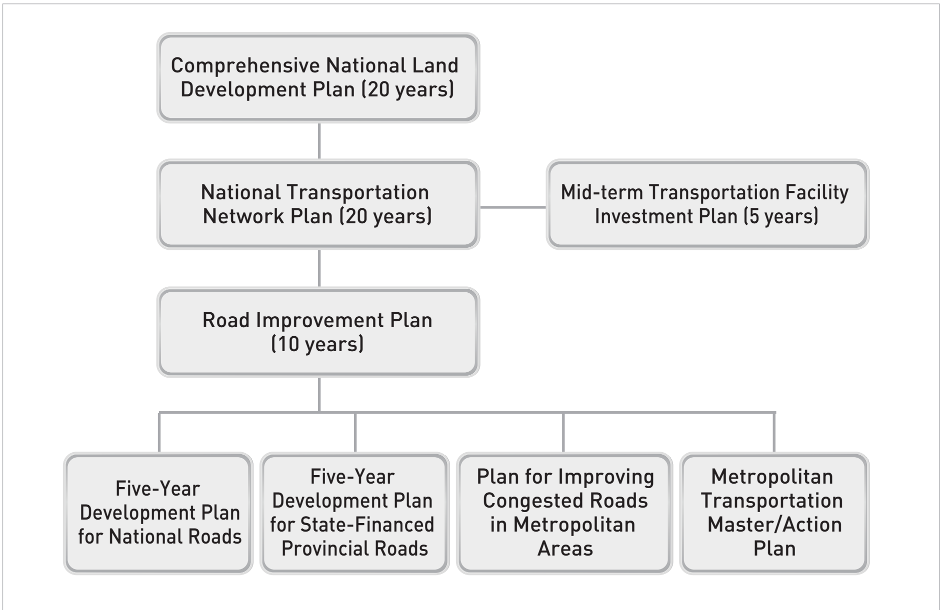
on securing funding sources and making project proposals. Preliminary and main feasibility studies are conducted at the assessment stage, while the basic and execution designs are made at the planning stage. The last stage covers the construction, opening and post-management of a particular road.

Hierarchical System of Major National Road Network Plans

Korea's major national road network plans have a hierarchical system as outlined in Figure 4.2. The Comprehensive Public Land Development Plan and the National Transportation Network Plan present a fundamental framework of the nation's network of roads. The Mid-Term Transport Facility Investment Plan provides for the establishment of comprehensive investment plans and transport policies based on the National Transportation Network Plan. The Road Upgrade Basic Plan aimes to carry out specific measures for developing and upgrading the nation's road network.

Specific action programs are incorporated into the Five-Year Plan for

Figure 4.2. Hierarchy of plans pertaining to road projects



National Roads, the Five-Year Plan for State-Financed Provincial Roads, the Plan for Improving Congested Roads in Metropolitan Areas, and the Basic and Implementation Plans for Metropolitan Transport. The Five-Year Plans for national roads and state-funded provincial roads are renewed every five years. The Plan for Improving Congested Roads in Metropolitan Areas covers state-financed road projects aimed at improving the functions of trunk routes in metropolitan cities. The basic and implementation plans for metropolitan transport are mid- and long-term plans designed to ensure consistent and sustainable metropolitan transport policies.

03

National Transportation Network Plan

Legal Grounds

The National Transportation Network Plan is based on Article 4 of the "National Integrated Transportation System Efficiency Act."

Article 4 (Establishment of the National Transportation Network Plan, etc.)

① The Minister of Land, Infrastructure and Transport shall formulate a plan pertaining to the national transport network (hereinafter referred to as the "National Transportation Network Network Plan") every 20 years in order to build an effective national transport system; Provided that the minister may change the plan, when deemed necessary, by considering the social and economic conditions. 〈Amended on March 23, 2013〉

② The National Transportation Network Plan shall include each of the following matters.

1. Predictions of traffic conditions and demand;
2. Comprehensive transport policy and directions for traffic facility investment;
3. Goals for building core transport networks and implementation strategy by stage;

4. Projects to install, expand and upgrade the core transport facilities (hereinafter referred to as "core transport facilities development projects") and intermodal transport systems;
5. Basic directions for securing financial resources necessary for carrying out core transport facilities development projects, and overall investment priorities;
6. Development and utilization of transport technology;
7. Operation and development of the backbone transport network in association with key transport networks of other countries, and promotion of relevant international cooperation; and,
8. Other matters related to the improvement of traffic systems.

③ The head of a central administrative agency concerned and the special city mayor/a metropolitan city mayor/a provincial governor/the governor of a special self-governing province (hereinafter referred to as the "heads of administrative agencies concerned") shall submit to the Minister of Land, Infrastructure and Transport their respective plans necessary for formulating the National Backbone Transport Network Plan as prescribed under Paragraph ①, if requested to do so by the minister. 〈Amended on March 23, 2013〉

④ The Minister of Land, Infrastructure and Transport shall formulate a draft National Backbone Transport Network Plan based on the plans submitted by the heads of administrative agencies concerned as prescribed under Paragraph ③. The minister shall determine the final plan after consulting with the heads of administrative agencies concerned, and after deliberations of the draft by the National Transport Commission, in accordance with Article 106. This procedure shall apply to any move to amend the plan (except for making changes to minor matters prescribed by Presidential Decree). 〈Amended on March 23, 2013〉

⑤ When the plan is finalized or amended as prescribed under Paragraph ④, the Minister of Land, Infrastructure and Transport shall report the contents to the Cabinet Meeting, inform the heads of pertinent administrative organizations of the contents, and publish them on the gazette; Provided that this procedure shall not apply to the revision of minor matters that are determined by Presidential Decree. 〈Amended on March 23, 2013〉

Necessity

It is difficult to achieve the national transport policy goals only through uncoordinated expansion of traffic facilities such as roadways, railways, airports and seaports. To address this problem, it is necessary to build an efficient national integrated transport system by improving the operation of transport systems along with the expansion of traffic facilities. Additionally, there is a need to develop a systematic long-term comprehensive transport based on the future transport vision for the coming era of Northeast Asia.

Characteristics

The plan is designed to present the directions for effectively building a national comprehensive transport system. Required to be updated every 20 years, it also aims to establish long-term and comprehensive investment policies for the nation's core infrastructure transport facilities. It is a framework plan for various transport-related programs.

Major Contents

The plan has the following contents: comprehensive transport policy directions, implementation strategy for the national backbone transport network, expansion of core transport facilities and comprehensive transport system, basic directions for securing funding sources, and general investment priorities.

Scope

The 20-year plan (2000-2019) targets expressways, national roads, national roads' bypass alternative roads, state-funded local roads, railways (excluding urban railways), airports, seaports, and integrated freight terminals.

Goals and Implementation Strategy

Goals

The plans have the following objectives: First, securing the infrastructure facilities necessary for strengthening national competitiveness in the era of unlimited competition of the 21st century; Second, building an integrated transport system featuring a cost reduction-oriented logistics system and high efficiency; Third, realizing an environment-friendly transport system that can provide fast, safe and convenient services; and, Finally, building a Korean Peninsula transport network in preparation for inter-Korean unification.

Directions

First, the plan is designed to build a high-efficiency transport system for the realization of national transport policy goals through structural integration of transport systems, and to reinforce the inter-modal connections by fully exploring the prospects of transport modes complementing and replacing each other.

Second, the plan is aimed at ensuring a balanced development among transport modes based on their characteristics in order to achieve harmony between efficiency and equity in implementing transport policies. It also aims to promote quality-oriented values such as traffic safety and environmental protection along with the expansion of traffic facilities.

Third, the plan is designed to expand the opportunities for participation and competition in the development of high-quality transport services, by pursuing a policy oriented towards various stakeholders such as the nation, businesses and the public, as opposed to the supplier-centered transport policy. Additionally, it serves the purpose of reorganizing the structure of the transport industry by allowing the private sector's active participation in the construction and operation of traffic facilities based on the principles of the market economy.

Fourth, the plan aims to build an world-class transport network in preparation for the upcoming era of liberalization, consequently fostering Northeast Asian transportation and logistics hubs as well as transforming the nation into a half-day living sphere.

Main Tasks

The plan envisages:

- Establishing an efficient intermodal transport structure and improving the mobility and accessibility of key land transport networks;
- Boosting air transport capacity, increasing the competitiveness of seaports, and

building a cost-effective logistics system in order to transform the nation into a transport/logistics hub in the Northeast Asian region;

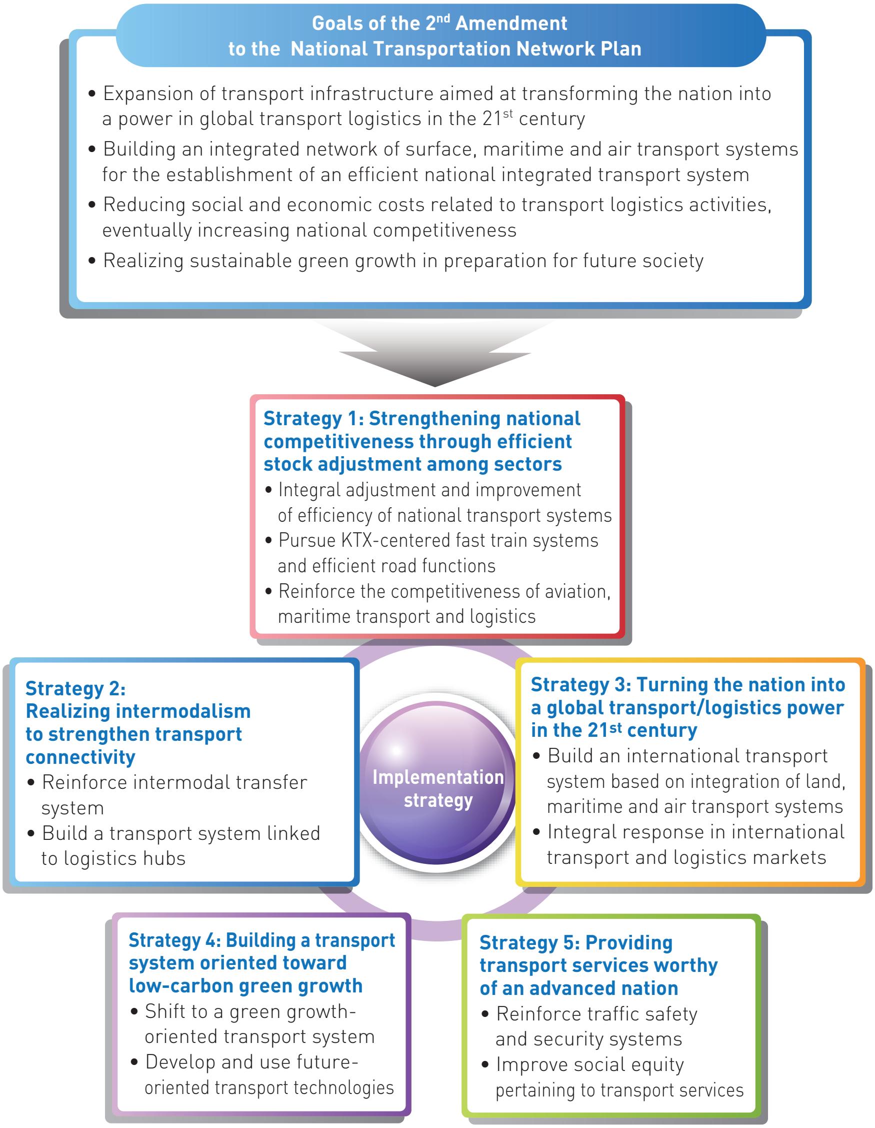
- Building an inter-Korean transport network that would be eventually linked to continental transport networks;
- Developing and increasing the use of cutting-edge transport technologies; and,
- Laying the foundation for traffic safety worthy of an advanced society and ensuring effective management of transport demand.

2011 2nd Amendment to the National Transportation Network Plan (2001-2020)

Background to Amendment

Uncoordinated investments into independent transport modes such as railways and roads cause inefficiency in infrastructure investments. Moreover, differences in implementation periods of various transport-related plans were making it difficult to ensure consistency in carrying out various related projects. In order to address these problems, it became necessary to strengthen the role of the National Backbone Transport Network Plan as a framework plan. There was also a need to reinforce intermodalism to ensure efficient connectivity and complementarity among various transport modes. It was also essential to develop future-oriented transport policies by considering changes in transport environments at home and abroad as exemplified by the pursuit of green transport and high-speed railway systems.

Goals and Implementation System



Action programs by tasks

The following are action programs by tasks:

- Promote integral adjustment and improvement of efficiency of national transport systems, pursue KTX-centered fast train systems and efficient road functions, and reinforce the competitiveness of aviation, maritime transport and logistics;

- Build a transport system linked to logistics hubs by realizing intermodalism aimed at strengthening transport connectivity;
- Turn the nation into a global transport/logistics power in the 21st century by building an international transport network based on the integration of land, maritime and air transport systems;
- Build a transport system for low-carbon green growth by promoting a shift to green growth-oriented transport systems as well as developing and promoting the use of future-oriented transport technologies; and,
- Provide world-class transport services by strengthening traffic safety, disaster relief and information security inspection systems as well as improving social equity in terms of transport services.

Road Sector Investments for Facility and Capacity Expansion

The target for the total length of roads had been revised to 19,854 km, up by 2,258 km from the original 17,596 km.

Table4.1. Expansion of road-sector transport facilities

Category	2001 (A)	2005	2009 (B)	2015	2020 (C)	C/A	C/B
length of expressways (km)	2,637	2,968	3,776	4,290	5,470	2.07	1.45
Length of national roads (km)	14,254	14,224	13,820	14,312	14,384	1.01	1.04
Total	16,891	17,192	17,596	18,602	19,854	1.18	1.13

• Note: Figures include the length of privately funded roads. National road statistics include those on bypass roads, local trunk roads, and logistics arteries.

Future Vision

The plan pursues the following visions:

- Improve the quality of arterial transport services as part of efforts to create new values;
- Integrate metropolitan areas by making it possible to travel between mega economic zones within 90 minutes and to travel anywhere within mega

economic zones within 30 minutes;

- Exert efforts for Korea to emerge as a Northeast Asian hub for logistics by increasing freight transport performance at Incheon International Airport and freight throughput at Busan and Gwangyang ports;
- Reduce energy consumption and CO_2 emissions through realization of a sustainable transport system;
- Prevent traffic congestion through provision of traffic information unrestricted by time and space;
- Establish a system that makes it possible for even the elderly and mobility handicapped people to travel anywhere in the nation without any inconvenience.

Figure 4.3. Future vision of the 2nd Amendment to the National Transportation Network Plan

04

Mid-Term Transportation Facility Investment Plan

Legal Grounds

This plan is based on Article 6 of the “National Integrated Transportation System Efficiency Act.”

Article 6 (Establishment of Mid-Term Transportation Facility Investment Plan)

① The Minister of Land, Infrastructure and Transport shall formulate the Mid-Term Transport Facility Investment Plan (hereinafter referred to as "mid-term investment plan") every five years for effective implementation of development projects as prescribed by the National Transport Network Plan and the related projects to build, expand or repair traffic facilities under the jurisdiction of local governments (hereinafter called "local transport facility development projects"). 〈Amended on March 23, 2013〉

② The Mid-Term Investment Plan shall include each of the following matters.

1. Transport facility supply goals and basic directions for investments
2. Size of national backbone transport facility development projects, investment priorities and financial resources need for carrying out the projects
3. Appropriate shares among transport facilities and allotment investment resources
4. Development of national backbone transport facilities in association with local transport development projects
5. Investment plans for local transport development projects
6. Other matters related to investment in other transport facilities

③ The mid-term development plan shall be harmonized with the national finance operation plan pursuant to Article 7 of the "State Finance Act."

④ Provisions under Paragraphs ③ to ⑤ of Article 4 shall be applied to the establishment and amendment of the Mid-Term Investment Plan.

Functions

This is a Five-Year Plan for implementing comprehensive investment projects for national infrastructure facilities like roadways, railways, airports and seaports as well as developing transport policies based on the National Transport Network Plan.

Contents

The plan establishes the facility supply goals, basic directions for investment, and a scheme for determining market shares among transport facilities. It also provides for the determination of the size of national backbone transport facility development projects, investment priorities and funding methods, as well as the pursuit of the development of such projects in association with local transport facility development projects. Moreover, it specifies programs related to green transport facilities, local transport facilities, investment efficiency promotion, and other matters pertaining to investment into transport facility projects.

Characteristics

This is a plan required to be updated every five years in association with the National Transport Network Plan, covering nationwide transport facility investment programs, including those for local traffic facilities. It presents action programs that need to be carried out within a five-year period in order to alleviate problems in the transport sector and coping effectively with changes at home and abroad. It also presents the optimum investment scale, allocation of resources, and investment priorities by considering the limited resources conditions and the predictions on transport demand. Additionally, it seeks to maximize investment efficiency by preventing budget waste caused by excessive and redundant investments, ensuring focused investments into appropriately selected projects, and pursuing green growth.

Scope

It covers the entire nation in terms of spatial scope, as is the case with the National Transport Network Plan. It targets national backbone transport facilities such as expressways, national roads, alternative routes bypassing national roads, state financed local roads, high-speed railways, standard railways, metropolitan railways, airports, trade ports, and intermodal logistics terminals. It also deals with local transport programs promoted in association with national backbone facility projects, such as those to build metropolitan roads, urban railways and light rail systems, improve road congestion problems, and develop coastal ports and logistics complexes.

History

Mid-term development plans have been developed three times: the first plan (2000-2004), the second plan (2005-2009), and the third plan (2011-2015).

Goals and Implementation Strategy

Implementation Strategy	
Building/expanding an environment -friendly, energy-saving green transport system	• Reinforce transport demand control policy • Strengthen connectivity between railways and ports through building a green logistics system • Build public transport facilities and pursue transit-oriented urban development • Continuously develop green transport technologies and put them into practical use
Raising network efficiency through expansion of seamless transport connection systems	• Build seamless transport networks centered on transport/logistics hubs • Promote low-cost, high-efficiency intermodal transfer system • Reinforce connections between national backbone transport facilities and local transport facilities
Improving national competitiveness through efficient stock adjustment among sectors	• Ensure efficient allocation funding resources among transport facilities • Make efficiency-oriented investments and prevent redundant investments • Reorganize pertinent systems to prevent incorrect demand predictions and to improve feasibility assessment
Ensuring efficient use of transport facilities through utilization of state-of-the-art technologies	• Promote shifts to green transport modes and reduction of social costs • Proactively implement core technology R&D, improve the capability to cope with traffic accidents and disasters, and reinforce information security system
Strengthening international transport/logistics capability through expansion of global networks	• Continuously improve the competitiveness of international hub airports • Expand the facilities and capabilities of hub ports in preparation for the integration of the Northeast Asian transport markets • Secure the competitiveness through continuous expansion of international transport infrastructure

05

Road Improvement Plan

Legal Grounds

This plan is based on Article 22 of the "Road Act."

Article 22 (Establishment of basic plans of road upgrade) ① Each road management agency shall establish a 10-year road upgrade plan, setting long-term directions for upgrading roads (hereinafter referred to as "basic plan") under its jurisdiction.

② The basic plan shall include each of the following matters. 〈Amended on March 23, 2013〉

1. Objectives of and direction-setting for upgrading road;
2. Programs for upgrading and managing roads;
3. Environmentally friendly means to build roads;
4. Funding plans of financial resources;
5. Other matters that the Minister of Land, Infrastructure and Transport or a road management agency deems necessary to systematically upgrade roads.

③ Each road management agency shall review its basic plan every five years from the date of planning to determine its feasibility, and if necessary, revise it.

④ Where a road management agency intends to prepare or revise a basic plan, it shall consult with the heads of the relevant administrative agencies (if the special city mayor, a metropolitan city mayor, the special self-governing city mayor, a provincial governor, or the governor of a special self-governing province is the road management agency, the Minister of Land, Infrastructure and Transport shall be included, and if the head of si (city)/gun (county)/gu (district) is the road management agency, the special city mayor, a metropolitan city mayor, the special self-governing city mayor, or the governor of a province shall be included). 〈Amended on June 1, 2012, March 23, 2013〉

⑤ Where a road management agency has prepared or revised a basic plans pursuant to paragraph ①, it shall publicly announce such fact, as stipulated by Ordinance of the Ministry of Land, Infrastructrure and Transport. 〈Amended on March 23, 2013〉

Scope and Characteristics

Scope

This plan, which should be updated every 10 years, covers expressways, national roads, alternative bypasses to national roads, state financed local roads and other roads whose management is under the responsibility of the Minister of Land, Infrastructure and Transport.

Characteristics

It includes mid- to long-term action programs in the road sector for the realization of the Comprehensive Public Land Development Plan. It serves as a guide for developing road maintenance plans for local roads and other lower-echelon roadways.

Contents

The major contents of this plan are as follows:

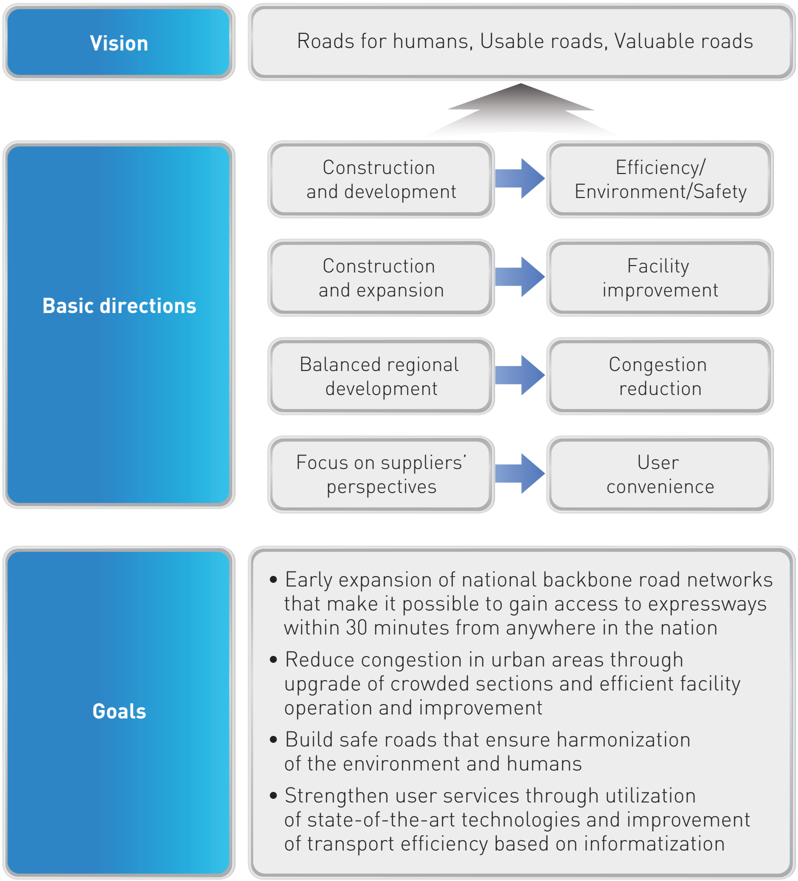
- Review the social and economic conditions and evaluate the achievements of the previous road upgrade basic plan;
- Set the goals and major implementation tasks;
- Major tasks should aim to ensure early establishment of national backbone road networks as well as network efficiency, construct human- and environment-friendly roads, develop leading-edge technologies and pursue technology convergence and an advanced management system, and improve the nation's international status in the road sector; and,
- Develop practical investment plans, thereby establishing appropriate funding methods and estimating the effects of the upgrade plan.

History

The Road Upgrade Basic Plan has been established twice: the first (1998-2011) and the second (2011-2020). The first plan was amended once (2006-2010).

2nd Road Improvement Plan

Goals and Vision



Implementation Strategy

This plan pursues building national backbone road networks at an early date, ensuring relevant network efficiency, and constructing human- and environmentally-friendly roads. It also aims to build an advanced management system featuring convergence of cutting-edge technologies, securing a stable funding scheme, and reinforcing investment efficiency.

Major Tasks

The major tasks of this plan are as follows:

- Build a national network of arterial roads through integral management of the national backbone roads network (7×9) and the network of expressways in the nation's capital region (7×4+3R);
- Give priority to the upgrade of congested sections in urban areas, facilitate the construction and operation of underground passages, prepare upgrade plans for congested urban roads in association with efforts to promote private road investment projects.
- Create new added values of roads through utilization of roadside spaces (idle lands, etc.);
- Provide comprehensive support to maximize the efficiency of national transport systems, and develop road upgrade plans to improve the connectivity among transport facilities through various measures such as the system of designating national highways/national highway branch lines.
- Devise programs to ensure transport demand management as well as environment- and human-friendly road construction and operation in order to realize low-carbon energy-saving green transport;
- Develop an advanced road management system by improving the connectivity of roads through road grade adjustment, and introducing an asset management concept;

Figure 4.4. A national arterial roads network

- Pursue advancement of road technologies through relevant R&D projects, and raise the nation's global status through international cooperation pertaining to roads; and,
- Develop an idea for inter-Korean road networks in preparation for national unification.

06

Plan for Construction of National Roads, Alternative Bypasses to National Roads, and State-Financed Provincial Roads

Legal Grounds

This plan is based on Article 23-2 of the Road Act.

② For efficient construction of national roads (excluding the national roads to which Article 20-2 applies), alternative bypasses to national roads and state-funded local roads, the Minister of Land, Infrastructure and Transport shall develop a work plan, and conduct research and prepare a design scheme in conformity therewith. The road management agency shall follow the work plan established by the minister as well as the related research outcome and the design scheme, when building such roads. In such cases, a work plan shall be made every five years. 〈Amended on March 23, 2013〉

Purpose

This plan is aimed at exploring more systematic and effective road investment schemes to reestablish the functions and roles of state-managed roads, realize the idea of transforming the nation into an economic hub in Northeast Asia, and improve people's quality of life.

History

A Five-Year National Road Expansion Plan was implemented during the first stage (2001-2005). The second national road expansion plan and the state-funded local road construction plan were carried out during the second stage (2006-2010). These were followed by the development of third-stage plans (2011-2015): a plan for construction of national roads and alternative bypasses to national roads, and a state-funded local road construction plan.

Scope

The Five-Year Plan targets national roads, alternative bypasses to national roads and state-financed provincial roads.

Implementation Strategy

Securing the National Network of Arterial Roads

This plan provides for road maintenance projects aimed at maximizing the efficiency of national transport systems and intensifying the connectivity among transport facilities.

Improving Investment Efficiency of Road Projects

The plan is designed to raise the efficiency of road investments by focusing on projects that can be completed within the projected period, in a move to cope with the downward trends in road budgets.

Building Safe/Environmentally Friendly Roads

The plan provides for the restructuring of green transport-related road project plans, shifting emphasis to roads usability.

Project Plan

The plan for national roads covers 72 segments. Of these segments, 22 are for new construction and expansion projects (length: 206.4 km, total cost: 2,374 billion KRW), and the rest 50 are for facility improvement (length: 603.5 km, total cost: 2,660 billion KRW).

The plan for alternative bypasses to national roads covers 13 sections (length: 85.9 km, total cost: 2,073.4 billion KRW).

The plan for state-financed provincial roads targets 32 segments: 12 segments for new construction and lane expansion (length: 82.6 km, total cost: 1,049.5 billion KRW), and the remaining 20 for facility improvement (length: 230.9 km, total cost: 1,307.7 billion KRW).

07

Plan for Improving the Congested Roads in Metropolitan Areas

Legal Grounds

This plan is based on Article 23-2 of the Road Act.

Article 23-2 (Improvement of traffic congestion on roads in metropolitan areas)

① The Minister of Land, Infrastructure and Transport shall formulate improvement plans by each area every five years for the sections that need improvements in order to relieve traffic congestion and enhance the circulation of logistics as major roads within metropolitan areas (hereinafter referred to as "traffic congested metropolitan roads") among the roads of which local governments are the road management agencies. 〈Amended on March 23, 2013〉

② The improvement plans under paragraph ① (hereinafter referred to as "project plans" in this Article) shall include the matters of the following subparagraphs:

1. Goals of the project plan;
2. Roads subject to the project plan;
3. Annual project plan;
4. Total scale of investments required to carry out the project plan;
5. Measures to procure financial resources required to carry out the project plan; and,
6. Other matters prescribed by Presidential Decree.

③ The Minister of Land, Infrastructure and Transport shall consult with the heads of a central administrative agency and a local government concerned when he/she intends to formulate project plans. 〈Amended on March 23, 2013〉

④ A road management agency shall formulate and carry out detailed project plans every year for the improvement of traffic congested metropolitan roads according to the project plans.

⑤ The Minister of Land, Infrastructure and Transport may subsidize part of expenses required for a road management agency to carry out the detailed project plans under Paragraph ④, as prescribed by Presidential Decree. 〈Amended on March 23, 2013〉

⑥ Necessary matters, such as standards for designation of the traffic congested metropolitan roads and methods of management thereof, shall be prescribed by Presidential Decree.

[This Article newly created on March 22, 2010]

CHAPTER 04

Goal of the Plan

This plan is aimed at lowering traffic congestion levels in metropolitan areas through expansion of their beltway and major road networks, consequently strengthening the national competitiveness. For the improvement of traffic environments in metropolitan cities, the plan specifically provides for the exploration of relevant projects and their prioritization as well as the development of annual investment plans and financing schemes.

History

This plan has been developed twice: the 1st plan to improve the congested roads in metropolitan areas (2006-2010), and the 2nd plan to improve the congested roads in metropolitan areas (2012-2016).

Scope

Established every five years, this plan targets the major arterials in metropolitan areas.

2nd Metropolitan Traffic Congestion Mitigation Program

A total of 27 projects (length: 114.1 km, total cost: 5.2 trillion KRW) were reviewed for implementation in six metropolitan cities (Incheon, Daejeon, Daegu,

Table 4.2. Priority of projects selected for 2nd metropolitan traffic congestion mitigation program

Area	Project names	Length (km)	Number of lanes	Total project cost (100 million KRW)
Total (15)		76.4		36,466
Incheon	1 project	4.1		2,611
	Gyeongseodong - Wanggildong road construction	4.1	6	2,611
Daejeon	2 projects	15.1		6,026
	Gwanjeo - Munchang road construction	8.4	4	3,071
	Yucheon - Ojeong road construction	6.7	4	2,955
Daegu	4 projects	17.6		10,677
	Integrated Retail Complex - Esiapolis road construction	3.4	6	1,980
	Wolbae Train Depot - Wolgongno road construction	2.1	4	643
	Maecheon Bridge - Ihyeon Intersection road construction	1.6	4	1,234
	Daegu Airport - City limits road construction	10.5	4	6,820
Ulsan	3 projects	14.4		5,542
	Sanggae - Maeam road construction	4.6	4	1,964
	Nongso - Hogye road construction	5.3	4	1,820
	Dongcheon embankment road construction	4.5	4	1,758
Busan	3 projects	14.1		8,669
	Eulsuk Islet - jangnimgogae road construction	2.6	4	3,035
	Samnakdong - Asiad Main Stadium road construction	7.1	4	4,014
	Deokcheondong - Asiad Main Stadium road construction	4.4	4	1,620
Gwangju	2 projects	11.1		2,941
	Woljeondong - Mujinno road construction	6.2	6	985
	Sangmu District - Cheomdandong road construction	4.9	6	1,956

Ulsan, Busan, and Gwangju). Of them, 15 road sections were selected as priority projects based on feasibility (76.4 km, cost: 3.6 trillion KRW). The remaining 12 projects were set aside for long-term plan (37.7 km, project cost: 1.6 trillion KRW).

08
Metropolitan Transportation Master and Action Plan

Legal Grounds

This plan is based on Article 3 of the "Special Act on Metropolitan Transport Management."

Article 3 (Formulating a Metropolitan Transportation Master Plan)

① For effective management of metropolitan transport, the Minister of Land, Infrastructure and Transport shall formulate a basic plan pertaining to metropolitan transport (hereinafter referred to as the "Metropolitan Transportation Master Plan") every 20 years after consulting with the head of a central administrative agency concerned and the special city mayor, metropolitan city mayor or the provincial governor (hereinafter referred to as "mayor and governor") who is in charge of an administrative district included in a metropolitan area. 〈Amended on March 23, 2013〉

② The Metropolitan Transportation Master Plan shall include each of the following matters.

1. Matters related to the status of transport in metropolitan areas and long-term transport demand prediction
2. The plan's goals and matters related to the phased implementation strategy
3. Matters related to the improvement of metropolitan transport systems and the relevant transport demand management
4. Matters related to long-term expansion of metropolitan transport facilities and their connectivity with other transport facilities

CHAPTER 04

5. Matters related to long-term expansion and improvement of modes of public transport in metropolitan areas
6. Matters related to basic directions for securing funding sources and investment priorities
7. Other matters stipulated by Presidential Decree for the improvement of metropolitan transport

③ When determining or revising the Metropolitan Transportation Master Plan, the Minister of Land, Infrastructure and Transport shall refer it to the National Transport Commission (hereinafter referred to as the “Commission”) for deliberations, pursuant to Article 106 of the National Integrated Transport System Efficiency Act; Provided that the deliberation by the commission is not necessary when making changes to minor matters prescribed by Presidential Decree. 〈Amended on March 23, 2013〉

④ When determining or amending the Metropolitan Transportation Master Plan pursuant to Paragraph Ð, the Minister of Land, Infrastructure and Transport shall consider the opinions of residents and relevant experts by holding a public hearing before referring it to the Commission for deliberation; Provided that this procedure is not necessary when making changes to minor matters prescribed by Presidential Decree. 〈Amended on March 23, 2013〉

⑤ The Minister of Land, Infrastructure and Transport shall publish the Metropolitan Transportation Master Plan determined or amended pursuant to Paragraph Ð and inform the head of a central administrative agency and the mayor or the governor of the contents, as prescribed by Presidential Decree. 〈Amended on March 23, 2013〉

[Wholly amended on Jan. 17, 2012]

Purpose

This plan is aimed at developing comprehensive long-term transport programs to cope effectively with changes in metropolitan transport conditions. It is designed to present the directions for implementing such programs that should be updated every five years, and to provide a systematic framework for resolving metropolitan traffic problems by ensuring organic linkage between state plans and those prepared by local governments.

Scope

The Metropolitan Transportation Master Plan should be updated every 20 years, while its action plan is required to be renewed every five years. They are applied to metropolitan areas (capital region, Busan/Ulsan region, Daegu region, Gwangju region, Daejeon region).

Main Contents

The framework plan is to analyze the status and problems of metropolitan transportation and establish visions and implementation strategies. It includes important measures aimed at improving the traffic conditions in metropolitan areas: establishing a rail-oriented public transport system, systematically building metropolitan trunk roads, and ensuring efficient operation of metropolitan transport facilities. The plan is aimed at developing ways to secure investment and funding sources.

Road-Sector Implementation Plan

It is necessary to build a systematic network of metropolitan arterial roads in order to cope with the future metropolitan transport demands and ensure traffic distribution. To ensure its efficient operation, habitually congested roads must be renovated. It is also essential to increase the quality of metropolitan trunk road networks through maintenance of congested roads. Additionally, rigorous efforts should be exerted to increase the efficiency and safety of metropolitan traffic facilities and build a rational transport administration system.

CHAPTER 5

Road Design

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01
Basic Elements of Road Design

Design Vehicles

Design vehicles are selected standard motor vehicles that can represent all types of cars on the road. The specifications of design vehicles serve as the basis for which the geometry of the road structure is determined, and its dimensions are as shown in Table 5.1.

Table 5.1. Specifications of design vehicles

Specs (meter) / Vehicle types	Width	Height	Length	Wheelbase	Front overhand	Rear overhang	Medium turning radius
Passenger vehicle	1.7	2.0	4.7	2.7	0.8	1.2	6.0
Small-size vehicle	2.0	2.8	6.0	3.7	1.0	1.3	7.0
Large-size vehicle	2.5	4.0	13.0	6.5	2.5	4.0	12.0
Semi-trailer	2.5	4.0	16.7	Front wheelbase 4.2 Rear wheelbase 9.0	1.3	2.2	12.0

• Source: Road Design Manual 214-9

CHAPTER 05

When designing a specific road section, the largest car is selected as the design vehicle among various types of cars that are expected to use the road with considerable frequency. The following Table 5.2 shows design vehicles determined in accordance with the classification of roads. In case there are bypass roads, the design vehicle can be selected from any of the three types – passenger vehicle, small-size vehicle, and large-size vehicle – regardless of road classifications.

Table 5.2. Road classification and design vehicles

Classification of roads	Design vehicles
Expressways and arterial road	Semi-trailer
Minor arterial roads and collector road	Semi-trailer or large-size vehicle
Local road	Large-size vehicle or passenger vehicle

• Source: Road Design Manual 214-11

Design Speed

The design speed refers to the maximum speed a driver can maintain without losing comfort under conditions that allow the road design features to govern. It is determined to correlate the physical features of a road that affect a car's driving in terms of the road's structural aspects (geometric design controls). As such, it serves as the basis in road design. Table 5.3 shows the design speeds for various types of roads.

Table 5.3. Design speed of roads

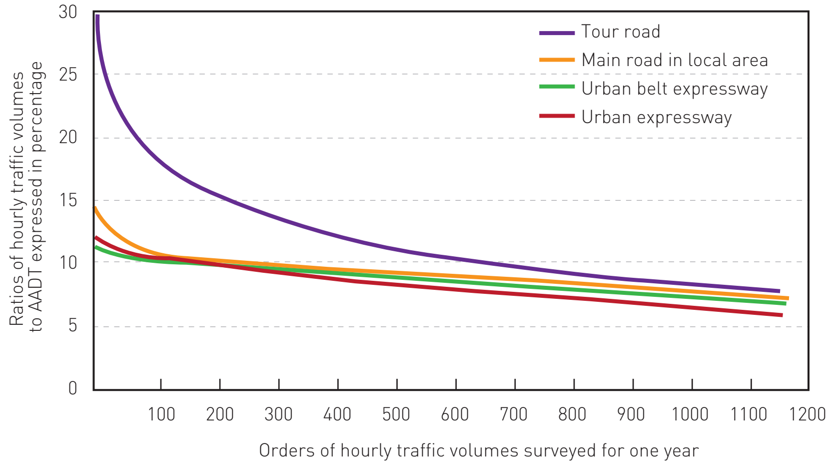
Functional classification of roads		Design speed (km/h)			
		Rural areas			Urban areas
		Flat areas	Rolling areas	Mountainous areas	
Expressway		120	110	100	100
General roads	Arterial road	80	70	60	80
	Minor arterial road	70	60	50	60
	Collector road	60	50	40	50
	Local road	50	40	40	40

• Source: Road Design Manual 214-4

Design Hourly Volume

The design hourly volume refers to the future volume of traffic used in road design. It is almost equivalent to the estimated maximum hourly traffic of the year. As defined by the U.S. AASHTO, the 30th highest hourly volume (K_{30}) in a year is used as the design hourly volume. It represents the point at which the slope changes rapidly on the graph of hourly traffic volumes arranged in descending order of size as shown in Figure 5.1.

Figure 5.1. Relations between hourly traffic volumes and their percentages to AADT



• Source: Introduction to Transportation Engineering

In reality, it is very difficult to obtain K_{30} after gaining the AADT values. As for the newly built roads, errors are inevitable even if a standardized K_{30} value is applied for use. Therefore, it would be convenient to use ADT (Average Daily Traffic) instead of AADT, and apply the percentage of DHV to ADT.

$$DHV = ADT \times \frac{K}{100}$$

Where, DHV = Design hourly volume (two-way, vehicles/hour)

ADT = Average daily traffic (two-way, vehicles/hour)

CHAPTER 05

K = Percentage of DHV to ADT

ADT represents the traffic volume of an average day during a year. So, its direct use could lead to a significant difference between the design hourly volume and . To avoid this problem, it is desirable to gain the ADT on an average day of a peak month.

Design Section

The design section refers to a segment where the same design standards and design speed can be applied based on the characteristics and importance of the route, the location, the geographical conditions, and the planned traffic volume. Frequent design changes along a road section would cause confusion among drivers and such an inconsistency results in adverse consequences in traffic safety. To prevent this problem, it is desirable to ensure the maximum possible length of the design section as outlined in the general guidelines in Table 5.4.

Table 5.4. Broad guidelines for design section length

Classification of roads		Minimum design section length
Expressway		5 km
General road	Rural areas	2 km
	Urban areas	Distance between major intersections

• Source: Road Design Manual 214-6

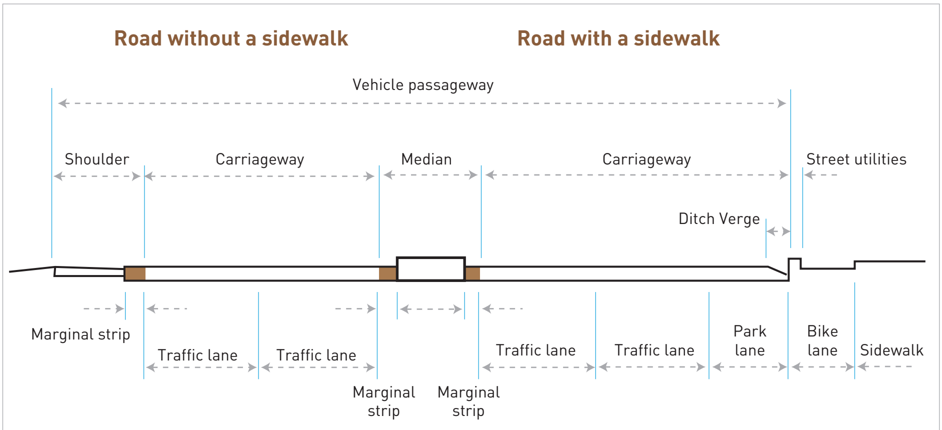
The points of design section change can be determined by considering various topographic conditions. They may be major locations of traffic change such as intersections and interchanges, or places where significant structures such as long bridges are located. Pertinent decisions should be taken on the basis of thorough examination of the data on the geometric structure of the relevant sections. Particular care should be taken to ensure that drivers can recognize the change at a sufficient distance in advance.

02
Cross-Section Composition

Cross Section Elements

A cross section is a vertical plane that appears when a road is sliced at right angles to the direction of travel. Features that should be considered in terms of the cross section's geometric structure include the traffic lane, the road shoulder, and the road median. Moreover, other additional infrastructures include safety fence, the curb, the ditch, the sidewalk, and the roadside slope. However, these minor facilities are not necessarily regarded as the geometric features of a road. The following Figure 5.2 shows the cross section of a four-lane road, which has different elements depending the existence of the pedestrian walkway.

Figure 5.2. Cross-section elements and combination



• Source: Introduction to Transportation Engineering

Travel Lane

The roadway is a part of the road built for the passage of vehicles. It is composed of travel lanes, which can be classified into drive-through lanes, turn lanes, speed-change lanes, climbing lanes, and passing lanes.

Travel Lane Width

The width of a travel lane is the distance from the center of a lane marking to the center of an adjacent marking. Table 5.5 presents the guidelines on the minimum lane widths that vary according to the road types, the design speed and locations.

Table 5.5. Traffic Lane Width

<table>
<tr><th colspan="3" rowspan="2">Road classification</th><th colspan="3">Minimum traffic lane width (m)</th></tr>
<tr><th>Rural areas</th><th>Urban areas</th><th>Roads for small-size cars</th></tr>
<tr><td colspan="3">Expressway</td><td>3.50</td><td>3.50</td><td>3.25</td></tr>
<tr><td rowspan="4">General road</td><td rowspan="4">Design speed (km/h)</td><td>80 or above</td><td>3.50</td><td>3.25</td><td>3.25</td></tr>
<tr><td>70 or above</td><td>3.25</td><td>3.25</td><td>3.00</td></tr>
<tr><td>60 or above</td><td>3.25</td><td>3.00</td><td>3.00</td></tr>
<tr><td>Below 60</td><td>3.00</td><td>3.00</td><td>3.00</td></tr>
</table>

• Source: Road Design Manual 215-2

The lane width can be determined from economic and environmental perspectives. The following aspects should be considered when determining the lane width.

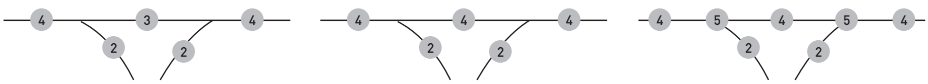
- It may be economical to reduce the lane width in terms of construction costs. However, reducing the lane width is likely to cause such problems as pavement damages due to the concentration of the wheel path, frequent repairs to road shoulder, and decrease in road capacity. Given these problems, it is desirable to set the lane width at an appropriate scale.
- In urban areas where bus volumes are heavy or on roads used frequently by heavy vehicles, the outer lane should be wider than the inside lane. It is particularly necessary to develop appropriate plans and designs with regard to the width of bus-only lanes.
- As for the acceleration and deceleration lanes, their width may be the same as the main lanes or be reduced to a minimum of 3.0 m.
- The standard width of turn lanes (left-turn, right-turn lanes) is 3.0 m, but it may be reduced up to 2.75 m through consultations with the pertinent road

management agency, if the reduction is unavoidable due to the land space constraints.

Number of Travel Lanes

The basic number of travel lanes refers to the minimum number of lanes that should be maintained for a considerable distance of a road regardless of traffic volume. It is dependent on the determination of design traffic volume, traffic capacity, and the level of service. Motorways and trunk roads ought to be provided with the basic number of lanes in order to maintain their consistency. In addition, the number of lanes needed for weaving should be minimized. In the exit and entry parts of connecting roads, factors causing structural reduction of road capacity should be removed through balanced provision of lanes. Specifically, the number of lanes of the main road joined by another road should be one less than the sum of the roads. Figure 5.3 illustrates the circumstances where principles on both the basic number of lanes and lane balance criteria should be satisfied.

Figure 5.3. Basic number of lanes and lane balance criteria



(a)
Appropriate balance in the number of lanes, but in violation of criteria on basic number of lanes

(b)
In violation of lane balance principle, but appropriate in the basic number of lanes

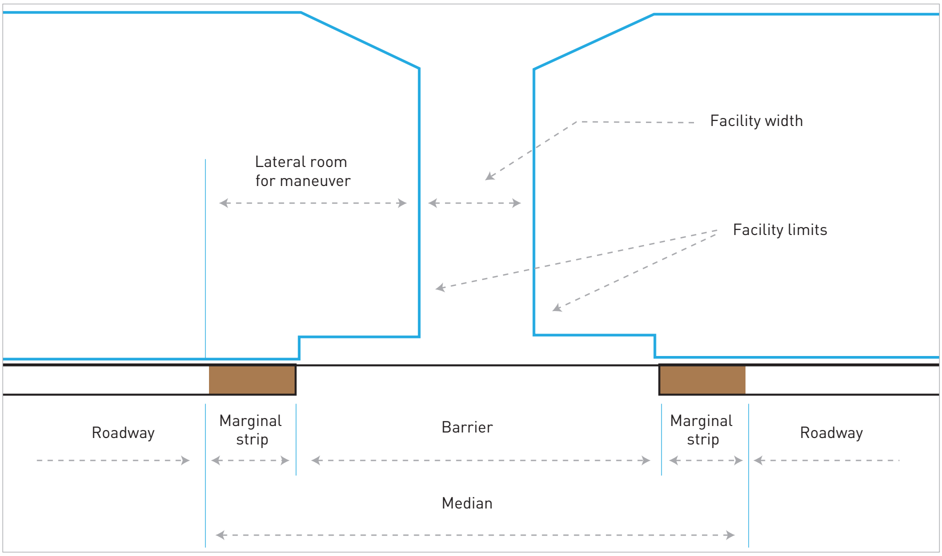
(c)
Appropriate in both lane balance, and the basic number of lanes

• Source: Road Design Manual 215-4

Median

The median is a narrow area of land that separates the opposing directions of traffic on two-way roads. It consists of the barrier and marginal strips.

Figure 5.4. Composition of a median strip



• Source: Road Design Manual 215-5

Median Width

The wider the median, the better it executes its designed function. For example, a car may move out of its lane and enter a median. In cases where the median is sufficiently wide, the driver could regain control of the vehicle and drive it back to the original lane, thereby avoiding a serious accident. Moreover, mechanical maintenance work can be carried out conveniently when the median provides enough space without interfering the passing traffic. However, because of the difficulty of securing land lots for road construction, it is customary to reduce the

Table 5.6. Minimum requirements for median width (Unit: m)

Road categories		Standard width
Expressway	Rural areas	3.0
	Urban areas	2.0
	Roads for small-size cars	2.0
General road	Rural areas	1.5
	Urban areas	1.0
	Roads for small-size cars	1.0

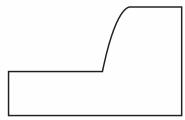
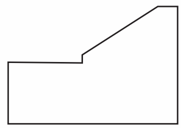
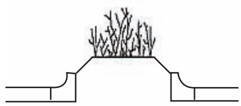
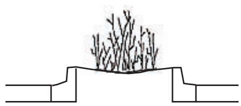
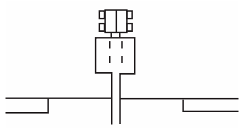
• Source: Road Design Manual 215-5

median width and install a high barrier. Table 5.6 presents the criteria for minimum median width requirements, depending on road types and areas. As for the motorways, the width should be at least 2.0 m.

Median Format

Medians can be classified into various types depending on the specifications and structures such as the curb style, the shape of barriers, and the barrier surface

Table 5.7. Median format and structure

Classification method	Basic design elements and types	Characteristics and usage	Curb and barrier types (examples)
Curb style	(a) Mountable curb	• Narrow median • Used in urban areas	
	(b) Unmountable curb	• Wide median	
Barrier surface style	(c) Convex median (installation of curbs)	• Used for narrow medians • Installation of unmountable curbs; Used mainly in urban areas	
	(d) Concave median (installation of curbs)	• Used at wide medians for drainage; In general, with installation of mountable curbs	
Barrier surface treatment	(e) Median strip : A curbless median used for high-specification roads or motorways	• Surface treatment: grass, pavement • Wide median : grass • Narrow median : pavement • The grass at a narrow median has a high risk of danger	
	(f) Wide-width separation structure : Median structure used in countries with sufficient land spaces like the United States	• The grass looks good esthetically and achieves good harmony with roadways in terms of color, but costs a lot for maintenance and management	

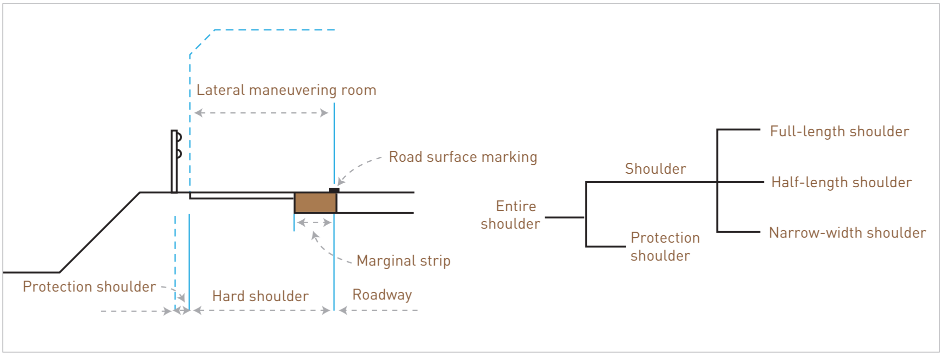
• Source: Road Design Manual 215-6

treatments, as shown in Table 5.7. In Korea, curbs with convex or grass strips have been customarily used as barriers because of the difficulty of securing wide medians. However, such curbs could not prevent accidents caused by cars slamming into the median. Moreover, the difficulties of maintaining the grass or planted trees are known as the hindrances. To address these drawbacks, efforts are being made to install medians in a way that can use marginal strips more effectively. When used as median facilities, curbs need to be mountable so that they can help prevent cars from being overturned. However, unmountable curbs may be used on roads where the speed limit is 60 km/h or below.

Hard Shoulder

A hard shoulder refers to a piece of road built next to a roadway, a sidewalk or a bike lane to provide structural support of the road and to provide a space where motorists can stop in the event of a breakdown. The major components of a shoulder are illustrated in Figure 5.5.

Figure 5.5. Shoulder elements and various types of shoulders



• Source: Road Design Manual 215-10

Shoulder Width

The hard shoulder installed at the right side of a road should be wide enough for vehicles to stop there temporarily without hindering the traffic of other vehicles in the event of a breakdown. Guidelines on minimum shoulder width based on road types and design speeds are shown in Table 5.8.

Table 5.8. Minimum widths for right-hand shoulders

Road classification			Minimum widths of right-hand shoulders (meter)		
			Rural areas	Urban areas	Roads for small-size cars
Expressway			3.00	2.00	2.00
General road	Design speed (km/h)	80 or above	2.00	1.50	1.00
		60 or above Below 80	1.50	1.00	0.75
		Below 60	1.00	0.75	0.75

• Source: Road Design Manual 215-11

Marginal strips of hard shoulders have the following functions:

① Increase driving safety by clearly showing the roadway boundaries through the use of surface markings and attracting the drivers' attention.

② Maintain the utility of roadways by securing part of lateral wheel clearance.

③ Increase the safety of vehicles moving out of their lanes, particularly while driving at high speed.

④ Protect the roadway by virtue of pavement structure with the same level of strength as the roadway

It is necessary to ensure that the roadway and marginal strips have the same level of surface brightness and strength. However, under unavoidable circumstances that require the installation of a drainage structure on a marginal strip section of a shoulder, the structure should be strong enough to withstand the moving traffic.

Left Shoulder

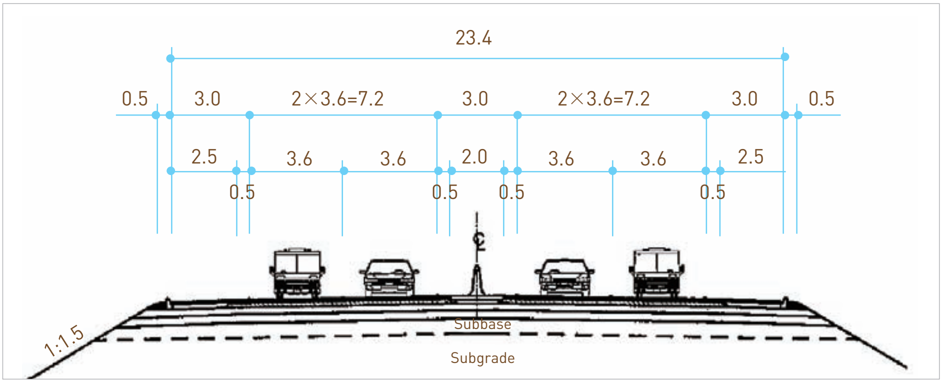
On divided roads or one-way streets, left-hand shoulders are installed to secure lateral room for maneuver needed for traffic safety. Unlike right-hand shoulders which are normally used by vehicles in the event of emergencies or breakdowns, left-hand shoulders are designed to secure lateral clearance. Given this, left shoulders do not have to be as wide as right-hand shoulders.

In general, it is not necessary to install left shoulders on roads with medians. Such roads need to be equipped with just marginal strips within the median. On roads with eight or more lanes, however, left shoulders may be built for the evacuation of cars in breakdown conditions that occur at the side of the median, or for road maintenance and management. In particular, it is necessary to secure left-hand shoulders with the width of around 2.0 m on expressways with eight or more lanes in order for vehicle evacuation and road management.

Standard Cross Section

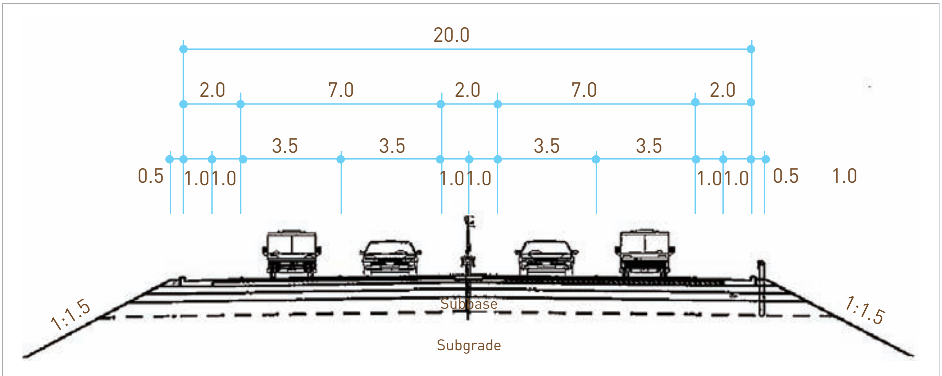
The following figures represent standard cross section drawings of an expressways and a national highway.

Figure 5.6. A standard cross section drawing of an expressway (example)



• Source: Road Design Manual 215-32

Figure 5.7. A standard cross section drawing of a national highway (example)



• Source: Road Design Manual 215-32

03

Road Alignment Design

Overview

Road alignment refers to continual three-dimensional shapes drawn by the centerline of a roadway. The horizontally viewed shape of the centerline is horizontal alignment, and the vertically viewed shape is vertical alignment. Road alignment is mainly dependent on the design speed of a particular road. Road alignment for a specific section should be designed based on consistent criteria in order to prevent abrupt changes. The three-dimensional vertical and horizontal shapes should also be formed safely and effectively so that they can be mutually complementary.

Sight Distance

Sight distance refers to viewable distance over the road surface needed for the driver to visually identify obstacles or hazards ahead, and stop the car or avoid them. It is the length measured along the centerline of a roadway. There are three types of sight distance – stopping, passing and escaping. Of them, stopping sight distance is the most important element that must be secured on the all sections of a roadway. Escaping sight distance refers to the viewable length needed for a vehicle to escape to adjacent lanes in the event of emergencies, like a car standing on the same lane as the vehicle in a breakdown situation. Generally, securing stopping sight distance is sufficient to cover escaping sight distance.

Minimum Stopping Sight Distance (MSSD)

Stopping sight distance long enough to meet at least the minimum criteria must be provided throughout the entire sections of a roadway. The minimum stopping sight distance is calculated by adding the breaking distance to the distance a vehicle travels during the driver's response time after perception of emergency situations ahead on the roadway.

$$MSSD = Response\ time + Braking\ distance = \frac{V}{3.6}t + \frac{V^2}{2g(f \pm G)(3.6)^2}$$

Where, $MSSD$ = *minimum stopping sight distance* (m)

V = *velocity* (km/h)

t = *response time* (*2.5 seconds*)

g = *gravitational acceleration* ($9.8m/sec^2$)

f = *tire-road longitudinal sliding friction coefficient* (*0.28-0.44*)

G = *vertical slope* (*%/100*)

Passing Sight Distance

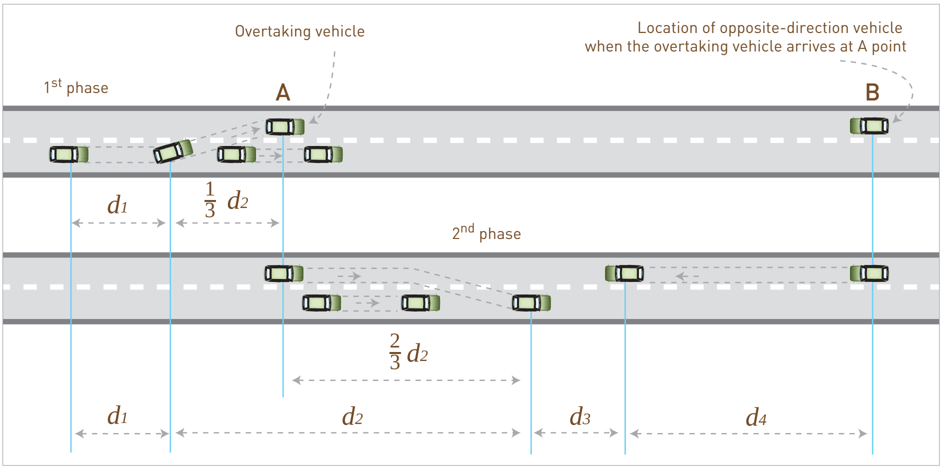
Passing sight distance is relevant to bi-directional two-lane roads. It needs to be provided in order to increase the road capacity. It is calculated by the following formula:

$$D = d_1 + d_2 + d_3 + d_4$$

Where, D = *passing sight distance*

d_1 = *passing reaction distance*

Figure 5.8. A standard cross section drawing of an expressway (example)



• Source: Introduction to Transport Engineering 230

d_2 = *passing distance*

d_3 = *distance to opposite-direction vehicle after passing*

d_4 = *distance traveled by opposite-direction vehicle while passing*

Passing sight distances for the overtaking vehicle and the vehicle being overtaken are shown in Table 5.9.

Table 5.9. Passing sight distances

V (km/hour)	V_0 (km/hour)	d_1 (m)	d_2 (m)	d_3 (m)	d_4 (m)	D (m)	Minimum D (m)
100	85	107	317	80	211	715	502
80	65	82	231	60	154	527	368
60	45	51	158	40	105	354	251
50	37.5	39	125	30	83	277	197
40	30	29	94	25	63	211	151
30	20	19	67	20	45	151	109
20	10	10	42	15	28	95	71

- Note: V= velocity of the overtaking vehicle, V_0= velocity of the vehicle being overtaken
- Source: Introduction to Transport Engineering 231

Horizontal Alignment

Radius of Curvature

Curved segment design should be carried out in a way that can ensure driving comfort, construction feasibility and aesthetic harmony with the surrounding environment. Under this guideline, particular efforts must be exerted to properly coordinate the following factors: the method of connection to the straight section, the type of curve, and the radius and length of curvature. In many cases, a horizontal curvature segment is partially or mostly a circular curve. This circular curve should be designed in such a way that its radius exceeds the minimum level that can satisfy the design speed. The minimum curvature radius can be calculated by using the formula below.

$$R = \frac{V^2}{127(e+f)}$$

Where, R = *radius of curvature* (m)

V= *design speed* (km/h)

e = *superelevation* (6%)

f = *lateral sliding friction coefficient*

Table 5.10 shows the reference values for minimum curvature radius based on the application of 6% superelevation and lateral sliding friction coefficients.

Table 5.10. Reference Values for Minimum Radius of Curvature

Design speed (km/h)	Friction coefficient	Minimum radius of curvature (m)	
		Calculated values	Reference values
120	0.10	709	710
100	0.11	463	460
80	0.12	280	280
70	0.13	203	200
60	0.14	142	140
50	0.15	94	90
40	0.16	57	60
30	0.16	32	30
20	0.16	14	15

• Source: Introduction to Transport Engineering 234

Length of Horizontal Curves

In case the length of the curve of a horizontal curvature segment is short, drivers have to turn the steering wheel towards the curvature direction and immediately turn it in the opposition direction to enter the straight through section. When doing this, the car receives lateral force, causing discomfort to the driver and reducing the level of traffic safety. When even the road bridge is small under these circumstances, the curve looks shorter to the driver. In extreme cases, it looks as if the road were bent. The driver slows down as the curvature radius looks shorted than its actual length. In case the driver does not reduce speed, the trajectory of the car might move on to another lane due to the outward pull. This raises the risks of accidents. Based on consideration of such circumstances, the minimum curvature length is determined by the following formula:

$$L = \frac{V}{3.6} t$$

Where, *L*= *length of horizontal curvature* (*m*)

V = *vehicle speed* (*km/h*)

t = *driving time* (*4 seconds*)

Transition Curve and Transition Part

The transition curve is a curve established between a curved part and the straight through part or between two curves that have significantly different curvature radii. The transition curve is being widely used as its use can help adjust the centrifugal force adequately during driving. it is used mostly at the entry and exit parts of the circular curve.

On a road with design speed of over 60 km/h, it is essential to install a transition curve that can help attract the driver's gaze to the normal driving trajectory so that any aberration caused by a tiny lapse in steering wheel control can be returned to normal. In case a transition curve is not installed on a road with design speed of less than 60 km/h, a transition section should be established between the straight through and circular curvature parts to develop superelevation and widening at the horizontal curvature part. A clothoid loop is frequently used in road design as a representative transition curve that is most similar to a vehicle driving trajectory.

Length of Transition Curve and Transition Section

The equation for calculating the minimum length of the transition curve and the transition section is shown below. It is based on an assumption that the driver would not feel difficulty controling the steering wheel for two seconds.

$$L = \frac{V}{3.6} t$$

Where, *L* = *length of the transition curve* (*m*)

t = *driving time* (*2 seconds*)

V= *driving speed* (*km/h*)

The minimum transition curve lengths based on design speed are shown in Table 5.11.

Table 5.11. Minimum transition curve lengths

Design speed (km/h)	Minimum transition curve length (m)
120	70
110	65
100	60
90	55
80	50
70	40
60	35

• Source: Road Design Manual 216-8

On roads with design speed of less than 60 km/h, a transition section should be installed at the horizontal curvature part to develop superelevation and widening. Table 5.12 presents the minimum required lengths for such a section.

Table 5.12. Minimum required length of a transition section

Design speed (km/h)	Minimum transition curve length (m)
50	30
40	25
30	20
20	15

• Source: Road Design Manual 216-8

Cross Slope and Superelevation

The cross slope is a cross-section slope from the centerline of a roadway to the roadway edge. It is necessary to develop such a slope in order to drain rain water from roads through a ditch. Its values should be sufficient enough to ensure rain water drainage and driving safety. If the cross slope at the straight through section has the value of 2% or more, the driver is likely to feel that the steering wheel is leaning to one side. Such a slope may cause lateral sliding on freezing or wet road surfaces. Even if the road surface has dry conditions, the same phenomenon could occur in the event of sudden braking. Special care should be taken for bi-directional two-lane roads, where an overtaking vehicle faces an abrupt change in the direction of the slope as it has to pass another vehicle by using the opposite lane. For this reason, when a vehicle with a high center of gravity runs at high speed, it may encounter a dangerous situation because of difficulty in controling the steering wheel. When determining the cross slope values, various factors need to be considered, including vehicle type, weather, road alignment, vertical slope, and road surface type. However, the standard values are critically dependent on the road surface type and the number of lanes as these factors have the greatest impacts on drainage.

When the curve radius is determined at a horizontal curvature part of a roadway, an appropriate level of superelevation is required depending on the design speed and the radius so that the driver can maneuver safely without feeling discomfort related to the centrifugal force at the curvature part.

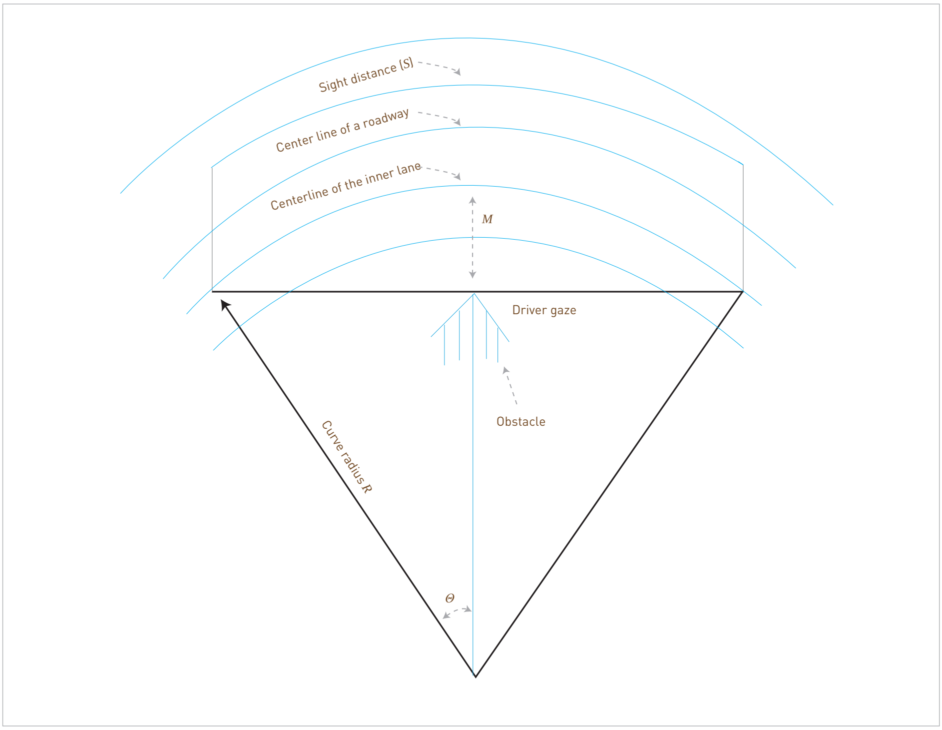
Sight Distance and Horizontal Alignment

The driver's viewable distance on a road with horizontal alignment is determined by the distance to an obstacle, the location of a slope, and other things that obstruct visibility. Figure 5.9 illustrates the elements required to be considered in general with regard to the sight distance on a horizontal curve. To secure sight distance in such a case, the lateral room for maneuver should be secured as calculated by the following formula.

$$M = R\left(1 - \cos \frac{28.65S}{R}\right)(\text{degree})$$

CHAPTER 05

Figure 5.9. Sight distance on a horizontal curve



• Source: Introduction to Transport Engineering 245

Vertical Alignment

Vertical alignment of a roadway is the vertical shape of the road surface that appears when the roadway is cut along the direction of a vehicle. It is composed of straight lines and curves, and its design elements are vertical grades and vertical curves.

Vertical Grade

Vertical grade values are determined in a way that can minimize speed reduction within the slope allowable from the environmental and economic perspectives, thereby avoiding undermining of traffic capacity and safety. Maximum vertical grades based on design speeds, road types and topographical conditions are presented in Table 5.13.

Table 5.13. Maximum vertical grades

Design speed (km/h)	Maximum vertical grades (%)							
	Expressways		Arterial roads		Collector and connecting roads		Local roads	
	Flat areas	Mountainous areas, etc.	Flat areas	Mountainous areas, etc.	Flat areas	Mountainous areas, etc.	Flat areas	Mountainous areas, etc.
120	3	4						
110	3	5						
100	3	5	3	6				
90	4	6	4	6				
80	4	6	4	7	6	9		
70			5	7	7	10		
60			5	8	7	10	7	13
50			5	8	7	10	7	14
40			6	9	7	11	7	15
30					7	12	8	16
20							8	16

• Source: Road Design Manual 216-35

Vertical Curve

When two different vertical curves meet, they should be connected with appropriate changes in grades in a way that can mitigate the impacts on vehicles caused by changes in momentum when passing through the connection point as well as securing the stopping sight distance. The curves can be divided into convex and concave types. The vertical curves are generally in parabolic form, being installed in a manner that can ensure driving comfort and safety as well as smooth drainage.

The size of a vertical curve is indicated by the rate of change. The vertical curve rate of change represents a horizontal distance that should be secured when the algebraic difference between two connecting vertical curves changes by 1%. It is calculated by the following formula.

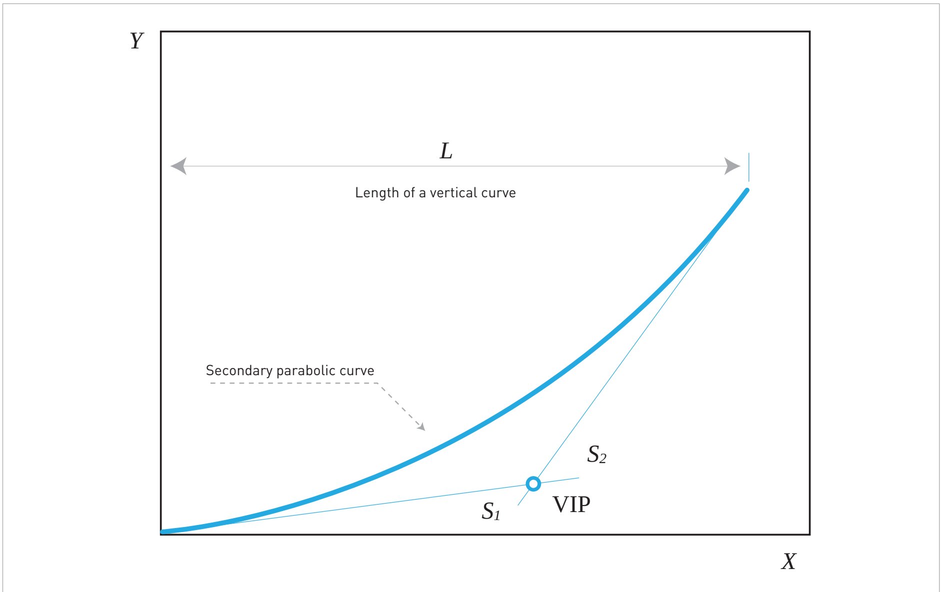
$$K = \frac{Kr}{100} = \frac{L}{(|S_2 - S_1|) \times 100} = \frac{L}{S}$$

Where, *K: vertical curve change rate* (*m*/%)

L: vertical curve length (*m*)

S: vertical curve algebraic difference

Figure 5.10. Indication of the size of a vertical curve

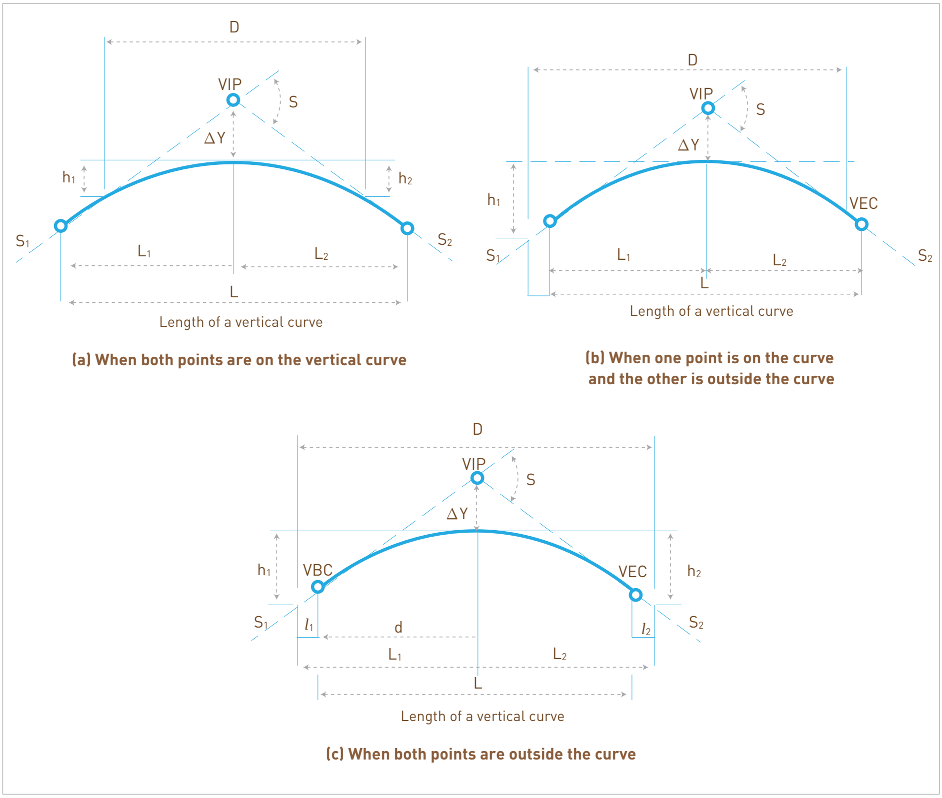


• Source: Road Design Manual 216-36

The minimum length of a convex vertical curve is normally determined by pertinent sight distances. The driver should be able to see an object on the curve from a distance farther than the pertinent sight distances. To induce an equation involving the curve length (L), the grade difference (S), and the visible distance between the two points (D), L and D are displayed in horizontal distance.

Table 5.14 shows standards on the eye-level height and the height of objects regarding stopping and passing sight distances as well as the equations for calculating the length of convex vertical curves.

Figure 5.11. Sight distance on convex vertical curves



• Source: Road Design Manual

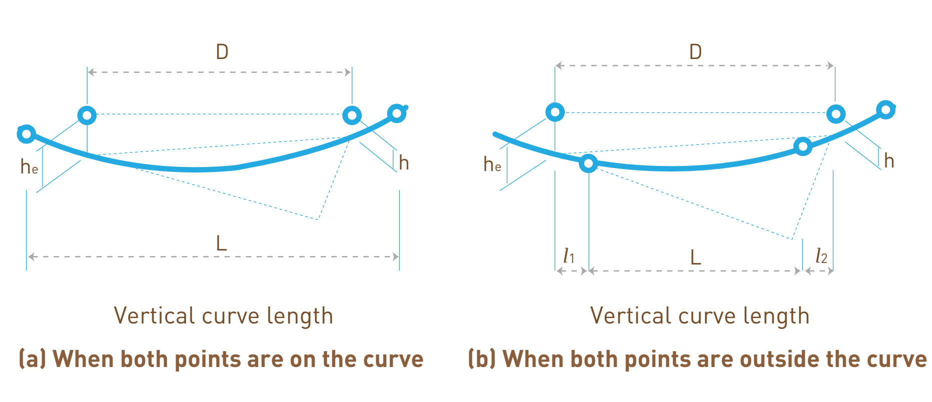
Table 5.14. Calculation of convex vertical curve length

Parameters	Stopping sight distance	Passing sight distance
Eye-level height (h_1)	1.0 m	1.0 m
Height of the object (h_2)	0.15 m	1.20 m
In case D 〉 L	$L = 2D - \frac{385}{S}$	$L = 2D - \frac{897}{S}$
In case D 〈 L	$L = \frac{S \cdot D^2}{385}$	$L = \frac{S \cdot D^2}{897}$

• Source: Road Design Manual 216-38

The factors that should be considered when determining the length of a concave vertical curve include headlight sight distance, driving comfort, and drainage. The

Figure 5.12. Sight distance on a concave vertical curve (in the event of nighttime headlight irradiation)



• Source: Road Design Manual 216-36

most important are the headlight sight distance and the underpass sight distance. When a vehicle drives on a concave vertical curve at night, the extent to which the driver can see is restricted to the range of headlight illumination. Table 5.15 and Figure 5.12 show the relations between the headlight illumination distance (D), the height of the headlight (h), and the headlight angle (θ) in order to determine the minimum concave vertical curve length (L).

Table 5.15. Calculation of concave vertical curve length based on consideration of nighttime headlight irradiation

Parameters	Based on consideration of headlight irradiation
height of the headlight (h_1)	1.0m
Headlight angle (θ)	1°
In case D 〉 L	$L = 2D - \frac{120+3.5D}{S}$
In case D 〈 L	$L = 2D - \frac{S \cdot D^2}{120+3.5D}$

• Source: Road Design Manual 216-38

04

Road Intersection

Overview

An intersection refers to a space where two or more roads meet or cross. It is a place where drivers make decisions on their pathways, based on its geometric structure and operational method. Not only normal traffic progression but crossings and turns take place at intersections. Because of such complicated conditions, crashes and congestion are more likely to occur at intersections than other road parts. In this respect, it is essential to appropriately plan, design and operate an intersection in order to handle traffic flows in a safe and smooth manner. Intersections can be broadly divided into at-grade intersections and interchanges, depending on their spaces for road junction and crossing as well as their facilities.

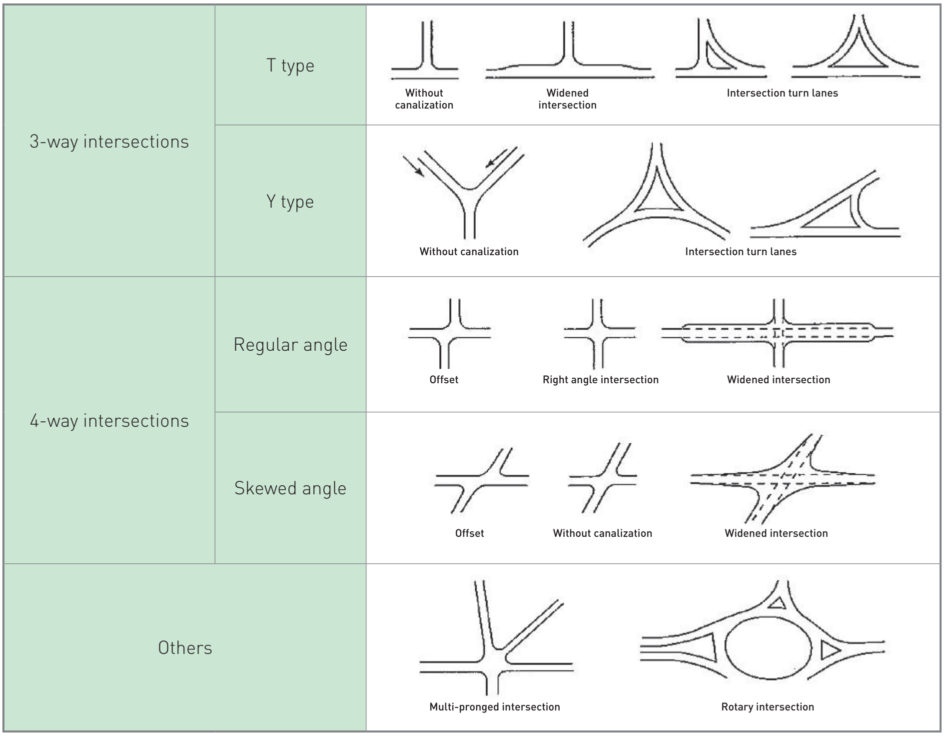
At-Grade Intersection

At-grade intersections are established mainly to change pathways. Without restrictions on the right-of-way, traffic flows from different directions conflict with each other at intersections. This feature should be fully considered in devising design techniques for intersections so that the mutual confliction problem can be avoided. The techniques should also accommodate the need to help the drivers recognize the possibility of conflicts and be prepared in advance.

Types of At-Grade Intersections

At-grade intersections can be classified according to the number of roads that cross, crossing angle and crossing locations. Generally, they are divided into the following four categories: ① Three-way intersections, ② Four-way intersections, ③ Multi-pronged intersections, ④ Rotary intersections. More specific at-grade intersection types are presented in Figure 5.13.

Figure 5.13. At-grade intersection types



• Source: Introduction to Transport Engineering 260

Basic Principles of At-Grade Intersection Design

When designing at-grade intersections, the foremost attention is placed on rational handling of the longitudinal slope, the sight distance and the intersection angle from geometric perspectives. However, given the crucial need to effectively handle conflicts, it is necessary to divide the intersection into multiple parts and conduct detailed research about each part. The basic design guidelines for ad-grade intersections are as follows:

① Specify the relationship between the main and minor traffic streams.
② Avoid building intersections with five or more prongs.
③ Make sure that the intersection angle is close to the right angle.
④ Avoid abnormal types such as staggered intersection and intersections on curve.
⑤ Make sure that the intersection area is as small as possible.
⑥ Separate the left- and right-turn traffic flows from the straight through

streams.

⑦ Install road markings to provide guidance to vehicles turning left and right.

⑧ Give full consideration to ways to ensure harmony between the intersection's geometric structure and traffic control methods.

⑨ Make sure that various traffic facilities are installed at correct locations.

At-Grade Intersection Alignment

At-Grade intersections are places where vehicles, pedestrians and various facilities are closely interacting in a complicated manner. Such complex conditions raise risks of traffic accidents and lower the operational status of the traffic. To avoid such problem, it is essential to keep the roads straight to the maximum extent in order to ensure swift and safe passage through the intersection.

It is desirable that the intersecting roads are designed in such a way that they cross each other at close to right angles regardless of the intersection types. Acute-angle crossing causes significant damages at the parts of roads where vehicles make turns. It also prevents drivers from securing sufficient visibility. In contrast, obtuse-angle crossing makes drivers unable to see one side. It is also necessary to ensure sufficient sight distances near intersections. Vertical grade should not surpass the maximum criteria in order to ensure the safety of vehicles at stop lines. It is recommended that the vertical grade should not exceed 3%. When the need arises to change the vertical grade, it is desirable to adjust the rate of the connecting road while keeping the main road intact. However, when the speed is not significantly high, the cross-section grades of both roads may be adjusted to ensure flat-level crossing.

Interchange

Types of Interchanges

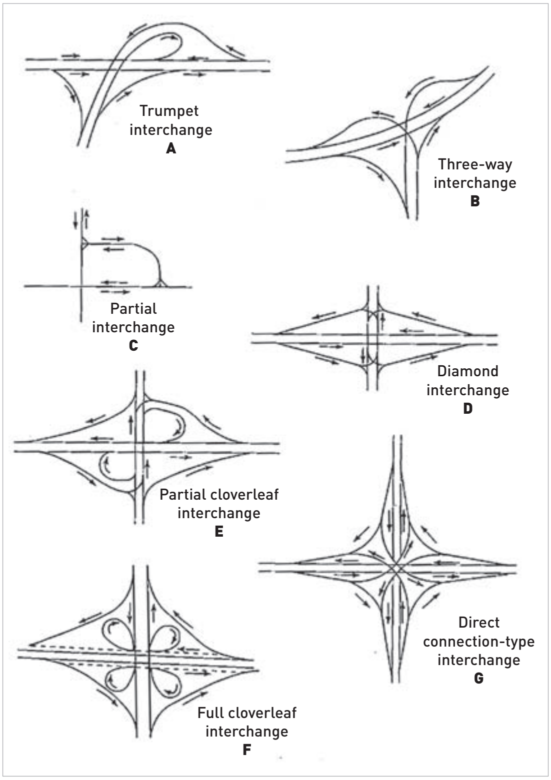
An interchange refers to a road junction that uses grade separation to handle traffic involving at least two roads in a safe and efficient manner. Representative types of interchanges are illustrated in Figure 5.14.

Basic Principles for Interchange Design

The most important interchange design concepts are as follows:

① Intersection ramps should be built under a consistent design concept. Common ways of road operation expected by drivers, such as the ramp installation locations and speed limit restrictions on ramps, and interchange characteristics must be consistent with each other.

Figure 5.14. Various types of interchanges



• Source: Introduction to Transport Engineering 277

② Easy-to-understand information on how to use interchanges should be provided to drivers through traffic signs and other facilities. Even exquisitely designed interchanges cannot function properly unless their operational methods are communicated to the users in a rational manner through such means as traffic signs.

③ In case two access restricted expressways are connected through an interchange, they should be accessible through ramps in all directions. The ramps may not be installed in the event of a very small amount of roundabout traffic flows. Even in such case, drivers should be given maximum convenience through the use of by-pass roads and other facilities.

Interchange Locations

Interchanges should be installed in a way that can ensure the maximum social and economic effects by reasonably distributing transport demand through a network of roads. As interchange installation plans are closely related to route planning, interchange plans must always be considered when developing new route plans. Interchange locations should be determined based on the consideration of local and regional transport operation plans, in accordance with the criteria as presented in Table 5.16.

Table 5.16. Interchange placement criteria

<table>
<tr><th>Categories</th><th colspan="2">Descriptions</th></tr>
<tr><td>Intersection or access points pertaining to national highways or other main roads.</td><td colspan="2">-</td></tr>
<tr><td>Intersection or access points pertaining to main roads leading to ports, airports, distribution facilities, and major tourist attractions.</td><td colspan="2">Determination cannot but be dependent on populations of the spheres of influence.</td></tr>
<tr><td>Interchanges should be spaced minimum 2 km, maximum 30 km apart.</td><td colspan="2">Minimum space of 2 km : Distance needed for traffic operation such as the handling of planned traffic volume and the installation of traffic signs.
Maximum space of 30 km : Distance needed for road maintenance and management.In urban areas, the distance between two interchanges may be less than 2 km. Under unavoidable circumstances, it can be as short as 1 km.</td></tr>
<tr><td rowspan="5">Interchanges should be located near cities with a population of over 30,000, or in areas where the sphere of influence would have a population of 50,000-100,000.</td><td>Area</td><td>Standard space (km)</td></tr>
<tr><td>Urban expressway in large cities</td><td>2-5</td></tr>
<tr><td>Major industrial areas around large cities</td><td>5-10</td></tr>
<tr><td>Fields where small cities are located</td><td>15-25</td></tr>
<tr><td>Rural villages, mountain areas</td><td>20-30</td></tr>
<tr><td>Entry/exit traffic volumes should not exceed 30,000 vehicles per day.</td><td colspan="2">Depending on directional differences in entry/exit traffic volume, multiple exchanges may be installed. So, interchanges should be installed by considering not only their own capacity but the capacity and structure of access roads.</td></tr>
<tr><td>Placement should be made in a way that can ensure that the ratio of benefits to cost pertaining to the main road and interchanges can be maximized.</td><td colspan="2">The ratio of total revenue to total cost tends to decrease after reaching a high at a certain point. However, interchange placement decision cannot be based on this because of the leveling off of its effects. So, there is a need to compare the marginal cost with marginal revenue. With the increase in the number of interchanges, the latter exceeds the former up to a certain point. Then, marginal revenue equals marginal cost, and begins to lag behind. Maximization of the total benefit-cost ratio can be realized at a point where marginal revenue equals marginal cost.</td></tr>
</table>

• Source: Road Design Manual 218-10

CHAPTER 6

Road Operation

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01
Introduction

Roads can be broadly divided into two categories based on their operational characteristics: uninterrupted flow roads and interrupted flow roads. Uninterrupted flow roads, as in the case of expressways, have no regular interruptions to the traffic stream, whereas interrupted flow roads have traffic stream interruptions caused by traffic signals or other control facilities.

There are differences in operation and traffic control methods between the two types of roads. This chapter introduces the following operational schemes: the traffic signal system which is a typical control method for interrupted flow; the exclusive bus lane system that contributes greatly to facilitating public transportation in urban areas; the Hi-Pass system, a type of a toll collection scheme introduced to enhance the operational efficiency of uninterrupted flow roads; and, the system of using expressway rest areas as transfer points as a way to increase the convenience of express bus users.

02

Traffic Signal System

The total length of roads in Korea is 105,930 km. Of them, the uninterrupted flow roads account for just about 5%: expressways (3,913 km) and exclusive motorways (1,572 km). The remaining 95% covering 100,445 km are counted as interrupted flow roads. The operation of the roads with interruptions in traffic streams is crucially dependent on the traffic signal system. Relevant statistics show that Korea has 57,356 traffic signal controllers installed throughout the nation. This means that the controllers are installed every 1.75 km on average along the nation's roads, although, in reality, they are concentrated mainly in central urban areas. These figures indicate a significantly high level of frequency with which drivers meet signals during driving. As explained so far, the traffic signal system has great impacts on road operation and the drivers. This makes it essential to ensure effective operation of traffic signal systems.

Traffic signal systems are installed and managed in accordance with the Road Traffic Act. In particular, the "Manual on Traffic Signal Installation and Management" presents specific conditions and operational methods. Matters concerning the installation and management of traffic signals are stipulated in Article 3 of the Act, while the kinds of traffic safety facilities and places where they are to be installed are set forth in Article 4. Article 5 contains provisions on the users' obligations to observe signals and instructions. Article 147 provides for the delegation of authority and tasks related to traffic signals to the commissioner of a regional police agency or the chief of a police station. Based on this provision, nearly all the local governments are allowing the police to be in charge of the tasks pertaining to traffic signals.

[Road Traffic Act]

Article 3 (Installation and management of traffic signals, etc.) ① When it is deemed necessary to prevent dangers and to ensure safe and smooth flow of traffic on the road, the special city mayor, the metropolitan city mayor, the governor of Jeju Special Self-Governing Province, or the head of si (city) or gun (county) (excluding the head of Gun in a metropolitan city. Hereinafter referred to as "Mayor, etc.") shall install and manage traffic signals and safety signs (hereinafter referred to as "traffic safety facilities"); Provided that in cases of toll roads provided for in Article 6 of the "Toll Road Act," road managers shall install and manage traffic safety facilities upon receiving instructions from the mayor, etc.

Article 4 (Types of traffic safety facilities, etc.) The types of traffic safety facilities, methods of manufacturing traffic safety facilities, places where traffic safety facilities are to be installed, and other necessary matters concerning traffic safety facilities shall be prescribed by Ordinance of the Ministry of Security and Public Administration.

Article 147 (Commission and entrustment, etc.) ① The Mayor, etc. may delegate or entrust part of his/her authority or clerical work provided for in this Act to the commissioner of a regional police agency or the chief of a police station, as prescribed by Presidential Decree.

The Purpose and Functions of Traffic Signals

The purpose of traffic signal installation is to prevent dangers on roads and ensure traffic safety and smooth flows of traffic. By displaying signals for progression, stop, turns and caution through words, signs or lights, the signal system allocates rights-of-way to various traffic flows.

Signal Installation Standards

Standards for Installing Signals for Vehicles

The standards for installing traffic signals for vehicles can be broadly divided into four categories. The most important factor is the vehicle traffic volume: Traffic lights need to be installed when the traffic volume of vehicles passing through an intersection surpasses a certain level. In case the traffic volume is below a certain level, installation of traffic signal is not necessary. These criteria, therefore, are designed to prevent indiscriminate installation of unnecessary signals. The second important factor is the pedestrian volume: Even if an intersection does not meet the criteria by the measure of the vehicle traffic volume, signals still have to be installed there to ensure the safety of pedestrians in case the pedestrian volume exceeds a certain level. There are also stipulations that provide for the installation of signals to ensure traffic safety on school zones or at accident-prone locations, even when a particular intersection does not meet the criteria in terms of vehicle and pedestrian volumes.

① Criteria 1 (Vehicle Traffic Volume) : Traffic signals should be installed when the eight-hour traffic volume during weekdays exceeds the criteria given in Table 6.1. The eight hours in this criteria do not have to be continuous eight hours. Traffic volumes of the major and minor roads ought to be those of the same time slots.

Table 6.1. 8-hour traffic volume

Number of approach lanes		Traffic volume on main road (two-way)	Traffic volume on minor road (the side with heavier traffic)
Main road	Minor road	(vehicles/hour)	(vehicles/hour)
1	1	500	150
2 or more	1	600	150
2 or more	2 or more	600	200
1	2 or more	500	200

② Criteria 2 (Pedestrian Volume) : Signals should be installed in case the pedestrian volume during weekdays surpass the criteria presented in Table 6.2.

Table 6.2. Minimum vehicle traffic volume and pedestrian volume

Vehicle traffic volume (8 hours, two-way: vehicles/hour)	Pedestrians crossing the road (one hour, two-way, including bikes: persons/hour)
600 vehicles	150 people

③ Criteria 3 (School Zones): Signals should be installed in case there are no traffic lights within 300 meters from the main entrance of an elementary school or a kindergarten within a child protection zone, and the interval of vehicles travelling through the area is less than a minutes. In other cases, signals should be installed on the crosswalk located at the nearest place from the main entrance.

④ Criteria 4 (Traffic Accident Record): Signals should be installed in such places where traffic accidents take place five or more times a year within a 50-meter radius, on the basis of the foundation that the presence of traffic lights could prevent such accidents.

Standards for Permissive Left Turn Signals

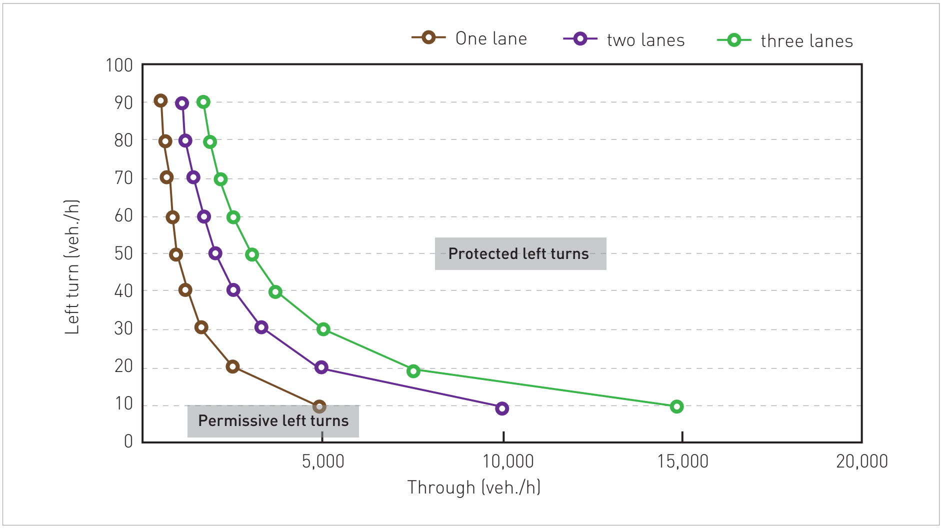
The most important factor in intersection signal operation is how to handle left-turn traffic volumes. The signal operation efficiency of an intersection is dependent on how efficiently the left-turn volumes are handled. Generally, simultaneous left-turn and straight through signals or separate left-turn signals are used to handle left-turn volumes. However, these are protected left-turn measures used when left-turn volumes exceed a certain level. In case the left-turn volumes fall behind such a level, there is no need to provide such protected left-turn measures. The "Manual on Traffic Signal Installation and Management" provides guidelines that suggest operating protected left-turn signals, in case of opposing through and left-turn traffic volumes exceed the criteria shown in Table 6.3, and permissive left-turn signals when the volumes are below the criteria.

Table 6.3. Traffic volume criteria by the number of lanes

Number of lanes	Squared traffic volume	Left-turn traffic volume
1 lane	50,000 veh./h	Maximum 90 vehicles/h
2 lanes	100,000 veh./h	
3 lanes	150,000 veh./h	

As shown in Figure 6.1, protected left-turn signals are operated in case the traffic volume is located above a ceratin level of curvature. Permissive left-turn signals are operated when the traffic volume is below the threshold curvature. Regardless of the traffic volume, there ought to be protected left-turn signals in case

Figure 6.1. Left-turn and straight through traffic volumes by number of lanes



left turn accidents occur five or more times a year, or when there are four or more opposing through lanes. When operating a permissive left-turn scheme, a separate left-turn bay must be established, and efforts should be made to secure sufficient visibility depending on speeds.

Figure 6.2. Typical pedestrians pushbutton and sign

• Source: http://blog.naver.com/jyf5389?Redirect=Log&logNo=140190025744
http://blog.naver.com/qkrakstns77?Redirect=Log&logNo=40123165558

Standards for Installing Pedestrian Signals

In principle, pedestrian signals should be installed along with vehicle signals. As described in the criteria for vehicle signals, the foremost priority ought to be given to crosswalks where the average daily peak-hour pedestrian volume exceeds 150. Pedestrian signals should also be installed at crosswalks at downtown intersections or in front of railway stations, crosswalks with vehicle signals, and crossings at the nearest location from the main entrance of an elementary school or a kindergarten within a child protection zone. There are certain presence of ambiguity such as "downtown intersections," but their interpretation should follow the operator's determination by an engineering judgement.

Standards for Installing Bicycle Signals

Bike signals are installed on bike paths and bike crossings. However, the criteria for bike signals are not as clear as those for vehicles and pedestrians. In general, vertical 3-color signals are installed in bike paths, while vertical 2-color signals are established at bike crossings. Bike riders must observe vehicle signals at locations where bike signals have not been installed. At bike crossings without bike signals, they should follow the directions of pedestrian signals.

Places and Standards for Installing Pedestrians Pushbutton Signals

Pedestrians Pushbutton Signals are installed at locations where there are signal heads for vehicles and there is a need to provide a way for pedestrians to cross the street although their number is not large enough for constant operation of pedestrian signals. They may also be installed at locations where pedestrians cross the street only during specific hours of the day. Special care should be taken to ensure the detection of malfunctioning push-buttons or circuits. When such breakdowns occur, pedestrian signals should be provided regularly in accordance with pre-entered values in the local signal controller. Lack of such measures would likely cause jaywalking, which might result in fatal consequences.

Pedestrians Pushbutton Signals are generally installed on midblock crosswalks, but may be set up at intersections, depending on circumstances. On midblock crosswalks, they are mostly installed at crossings within a child protection zone, which normally have low pedestrian volumes except for specific hours of the day. They are also installed at locations on national or local highways, where there is a need to provide a way for pedestrians to cross the road despite low levels of pedestrian volume. Pedestrians Pushbutton Signals are also installed at intersections where signal controllers have been established based on other criteria than those related to pedestrian volume. They can also operate the signal of the intersections more efficiently, especially in the case of relatively low level of vehicular traffic on minor roads.

The operation of Pedestrians Pushbutton Signals prevents full-cycle provision of pedestrian signals, thereby helping to enhance the efficiency of signal operation. In other words, pedestrians Pushbutton Signals are installed at locations where traffic congestion on main roads can be significantly decreased through the installation of them and when no adverse effects are expected to be caused by reduction in phase time on minor roads.

Locations and Criteria for Installing Audible Signals for Visually Impaired Persons

There are no clear-cut criteria for installing audible signals for visually handicapped pedestrians. Generally, however, they are installed first at areas with high degrees of concentration of people with visual impairments and complexes of lease apartments for visually handicapped residents. They are also installed in areas near the facilities for people with visual disabilities: welfare facilities (social welfare centers, accommodation facilities, etc.), education institutes, districts with high levels of concentration of jobs for visually impaired persons (tourist hotels, massage parlors, etc.), subway stations, passenger terminals, and public buildings like state or local government office buildings.

When installing audible signals at intersections, facilities that might adversely affect the safety of visually impaired pedestrians crossing the roadway should be upgraded in advance. It is also recommended that the audible signals be installed in a way that allows their remote-control operation as well as touch-button operation in order to increase the benefits for the visually impaired.

Figure 6.3. Audible signals to assist visually impaired persons

• Source: http://blog.naver.com/PostView.nhn?blogId=xanto74&logNo=140137852160,
http://blog.daum.net/_blog/BlogTypeView.do?blogid=0IqvW&articleno=8497994&categoryId=847210&regdt=20100726095553

Traffic Signals in Seoul

Status of Traffic Signal Operation in Seoul

As of 2011, the total length of roads in Seoul was 8,148 km, while there were 3,670 signal controllers installed in the city as shown in Table 6.4. These figures suggest that there are traffic lights every 2.22 km on average in Seoul. Of the controllers, 88.1% are standard signal controllers. The others are electronics and ordinary controllers, which are being replaced gradually with standard control units. Vehicle detection systems are installed at 288 locations, but they are rarely used for signal operation.

Table 6.4. Status of traffic signal equipment and facilities in Seoul

Signal control computer (unit)			Signal controller (unit)					Detector	Vehicle
Total	Central control computer	Local control computer	Total	Standard	Electronic	Ordinary	Variable	locations/ unit	
34	2	32	3,670	3,232	195	237	6	288/2,219	15

Seoul City and the Seoul Police Agency are pursuing various measures aimed at raising the efficiency of traffic signal operation. These measures include the through priority phase scheme, expansion of permissive left turns and time-based left turns, and the operation of yellow flashing at nighttime when the traffic volume is low. These measures are used flexibly, depending the circumstances at each location. As shown in Table 6.5, through priority phase scheme are installed at 1,528 intersections, which make up 41.6% of the total intersection in the city.

The other intersections provide through and left-turn signals simultaneously, overlap signals, or left-turn signals first, depending the geometric design of the intersection and on-site circumstances. The permissive left-turn signal scheme is being operated at 1,493 intersections, or 40.7% of the total. The time-based left-turn system is in operation at just 24 intersections. However, the number is expected to increase as its effects have been positively appraised. The nighttime flashing signals are operated at 1,198 intersections. At 66 intersections, the signals are constantly in flashing. Roundabouts are highly recommended at these intersections.

Table 6.5. Status of traffic signal operation in Seoul

Category	Diagonal crosswalk	Staggered crosswalk	Lane-based signal	Time-based left turn	Overlap signal	Pedestrian green phasing (BEF,PED)	All Red	Right-turn signal	Through priority phase
Total	52	56	69	24	130	2,958	708/1042	89	1,528

Permissive left turn	Flashing signal			Pedestrian signal 0.8m/s application (locations/units)				Half-cycle operation	Time-based group movement	Group
	Sub-total	Full-time	Time-based	Sub-total	Child protection zone	Elderly protection zone	Areas of pedestrian concentration			
1,493/ 2,475	1,264/ 1,841	66/ 80	1,198/ 1,761	1,862/ 2,899	1,123/ 1,762	240/ 368	499/ 769	194	4	789

Spillback Prevention Control

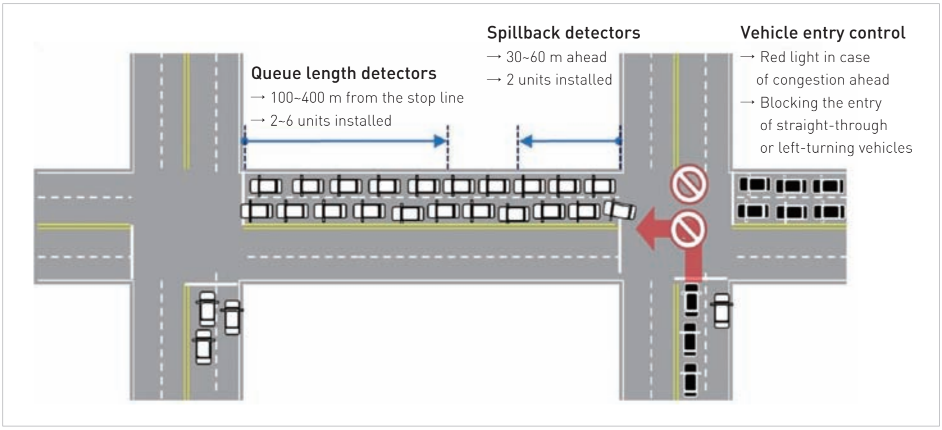
In an effort to tackle the problem of extreme congestion at intersections, Seoul City developed a spillback prevention control system in 2012, implementing it at 10 locations within the city in a pilot scheme. It has received strong positive evaluation that other local governments are seeking to introduce the system.

This system is designed to automatically prohibit the entry of vehicles into a congested intersection by showing a red light to incoming traffic based on real-time detection of traffic situations. It can prevent blocking of an intersection by vehicles that cannot make it through in time before the traffic lights turn red. It is a relatively simple system that connects the signal controller to detectors installed to determine whether there is sufficient space at downstream intersections. However, it is necessary to resolve the problem of the continued entry of right-turning vehicles even after the early termination of the through phases.

Figure 6.4. A spillback at an intersection

• Source: Flickr/H.F.Kais

Figure 6.5. A conceptual drawing of the spillback prevention control system



• Source: Seoul Metropolitan Government

The occurrence of intersection blocking was reported to have declined by 66% since the introduction of the spillback prevention control system. It was also reported to have led to an 83.3% reduction in the number of vehicles waiting within intersections and a 5.5% increase in the rate of vehicles observing the stop line regulations.

03
Exclusive Bus Lanes

General Status of Exclusive Bus Lanes

Concept of Exclusive Bus Lanes

The exclusive bus lane system refers to a scheme that gives right-of-way priority to buses on specific lanes of expressways or general roads. Either curbside or median lanes are designated as bus-only lanes. This scheme is designed to separate passenger car traffic from the flow of buses, which have a far better passenger transport capacity. By so doing, it aims to improve the bus travel speed and punctuality, and eventually increasing the modal share of public transportation.

Types of Exclusive Bus Lanes

Curbside Bus Lanes

The curbside bus lane scheme provides for the traffic of buses on bus-only curbside lanes in the same direction as other traffic flows. In general, the curbside lane system can be operated only when there are two or more lanes for other vehicles in one direction. Besides, the curbside parking and stopping of other vehicles should be prohibited. This system is easy to implement at relatively low cost with minimum changes to the existing network of streets. However, its effects can be undermined by various factors, including most conspicuously, the curbside vehicle activities and the curbside parking and stopping of taxis. Table 6.6 gives a brief summary of the strengths and weaknesses of the curbside bus lane system, while Figure 6.6 provides photos of curbside bus lanes.

Table 6.6. Strengths and weakness of curbside bus lanes

Strengths	Weaknesses
• Easy to implement • Possible to operate at relatively low cost • Little impact on the existing street network • Easy to fix or reinstate when problems occur	• Lack of significant effects • Conflicts with vehicles engaged in curbside activities • Conflicts with right-turning vehicles at intersections

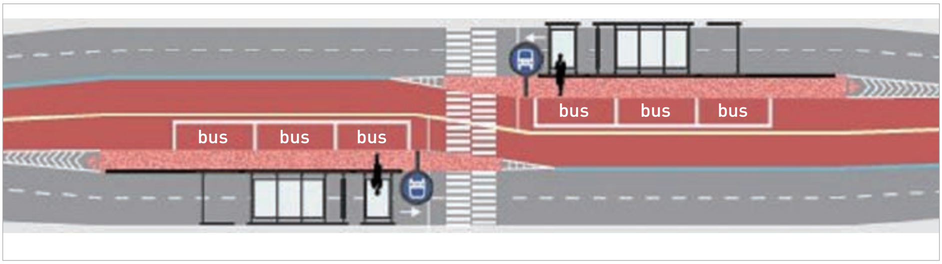
Figure 6.6. Curbside bus lanes

• Source: http://blog.naver.com/chonchu?Redirect=Log&logNo=110017058842

Median Bus Lanes (general arterial roads)

This scheme represents an operational scheme designed to ensure bus-only traffic on median lanes of the existing roads that have three or more lanes in one direction. As the number of lanes increases, it becomes easier to apply this scheme. It can have a huge impact on traffic when implemented at chronically congested areas or on downtown streets where many buses make left-turns. By effectively separating

Figure 6.7. Median bus lane ground plan



• Source: Seoul Metropolitan Government

Figure 6.8. Median bus lanes in operation

• Source: http://blog.naver.com/pentium444?Redirect=Log&logNo=137851341, http://blog.daum.net/spogood/326 the buses from other vehicles, it can result in a more effective performance than the curbside bus lane system. Moreover, this scheme can keep the curbside accessibility of general vehicles.

Table 6.7. Strengths and weaknesses of median bus lanes

Strengths	Weaknesses
• Prevention of conflicts between buses and other vehicles • Ensuring the curbside accessibility of general vehicles • Definite effects expected in heavily congested sections • Improvement in bus travel speed and punctuality	• Occurrence of passenger safety problems related to median-lane bus stops • Excessive installation costs • Reduction in the capacity of general traffic lanes

Status of Exclusive Bus Lanes in Korea

The exclusive bus lane system was introduced into Korea in 1985, when Seoul City implemented a pilot program of operating curbside bus lanes along a 4-km segment between Seoul Station and the Han River bridge. The system has since expanded, now being in operation throughout the city. In 2004, the city government took a more drastic step, actively pursuing a median bus lane scheme. Curbside bus lanes are in operation in Seoul and other metropolitan cities on a full-time or part-time basis, while the median bus lane system is in operation on a full-time basis.

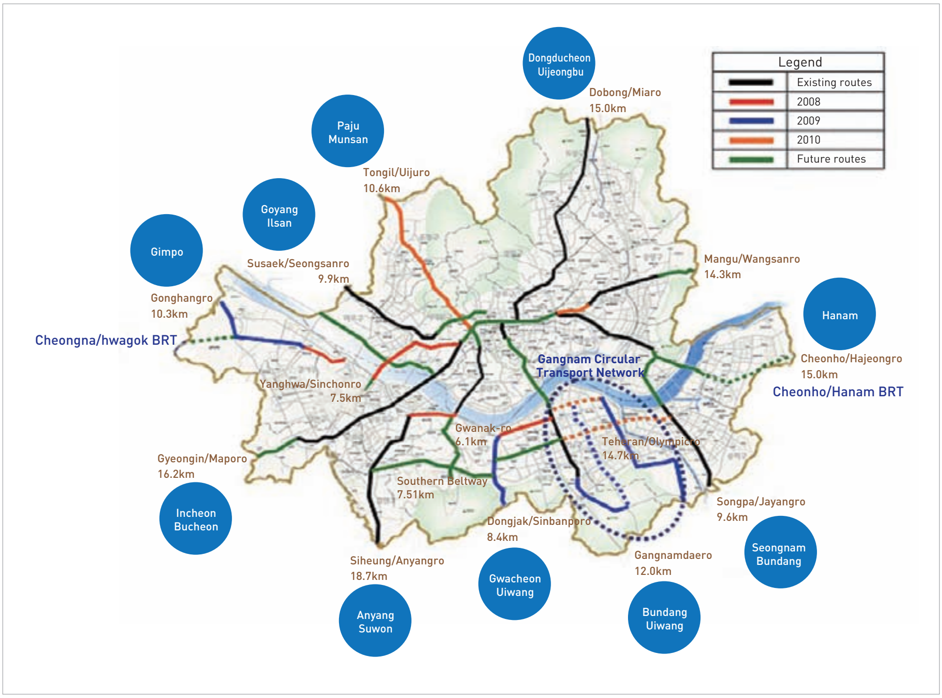
As for the expressways, implementation of the median bus lane system began in 1995 between Seocho IC and Sintanjin IC on a part-time basis in weekends and public holidays. In the subsequent year, the median bus lanes opened for full-time operation along the Cheonhodaero in Seoul. They were the first median bus lanes built on the general arterial roads apart from expressways. As shown in Table 6.8, Seoul City began to expand the median bus lane system in 2004 as part of efforts to promote the use of public transportation. In 2004, the median bus lanes covered 36.1 km of the roads on four routes. After a gradual expansion, they were in operation on 12 routes, covering 100.4 km of roads, in 2010. With opening of the BRT section along the Cheonho-Hanam corridor in March 2011, the total length of the median bus lanes increased to 105.5 km. In contrast, the curbside bus lanes have shown a downward trend. In 2004, the curbside bus lanes were in operation, on a part-time or full-time basis, in 65 segments, with their total length reaching 170.9 km. Since the introduction of the median bus lane system, the us of curbside bus lanes have declined in scope. As of 2010, the curbside bus lanes were in operation on 101.1 km of roads in 44 segments.

Table 6.8. Trends in operation of exclusive bus lanes in Seoul

Classification	Prior to 2001	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Median lane (full-time)	1 corridor 4.5 km	1 corridor 4.5 km	1 corridor 4.5 km	1 corridor 7.6 km	4 corridors 36.1 km	7 corridors 57.1 km	7 corridors 67.9 km	7 corridors 67.9 km	9 corridors 75.9 km	12 corridors 92.6 km	12 corridors 100.4 km
Curbside lane (full-time)	36 segments 143.9 km	36 segments 143.9 km	36 segments 143.4 km	39 segments 143.0 km	40 segments 103.3 km	29 segments 83.1km	28 segments 75.4 km	33 segments 82.1 km	31 segments 66.6 km	28 segments 58.8 km	2 6 segments 55.3 km
Curbside lane (part-time)	23 segments 70 km	23 segments 70 km	23 segments 70 km	24 segments 68.5 km	2 5segments 67.6 km	25 segments 67.6 km	25 segments 67.6 km	18 segments 48.8 km	19 segments 49.2 km	19 segments 49.2 km	18 segments 45.7 km
Other schemes	-	-	-	1 segment 2.6 km	1 segment 2.6 km	1 segment 2.6 km	1 segment 2.6 km	1 segment 2.6 km	1 segment 6.8 km	1 segment 6.8 km	1 segment 6.8 km
Total	60 segments 218.4 km	60 segments 218.4 km	61 segments 217.9 km	65 segments 221.7 km	70 segments 209.6 km	62 segments 210.4 km	61 segments 213.5 km	59 segments 201.4 km	60 segments 198.5 km	60 segments 207.4 km	57 segments 208.2 km

• Source: Seoul Metropolitan Transport Headquarters, As of December 2010.

Figure 6.9. A route map of median bus lanes (as of 2010)



• Source: Seoul Metropolitan Government

CHAPTER 06

As mentioned earlier, the median bus lanes in Seoul have been built in 12 segments, with their total length amounting to 105.5 km as detailed in Table 6.9. In the Gyeonggi Province area, median bus lanes with a total length of 27.4 km have been installed in 4 segments.

Table 6.9. Status of median bus lanes installed in Seoul

Road names	Operation segments	Length (km)	Started on	Segment names
Cheonho-Hajeongno	Achasan Station-Sindap Station-Sinse-oldong	7.6	2003.07	1.Cheonho-Hajeongno
Dobong-Miaro	Uijeongbu limits-Mia Intersection-Jongno 4-ga	15.8	2004.07	2.Dobong-Miaro
Susaek-Seongsanno	Goyang city limits-Susaek Station-Ewha Womans Univ. rear gate	6.8		3.Susaek-Seongsanno
Gangnamdaero-Samilno	Yeongdong 1 Bridge-Sinsa Station, To-egyero 2-ga-Jongno 2-ga	5.9		4.Gangnamdaero
Manguro	Mangu Station-Jungnang Bridge-Cheon-gnyangni Station	4.8	2005.07	5.Mangu-Wangsanno
Gyeonginno	Oryu IC-Yeongdeungpo Station-Yeouido	6.8		6.Gyeongin-Maporo
Siheung-Daebangno	Anyang city limits-Guro Digital Station-Daebang Station	9.4	2005.12	7.Siheung-Hangangno
Hangangno	Han River Bridge-Southern tip of Seoul Station	5.5	2006.12	7.Siheung-Hangangno
Maporo	Mapo Bridge-Ahyeon Intersection	5.3		6.Gyeongin-Maporo
Songpadaero	Seongnam city limits-Southern tip of Jamsil Bridge	5.6	2008.01	8.Songpadaero
Tongil-Uijuro	Goyang city limits-Bakseok-gogae	2.4	2008.11	9.Tongil-Uijuro
Gonghangno (1st phase)	Deungchon Middle School-Yanghwa Bridge	2.5	2009.04	10.Gonghangno
Noryangjnno	Daebang Station-Southern tip of Han River Bridge	2.8	2009.05	7.Siheung-Hangangno
Sinbanporo	Isu Intersection-Nonhyeon Station	3.5	2009.06	11.Dongjak-Sinbanporo
Dongjakdaero	Sadang Station-Isu Intersection	2.7	2009.11	
Yanghwa-Sinchonno	Yanghwa Bridge-Ewha Womans Univ. Station	5.2	2009.12	12.Yanghwa-Sinchonno
Gonghangno (2nd phase)	Balsan Station-Deungchon Middle School	2.3	2010.08	10.Gonghangno
Manguro extension	Guri city limits-Mangu Station	2.2		5.Mangu-Wangsanno
Tongil-Uijuro (1st phase)	Bakseok-gogae-Nokbeon Station	3.3	2010.12	9.Tongil-Uijuro
Cheonhodaero	Cheonho Station-Sangil Elementary School (Hanam city limits)	5.1	2011.03	1.Cheonho-Hajeongno
Subtotal	12 segments	105.5		

• Note: These statistics do not include those of the Gyeongbu Expressway median bus lanes (1 segment 6.8 km, since 2008)
• Source: Based on Seoul Metropolitan Transport Headquarters, as of December 2010 / The list includes the Cheonhodaero section that opened in March 2011

Table 6.10 presents trends in vehicle travel speeds by road types in Seoul. It shows that the average travel speed on median bus lanes is higher than those on curbside bus lanes and normal traffic lanes by 16.7% and 14.9%, respectively.

Table 6.10. Trends in travel speeds on different types of lanes in Seoul

Category	2004	2005	2006	2007	2008	2009	2010
General traffic lanes	17.7	17.0	17.3	18.4	18.3	18.9	19.0
Curbside bus lanes	18.9	18.4	18.7	18.4	18.5	18.1	18.2
Median bus lanes	22.0	21.3	21.1	22.3	22.2	21.2	21.8

Source: 2010 vehicle travel speeds in Seoul, Seoul Metropolitan Transport Headquarters

Design Elements for Median Bus Lanes

Design specifications for median bus lanes are mostly presented in the "Bus Rapid Transit (BRT) Design Guide (2010)." This section is devoted to reviewing the elements affecting the operation of median bus lanes, such as the design speed and the geometric design of median bus lanes, bus stops, by-pass lanes, and crosswalks.

Design Speed and Geometric design of Median Bus Lanes

The "Bus Rapid Transit (BRT) Design Guide (2010)" stipulates that the design speed for median bus lanes and bus-only roads should be determined through the application of the design speeds presented in the "Regulations for Standard of Road Structure and Facilities".

The design speed of median bus lanes should be determined at or above the levels shown in Table 6.11, which were presented as guidelines by considering road functions. Depending on the conditions of sites, the design speed may be flexibly determined with the fluctuation range of 0-20 km/h, if it is possible to ensure the travel conditions of the median bus lanes and traffic safety. Currently, Seoul City is generally applying the design speed of 60 km/h.

Table 6.11. Design speed by functional category of roads

Functional classification of roads		Design speed (km/h)		
		Rural areas		Urban areas
		Flat areas	Mountainous areas	
Expressways		120	100	100
General roads	Main arterial roads	80	60	80
	Minor arterial roads	70	50	60
	Collector roads	60	40	50
	Local roads	50	40	40

• Source: Bus Rapid Transit (BRT) Design Guide, Ministry of Land, Transport and Maritime Affairs, 2010. 6.

The median bus lanes should be wide enough to secure the driving safety of the buses. The width is determined by adding the values of bus width (2.5 m) and the lateral clearance (25-50 cm). According to the "Bus Rapid Transit (BRT) Design Guide (2010)," the width of median bus lanes should be set above the values presented in Table 6.12. The width can be a minimum of 3.25 m for acceleration and deceleration lanes. The width of 3.25 m is applied as the standard for left-turn and right-turn lanes.

Table 6.12. Width of BRT roads

Category		Design speed (km/h)	Lane width (m)	
			Rural area	Urban area
Expressway	Exclusive bus roads	100 or higher	3.60	3.60
	Exclusive bus lanes			
General arterial roads	Exclusive bus roads	80 or higher 60 or higher	3.50 3.50	3.50 3.25
	Exclusive bus lanes	80 or higher 60 or higher	3.50 3.50	3.50 3.25

• Source: Bus Rapid Transit (BRT) Design Guide, Ministry of Land, Infrastructure and Transport, 2010. 6.

Seoul City has installed median bus lanes by using two lanes in the middle of general arterial roads. To distinguish them from ordinary lanes, the bus lanes have been paved with dark red-colored materials, while blue markings have been used for the lane separations. According to Seoul City criteria, the main median bus lanes and the by-pass lanes should be at least 3.25 m in width. The minimum width

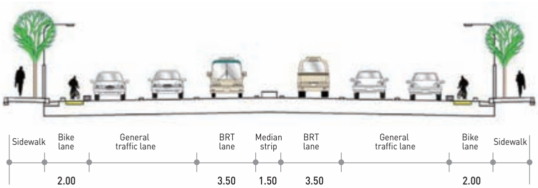
Figure 6.10. Exclusive median bus lanes in Seoul

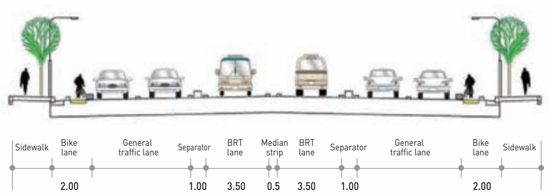
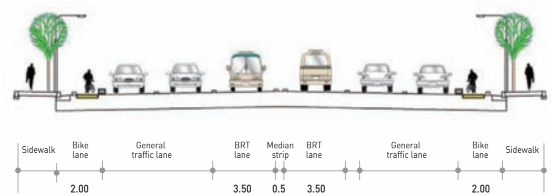
• Source: http://www.inews.org/Snews/article_print.php?Domain=ngoanyang&No=10138,
http://blog.naver.com/PostView.nhn?blogId=starshow88&logNo=103427769

for stopping lanes has been set at 3.0 m.

In addition, the operation types of exclusive median bus lanes can be divided into four categories as shown in Table 6.13 depending on the method of separating traffic directions (Barrier and lane markings) and the method of separating the exclusive bus lanes and ordinary lanes. The operation types can vary according to the condition of the sites.

Table 6.13. Types of BRT lane installation

Category		Cross section plan
Traffic direction separation	Separation from ordinary lanes	
Median Barrier	Barrier	
	Lane marking for separation	

Median marking	Barrier	
	Lane marking for separation	

• Source: Ministry of Land, Infrastructure and Transport, *Bus Rapid Transit (BRT) Design Guide*, 2010. 6.

Bus Stops

Median bus stops are facilities installed for passengers getting on and off the buses or transferring from one bus to another. As such, they should be installed in a way that can prevent crowdedness and ensure even distribution of passengers to the buses. The bus stop design guidelines, as presented in Table 6.14, are specified in the “Bus Rapid Transit (BRT) Design Guide (2010).”

Figure 6.11. **Median bus stops in Seoul**

		
Bus stop shelter (Gangnamdaero)-Open-type station	Security fence installed at a median bus stop (Gangnamdaero segment)	Appearance of a median bus stop and its adjacent areas (Cheonhodaero segment)

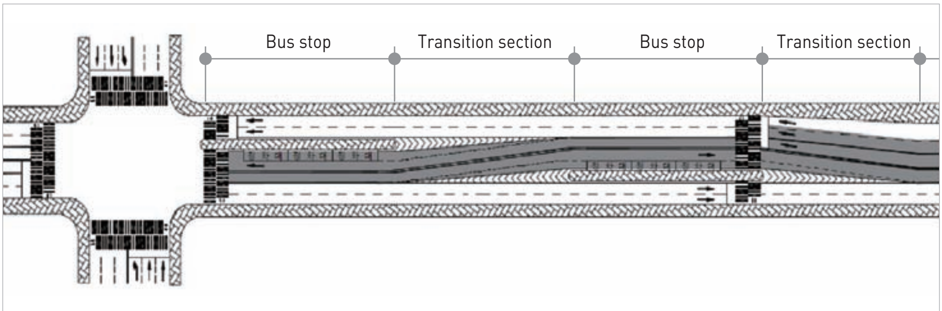
According to the “Regulations for Standard of Road Structure and Facilities” the horizontal alignment of a bus stop should have features of a straight line or a curvature radius above the standard level. The “BRT Design Guide” provides guidelines on transition sections, as shown in Figure 6.12 and Table 6.15, in order

Table 6.14. Bus stop (platform) design guidelines

Categories	Design guidelines for Bus Rapid Transit (BRT)	Seoul City guidelines
Width of platform	• 3.0m or more	• Minimum width of a bus platform (3.0 m) = Bus clearance (0.8)+waiting space for boarding(0.6)+extra room for boarding and alighting(0.8)+barrier(0.5)+shelter wall(0.3)
Length of platform	**[Method 1]** • Application of the method suggested in "Transit Capacity and Quality of Service Manual" **[Method 2]** • Application of the method of calculating the number of parking spaces as presented in the "Design Manual for Transfer Facilities at Intermodal Transit Centers" $Bs=Neb\times Bbb=Neb\times \frac{3,600(g/C)}{tc+(g/c)td+Za^{x}Cv^{x}td}$ - Bs = Capacity of bus stops considering utilization efficiency - Neb = Utilization efficiency of bus berth - Bbb = Maximum throughput of buses per bus berth per hour(vph) - tc = time spent before returning to the main bus lane - g/C = Green time ratio - td = Average boarding and alighting time - Za = Failure Rate - Cv = Coefficient of variation • Bus berth length = Bus length+ Extra space (3m) • Bus length = Community bus (9m), Ordinary bus (12m), Articulated bus (18m) • Bus berth width = 3m • Bus stoping space = Number of berths × Bus berth length • Platform length = Stopping space+Extra length (5m) + Length of connection to crosswalk	**[Method 1]** • Application of the method suggested in "Transit Capacity and Quality of Service Manual" **[Method 2]** • Application of Poisson distribution (applied to random traffic flows with small traffic volumes) Formula : $P(n)=(\frac{\lambda}{\mu})^{n}\times \frac{e^{-\frac{\lambda}{\mu}}}{n!}$ Here $P(n)$: Probability of n buses arriving λ = Number of buses arriving ÷ 3,600 sec. μ = 1 ÷ Service time • Input data : ① Number of route buses arriving per hour ② Service time (average time spent for boarding and alighting) • Number of buses standing simultaneously : Application of accumulated probability of 98% • y = 2.5674x + 1.4995 ($R2$=0.8795) Here x = Number of boarding and alighting passengers per vehicle • Bus stoping space = Number of buses standing simultaneously × 15m (1 berth) • Platform length = Bus stoping space + Extra length (5m) + Length of connection to crosswalk
Height of platform	• Platform structure may be appropriately adjusted depending on BRT routes and vehicle types (25cm or below)	• Application of 25cm criteria

• Source: Ministry of Land, Infrastructure and Transport, *Bus Rapid Transit (BRT) Design Guide*, 2010. 6.

Figure 6.12. Median bus lane transition section (example)



to prevent accidents on median bus lanes and minimize the lowering of traffic capacity.

Table 6.15. Design guidelines on bus stop transition sections

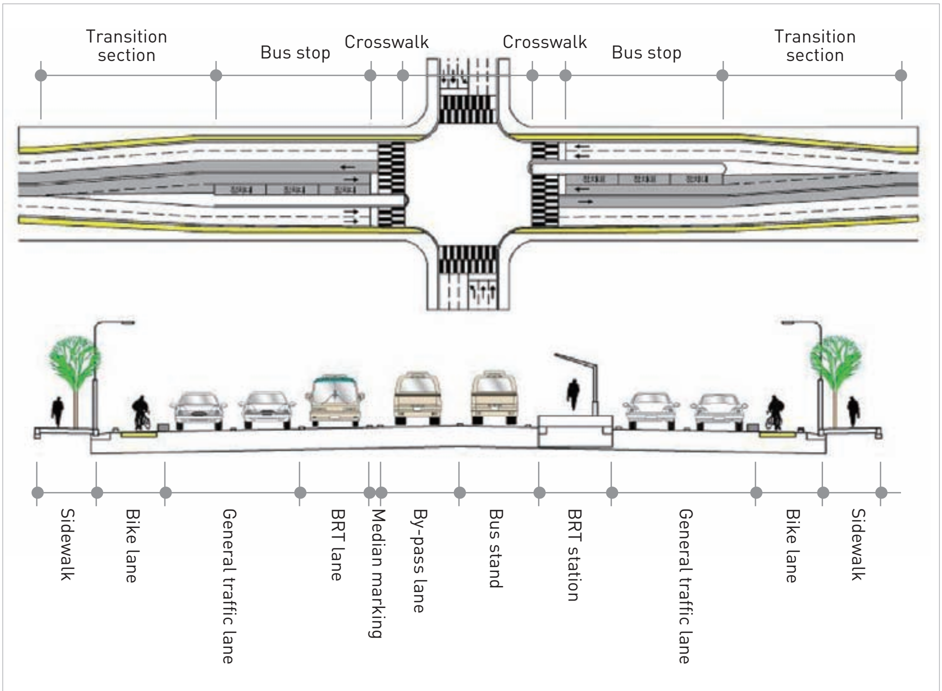
Category	BRT design guide		Seoul City guidelines	
	Inside	Origin/destination points	Inside	Origin/destination points
Expressway	1:20	1:30	-	-
General arterial roads	1:10	1:20	1:8	1:15

• Source: Ministry of Land, Infrastructure and Transport, *Bus Rapid Transit (BRT) Design Guide*, 2010. 6.

Existence of By-Pass Lanes and Pavement Types

It takes time for passengers to get on the buses including the waiting time at median bus stops. So, the absence of a by-pass lane would cause a long queue of buses

Figure 6.13. Composition of an intersection that includes median bus lanes and a cross-section plan (example)



• Source: Ministry of Land, Infrastructure and Transport, *Bus Rapid Transit (BRT) Design Guide*, 2010. 6.

standing at the bus stop for the boarding and alighting of passengers, consequently lowering the road capacity rapidly. To prevent such a problem, by-pass lanes have been installed near the median bus stops as illustrated in Figure 6.14. The by-pass lanes are paved with red-colored materials like the main bus lanes, or are paved with block paving bricks to induce speed reduction. After completion of passenger boarding and alighting, buses in rear berths can get on to the main bus lane through the by-pass lane, thereby reducing the time spent standing at bus stops. Buses that pass the bus stops may also use the by-pass lane.

In case the by-pass lane is not operated, the bus in the front berth may keep other buses standing at a median bus stop (See Figure 6.15). Such a situation leads to a long queue of buses, lowering the quality of services of median bus lanes.

Figure 6.14. Types of by-pass lane pavement

• Source: http://map.daum.net/ (Daum map)

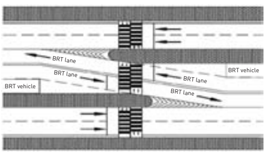
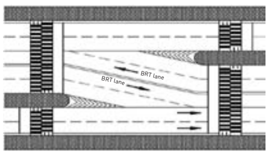
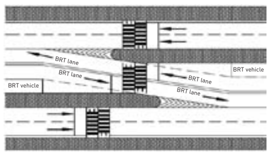
Figure 6.15. A median bus stop without a by-pass lane

• Source: http://map.daum.net/ (Daum map)

Crosswalks

There are three types of crosswalks in operation at the median bus lane segments: integral, discrete and staggered crosswalks. The integral type allows a one-step crossing and minimizes the number of vehicle stoppages. The discrete type also allows a one-step crossing, but it may cause increases in vehicle stoppages due to the operation of two crossings and two stop lines. Separated by traffic direction, the separate crossings may cause inconvenience to passengers standing by for transfers. The staggered type has a structure under which a roadway can be crossed after waiting for signals two or more times. Crosswalks of this type are installed mostly near intersections or at wide-width roadways. The strengths and weaknesses of these types are explained in Table 6.16, and examples of these crosswalks are shown in Figure 6.16 and Figure 6.17.

Table 6.16. Characteristics and strengths/weaknesses of different types of crosswalks at median bus lane segments

Categories	Integral type	Discrete type	Staggered type
Features	• An integral crosswalk • Cross a roadway in one or two step • Applied to segments where there is sufficient width for lanes	• Two crossings divided by direction • One-step crossing • Applied to segments where it is difficult to install integral types due to narrow lane width, or there is a need to separate the crosswalk because of high pedestrian volume	• An articulated integral cross-walk • Crossing requires waiting for signals two or more times • Applied mostly to intersection areas or wide-width roadway sections
Floor plan			
Strengths	• Easy to transfer to buses in the opposite direction • Possible to cross the street at one time • Minimize the number of vehicle stoppages	• Enable one-step crossing • Suitable for locations with high pedestrian volume as the pedestrians are separated by direction	• Reduction in signal time loss caused by pedestrian signal
Weaknesses	• Increase in pedestrian green time causes signal time loss	• Increase in vehicle stoppages due to two stop lines • Disadvantageous in terms of transfer because of the separation by traffic direction	• Increase in delays in roadway crossing • Possible increase in jaywalking

• Source: Ministry of Land, Infrastructure and Transport, *Bus Rapid Transit (BRT) Design Guide*, 2010. 6.

Figure 6.16. Integral type crosswalk (left) and discrete type crosswalk (right)

• Source: http://www.chosun.com/national/news/200504/200504210207.html, http://procella.egloos.com/6130517

Figure 6.17. Staggered crosswalk

• Source: http://map.daum.net/ (Daum map)

04
Tollgate System

Crowded conditions around tollgates is considered one of the most important factors causing congestion on expressways. At toll gate areas, vehicles slow down and stop to pay tolls. When the traffic volume exceeds the capacity of tollgates, the number of vehicles waiting in line increases, which forms a bottleneck.

In an effort to address such a problem, Korea Expressway Corporation began to implement a "Hi-pass system," which allows drivers to pay tolls without having to stop and make cash payment at some expressway sections in 2000, which has expanded to cover the entire nation at the end of 2007. Now, the system is used not only by the corporation, but by the operators of privately financed expressways and various toll collecting agencies. By using a wireless communications network, Hi-pass makes it possible to collect tolls automatically from vehicles passing through gates. To use the service, drivers should insert the Hi-pass card into the onboard unit (OBU) attached to the vehicle. When vehicles equipped with Hi-pass card pass through gates installed with the Hi-pass antenna, the tolls are collected electronically and relevant information is sent to the OBU. Using Dedicated Short-Range Communication (DSRC) technology, this scheme reduces traffic congestion through automatic toll collection, consequently contributing to reduce gas emissions.

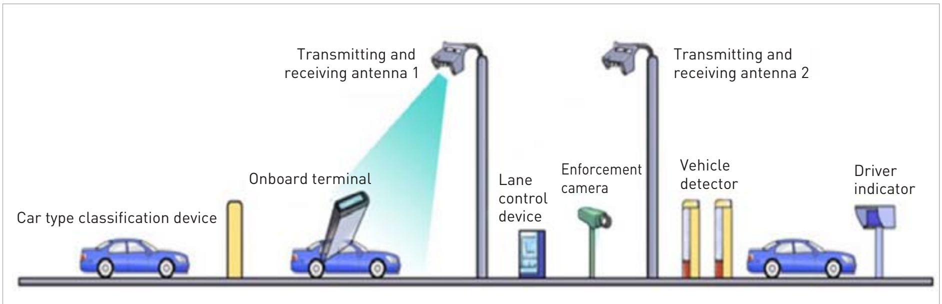
Hi-Pass System

Hi-Pass Toll Collection Process

To collect tolls using Hi-pass, it is necessary to establish an electronic detection and transmission system as illustrated in Figure 6.18. The essential components are the electronic card, the onboard unit, and the tollgate antenna. Vehicles using the service should be equipped with the Hi-pass OBU and the electronic card. Around the tollgate, there should be the antenna for sending and receiving relevant information, and a driver indicator displaying the receipt of toll payment. Moreover, a camera system for toll enforcement needs to be installed at the gates.

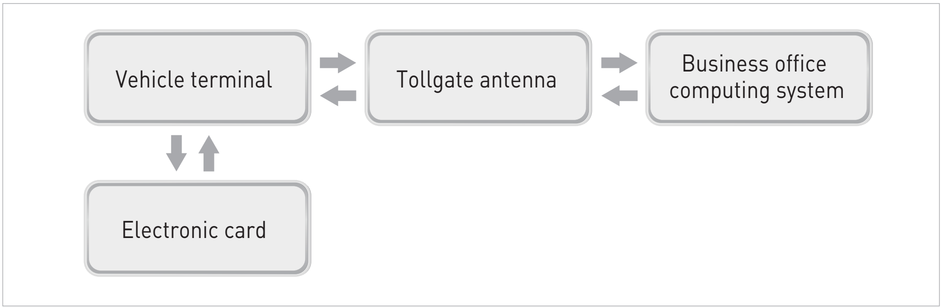
Upon recognizing a vehicle, the antenna sends payment request information to the OBU in the vehicle, the delivery process information of which is outlined in

Figure 6.18. Toll collection system using Hi-pass



•Source: http://navercast.naver.com/contents.nhn?contents_id=3698

Figure 6.19. Information delivery process pertaining to Hi-pass toll collection



•Source: http://navercast.naver.com/contents.nhn?contents_id=3698

Figure 6.19. The OBU reads payment information on the card (card type, payment method, etc.), and sends it to the tollgate antenna. After the payment is completed, relevant information is sent in the reverse order to be recorded on the card.

A contact-type communication method is used for the exchange of information between the OBU attached to the vehicle and the Hi-pass card. Power supply and external communication are realized via the gold-colored contact plate on the front of the card. As for prepaid cards, they deduct a certain amount in toll from the card balance when they receive a payment request signal from the OBU. They then send back to the OBU a signal indicating that the payment has been made. In case the remaining value is not sufficient to pay the toll, the cards send a signal indicating that the payment has not been made.

Method of Communication Between the OBU and the Tollgate Antenna

Communication between the OBU and the tollgate antenna is carried out through DSRC, a mobile radio communication method designed to provide intelligent transportation systems (ITS) services. ITS requires transmission of information between roadside stations and vehicles. This involves the utilization of technologies that makes it possible to conduct high-speed wireless packet communication between the devices of both sides. DSRC can implement such functions as short-range two-way communication between roadside stations and vehicles, multiplex communication, high-speed transmission, and the use of cheap and simple modulation techniques.

Types of OBU

OBU classification is made on the basis of communication methods and power supply systems. Depending on communication methods, the OBU can be divided into the radio frequency (RF) type and the infrared ray (IR) type. With long-distance communication capability, the RF type can be attached anywhere in a vehicle, while the IR type has relatively short communication ranges. Moreover, its operation is affected by the transmission direction of the infrared rays. For these reasons, the IR terminals must be attached to the front windshield. Depending on the power supply system, the OBU can be categorized into those dependent on in-vehicle power supply or the built-in battery type. Drivers using vehicle power supply-type OBU have no concerns over battery discharge, but its installation to the vehicle is known to be complicated. On the other hand, the use of built-in battery type OBU maintains the inside of the vehicle neatly. However, such an OBU system should be checked for the battery life at regular intervals. The IR type terminals consume relatively low levels of electricity, hence the built-in battery system is more widely preferred by the users.

Hi-pass Lane

Hi-pass lanes start at locations 2 km ahead of tollgates. The number of the Hi-pass lanes vary depending on the infrastructure and traffic volume. Hi-pass signs are installed 2 km and 1 km ahead of tollgates, and their visibility is enhanced by blue colors. In addition, dedicated electric sign boards are installed on Hi-pass lane gantries, informing drivers that the lanes are dedicated for Hi-pass users.

With the speed limit of 30 km/h set at tollgates, the drivers are required to slow down 50 m ahead of the gates. The speed limit was initially set at the relatively low level of 30 km/h because of the technicalities related to communication between the OBU and the tollgate antenna. At the current level of relevant technologies, there would be no difficulty in ensuring such communication even at higher speeds. However, the 30 km/h speed limit is maintained to prevent accidents and violations.

Figure 6.20. Hi-pass signs

• Source: A study on improving the design of Hi-pass safety facilities, KEC, March 2012

Figure 6.21. Status of the operation of Hi-pass lanes

• Source: Yonhap News, Reporter Yun-gyeong Hyun

Figure 6.22. Hi-pass lane markings

• Source: Catseye Stud

Figure 6.23. Gantry sign board

• Source: Ohmy News, Reporter Jun-gyu Park

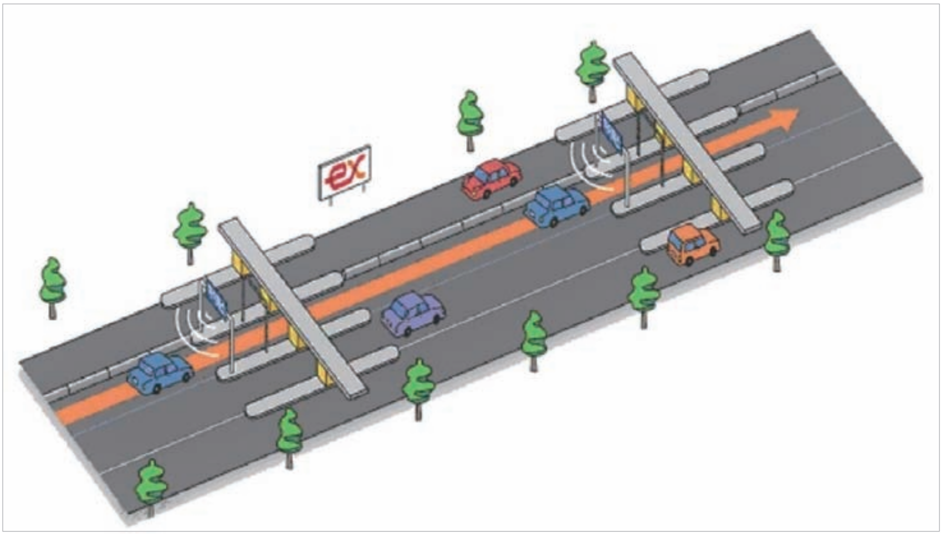
How to Use Hi-Pass Service

The Use of Proper Lanes

Tollgate operation methods on expressways can be classified into closed and open toll systems. Under the closed system, drivers receive toll tickets at toll booths as they enter the expressway, and pay the toll as they pass through exit gates. The open toll system does not operate tollgates for vehicles to pass through when entering the expressway. Toll booths are installed on the main expressway, collecting uniform tolls from vehicles travelling within certain sections. Under the open system, the same amount of tolls are collected from vehicles regardless of the distance travelled. So, no particular problems are caused by whether a vehicle uses Hi-pass lanes or not. In the case of closed system, however, caution should be taken when using Hi-pass services as the tolls are calcuated depending the distance traveled between the entry and exit gates.

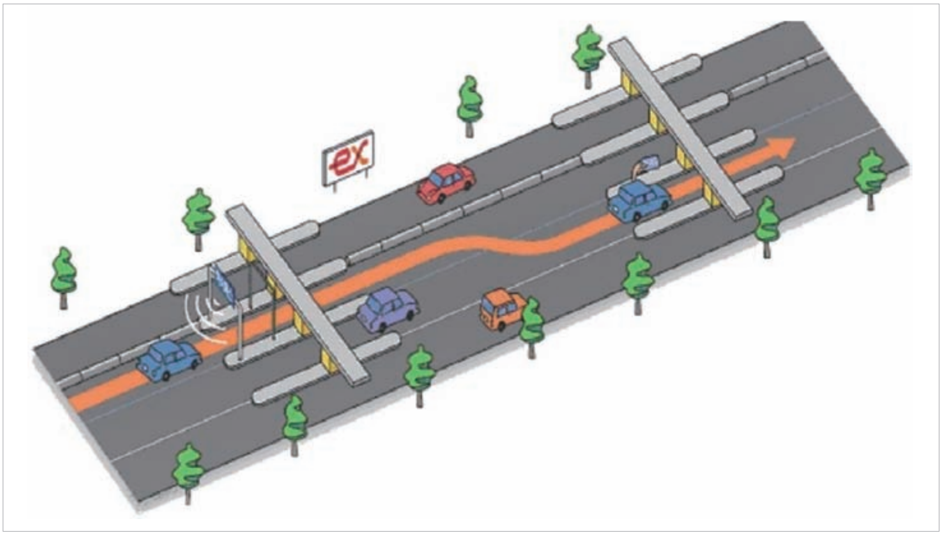
As illustrated in Figure 6.24, vehicles equipped with Hi-pass OBU normally use Hi-pass lanes when entering and exiting the expressway. Tolls are automatically collected as such vehicles are automatically recognized at the entry and exit gates.

Figure 6.24. An illustration showing how a vehicle equipped with a Hi-pass OBU uses tollgates under the closed system



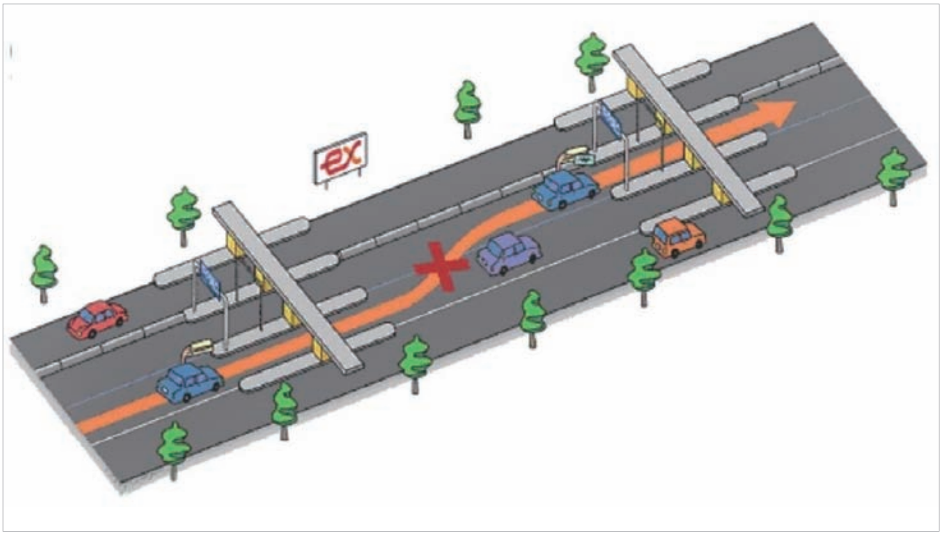
• Source: http://www.hi-passplus.co.kr/sub/info3.asp

Figure 6.25. An illustration showing how a vehicle equipped with a Hi-pass terminal(OBU) uses tollgates under the closed system



• Source:http://www.hi-passplus.co.kr/sub/info3.asp

Figure 6.26. An illustration showing how a vehicle equipped with a Hi-pass OBU uses tollgates under the closed system



• Source:http://www.hi-passplus.co.kr/sub/info3.asp

Drivers of vehicles entering the expressway using the Hi-pass lane and existing via a General traffic lane, as shown in Figure 6.25, are required to present their Hi-pass card to the toll booth attendant, who collects tolls after checking their entry points.

It is not allowed to enter the expressway via the general traffic lane and exit through the Hi-pass lane, as illustrated in Figure 6.26. This is because the exact travel distance and toll cannot be calculated due to the lack of vehicle recognition at the entry point. Therefore, even the vehicles equipped with Hi-pass OBU should exit the expressway through a general traffic lane when having entered using a general traffic lane.

Benefits of Using Hi-Pass

About half of the nation's total vehicles are estimated to be equipped with Hi-pass OBU. The Korea Expressway Corporation is providing toll discounts to such vehicles during commute hours in order to encourage the Hi-pass usage rate. The discount is applied to vehicles travelling in sections less than 20 km between entry and exit toll gates. The discount does not cover privately funded expressways. The Hi-pass toll discounts are given only during commute hours at rates of 20-50%. Korea Expressway Corporation is planning to further expand the discount service to cover non-commute hours as well. Whether a vehicle using the Hi-pass is eligible for discounts during particular trips is determined by the time it passes the exit tollgate. Electronic cards are given 20% automatic discounts plus a maximum 3% extra reduction of recharging fees. Advance commute tickets, which sell in 10,000-KRW units, were found to have the effect of gaining 20.6-23.1% discounts. Table 6.17 shows the discount application sections, eligible vehicles and the application hours.

Table 6.17. Hi-pass toll discount criteria

Application criteria	Travel distance of less than 20 km between entry and exit tollgates on expressways managed by KEC
Application sections	384 segments (discount application for advance commute tickets) - Open system: 13 tollgate offices - Closed system: 371 segments
Eligible vehicles	Type 1-3 vehicles (passenger cars, vans, 2-wheelbase trucks under 10 tons)
Application hours and discount rates	Morning commute : 05:00 - 07:00 — 50% Evening commute : 20:00 - 22:00 — 50% Morning commute : 07:00 - 09:00 — 20% Evening commute : 18:00 - 20:00 — 20%

Handling Hi-Pass Violations

Vehicles passing through Hi-pass toll gates are considered as toll violators in the following cases: when the Hi-pass card or the OBU fail to function while passing through the gate; when the prepaid card balance is not enough to pay for the toll; when the principal card of the post-payment Hi-pass card has been suspended; or, when the vehicle does not match OBU information of the registered vehicle. The image detector records the number plates of violating vehicles. And by using the information, a toll bill is sent to the address of the vehicles. Whether drivers have violated the Hi-pass regulations may be confirmed by consulting the Hi-pass call center or visiting the tollgate office. Frequent violators are subject to additional toll payment. While vehicles with Hi-pass OBU become subject to the additional payment if they violate the regulations 10 or more times a year, vehicles without Hi-pass OBU become subject to the additional payment when they violate the rule three or more times a year. Inquiries and payment of unpaid tolls can be made via the post-payment Hi-pass card homepage.

05

Expressway Rest Areas Based Transfer Centers (ERTC)

Concept of the Expressway rest areas based Transfer Centers (ERTC)

Figure 6.27 illustrates the status of express bus services in Korea. The larger the population, the higher the number of routes and the frequency of operation. Often, the express bus services are not available to the residents of small cities.

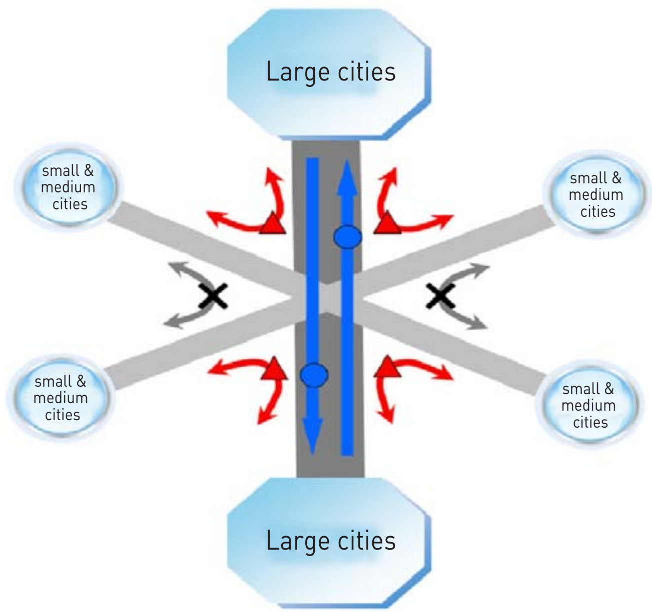
- Large city—large city: high level of service quality for express bus users
- Large city—small/medium city: average level of service quality for express bus users
- Small/medium city—small/medium city: low level of service quality for

express bus users

Rest areas on expressways are spaces established to help long-distance drivers take a rest. There are many differences between rest areas on Korean expressways and rest areas of other foreign countries. In foreign countries, beverage vending machines and restrooms are nearly all the facilities available at expressway rest areas. By comparison, the expressway rest areas in Korea are equipped with a diversity of amenities, including restaurants and various sales facilities. They are designed for not just rest but various other functions and activities.

ERTC refers to expressway service areas equipped with the facilities including platforms, ticket offices, transfer information, necessary for transfers between passenger cars and express buses, as well as between express buses. In 2009, the

Figure 6.27. Status of access to cities using intercity buses (express, intercity)



●	High level of convenience	▲	Medium level of convenience	✕	Poor level of convenience

Korea Transport Institute conducted relevant studies, developing a strategy for the construction and operation of ERTC. The establishment of such transfer centers is considered to have contributed significantly to improving the accessibility of express bus services for a number of small and medium cities.

Status of the Establishment and Operation of ERTC

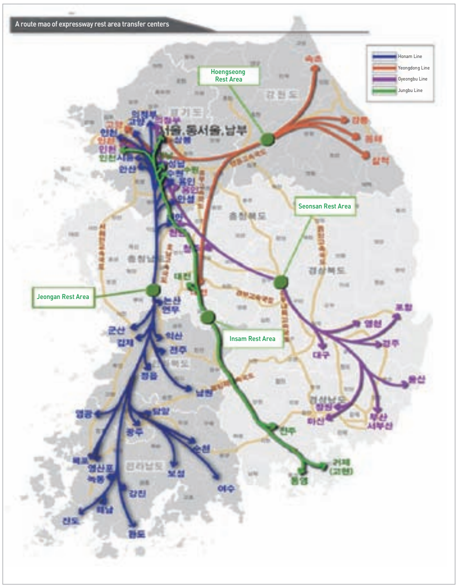
There are about 150 rest areas located along the expressways in Korea. Of them, eight have been upgraded to provide bus transfer services. They include the Seonsan Rest Area on the Gyeongbu Expressway, the Jeongan Rest Area on the Cheonan-Nonsan Expressway, the Hoengseong Rest Area on the Yeongdong Expressway and the Insam-Land Rest Area on the Daejeon-Tongyeong Expressway. The installation of transit centers at these rest areas have been implemented gradually in stages in order to prevent confusion among express bus users.

- 1st phase: Transfer facilities were established at the Jeongan (Cheonan-Nonsan Expressway) and Hoengseong (Yeongdong Expressway) rest areas on Nov. 2, 2009, implementing a pilot scheme to provide transfer services for some routes (Monday-Thursday).
- 2nd phase: Seonsan Rest Area was upgraded into an expressway transfer rest areas on March 2, 2010, providing transit services for all routes. At the same time, the existing Jeongang and Hoengseong transfer areas were allowed to offer transfer services for all routes.
- 3rd phase: These transfer centers on expressways were allowed to offer their transfer services during weekends as well as weekdays beginning on Oct. 8,

Table 6.18. Status of expressway rest area transfer centers

Phase	Started on	Rest areas	Service period	Routes
1st phase	2009.11.2	Jeongan (Cheonan-Nonsan Expressway) Hoengseong (Yeongdong Expressway)	Monday-Thursday (excluding weekends)	Some routes
2nd phase	2010.3.2	Jeongan (Cheonan-Nonsan Expressway) Hoengseong (Yeongdong Expressway) Seonsan (Gyeongbu Expressway)	Monday-Thursday (excluding weekends)	All routes
3rd phase	2010.10.8	Jeongan (Cheonan-Nonsan Expressway) Hoengseong (Yeongdong Expressway) Seonsan (Gyeongbu Expressway)	Monday-Sunday (including weekends)	All routes

Figure 6.28. Hi-pass lane markings



• Source: http://www.mltm.go.kr/USR/policyTarget/m_24066/dtl.jsp?idx=243

Figure 6.29. Status of ERTCs

• Source: http://blog.naver.com/lk17won?Redirect=Log&logNo=40123139315

2010. However, the traditional holidays of Chuseok and Seollal were excluded from the service days due to capacity shortages.

Effects of ERTC

To analyze the effects of the ERTC, a survey was conducted for users in February 2011. The major findings are as follows:

- Inducement of passenger car users to public transportation
  - Of those surveyed, 25.8% were found to have used passenger cars before the establishment of ERTCs. This result indicates that the ERTCs contributed to promoting the use of public transportation.

Table 6.19. Major modes of transport used before the opening of the rest area transfer centers

Category	Express bus	Intercity bus	Passenger car	Train	Airplane	Other modes	Total
Hoengseong	33	7	26	1	0	1	68
Seonsan	148	15	26	10	1	0	200
Jeongan	106	21	82	39	1	3	252
Total	287 (55.2%)	43 (8.3%)	134 (25.8%)	50 (9.6%)	2 (0.4%)	4 (0.8%)	520

- Reduction in travel time of bus users
  - The average travel time was found to have reduced by 42 minutes on average (255 minutes→213 minutes, 16.6%)
  - In particular, the travel time of users using Hoengseong rest area (Yeongdong Expressway) have reduced by 57 minutes (241 minutes→185 minutes, 23.5%).

Table 6.20. Changes in travel time (terminal → terminal)

Category	Average reduction in travel time	
	Time savings (minutes)	Reduction ratios (%)
Total	42(255 → 213)	16.6
Hoengseong rest area	56(241 → 185)	23.5
Seonsan rest area	33(279 → 246)	11.6
Jeongan rest area	45(243 → 198)	18.8

- Passengers' travel expense savings
  - The average fare was found to have reduced by 1,566 KRW (20,030 KRW→18,464 KRW, 7.8%).
  - In particular, the fare went down by 4,013 KRW for Hoengseong rest area (Yeongdong Expressway) users (20,206 KRW→16,193 KRW, 19.9%).

Table 6.21. Reduction in travel expenses (terminal → terminal)

Category	Reduction in average travel expenses	
	Reduced amount (KRW)	Reduction rate (%)
Total	1,566 (20,030 → 18,464)	7.8
Hoengseong Rest Area	4,013 (20,206 → 16,193)	19.9
Seonsan Rest Area	1,608 (21,857 → 20,249)	7.4
Jeongan Rest Area	1,181 (18,965 → 17,785)	6.2

- Increase in bus routes
  - A GIS-based comparison of bus routes found that the number of bus routes rose by 140.9% from 181 to 436 through the nation.

Table 6.22. Increase in the number of routes after the establishment of rest area transfer centers

Category	Number of routes before establishment of rest area transfer centers	Number of routes after establishment of rest area transfer centers	Growth rate (%)
Total	181	436	140.9
Honam corridor	54	264	388.9
Yeongdong corridor	14	20	42.9
Gyeongbu corridor	49	88	79.6
Other corridors	64	64	-

- User satisfaction level
  - About 90% of the surveyed users showed positive responses

Table 6.23. Survey results on user satisfaction on rest area transfer centers

Category		Improvements made after establishment of rest area transfer centers					
		Reduction in travel expenses	Reduction in travel time	Diversification in routes	Reduction in operation interval	Nothing in particular	Others
Total		127 (24.4%)	207 (39.8%)	82 (15.8%)	44 (8.5%)	38 (7.3%)	22 (4.2%)
Gender	Male	85 (25.7%)	130 (39.3%)	57 (17.2%)	28 (8.5%)	21 (6.3%)	10 (3.0%)
	Female	42 (22.2%)	77 (40.7%)	25 (13.2%)	16 (8.5%)	17 (9.0%)	12 (6.3%)

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10. Korea Expressway Corporation website: (http://www.ex.co.kr/portal/rod/toll/toll_system/discount/1191300_3429.jsp?clickParentNum=2&clickNum=13)

CHAPTER 7

Funding

Hee Kyung KIM

Associate Research Fellow

01

Changes in Road Funding Sources

Road Funding Under U.S. Army Military Government and During Post-War Rehabilitation Period

Road Projects Under U.S. Army Military Government

Road projects under the U.S. Army military government were implemented without fundamental and long-term plans, and the budget invested into them was limited in scale. However, by the mobilization of various modern equipments brought by the U.S. military, the road repair and maintenance projects achieved significant results. Beginning in 1947, the ECA (Economic Cooperation Administration) projects based on the Marshall Plan were carried out, leading to the first-ever structural construction works after Korea was liberated from the Japanese colonial rule. The U.S. military government upgraded the Civil Engineering Bureau from the Ministry of Commerce to the Ministry of Civil Engineering, structured with five bureaus—Road, Water Management, Urban Affairs, Land Survey, and General Affairs bureaus. Placed under the Road Bureau were the Planning and Construction divisions. For its first major road project aimed at repairing and paving the Seoul-Busan National Highway, the U.S. military government spent 103 million won and mobilized an aggregate number of 850,000 workers.

Foreign Aid After the Korean War

Implementing recovery projects after the Korean War required pertinent financial resources. The war destroyed 60% of the nation's roads and most of its railroad infrastructure. It was just several years after the nation gained independence from Japan's occupation. Korea, which could not afford to prepare investment funds itself, had no other choice but to rely on its allies. Through strenuous efforts to get foreign aid, Korea finally gained assistance from the U.S. ICA (International Cooperation Administration) in 1954. The aid, which amounted to US$236.7 million in 1955, US$326.7 million in 1956 and US$382.8 million in 1957, continued until 1962.

The road and bridge sector were treated as a separate sector under the aid plans of the ICA and the AID (Agency for International Development). Accordingly, Korea received US$15,076,623 worth of grants between 1954 and 1962, which thence secured funds for road and transport projects. With such foreign aids, Korea completed the project to rehabilitate the Han River pedestrian bridge in 1958. In 1957, it could begin works to pave the Seoul-Busan national road. The labor costs for these projects were covered by taxes collected by the central government or local administrative bodies. In 1963, the Exim Bank and the IBRD replaced the AID, taking over its role to provide loans to Korea.

The imbalance in demand for various transport sectors was revealed as the consequently significant hindrances in economic growth during the 1st Five-Year Economic and Social Development Plan period. To address this problem, the Transport Ministry asked the IBRD to conduct a relevant transport survey in Korea. The ministry entrusted the task to the IBRD by considering its international authority as well as the prospects for getting loans for future investment in transport infrastructure development projects.

Based on the results of this survey, the IBRD proposed that the Korean government drastically increase its road investments and reduce its spending on the rail sector in order to pursue economic growth efficiently. It also suggested upgrading of the Road Division to the Road Bureau. Moreover, it presented its view that introduction of toll roads would be inappropriate for some time to come unless it was needed as a means of obtaining loans. Beginning in 1972, the IBRD provided loans to Korea. The loans, which eventually amounted to US$764.5 million, were used to build 571 km of expressways, expanding 300 km of national roads, and paving 2,968 km of national roads, thereby significantly contributing to the economic development of Korea.

Changes in Annual Road Budget Based on Accounting Types

This part considers the scale of the road budget the government has set annually since 1980. To ensure the convenience of data compilation and its understanding, the budgets were broadly classified into those before and after the introduction of the Special Account for Transport Facilities. More specifically, they were categorized by accounting types.

Road Budget Status Before Introduction of the Special Account for Transport Facilities

1980~1988 Annual Budget Status (general account)

The size of the road budget was 124.8 billion KRW in 1980, when funds for road projects began to be appropriated through the general account. The road budget generally showed an upward trend from then on, with its size reaching 664.6 billion KRW in 1988. The major budget programs during this period were focused on building roads with loans from IBRD (4^{th}-5^{th}) and ADB (5^{th}), installing general road facilities, funding maintenance works for national roads, and constructing expressways.

Table 7.1. Annual budget status (1980-1988)

(Unit: 100 million KRW)

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Budget	1,248 (90)	1,965 (100)	2,637 (140)	3,416 (140)	2,712 (-)	4,572 (250)	4,238 (250)	5,733 (350)	6,646 (500)
Growth rate	-	57.5%	34.2%	29.5%	-20.6%	68.6%	-7.3%	35.3%	15.9%

- Note: ( ) represents government bonds
- Source: Ministry of Land, Infrastructyre and Transport, *White Paper on Roads*, 2011.

1989-1993 Annual Budget Status (special account for road projects)

In 1989, when the government began to secure funds for road projects through a special account, the road budget more than doubled from the previous year to 1,247 billion KRW. From then on, the road budget kept increasing in size, amounting to 2,732.4 billion KRW in 1993, when the operation of the special account for road projects was discontinued.

During this period, the special account accounted for most of the government's entire budget for road projects. Capital investments in Korea Expressway Corporation and loans to the corporation were funded through the special account for financial investment and loans. Every year, an average of 15 billion KRW was transferred from the general account to the road budget for road operation and administration.

Table 7.2. Annual budget status (1989-1993) (Unit: 100 million KRW)

Year	1989	1990	1991	1992	1993
Budget	12,470 (1,000)	12,967 (1,100)	19,623 (1,300)	21,720 (1,500)	27,324 (2,500)
Growth rate	-	4.0%	51.3%	10.7%	25.8%

• Note: ( ) represents government bonds
• Source: Ministry of Land, Infrastructyre and Transport, *White Paper on Roads*, 2011.

Road Budget Status After Introduction of the Special Account for Transport Facilities

1994-2002 Annual Budget Status (special account for transport facilities)

The Special Account for Transport Facilities was introduced in 1994 as a way to secure stable sources to finance road projects. Funded mainly by transport tax revenues, the special account was comprised of sub-accounts for such sectors as roads, railroads, aviation, and seaports. The account funds were allocated to these sub-accounts at specific ratios, being used for investment in transport facilities by mode.

Funding for road projects was made through the sub-account for the road sector. During this period, the investment budgets for road projects came from the special account's roadway sub-account, except for a small amount of revenues transferred from the general account. More than 50% of the funds were used for expanding and paving the national roads, including backbone arterial routes. The next largest portion was spent for expressway construction.

Table 7.3. Annual budget status (1994-2002)

(Unit: 100 million KRW)

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002
Budget	28,599 (2,500)	33,715 (2,500)	41,910 (2,500)	51,910 (2,500)	59,204 (2,500)	71,721 (2,500)	75,331 (3,000)	82,799 (3,000)	80,976 (3,000)
Growth rate	-	17.9%	24.3%	23.9%	14.1%	21.1%	5.0%	9.9%	-2.2%

• Note: ( ) represents government bonds
• Source: Ministry of Land, Infrastructyre and Transport, *White Paper on Roads*, 2011.

2003-2011 Annual Budget Status (special accounts for transport facilities, car traffic management, balanced national development, and metropolitan development)

Beginning in 2003, the funds for road projects came not only from the Special Account for Transport Facilities but other special accounts such as the Special Account for Automobile Traffic Management, the Special Account for Balanced National Development, and the Special Account for Metropolitan Development. Still, however, the road-sector sub-account of the Special Account for Transport Facilities accounted for a predominantly large portion of the funding for road projects. The Special Account for Balanced National Development was particularly designed to support the construction of roads on Jeju Island. It was replaced with the Special Account for Metropolitan Development in 2009. After rising up to 9,026 billion KRW in 2003, the road budget steadily decreased for the next several years. In 2009, it climbed again, reaching a record high of 9,406.9 billion KRW. It then fell again, hovering below the level of 8 trillion KRW. The budges were used to build and manage national roads and expressways, support the construction and management of privately financed roads, and provide support for local governments' road construction projects.

Table 7.4. Annual budget status (2003-2011)

(Unit: 100 million KRW)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Budget	90,260	80,647	76,614	73,363	73,554	79,259	94,069	77,817	72,638
Growth rate	-	-10.7%	-5.0%	-4.2%	0.3%	7.8%	18.7%	-17.3%	-6.7%

• Source: Ministry of Land, Infrastructyre and Transport, *White Paper on Roads*, 2011.

02
History of Special Accounts Pertaining to Road Projects

Special Account for Road Maintenance Projects (1968)

A mid-term evaluation of the first Five-Year Economic Development Plan (1962-1966) found that the nation was lacking in sufficient transport capacity needed to support the rapid pace of its economic growth, thus hindering the progress of its industrial development. Cargo traffic was predicted to grow more rapidly in accordance with expansion in industrial production and population increases, during the second Five-Year Economic Development period, which was set to start in 1967 under the goal of “modernizing the industrial structure and expediting the process for establishing a self-reliant economy.” In particular, it was expected that the nation’s dependence on cars for transport of passengers and freight would rise, given such conditions as the industrial distribution throughout the nation and the need for mobility for short-distance transportation. These predictions prompted the government to set the road development directions oriented toward upgrading the national network of roads and ensuring the maintenance of roads.

In an effort to ensure high economic growth, the government developed in 1968 a plan to drastically raise the road-sector investments from the original 30 billion KRW to 82.1 billion KRW. To secure the funds, the government enacted the Road Maintenance Expedition Act and the Special Account for Road Maintenance Projects Act. These laws were designed to funnel gasoline and toll tax revenues into road projects. The year 1968 was a major turning point in the history of the nation’s road policy and funding schemes.

Special Account for Road Projects (1988)

Korea carried out large-scale road projects by using IBRD loans, opening the Gyeongin Expressway in 1968 and the Gyeongbu Expressway. These achievements were followed by full-fledged road construction projects in the 1970s. The Honam, Yeongdong and Southern Coastal expressways were built or promoted during this period. The ratio of paved national roads rose from 23.7% in 1971 to 45.5% in 1976. Such progress led to a modal shift in passenger transport from rail to road transport. However, the 1980s saw a considerable reduction in the scale of investments in transport facilities, despite rapid growth in the nation's economic size following the successful implementation of economic development plans.

In the early and mid-1980s, the government did not implement active road projects. It just tried to increase the efficiency of the existing network of arterial roads while carrying out projects to pave and manage the national and local roads. After the 1988 Seoul Olympics, rapid increases in public income levels led to a rise in private car ownership, causing traffic congestion. The situation was getting worse by the day. The government, which had financed transport-related projects by using the general account budget, came to face the need to explore new funding sources. Out of this necessity, the government enacted a law for operating special accounts for road projects, which would be funded by special excise taxes imposed on gasoline and alternative oil products.

Special Account for Transport Facilities (1994)

Since 1994, projects to build roads and traffic facilities have been financed mostly by the Special Account for Transport Facilities. The revenue of this account is based the receipts of the Transportation Tax, an earmarked tax imposed on oil products such as gasoline and diesel.

The number of cars increased rapidly in the 1980s, a period when the investments in traffic facilities remained at relatively low levels. This resulted in very serious traffic conditions in the 1990s. Over a 10-year period from the early 1980s to the early 1990s, Korea recorded an almost two-fold expansion in its economic size and five-fold growth in the number of cars. However, the traffic facilities expanded by less than 20%. Consequently, traffic volumes surpassed the capacity of most transport facilities. Traffic difficulties throughout the nation posed a serious obstacle to industrial development, causing increases in social and economic costs. There was growing concern that the traffic problem would become the most serious barrier to economic growth in the 1990s, unless drastic measures were taken to turn around the situation.

Cognizant of the seriousness of the situation, the government enacted the Transport Tax Act in 1993 in an effort to ensure stable supply of transport facilities, and the Act on Special Account for Transport Facilities in 1994 for the purpose of establishing an efficient investment system and ensuring a smooth expansion of traffic facilities. The special account law was originally titled the “Act on Special Account for Roads and Other Transport Facilities.” It was revised in 1995 to a new title, “Act on Special Account for Transport Facilities.” The special account was created by unifying the Special Account for Road Projects and the Special Account for Urban Rail Projects, and absorbing the general account items for supporting the high-speed railway, airport and seaport projects. With Transport Tax revenues as its major funding sources, the special account was originally slated for temporary operation between 1994 and 2003. However, its operation was extended three times in 2004, 2006 and 2009, for three years each time, in order to ensure a stable supply of financial resources for road projects.

The special account initially had the following sub-accounts: road, urban rail, high-speed rail and airport, and port. In 1996, they were reclassified into road, rail, airport, and port sub-accounts. In 1998, the sub-account for metropolitan transport facilities was added to the existing sub-accounts. In 2005, the urban rail sub-account was separated from the rail sub-account, later being changed in its title to the public transport sub-account. Lately, it has been changed once again to the transport system management sub-account.

The special account budget is comprised of tax revenues from the Transport/Energy/Environment Tax, the Special Excise Tax on Automobiles, and customs duties on imported foreign cars, as well as other revenues such as facility usage fees and transfer revenues from the general account. The largest source of revenue is the Transport/Energy/Environment Tax; 80% of the receipts of this tax are set to be transferred to the special account. This tax once accounted for as much at 70% of the special account budget. The ratio has been declining a bit lately.

The Transport/Energy/Environment Tax is a special excise tax on gasoline and diesel. The tax is levied based on the basic rate and the flexible rate. As for gasoline, the basic rate has been 475 KRW since 2008, with the flexible rate changing between 30% to +30%. In 2009, for example, the tax was set at 529 KRW per liter, based on the base rate of 475 KRW plus the amount calculated through the application of the flexible rate of 11.37%.

Table 7.5. Status of Transport/Energy/Environment Tax rates

Targets	Basic rate		Flexible rate	Execution rate					
	2003	2008		2003.7	2005.7	2006.7	2007.7	2008.3	2009.5
Gasoline (A)	630	475	±30%	572	535	526	505	525	529
Diesel(B)	404	340	±30%	261	323	351	358	372	375
Ratio (B/A)	64.1	71.6	-	45.6	60.3	66.7	70.9	70.9	70.9

• Note: Taxes on oil products were reduced temporarily between March and December 2008 (gasoline: 472 KRW/l, diesel: 335 KRW/l)

As for the Transport Tax, 85.8% of its receipts were transferred to the special account until 2006. Later, the tax was converted to the Transport/Energy/Environment Tax. Its revenues are allocated to four special accounts: 80% to the Special Account for Transport Facilities, 15% to the Special Account for Environmental Improvement, 3% to the Special Account for Energy, and 2% to the Special Account for Balanced Development.

Table 7.6. Transport/Energy/Environment Tax receipts transferred to special accounts

(Unit: 100 million KRW)

Classification		Allotment ratios (changed at end of 2006)		Revenue transfer to special accounts				
		Before change	After change	2006	2007	2008	2009	2010
Transport Tax total revenues				117,219	113,240	120,355	122,368	116,950
Special Account for Transport Facilities	Account size	85.8%	80%	125,953	129,027	139,424	170,800	146,999
Special Account for Environmental Improve-ment	Account size	-	15%	26,326	28,967	31,309	41,172	39,651
Special Account for Energy	Account size	-	3%	30,072	38,944	56,178	38,018	45,075
Special Account for Balanced Development	Account size	-	2%	59,067	67,929	78,377	90,769	98,615

• Source: Ministry of Land, Infrastructure and Transport internal data

The Transport/Energy/Environment Tax revenues transferred to the Special Account for Transport Facilities are allocated according to relevant provisions, which allow the fluctuation of ratios within specific ranges as a way to ensure flexible use of the revenues according to fiscal needs. Table 7.7 shows trends in the change of allotment ratios. Initially, the road sector was given 65.5% of the revenues. From 2004 onwards, however, the road sector's share slid to the range of 46%-52%, while the rail sector's portion kept increasing steadily.

Table 7.7. Trends in Transport Tax revenue allocation ratios in the Special Account for Transport Facilities

Classification	Roadways	Railways	Sub-account for transport system management (public transport, urban railways)	Airports	Ports	Metropolitan areas
Allotment ratio (%) before the June 2004 amendment	65.5	18.2	-	4.3	10 (reserved)	2
Allotment ratio (%) after the June 2004 amendment	51~59	14~20	6~10	6 or below	10~14	2~6
Allotment ratio (%) after the July 2010 amendment	46~52	33~37	*	7 or below	10~16	Belonged to the Special Account for Regional and local Development

• Note: * Less than 25% of the total sum of revenues alloted to the road, rail, airport and seaport sectors.

The transport facilities account budget reached in 2003 a peak of 14 trillion KRW, 8 trillion KRW of which was allocated to the roadway sub-account. The revenue continued to dwindle for the next several years until 2009, when it amounted to a record high of 17 trillion KRW. The revenue allocated to the road sector also soared to a record high of 9 trillion KRW in that year. In 2010, the account's revenue dropped again to the level of previous years. The roadway sub-account's share in the special account, which had been around 60%, fell to the current level of 52% in 2005. As of 2010, the Transport Tax accounted for 64.1% of the revenues that went to the roadway sub-account.

Special Account for Automobile Traffic Management

A special budget for traffic accident prevention projects, this account is financed by fines and penalties collected through traffic enforcement activities of the police. It was slated to be closed after operation from 2003 through 2006.

Special Account for Balanced National Development

The purpose of this account is to promote balanced regional development and reduce the gap in financial conditions among the local governments. It provides support to about 200 local-account projects and various regional-account projects promoted on a metropolitan or provincial basis. In 2009, the account's revenues reached 8.6 trillion KRW. Of the revenues, 6.2 trillion KRW went to the regional development sub-account, 2 trillion KRW to the regional innovation sub-account, and 0.4 trillion KRW to the sub-account for Jeju Special Self-Governing Province.

Special Account for Regional and Local Development

In accordance with the rationale of amendment to the Special Act on Balanced National Development, the Special Account for Balanced National Development was converted to the Special Account for Regional and Local Development. This special account places particular emphasis on enhancing regional competitiveness by achieving balance between region-specific development and strategic allocation of state resources. The local-account projects implemented under the balanced national development account were consolidated into 22 block grant programs. As for the regional-account projects, the focus shifted to collaboration between the metropolitan cities and provinces.

This special account is comprised of three sub-accounts: local development sub-account, regional development sub-account, and Jeju Special Self-Governing Province sub-account. The 2010 budget amounted to 9.9 trillion KRW, which broke down to 3.7 trillion KRW for the local development sub-account, 5.8 trillion KRW for the regional development sub-account, and 0.4 trillion KRW the sub-account for Jeju Special Self-Governing Province. When devising spending plans for this account, the central government considers various factors such as the financial conditions and implementation schemes of each local government. As a result, the funds provided to local governments may vary in terms of the amount and ratios.

03
Trends in Investments by Road Types and Funding Sources

Trends in State Investments in Various Types of Roads

During the past five years, the state invested an annual average of 8,013.5 billion KRW into the road sector. The national roads had the largest share, 51.2% or 4,105.3 billion KRW. It was followed in second place by the expressways, which accounted for 15.3% or 1,223.7 billion KRW. Investments in the expressway and national roads showed slightly upward trends during this period. In contrast, spending on other activities such as road management and the construction of metro roads and industrial estate access roads decreased substantially. Spending on state-funded local roads also declined a bit. Overall, the total road-sector budget was also

Table 7.8. Trends in state investments in various types of roads over the last five years

(Unit: 100 million KRW)

Category	2008	2009	2010	2011	2012	For 5 years (1908-2012)	
						Average annual investment	Average annual growth rate
National expressways	9,293	14,544	11,405	11,474	14,469	12,237	11.7%
National roads	36,642	48,368	42,712	39,575	37,970	41,053	0.9%
State-funded local roads	7,236	5,865	6,285	6,270	6,072	6,345	-4.3%
Others[1]	26,088	25,292	17,415	15,319	18,385	20,500	-8.4%
Total	79,259	94,069	77,817	72,638	76,896	80,135	-0.8%

• Note: 1) Others represent the sum of spending on such activities as road management, local government projects to build inter-regional arterial roads and industrial estate access roads, the construction and management of private financed roads, support for the Special Account for Transport Facilities, repayment of road loans, and logistics.
• Source: Ministry of Land, Infrastructure and Transport, *Road Services Manual*, 2012.

decreasing. In particular, the 2011 budget dropped measurably from the level in all the categories except for the state-funded local roads. Spending on expressways and other activities rose slightly the next year, but investments in national roads kept declining.

Road Investments by Funding Sources

Korea's total annual budget invested in road projects reached a high of 22,898.9 billion KRW in 2009. It declined thereafter, dropping to 16.620.4 billion KRW in 2011. The Special Account for Transport Facilities was the largest funding sources, with its revenues making up 40% of the budget. It was followed by local expenditure, which accounted for slightly less than 30% of the budget.

In 2004, about 29% of the local governments' budget for road projects (local allocation tax + road-sector investments out of local expenditure) was covered by state support (grants). The grants system was abolished in 2005, being replaced with the road-sector investments of the local allocation tax. These road-sector investments kept decreasing to the extent that they accounted for just 10% of the investments into the local road projects in 2010. Such a deterioration in the local governments' financial conditions is making it increasingly difficult for the local governments to pursue their own road projects aimed at reducing traffic congestion.

Table 7.9. Investments in road projects by funding sources (Unit: 100 million KRW)

Category	2004	2005	2006	2007	2008	2009	2010	2011
Total	170,598	169,896	157,895	178,085	194,093	228,989	192,452	166,204
Transport Facilities Special Account	82,143	69,164	64,818	68,121	73,354	92,868	76,477	63,188
Regional and Local Development Special Account	-	6,754	10,423	14,108	18,709	17,413	25,211	26,105
Local Allocation Tax (Grants)	17,342	9,941	9,562	5,557	9,668	7,345	6,124	3,783
Local expenditure	42,574	47,880	42,196	49,238	57,656	68,811	53,648	44,300
KEC funds	14,732	22,119	23,978	19,957	18,795	22,312	23,776	21,565
Private investment, charges, etc.	13,807	14,038	6,918	21,104	15,911	20,240	7,215	7,263

- Note: Special Account for Balanced National Development (2005) → changed to Special Account for Regional and Local Development (2009), Block grants system → abolished in January 2004, Incorporated into the Local Allocation Tax in 2005
- Source: Ministry of Land, Infrastructure and Transport, *Road Services Manual*, 2012.

04
Road Project Funding Scheme

State-involved urban road projects are divided into the following categories: projects to upgrade congested roads in metropolitan areas, metro road projects, projects to build bypass roads to national roads, and metropolitan circular road projects. The definitions and implementation schemes of these projects are as follows:

The congested road upgrade program covers the roads selected for improvement according to the metropolitan road congestion mitigation plan based on the Road Act. Currently, the program is in its second phase (2011-2015). The state provides the entire designing costs, while pertinent local governments are responsible of the land costs. The construction cost is funded evenly by the state and local governments.

Metro roads refer to those that run through two or more administrative regions such as special city, metropolitan cities and provinces. The targets are selected according to the metropolitan transport basic plan and the metropolitan

Table 7.10. State involvement in urban road projects

Project type	Definition	Funding scheme
Congested roads in urban areas	Local government-managed trunk roads in metropolitan areas that need to be upgraded to improve traffic congestion and the flow of logistics	• State - Design cost - 50% of construction cost • Local government - Land cost - 50% of construction cost
Metro roads	Roads passing through two or more administrative regions such as the special city, metropolitan cities and the provinces, and meet conditions prescribed by Presidential Decree	• State: 50% • Local government: 50%
Alternative bypass roads to national roads	Roads constructed in bypass sections to replace existing national roads that run through special self-governing provinces or cities	• State - Design cost, construction cost • Local government - Land cost
Metropolitan circular roads	A network of roads that run along the outskirts of metropolitan cities like Seoul Busan, Ulsan, Daejeon and Gwangju (including the Basic Road Upgrade Plan)	State finance or private finance

• Source: Korea Research Institute for Human Settlements, *Road Policy Directions to Cope with Changes in National Land Spaces*, May 2012.

transport implementation plan based on the Special Act on Metropolitan Transport Management. These projects are funded evenly by the state and local government.

Bypass roads to national roads are alternative roads constructed to replace the national roads that run through special self-governing provinces or cities. The state provides design and construction costs, while local governments are in charge of the land costs.

CHAPTER 8

Private Capital Road

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01
Overview of Public-Private Partnership

Purpose of Public-Private Partnership

"Private capital roads" refers to roads built in a public-private partnership (PPP) scheme, which represents a way of implementing social infrastructure projects. PPP projects are conducted by private project companies based on private-sector proposals or the state's master plan for infrastructure facilities. Social infrastructure means fundamental facilities that serve as the basis for various production activities, increase the utility of such facilities, promote user convenience, and increase the benefits of the public. Social infrastructure includes road facilities like expressways. A way of providing public-sector services to the citizens, the PPP scheme allows private-sector contractors to be in charge of project design, construction execution and funding. It has the following objectives:

- Provide user-oriented high-quality services by overcoming state budget restrictions;
- Increase public service provision efficiency: measure the project effects

through expensing of various risks as well as losses and profits;

- Responsible execution and management: specifying risk-sharing duties and determining a single party responsible for maintenance and management
- Create demand through early implementation of projects that have been delayed because of their low priorities in terms of economic stimulation.

History of Public-Private Partnership

Before 1994 (Embryonic stage)

The concept for PPP projects for infrastructure facilities, including expressways, began to emerge only after the enactment of a pertinent law in 1994. In this context, the pre-1994 period can be called an embryonic stage. There was no comprehensive law regulating private investment projects, forcing the operators of privately funded construction projects to rely on provisions of various different laws. The nation's first major infrastructure facility built using private-sector investment, Namsan Tunnel No. 1, opened in 1970. The project, which cost 1.6 billion KRW, was financed by Korea Trust Bank. The bank established Hansin Real Estate Company for the operation of the tunnel. However, the company became bankrupt in 1978 due to its incorrect revenue predictions and lack of relevant expertise, eventually handing the Namsan Tunnel over to Seoul City along with Bugak Tunnel. In the same year, two privately financed Han River bridges opened. Dongah Construction Co. and Daewoo Development Co. constructed Wonhyo and Dongjak bridges, respectively, but failed to operate them in a profitable manner. In 1991, the government enacted the Act on Special Cases Concerning Promotion of Private Investments. However, the law did not achieve its desired effect amid controversy over the possibility of private corporations being given unjust preferences in connection with infrastructure projects.

1994-1998 (Introduction stage)

The Act on Attracting Private Capital for Social Overhead Capital Facilities and its enforcement decree were amended in August 1994, paving the way for introducing the PPP system into the nation. However, it did not lead to concrete results because of various problems such as the absence of feasibility studies, promotion of excessively large projects, and the financial crisis.

1999-2000 (Preparatory stage for growth)

The act was wholly amended and renamed to the Act on Promotion of Private Investment in Social Overhead Capital on Dec. 31, 1998. It marked the beginning of the 1999-2000 preparatory stage for promoting private participation in infrastructure projects. During this period, project risk sharing mechanisms like the minimum revenue guarantee scheme were prepared. However, neither the public nor the private sector was ready to actively move to launch partnership projects in the aftermath of the financial crisis.

2001-2002 (Initial growth stage)

The private participation system began to be facilitated significantly in 2001, not just for state-solicited projects but for unsolicited projects proposed by the private sector. The period saw the creation of an atmosphere favorable for the participation in infrastructure projects by financial investors, including foreigners.

Since 2003 (Accelerated growth stage)

Financial investors began to play leading roles in implementing infrastructure projects. In January 2005, the Act on Promotion of Private Investment in Social Overhead Capital was amended and renamed to the Act on Public-Private Partnerships in Infrastructure. Project developers began to appear, along with dedicated funds for private investment in infrastructure. Additionally, the refinancing scheme began to be implemented.

Structure of the Act on Public-Private Partnerships in Infrastructure

In 1994, the government enacted the “Act on Attracting Private Capital for Social Overhead Capital Facilities” to ensure efficient expansion and operation of social overhead capital by facilitating the participation of the private sector and foreign investors. In 2005, the law was renamed to the “Act on Public-Private Partnerships in Infrastructure.” Amended for the 54th time in June 2009, the law has provisions pertaining to public-private partnership projects, such as implementation methods, the Public-Private Partnership Review Committee, formulation and public notification of relevant master plans, and the Public & Private Infrastructure Investment Management Center.

The law’s enforcement decree contains provisions that stipulate such matters as the process of implementing unsolicited projects proposed by the public sector, review and evaluation of project plans, the scope of public notification subject to deliberation by the review committee, and the calculation of total project costs.

Besides, various guidelines and plans were developed in order to ensure smooth and rigorous implementation of projects. The most important are the master plan for PPPs in infrastructure (annually) that should be formulated by the Ministry of Strategy and Finance, and the master plan for PPP facilities projects/the notification for third-party proposal that should be drawn up by the competent authority. The ministry-formulated master plan is designed to serve as a general guide. It provides guidelines on Build-Transfer-Lease (BTL) project implementation, risk allocation, project management and operation, and PPP project subsidies. The master plan drawn up by competent authorities are guidelines for individual facilities. It includes stipulations on project overview such as investment size, location and scope. It also offers information on qualifications of the project company, the scope of financial support and other assistance from the competent authority, and matters related to the preparation and submission of a project plan.

The Public-Private Partnership Review Committee has been established to conduct deliberations on major policies pertaining to private investments in infrastructure facilities. The government should develop and publish master plan for PPPs in infrastructure, including PPP infrastructure policies related to various sectors. The competent authority should designate a planned infrastructure project as a potential PPP project when it is necessary to induce private capital for the project. Within a year after the designation, the competent authority ought to develop and announce a master plan for PPP facilities project pursuant to the state master plan for PPPs in infrastructure.

The concessionaire-designate is required to devise a project implementation plan and gain the approval from the competent authority. Once the implementation plan is publicly notified, the concessionaire is considered to have obtained permission and authorization required by other laws. If deemed necessary, the concessionaire may expropriate or use land, objects or relevant rights. Completion of a project must be confirmed by the competent authority. The concessionaire or pertinent financial institutions may issue infrastructure bonds necessary for funding a project.

For comprehensive implementation of support activities for PPP projects, the Public & Private Infrastructure Investment Management Center has been set up at the Korea Development Institute. An infrastructure credit guarantee fund may be established to facilitate the financing of PPP projects. Additionally, an infrastructure-based investment and loan company may be established for the purpose of investing its assets in an infrastructure project and distributing the profits to shareholders. The act also has stipulations on the competent authority's right to supervise the concessionaire, reduction and exemption of taxes and other related charges, the grant of the buyout right to a concessionaire of a revertible facility, and penalties.[1]

Implementation Methods of Public-Private Partnership Projects

Private investment projects as defined by the "Act on Public-Private Partnerships in Infrastructure" refer to any infrastructure project conducted by the private sector in accordance with a method as prescribed by the pertinent laws. The part that is constructed in excess (referring to construction implemented in excess of the project expenditure of the relevant year but within the scope that has been agreed upon between the state and a party to the contract) among the government-placed projects funded by continuing expenditures should be deemed a PPP project. PPP projects should be conducted in one of the following methods:[2]

1) Naver Knowledge Encyclopedia: Act on Public-Private Partnerships in Infrastructure (Doosan Encyclopedia)

2) Easy-to-understand urban planning terms, January 2012, Urban Planning Bureau of the Seoul Metropolitan Government

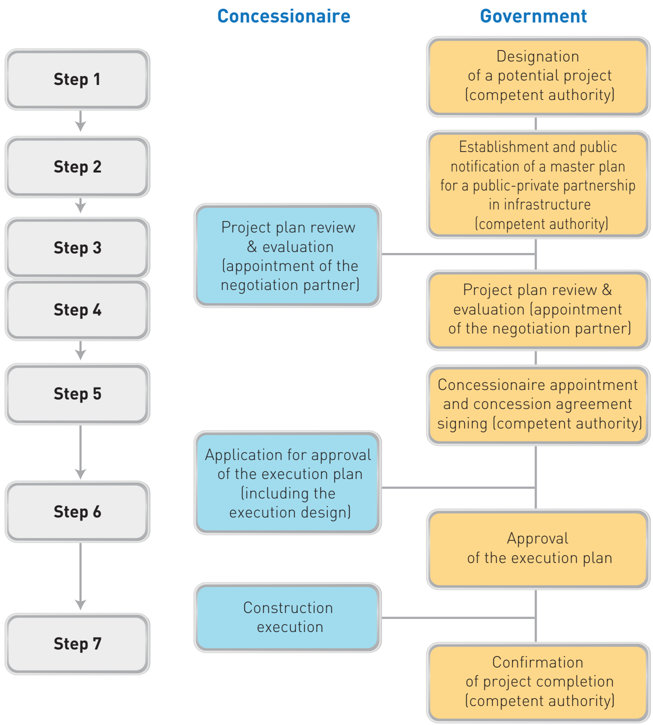
- BTO (Build-Transfer-Operate) method: The ownership of infrastructure facilities is transferred to the state or a local government upon completion of construction. The concessionaire has the right to manage and operate the facilities for a specified period.
- BTL (Build-Transfer-Lease) method: The ownership of infrastructure facilities is transferred to the state or a local government upon completion of construction. The concessionaire has the right to manage and operate the facilities for a specified period, but the state or a local government rents them for a specified period as provided for in the agreement, and use them and make profits.
- BOT (Build-Own-Transfer) method: The concessionaire assumes the ownership of infrastructure facilities for a specified period after completion of construction. The ownership is transferred to the state or a local government upon the termination of the concession period.
- BOO (Build-Own-Operate) method: The concessionaire assumes the ownership of infrastructure facilities upon completion of construction.
- Other than the above-mentioned four methods, a method presented by the

Table 8.1. Comparison of characteristics of PPP projects by implementation method

Category	State-solicited projects	Unsolicited projects
Definition	• The competent authority explores a potential public-private partnership project, and selects the concessionaire	• The private sector explores a potential PPP project, and requests the competent authority to select the concessionaire
Selection Criteria	• The infrastructure should meet facility stipulations as prescribed in Article 2-1 of the Act on Public-Private Partnerships in Infrastructure • The project should be in accord with mid- to long-term infrastructure plans and national investment priorities • The project should meet the beneficiary pays principle, the profitability principle, and the benefit principle	• The private sector may choose an infrastructure project from among those not included in the solicited projects list, and propose its implementation in a PPP scheme • The competent authority may implement the proposed project after confirming its economic feasibility and determining whether a PPP scheme would be more economically feasible than a state-funded scheme
Advance measures by the competent authority	• Feasibility analysis that includes a feasibility study (VFM*) based on comparison of PSC* and PFI* • Make a final decision on implementing the project in a PPP scheme, and establish a master plan • Public notification of the master plan for PPP facilities projects (bidding notice)	• Refer the project proposal to the Public & Private Infrastructure Investment Management Center for VFM analysis • Determine whether to promote the project in a PPP scheme based on consideration of review comments • Notice on third party proposal (tantamount to the master plan for PPP facilities projects)

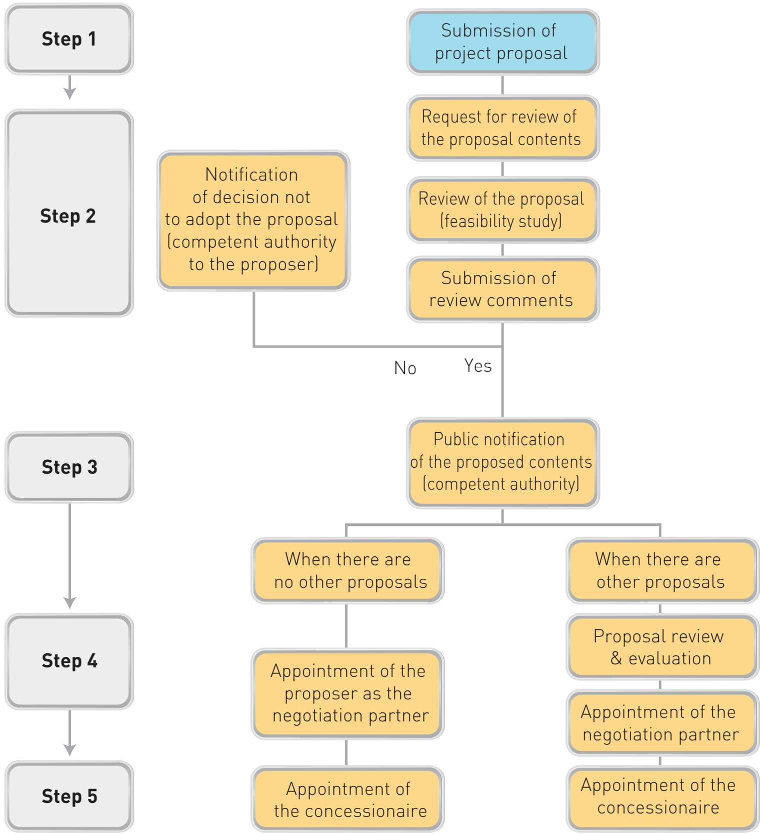
• Note: PSC - Public Sector Comparator, PFI - Private Finance Initiative, VFM - Value For Money

Figure 8.1. Implementation procedures for state-solicited projects



- Projects worth less than 200 billion KRW can be designated by the competent authority on its own
- Projects worth 200 billion KRW or more should be designated after deliberation by the Public-Private Partnerships Review Committee (100 billion KRW or more in the case of BTL projects)
- Clear statement on the concessionaire designation method and matters pertaining to state support
- Advance counseling at the Public & Private Infrastructure Investment Management Center (Projects worth at least 200 billion or state-supported projects worth less than 200 billion KRW should undergo deliberation by the Review Committee)
- Public notification of important matters in an English-language summary
- Formation and operation of a project plan evaluation team
- Possible to conduct PQ and 2-stage screening
- Appointment of at least two persons as negotiation partners
- Determining project execution conditions such as total costs, the facility usage period and user fees.
- Advance counseling service by the Public & Private Infrastructure Investment Management Center on concession agreement (draft) (Projects worth 500 billion KRW or more should be subject to screening by the Review Committee)
- Notification of the screening results within 3 months

Figure 8.2. Implementation procedures for private sector-proposed projects



- Private sector ⇨ Competent authority
- Competent authority ⇨ Public & Private Infrastructure Investment Management Center (15 days within application acceptance)
- Public & Private Infrastructure Investment Management Center
- Within 60 days (except for feasibility studies)
- Support center ⇨ Competent authority, Ministry of Strategy and Finance
- Competent authority ⇨ Ministry of Strategy and Finance
- Advance screening by the Public-Private Partnerships Review Committee is necessary for projects worth 200 billion KRW or more and local government projects that require state assistance of at least 30 billion KRW (except for the cases in which the financial assistance is covered by local government budget)
- Procedures after the appointment of concessionaires are the same as those for the state-solicited projects.

private sector in proposing a PPP project or in proposing a modification of the proposed project, and adopted by the competent authority as it deems reasonable.

- Other methods suggested in the master plan for PPP facilities projects established by the competent authority.

PPP projects can be divided broadly into state-solicited projects and projects proposed by the private sector. BTO projects can be implemented as either state-solicited or unsolicited projects, depending on who has made the proposal. However, BTL cannot be promoted as unsolicited projects under the current system. Matters pertaining to the implementation methods, such as the definition, selection criteria and implementation procedures, are outlined in the following table and figures.

02
Status of Privately Financed Roads

Currently in Korea, 24 privately financed roads are in operation, under construction, or in planning. The nation's first roadway built in a PPP scheme, the Incheon Airport Expressway, opened in 2000. Since then, nine more routes have been completed. They include the Cheonan-Nonsan and Daegu-Busan expressways and the circular beltway in Seoul. These completed roads, the construction of which cost a total of 18,175.1 billion KRW, cover a total length of 464.4 km. Under construction are seven routes, including the Suwon-Gwangmyeong and Gwangju-Wonju roadways. Covering a combined total length of 2,294.5 km, these routes are slated to open between 2016 and 2017. The total construction costs are expected to reach 10,999.4 billion KRW. Seven other road projects are at execution planning, negotiation, or research stages. Execution plans are being developed for two routes, including the Seoul-Munsan roadway. Their total length will be 47.7 km. Negotiations are underway for the Gwangmyeong-Seoul route and another roadway, the combined

Table 8.2. Status of road projects in private finance schemes

Category	Length (km)	Investment costs (100 million won)	Construction period	Implementation stage
Total (24 projects)	928.8	366,846	-	-
In operation (10 projects)	464.4	181,751	-	-
Incheon Airport	40.2 (6-8)	17,440	1995-2000	Operation (2000-2030)
Cheonan-Nonsan	81.0 (4)	17,297	1997-2002	Operation (2002-2032)
Daegu-Busan	82.0 (4)	27,477	2001-2006	Operation (2006-2036)
Seoul outskirts	36.3 (8)	22,792	2001-2008	Operation (2008-2038)
Busan-Ulsan	47.2 (4-6)	14,777	2001-2008	Operation (2008-2038)
Seoul-Chuncheon	61.4 (4-6)	21,833	2004-2009	Operation (2009-2039)
Yongin-Seoul	22.9 (4-6)	15,256	2005-2009	Operation (2009-2039)
Incheon Bridge	12.3 (6)	15,201	2005-2009	Operation (2009-2039)
Seosuwon-Pyeongtaek	38.5 (4-6)	16,415	2005-2009	Operation (2009-2039)
Pyeongtaek-Siheung	42.6 (4-6)	13,263	2008-2013	Operation (2013-2043)
Under construction (7 projects)	294.5	109,994	-	-
Suwon-Gwangmyeong	27.4 (4-6)	17,903	2011-2016	Under construction (2011.04.29)
Gwangju-Wonju	57.0 (4)	15,397	2011-2016	Under construction (2011.11.11)
Incheon-Gimpo	28.5 (4-6)	14,775	2012-2017	Under construction (2012.03.23)
Anyang-Seongnam	21.9 (4-6)	9,853	2012-2017	Under construction (2012.05.31)
Sangju-Yeongcheon	93.9 (4)	20,776	2012-2017	Under construction (2012.06.28)
Guri-Pocheon	50.5 (4-6)	25,915	2012-2017	Under construction (2012.06.30)
2nd New Busan Port road	15.3 (4)	5,020	2012-2017	Under construction (2012.07.13)
In execution planning (2 projects)	47.7	26,246	-	-
Seoul-Munsan	35.6 (4-6)	22,941	60 months	Agreement signed (2011.08.29)
Oksan-Ochang	12.1 (4)	3,305	48 months	Agreement signed (2012.01.11)
In negotiation (2 projects)	48.9	26,891	-	-
Gwangmyeong-Seoul	20.0 (4-6)	16,132	60 months	Negotiation completed(2010.11)
Pocheon-Hwado	28.9 (4)	10,759	60 months	Under negotiation
Under research	73.3	21,964	-	-
Bongdam-Songsan	18.5	6,954	48 months	3rd party proposal process underway (2012.07.12)
Icheon-Osan	29.7	7,507	60 months	3rd party proposal process underway (2012.07.12)
Gongju-Cheongwon	25.1	7,503	60 months	Feasibility study completed

• Source: Ministry of Land, Infrastructure and Transport homepage (http://www.molit.go.kr)/Policy Center- Status of expressways built in public-private partnership schemes length of which will be 48.9 km. Additionally, research is underway to build 73.3 km of roads on three routes, including the Bongdam-Songsan line.

03

Privately Financed Roads and Minimum Revenue Guarantee (MRG)

Overview

The minimum revenue guarantee (MRG) scheme refers to a system of guaranteeing the private project company a minimum revenue as promised in advance, should the revenue of a facility built with private capital fall short of the predicted level. This scheme is applied to infrastructure projects executed in the BTO mode, under which the concessionaire is granted the right to operate facilities like roadways and railways for a specified period after constructing them.[3] Under the MRG system, the government or the competent authority is required to make up for the shortfall when the operating revenue does not reach the level specified in concession agreement. This scheme was introduced to overcome the difficulties attracting private capital into infrastructure projects in the aftermath of the 1997 financial crisis. This system, under which the state (or the competent authority) should share project risks, was formally stipulated in the Act on Promotion of Private Capital into Social Overhead Capital Investment when it was amended in 1998.

Every year, the state or a pertinent local government should make up for the revenue shortfall as promised in the concession agreement. In return for providing the guarantee, they have the right to take excess profits. To minimize the size of MRG subsidies, it is essential to exert efforts to increase traffic on the pertinent roads, maximize the effects of private capital inducement through timely

3) Naver Knowledge Encyclopedia: minimum revenue guarantee, Dictionary of common sense on current issues, 2013.

opening of the roads, raise the operating efficiency of the roads through feasibility evaluation, expand the network of connecting roads, and facilitate the operation of complementary businesses.

Appraisal of the MRG System

Like any system or policy, the MRG scheme has both positive and negative aspects. However, the nation has seen the phenomenon of highlighting just the negative aspects while disregarding the positive aspects, amid social controversy over the waste of taxpayers' money in relation to MRG. The most important contribution of MRG is that it served as a catalyst in promoting private infrastructure investment projects at a time when it seemed almost impossible to do so in the aftermath of the financial crisis. The MRG system also helped increase the private sector's infrastructure investments by reducing project risks, eventually making it possible to develop a number of new public-private partnership projects. Analysis of its negative effects shows that its biggest problem was its contribution to causing moral hazard on the part of project companies. Besides, it was responsible for the emergence of a tendency to promote infrastructure projects recklessly while neglecting to examine their feasibility and to pay due attention to the importance and impacts of demand predictions. In addition, the government's financial burden increased due to MRG, causing negative views about private infrastructure investment projects.

Improvement of the MRG System

The MRG system was originally introduced to facilitate private investments in infrastructure that had plunged sharply in the aftermath of the financial crisis. It contributed to inducing private investment in infrastructure and ensuring timely construction of SOC facilities. However, amid continued controversy over excessive financial burdens it caused to the government, the system was abolished on two occasions: in 2006 for the unsolicited projects in 2006, and in October 2009 for state-solicited projects. This means that no new project will be granted

MRG benefits. Besides, the existing MRG terms are being eased. Consequently, the government's MRG subsidy payment is sure to decrease.

The Seoul-Chuncheon Expressway is a conspicuous example of a PPP project whose MRG terms have been revised. The guarantee rate for the project has been lowered to 80% for the first five years of operation, 70% for the next five years, and 60% for five more years until the 15th year. Predictions are that increase in traffic will no long make it necessary to apply the MRG after the 15th year. In addition, the government is seeking to minimize the MRG payment through various measures such as refunding schemes and facilitation of supplementary businesses.

Table 8.3. Improvement in the MRG system for PPP projects

<table>
<tr><th colspan="2">Category</th><th>1999</th><th>2003</th><th>2006</th><th>October 2009</th></tr>
<tr><td colspan="2">Guarantee period</td><td>No restrictions</td><td>15 years</td><td>10 years</td><td>Abolished</td></tr>
<tr><td rowspan="2">Guarantee rate</td><td>State-solicited projects</td><td>90%</td><td>90% (1-5 years)
80% (6-10 years)
70% (11-15 years)</td><td>75% (1-5 years)
65% (6-10 years)</td><td>Abolished</td></tr>
<tr><td>Unsolicited projects</td><td>80%</td><td>80% (1-5 years)
70% (6-10 years)
60% (11-15 years)</td><td>Abolished</td><td>Abolished</td></tr>
</table>

04

Characteristics of Privately Financed Roads[4]

Advantages in Operation and Management

Privately financed expressways are connected to other expressways, making it necessary to set up additional tollgate offices for revenue settlement between their operators and Korea Expressway Corp. It is also necessary to secure separate staff and equipment for their management and operation. Such operational conditions may cause inconvenience to users and weaken the road functions.

4) Korea Development Institute, *Feasibility report on the PPP project to build the Seoul-Sejong Expressway*, February 2009.

Despite these concerns, there is a good reason to pursue PPP road projects. By building expressways in private investment schemes, the government could avoid various difficulties related to the signing of contracts, the possibility of contract cancellation, and the actual operation of roads.

PPP schemes can reduce various contract-related difficulties and address the problem of operational inefficiency. Various agreements pertaining to design, construction execution and operation can be integrated into a single contract, under which the private project company should hold full responsibility for the project. In short, the PPP system can simplify the contract management process and reduce the chances of the project being undermined by the public sector's inefficiency.

Creativity and Efficiency

In general, PPP projects pursue the goal of realizing optimal management efficiency through maximum utilization of the private sector's creativity and efficiency. Operational inefficiency caused by the lack of appraisal of achievements is cited as the biggest problem with infrastructure facilities like roads and railways built by the state. Such a problem can be addressed by employing the private sector's creativity and efficiency. The PPP system utilizes the private sector's management techniques, raising the operational efficiency of infrastructure facilities and enhancing user satisfaction levels. It also helps to funnel private idle funds into infrastructure investment projects, thereby inducing a virtuous economic cycle, economic revitalization and job creation.

When implementing infrastructure projects, the government often finds it difficult to meet the need to spend a considerable portion of the entire project budget during the initial stage. It can address such a problem by utilizing the PPP scheme. The system makes it possible to manage project risks more effectively. The project company develops a design plan for a project based on its consideration of facility operation. These conditions allow the project company to carry out a project in a creative and efficient manner based on its consideration of the life cycle cost.

Risk Allocation

The basic principle in risk allocation requires that the risks should be taken care of by the stakeholder that is able to manage the risks most effectively and assess their values. Under current PPP schemes, the private sector assumes responsibility for a considerable portion of the risks that can occur in relation to construction execution, operation, funding and any other parts of the project implementation process. Under this structure, the government can transfer risks to the private sector or share them, whereas it has to take full responsibility when implementing state-financed projects.

It is difficult to manage market risks such as transport demand, the increase of which is hard to expect through marketing activities. Still, the private sector is supposed to exert more active efforts to manage such risks than the government, because it has to consider profitability. Besides, compared to state-financed projects, PPP projects face fewer constraints related to design, construction execution, and licensing. Naturally, PPP projects are more advantageous to the government than state financing schemes in terms of risk allocation.

05
Appraisal of PPP Road Projects

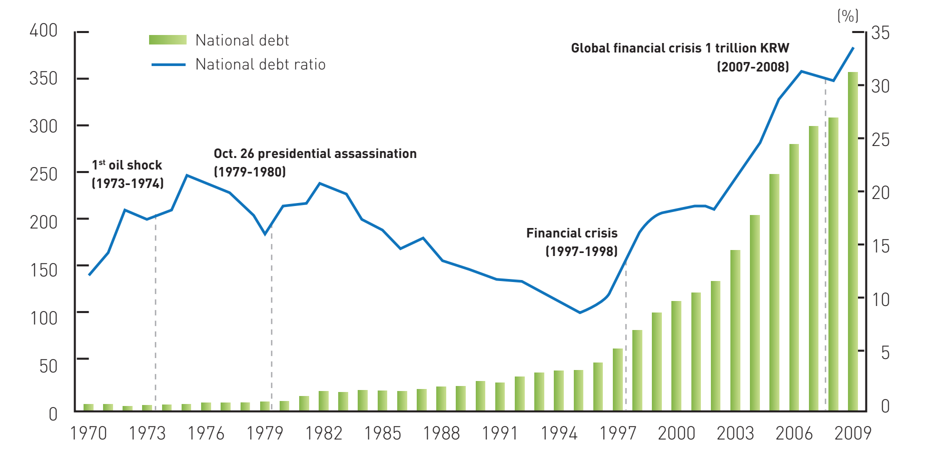
Positive Effects[5]

The positive effects that can be gained from private investment schemes for roads can be summed up in the following five categories:

First, it is possible to ensure early realization of user benefits through timely construction of SOC facilities. This is one of the most important effects, given

5) Ministry of Land, Infrastructure and Transport, *2011 White Paper on Roads*, 2012. 2.

Figure 8.3. Change in state bond ratios



the fact that publicly funded road projects are frequently delayed due to financial restrictions. A number of roads built at the right time in PPP schemes are executing important functions. For example, the Incheon Airport Expressway is executing its function as the portal road linking the airport and Seoul. The Ilsan-Teogyewon section of the Seoul circular beltway made it possible for the beltway to function properly as a whole. The Seoul-Chuncheon Expressway is considered to have made significant contributions to reducing traffic congestion on the Seoul-Chuncheon national highway. Such PPP road projects have undoubtedly contributed to increasing user convenience and reducing traffic congestion amid difficult conditions such as increase in national debt, growing financial requirements for welfare and various other sectors, and dwindling SOC investments from the public sector.

Second, securing private funding sources for SOC projects generates the effect of reducing the state's financial burden. Since 2005, the financial saving rate related to PPP projects has amounted to 13-16% a year on average. The ratio of state bonds as a percentage of GDP has gone down by 1-2.5%.

In particular, the financial burden is relatively low during the early stage of a project, making it possible to ensure efficient financial operation. Recently, private investments in SOC projects are on a slightly downward trend amid credit crunch in financial markets. Previously, the ratio of private investments in the SOC sector had kept rising, reaching 19.4% in 2008. Schematic analysis of the nine privately financed roads currently in operation shows that the are generating financial saving effects worth about 4.3 trillion KRW, even when the MRG subsidies awarded them are considered. Expressways being promoted in PPP schemes are expected to generate higher financial saving effects, given the fact that the MRG system has been abolished.

Table 8.4. Private-sector ratios in SOC investments (Unit: trillion KRW)

Category	2005	2006	2007	2008	2009	2010	2011
State budget	209.6	224.1	238.4	257.3	284.5	292.8	309.1
SOC investment	18.3	18.4	18.4	20.6	25.5	25.1	24.4
(compared to budget)	(8.7%)	(8.2%)	(7.7%)	(7.6%)	(9.0%)	(8.6%)	(7.9%)
Transport SOC	15.6	15.3	15.6	17.1	20.4	17.5	16.7
(compared to SOC investment)	(85%)	(83%)	(86%)	(84%)	(80%)	(70%)	(68%)
SOC private investment	2.9	2.9	3.1	3.8	3.9	2.7	2.7
(compared to SOC investment)	(15.8%)	(15.8%)	(16.8%)	(18.4%)	(15.3%)	(10.8%)	(11.1%)

Third, PPP projects contribute to facilitating economic recovery and creating jobs. They help funnel idle financial resources into long-term infrastructure projects and create jobs. They also contribute to the development of pertinent industries like project financing. The PPP infrastructure projects are said to be generating the production induction effects worth about 161 trillion KRW while creating jobs for 1.09 million people. Their creation of added values are estimated to be worth 62 trillion KRW. In 2008, the GNP growth rate related to PPP projects was estimated to be 0.198% (KDI).

Fourth, the private sector's efficiency helps to reduce the government's SOC-related risks such as increase in project costs, construction delays, and problems with quality and funding. The private sector is in charge of planning, design, construction execution and operation, thus making it possible to cope with risk factors expeditiously and eventually ensure stable operation. Consequently, private investment projects show excellent compliance rates in terms of meeting the construction deadline and the cost target. As for the construction deadline, the compliance rate is nearly 100% for PPP projects, compared to about 75% for publicly financed projects. Such a good performance generates the effect of reducing the sunk costs like increase in management costs due to construction delays.

Lastly, the private investment scheme can lower the construction costs by lowering the contract price. At initial stages, there was little competition over private investment projects. As a result, the contract prices for such projects were mostly higher than those for publicly funded projects, including those implemented on a turnkey basis. This phenomenon reflected the relevant conditions at those times. In those years, due to budget shortages, the government sought to shift from state financing to private funding for the Incheon Airport Expressway, the Cheonan-Nonsan Expressway and the Daegu-Busan Expressway. Accustomed to state financing schemes, construction companies showed reluctance to participate in such private-financed projects. As a condition for participation, they demanded that the construction costs be set at prearranged levels. The government had no other choice but to accept the demand, as it was under pressure to ensure timely opening of the new airport and tackle the problem of traffic congestion. The situation has changed recently. Competition over PPP road projects has been rising steadily. As a result, these projects are showing lower contract price levels than state-funded projects. The average rate of contract prices to government-set costs for recently signed eight PPP projects was 68.6%, lower than 84% for state-financed turnkey projects for expressways.

Table 8.5. Contract price levels for recently implemented PPP road projects (contract price/state-presented price)

Pyeongtaek Siheung	Incheon Gimpo	Anyang Seongnam	Gwangju Wonju	Sangju Yeongcheon	Suwon Gwangmyeong
67.0%	61.6%	60.0%	65.5%	78.0%	78.0%

CHAPTER 08

Negative Aspects of Privately Financed Roads[6)]

The negative effects related to privately financed roads can be mostly attributable to the MRG system. The scheme guaranteed minimum operating profits to project companies. Consequently, private-sector stakeholders often promoted projects hastily without carefully reviewing the feasibility and business prospects. There was also a lack of understanding on the importance of demand estimation. As for the government, it was so obsessed with the need to make achievements that it failed to review in advance the problems that might occur from private financing schemes.

Moral hazard on the part of private corporations can also be cited as a negative aspect. They were lacking in recognition of the importance of providing public services through road projects. They also neglected to conduct thorough analysis of project risks, as they were guaranteed state subsidies and MRG. They were particularly criticized for taking profits during the process of construction execution through excessive design as well as for failing to exert sufficient efforts to reduce construction costs.

A considerable number of infrastructure projects have been implemented in private investment schemes since the mid-1990s. However, there are assertions that the projects have failed to gain public understanding and trust. Such unfavorable opinions are related to the project implementers' failure to regard the projects from the perspectives of the public (users) as well as their neglect to properly respond to criticism from the National Assembly, the news media, and civic organizations. It should also be pointed out that no serious efforts have been exerted to establish the identity of the private investment projects or foster national consensus on them. There have been no proper explanations on why such projects should be implemented or through what procedures they are carried out. Nor has there been comparative analysis of the private investment schemes and other alternatives.

Another negative aspect of privately funded roads is their high level of tolls

6) Construction Association of Korea, Merits and demerits of private SOC investment projects and correct policy directions—Policy Forum, May 2011.

compared to the publicly financed roads. In particular, the tolls of the roads built during the initial years of the PPP system were two times as high as those of the publicly funded roads. There are views, however, the privately financed roads cannot but impose high tolls because of the following structural problems:

- First, there are no restrictions on the period for recovering the investment costs for the expressways operated by Korea Expressway Corporation (KEC) (Gyeongbu and Gyeongin Expressways, etc.). In contrast, the private investors have to recoup their investment costs within 30 years as they are awarded the right to operate the roads for maximum 30 years;
- Second, KEC tolls are determined at below-cost levels (75% of the cost), causing chronic operating losses (The operating losses of KEC-operated expressways are made up for through cross compensation or state subsidies. As of 2010, the corporation's debt amounted to 22.85 trillion KRW);
- Third, state subsidies account for 50% of the construction costs for KEC expressways. The ratio for privately financed roads is just 17.5% on average;
- Fourth, the KEC is exempt from the 10% value added tax on the tolls, while there is no such exemption for the privately funded roads. Given this, the tolls of privately financed roads cannot but be 1.1 times as high as those for the KEC expressways, even of all other conditions are the same; and,
- Fifth, the KEC virtually pays no corporate tax because of its chronic operating losses. However, the companies running the privately funded roads pay corporate taxes (22%+2.2%), which belong to the state coffer as tax revenues.

The most serious negative aspect of the privately funded roads is the waste of taxpayers' money due to the application of the MRG system. The scheme was first introduced in the nation while pursing the New Airport Expressway project. In its project master plan, the government adopted the scheme as a way to address the problem of gaps between the transport demand presented by the government and the private sector.

In the aftermath of the financial crisis in the late 1990s, private investments in infrastructure projects were completely suspended. Even the existing project plans faced murky prospects. The situation forced the government to develop measures to induce private-sector investments, especially foreign capital, into SOC projects badly needed for the nation to overcome its economic crisis. In the process of accommodating the views of prospective investors, foreigners pointed to the possibility of high operational risks arising from the lack of sufficient O/D data and the consequential uncertainty in demand estimation. They then demanded measures to address their concern about project risks. In a way to accommodate the demand, the government amended the enforcement decree of the Act on Promotion of Private Investment in Social Overhead Capital, creating a legal provision for MRG (Article 37-4). Since then, 36 projects have been implemented with MRG payment stipulations included in the concession agreement.

Conspicuously high amounts of MRG subsidies have been paid for early-stage PPP projects, including the Incheon Airport Expressway (907.6 billion KRW), the Cheonan-Nonsan Expressway (349.6 billion KRW), and the Daegu~Busan Expressway (235.7 billion KRW). Problems with the MRG system have been steadily raised by the National Assembly, the news media and NGOs, consequently forcing the government to abolish the scheme on two occasions, for the unsolicited projects in 2006 and the state-solicited projects in 2009.

06

Directions for Improving Private Road Financing Schemes[7]

Implementing state road policies requires an enormous amount of financial resources. In reality, however, the government confronts budget limitations, which cause delays in projects. Such restrictions can be overcome through PPP projects, which can help increase social benefits by ensuring timely supply of SOC facilities. Amid increase in social interest in welfare policies, the portion of welfare

7) Ministry of Land, Infrastructure and Transport, *2011 White Paper on Roads*, 2012. 2.

spending in state budget is growing every year. Given this, it will likely be difficult to steadily expand the budget for the road sector. These conditions are making it necessary to more actively promote private investments in pursuing road expansion projects.

In pursuing such policies, the government is likely to face difficulties related to negative public opinions on the MRG scheme and high toll rates for roads built during early stages of the PPP system. Private-sector financiers are also reluctant to make active investments in road projects because of high risks and low profitability. In order to tackle these problems, it is essential for the government to promote private investment schemes for the road sector based on efforts to foster understanding among the public on the need for PPP projects.

First of all, it is necessary to steadily pursue PPP projects by focusing on profitable sections. Priority should be given to high-demand routes in Seoul and other metropolitan areas. Emphasis should also be placed on the prospects of ensuring reasonable rates of return while maintaining state subsidies at appropriate levels. In addition, potential PPP projects ought to be selected through rigorous screening procedures by placing the top priority on profitability and funding prospects.

Persistent efforts should also be exerted to facilitate PPP projects. First, it is necessary to pursue an overhaul of pertinent systems in order to improve private investment conditions, particularly with regard to the difficulty of ensuring relevant funding regime involving financial institutions. Measures should also be developed for the government and private project companies to share project risks in a balanced manner. Additionally, research needs to be made to find out new types of private investment by considering changes in social, economic and financial conditions.

The biggest obstacle to active promotion of private funding schemes for roads is the difficulty in ensuring profitability. To resolve this problem, the current project evaluation system must be improved, focusing on creativity and efficiency rather than on price competition. At the same time, efforts should be made to raise the profitability of privately financed roads through facilitation of various supplementary businesses.

CHAPTER 9

Expressway Toll Policy

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CHAPTER 09

01
Status of Expressways

The expressways in Korea can be classified into two types depending on whether the construction was financed publicly or privately. The publicly financed expressways are constructed and operated by the Korea Expressway Corporation (KEC). The KEC-managed expressways include the Gyeongin Expressway, the nation's first expressway that opened in 1968 between Seoul and Incheon, and the Seoul-Busan Gyeongbu Expressway that opened in 1972, ushering the nation into a full-fledged era of expressways. As of 2012, the nation's publicly funded expressways were in operation on 31 routes with a combined length of 3,632 km. By comparison, the extension of the privately financed expressways is a total length of 281 km. Of a nationwide combination, they form a 3,913 km network of expressways.

The toll revenue of the publicly financed expressways reached about 3 trillion won in 2011 following steady increases since 2002. The upward trend continued throughout this period, except for 2008 when rapid rises in oil prices led to reduction in demand for expressway travel.

Table 9.1. Status of expressway operation in Korea

Total length of publicly financed expressways:
3,632 km (as of April 2012)

Classification	Length (km)
10 lanes	29
8 lanes	420
6 lanes	477
4 lanes	2,555
2 lanes	151
Total	3,632

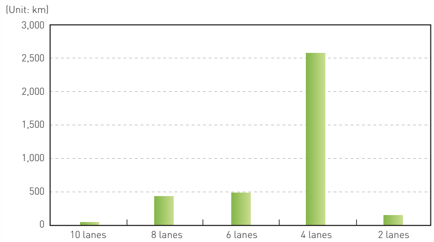
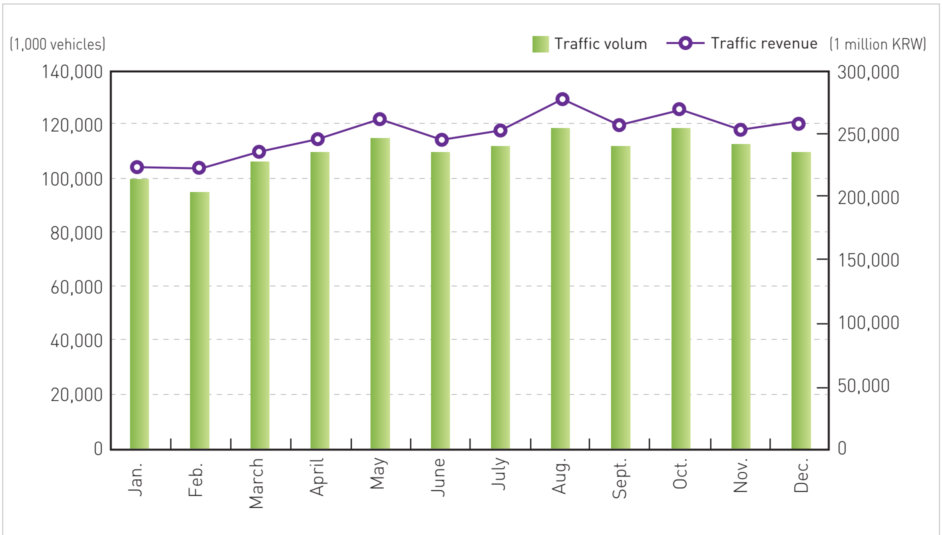


Table 9.2. Trends in traffic volumes and revenue (Unit : 1,000 vehicles, 1 million KRW, %)

Vehicle type / Year	Total			
	Traffic volume	Traffic growth rate	Traffic revenue	Traffic revenue growth rate
2002	999,949	-	2,200,345	-
2003	1,055,338	5.54	2,309,026	4.94
2004	1,071,232	1.51	2,407,088	4.25
2005	1,098,032	2.50	2,471,719	2.69
2006	1,152,000	4.91	2,659,931	7.61
2007	1,212,058	5.21	2,760,140	3.77
2008	1,210,334	-0.14	2,713,368	-1.69
2009	1,243,907	2.77	2,825,077	4.12
2010	1,298,410	4.38	2,936,598	3.95
2011	1,320,966	1.74	2,998,874	2.12

As for the monthly proportion of traffic volumes and revenue, the lowest is marked in January and February, and the highest in August.

Figure 9.1. Monthly average traffic volume and revenue



02
Changes of the Toll System

In the early days of expressways, Korea used a distance-based toll scheme. It later changed to a minimum pricing system, and finally to a two-part pricing scheme. In 1968, when the nation's first expressway opened between Seoul and Incheon, the vehicles subject to tolls were classified into five categories. Tolls were determined based on the distance traveled and the vehicle types. This system maintained through 1997. In September 1969, the vehicles subject to tolls were reclassified into eight categories for readjustment of toll rates. In December that year, a toll discount system was introduced for passenger cars and trucks. The discount system for passenger cars was abolished in 1972. In 1974, the vehicle classification system was reorganized, launching a four-category scheme. In May 1979, IC usage fees were introduced. Since the 1980s, expressway tolls have been raised steadily through adjustment of vehicle fees, which vary depending on vehicle types, and the IC usage fees. The rates for various vehicle types have been readjusted 23 times.

In February 1994, the vehicles were reclassified into five types. In December of the same year, per-km fees were readjusted, resulting in increases or reduction in fees depending on vehicle types. These criteria are still applied to classify the vehicles. However, a new category has been created: light cars (Type 6). The toll for Type 6 cars is half the fee for Type 1 vehicles.

The publicly financed expressways used a distance-based toll system until May 1997. Under the scheme, short-distance users had a relatively low burden of fees. Consequently, it led to a significant increase in the number of short-haul drivers, causing traffic congestion on expressways. To address this problem, a minimum pricing system was introduced. Under this system, minimum fees were collected from drivers travelling a specified distance (20 km) or less. Drivers traveling longer distances were subject to vehicle fees, which was based on a distance-based scheme, plus the minimum fee. Based on these methods, it was a kind of a multiple pricing system. In 1997, the minimum fee was set at 1,000 KRW. It was raised to 1,100 KRW in 1999. The minimum pricing scheme is applied to the closed and open toll systems as follows:

- Closed toll system = Minimum fee (1,100 KRW) + (driving distance×per-km rate)
  - Driving distance for vehicles in Category 1, 2 and 3 = Actual driving distance - 20 km
  - Driving distance for vehicles in Category 4 and 5 = Actual driving distance - 10 km
- Open toll system = Average distance at the tollgate section × Basic rate
  - The minimum fee of 1,100 KRW is imposed in case the calculated fee is below 1,100 KRW

The minimum pricing system faced criticism that it imposes an excessive burden on short-haul drivers traveling less than the fee deduction distance, thus causing an issue of equity among the users. Complaints about the lack of equity were particularly conspicuous among the drivers using the open toll roads. The minimum pricing system achieved its originally intended goal of ensuring the expressway functions by curbing short-haul passage. However, because of the controversy over equity among the users, the relevant authorities began to consider replacing it with a two-part pricing system.

A two-part pricing system was introduced in March 2004 as a way to accomodate the problem caused by the minimum pricing system. The new scheme provided for the collection of the basic fee plus the driving fee. The basic fee, imposed regardless of the travel distance, is to cover the fixed costs spent for construction, expansion and upgrading of roads. Based on the "beneficiary pays" principle, the fee is levied after determining the cost recovery period. The driving fee is imposed by multiplying the driving distance by per-km driving fee. Based on the theory of marginal cost pricing, the two-part pricing scheme can retain the strengths of a distance-based system while curbing the use of expressways by short-haul travelers.

Compared to the distance-based pricing system, the two-part scheme alleviated the relative burden of long-distance motorists while increasing the burden of short-distance travelers, thereby helping to maintain the functions of expressways. It allowed differentiation of fees even among the short-distance users, alleviating the inequity problem that occurred under the minimum pricing system. In February 2006, the basic fee was set at 862 KRW per vehicle for the closed system and 689 KRW per vehicle for the open system. The distance-based toll was 40.5 KRW/km. The rates were hiked a bit in November 2011. The basic fee rose to 900 KRW/vehicle for the closed system and 720 KRW/vehicle for the open system. The distance-based toll was set at 41.4 KRW/km.

Figure 9.2. Changes of the toll system

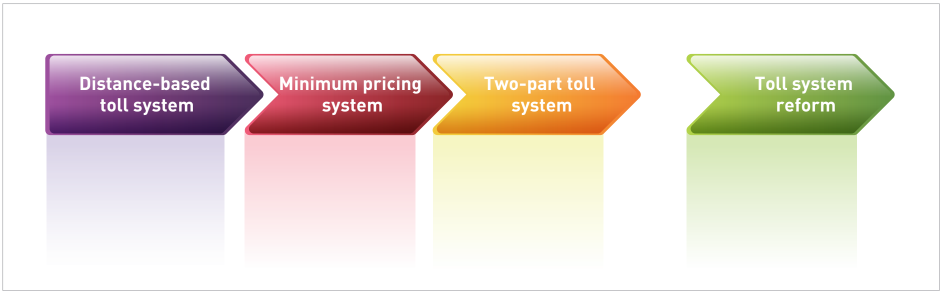


Table 9.3. Changes of the toll system

Classification	Adjustments	Average increase rate
1969. 2	• Classification of vehicles into five types; Application of a distance-based fee system • Toll rate (Type 1-3: 4.9 KRW/km, Type 4-5: 8.23 KRW/km)	-
1969. 9	• Reclassification of vehicle types (1st) → Classified into 8 types • Type 1: small-size passenger cars (small-size passenger cars, trucks under 2 tons) • Type 2: standard passenger cars (with four or mote seats) • Type 3: minibuses (with 16 or fewer seats) • Type 4: buses (with 17 or more seats) • Type 5: small-size trucks (under 2.5 tons) • Type 6: standard trucks (5-under 10 tons) • Type 7: large-size trucks (10-under 20 tons) • Type 8: special purpose vehicles (20 tons and above) • Toll rate (based on Type 1): 3.5 KRW/km	-
1969. 12	• Introduction of discounts for passenger cars and trucks • Type 1-2: -15%, Type 3-4: freeze, Type 5-8: -20%	-
1972. 1	• Discounts for passenger cars abolished	-
1974. 1	• Reclassification of vehicle types (2nd) → 4-type classification • Passenger cars (with up to 16 seats), buses (17 or more seats), standard trucks (under 10 tons), Large trucks (over 10 tons)	-
1979. 5	• Vehicle fee adjustment and introduction of IC usage fees	-
1980. 10	• Rate adjustment for all vehicle types and increase in IC usage fee • Toll rate (based on Type 1): 16.18 KRW/km	-
1986. 9	• Rate adjustment for all vehicle types • Toll rate (based on Type 1): 20 KRW/km	-
1994. 8	• Reclassification of vehicle types (23rd) → 5-type classification • Type 1: small vehicles (passenger cars, vans with up to 16 seats, trucks under 2.5 tons, 2 axle) • Type 2: mid-size vehicles (vans with up to 32 seats, trucks under 5.5 tons, 2 axle) • Type 3: large vehicles (buses with 33 or more seats, trucks under 10 tons, 2 axle) • Type 4: large trucks (trucks under 20 tons, 3 axle) • Type 5: extra large trucks (trucks over 20 tons, 4 axle) • Toll rate (based on Type 1): 27 KRW/km	-
1994. 12	• Per-km rate adjustment • Type 1-3: up 5%, Type 4-5: down 3%	3.8%
1997. 5	• Introduction of minimum pricing scheme and long-distance discount system (1,000 KRW) • Removal of IC usage fee	9.0%
1999. 8	• Hike of minimum rate (1,100 KRW) • Readjustment of per-km fee	9.8%
2002. 4	• Per-km rate adjustment (closed system)	5.2%
2004. 3	• Introduction of two-part pricing scheme (basic fee, driving fee) • Basic fee: 800 KRW (closed system), 640 KRW (open system) • Toll rate (based on Type 1): 39.1 KRW	4.5%
2006. 2	• Toll hike • Basic fee (closed system): 862 KRW • Basic fee (open system): 689 KRW • Toll rate (based on Type 1): 40.5 KRW/km	4.89%
2011. 12	• Toll hike • Basic fee (closed system): 900 KRW • Basic fee (open system): 720 KRW • Toll rate (based on Type 1): 41.4 KRW/km	3.17%

• Data: Korea Expressway Corporation internal data

03
Toll System

Toll System for Publicly Financed Expressways

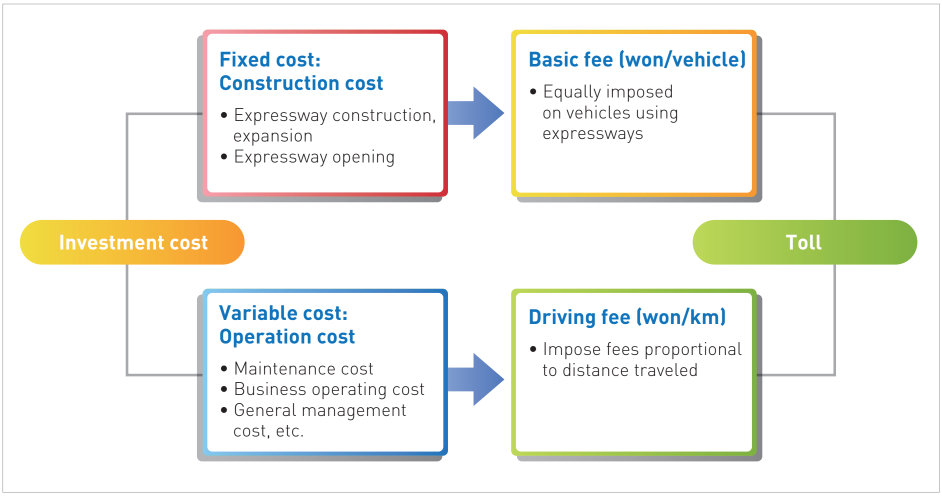
General Principles Regarding Toll Collection

Under the framework of the Toll Road Act, the nation's expressways are operated based on the following three principles: "user pays" "cost recovery" and "integrated accounting," The "user pays" principle refers to the policy of recovering the financial resources spent for the construction and maintenance of expressways from the road users. The "cost recovery" principle represents the policy for the determination of the level of tolls on the basis of the prospect of recovering the total construction and maintenance cost. The "integrated accounting" principle refers to the system of collecting tolls by considering the nationwide expressways as one route in order to ensure balanced national development, the toll equity among regions, and the continuous operation and management of unprofitable routes. Under these three principles, the two-part toll pricing system, still in use today, was adopted on March 3, 2004. This scheme is based on the idea of recovering the construction investments through the basic fee, and recovering the maintenance and management expenses through the distance-based toll. Different toll coefficients are applied to each type of vehicles, based on their contributions to transportation and effects on road maintenance and management. In addition, the toll collection period is set by considering the prospects of recovering the total construction costs and maintenance expenses. Even now, new investments are being made steadily. By taking the new investment costs into account, decisions are made at appropriate times to extend the toll collection period.

Present Toll Pricing System

As mentioned earlier, the Korea Expressway Corporation has been operating the two-part toll system since 2004, collecting the basic fee imposed regardless of the distance traveled, and the distance-based toll.

Figure 9.3. Two-part pricing structure



As of 2012, the toll fees were based on the rates adjusted upwards from the previous year. The basic fee was 900 KRW for the closed system, and 720 KRW for the open system. The distance-proportional toll was set at 41.4 KRW/km for the first type of vehicles.

Table 9.4. Current Toll Calculation Structure

Classification	Closed system	Open system
Basic rate	900 KRW(2-lane expressway: 450 KRW)	720 KRW
Toll calculation	Basic fee + (distance traveled×per-km driving fee by car type)	Basic fee + (shortest travel distance by tollgate×per-km driving fee by car type)

• Note: 50% off for 2-lane expressways, 20% additional fee for expressways with six or more lanes

Table 9.5. Per-km driving fee in 2012 (based on 4-lane expressway) (Unit: KRW/km)

Classification	Vehicles subject to driving fee	Driving fee
Type 1 (small vehicle)	• 2 axle vehicle, wheel width: no wider than 279.4 mm (passenger cars, small vans, small trucks)	41.4
Type 2 (mid-size vehicle)	• 2 axle vehicle, wheel width: over 279.4 mm, Tread: 1,800 mm or below (mid-size buses, mid-size trucks)	42.2
Type 3 (large vehicle)	• 2 axle vehicle, wheel width: over 279.4 mm, Tread: over 1,800 mm (large buses, 2-axle large trucks)	43.9
Type 4 (large truck)	• 3 axle large trucks	58.8
Type 5 (special purpose truck)	• Special purpose trucks with 4 or more axles	69.6

• Note: The fee for Type 6 cars (light cars) is half the fee for Type 1 cars (Unit: KRW/km)

The two-part pricing scheme is based on clear logic to recover the expressway construction costs. If operated effectively, it can realize the objective of recovering the investment costs, while ensuring equity among generations in terms of cost recovery. However, the imposition of the same basic fee regardless of the distance traveled is equivalent to making the short-haul travelers bear a higher burden compared to long-distance travelers in terms of paying the toll for cost recovery.

Table 9.6. Strengths and weaknesses of the two-part pricing scheme

Category	Descriptions
Strengths	• Give due consideration to generational equity by approaching the basic fee issue from the perspective of recovering construction costs • Able to reduce congestion in short-distance travel sections
Weaknesses	• Imposition of the same basic fee makes short-distance travelers bear a higher toll burden compared to long-distance travelers • Difficult to differentiate fixed costs from variable costs

Toll Exemption and Discount System

The toll exemption and discount system is in operation for the implementation of state policies and the achievement of public purposes pursuant to the Toll Road Act. The exemption and discount benefits are provided to emergency vehicles, persons who have rendered meritorious services to the state, and people with disabilities. In addition, there are discount schemes implemented in relation to transport policies.

The commute discounts are given to Type 1-3 vehicles (passenger cars, vans, trucks under 10 tons). The discount rates are 50% between 5 and 7 a.m. and between 8 and 10 p.m., and 20% between 7 and 9 a.m. and between 6 and 8 p.m. In case the distance between entry and exit tollgates is less than 20 km, the commute discounts are provided to only Hi-pass users (only on KEC-operated expressways). This commute discount system is designed to help reduce traffic expenses of working class people. However, it does not meet the intent to ease congestion by reducing traffic volumes.

Late-night discounts are provided to business trucks (type 4 and 5), from 9 p.m. through 6 a.m. on the closed toll sections, and from 11 p.m. to 5 a.m. on the closed system segments. The late-night discount scheme for trucks originally started as a five-year temporary measure when it was included in the appendix of the 2001 enforcement decree concerning vehicles subject to toll discounts. However, the expiry date has been extended to Dec. 31, 2013.

Table 9.7. Late-night discount system for trucks (closed system)

Discount time usage ratio	100%-80%	Below 80%-50%	Below 50%-20%	Below 20%
Discount rate (%)	50	30	20	0

• Note: Discount time usage ratio (closed system) = Travel time during discount hours ÷ Total travel time on expressways

Extra toll fees are imposed on Type 1 vehicles (passenger cars, vans with 16 or fewer seats, trucks under 2.5 tons) using expressways from 7 a.m. to 9 p.m. on Saturdays, Sundays and holidays (not including traditional holidays). The extra charge, which amounts to 5% of the regular toll, is collected in units of 100 KRW. This scheme is based on the Corlett & Hague Rule that calls for setting high tax rates for supplementary goods and low rates for substitute goods. Specifically, it provides for the collection of 5% of the weekday toll in extra charge during specified hours in weekends.

The discount system for light vehicles was introduced in June 1996 in association with the government's energy saving policy, slashing 50% off the tolls for cars with the engine displacement capacity of 800cc or less. In an effort to encourage the use of light cars further, it has since been expanded to cover vehicles with the engine capacity of up to 1,000cc. Such cars should not exceed 3.6m in length, 1.6m in width, and 2.0m in height.

The Hi-pass discount program was introduced in 2005 with the intent to reduce congestion during commute hours and promote the use of Hi-pass services. However, it was discontinued in 2012 after the Hi-pass usage rate exceeded 50%.

In 2011, the traffic counts of the vehicles that were exempted from tolls or received discounts reached 826,955,000, accounting for 62.6% of the total traffic counts of 1,320,966,000 (exemption: 0.6%, discounts: 62.0%). Hi-pass discounts made up the largest percentage of 68.8% of the total discounts, followed by discounts for commuters (16.6%) and discounts for light vehicles (7.9%). The exemption and discount ratios in terms of toll revenues were mostly equivalent to the ratios in terms of traffic volume. Noticeable were the relatively high percentages of late-night discounts (19.3%) and disability discounts (15.9%) in

Table 9.8. Vehicles and persons eligible for toll exemption and discounts

Items			Discount rates	Started on
Exemption	Military operations vehicles, emergency/relief/fire fighting vehicles		Exemption	1963. 11. 05
	Traffic enforcement, mail delivery vehicles		Exemption	1964. 07. 23
	Police operations vehicles, toll road construction/ maintenance vehicles		Exemption	2001. 09. 06
	Emergency logistics transport vehicles, emergency traffic control vehicles		Exemption	2004. 12. 31
	Persons of distinguished services to independence		Exemption	2005. 05. 07
	Persons of national merit (class 1-5)		Exemption	1998. 11. 01
	Persons wounded in 5·18 Democracy Movement (class 1-5)		Exemption	2004. 12. 31
Discounts	Persons of national merit	Class 6-7	50% off	1997. 08. 01
	Persons wounded in 5·18 Democracy Movement	Class 6-14	50% off	2004. 12. 31
	Disabled persons		50% off	1997. 08. 01
	Defoliant patients	Patients suffering from aftereffects of defoliants	50% off	2001. 05. 01
		Patients suffering from potential aftereffects of defoliants	50% off	
	Light cars (under 1,000cc)		50% off	1996. 06. 01 (Expanded on 2008. 1.11)
	Commuters		20%, 50% off	2000. 01.10 (2011. 11. 28 50% discount expanded to cover Type 1-3 vehicles)
	Trucks (late night)		20-50% off	2009. 09. 07 - 2013. 12. 31
	Hi-pass full-time discount		5% off	2005.12. 01 - 2012. 06. 30

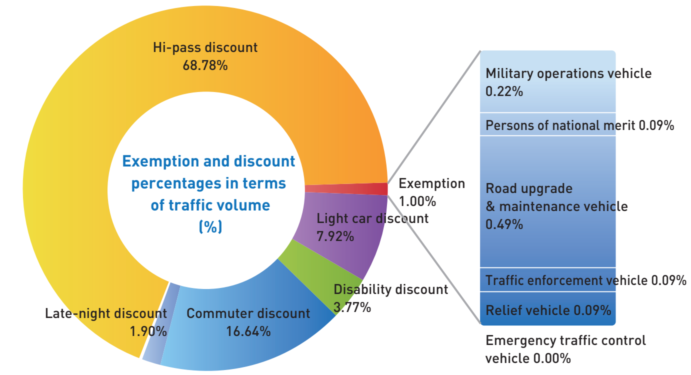
• Data: KEC internal data

terms of toll revenue, compared to their shares in terms of traffic counts.

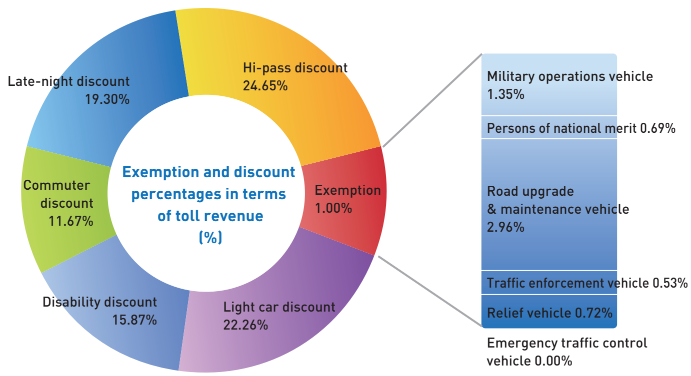
Open and Closed Toll Systems

Toll collection on publicly financed expressways is based on either open or closed system. Under the closed system, drivers receive toll tickets as they enter the expressway, travel all the way to their destinations, and pay the tolls as they exit the expressway. Under the open system, drivers pay the toll first for a specific section, then using the expressway freely until the next tollgate appears. The closed system accounts for 94.2% of the KEC-operated expressways. The total length of these expressways is 3,420 km, compared to 212 km of the expressways using the open

Figure 9.4. Exemption and discount percentages based on traffic volume and revenue in 2011



Exemption and discount percentages in terms of traffic volume (%)



Exemption and discount percentages in terms of toll revenue (%)

toll system. The open toll system is used as an alternative when the closed scheme cannot be adopted because of technical reasons. The expressways using the open toll system are mostly in the capital region, the Gwangju region, and the Busan-Gyeongnam region.

The closed system is advantageous in terms of control/enforcement. It is also relatively easy to ensure equity as the toll is levied in proportion to the distance traveled for all vehicles. However, it requires high costs for facility construction and operation. By comparison, the operating cost and the cost for facility construction is more economical for the open system. It, however, has disadvantages including the equity issue and the problem of vehicles using some expressway sections free of charge.

Table 9.9. Differences in toll collection methods between closed and open systems

Category	Closed system	Open system
Collection method	• Receive the toll ticket during entry, and pay the toll at the exit tollgate	• When passing a tollgate, motorists pay tolls for the section under the control of a pertinent tollgate office
Criteria	• High-traffic-volume routes • Long distance between entry and exit interchanges • Routes with high volume of long-distance traffic	• Segments with relatively low traffic volumes (2-lane section) • Short distance between entry and exit points (large city segments) • Routes with high volume of short-distance traffic
Merits	• Easy to secure equity by virtue of distance-based toll system • Easy to ensure control/enforcement, likely to increase revenues	• Requires low facility/operation costs • Smooth traffic flows on entry/exit roads
Demerits	• Requires excessive amount of facility/operation costs • Low level of usage by short-distance motorists	• Equity question arises because of toll imposition only on vehicles passing tollgate offices as well as the levying of the same amount • Hard to ensure control/enforcement • Occurrence of vehicles using expressways for free
Pertinent expressways	• Gyeongbu, Honam. Jungbu, Yeongdong expressways, etc.	• Gyeongin, 2nd Gyeongin, Seoul Beltway, etc.

Toll System for Privately Financed Expressways

Privately financed expressway tolls are determined in a way that can ensure appropriate pre-tax profit rates, eventually making it possible to recover the total project costs (excluding government subsidies) and operating costs (excluding corporate tax) while the operators have the right to use the roads free of charge. The KEC can adjust the basic toll charge and the driving fee for the expressways under its management. However, operators of privately funded expressways should set toll rates in advance for the 30-year free usage period, based on total costs, operating costs and the target yield. Only commodity price hikes[1] can be reflected

1) Until the operation starts, the rate of commodity price hikes to be reflected in toll rates are set based on past records. After the start of operation, the commodity prices are reflected in tolls in a variety of ways, with the ceiling set at 3%, for example, below the actual commodity price increase rate.

in adjusting the rates. In such a scheme, the determination of the toll rates is critically dependent on the economic feasibility of particular projects. The “Basic Plan for Private Investment Projects” stipulates that the toll rates for privately financed expressways should be determined based on the following formula:

$$\sum_{i=0}^{n} \frac{CC_i}{(1+r)^i} = \sum_{i=n+1}^{N} \frac{OR_i - OR_i}{(1+r)^i} + \sum_{i=0}^{N} \frac{ANR_i}{(1+r)^i}$$

Where, n: Moment of facility completion

N: Free usage period or the moment when the operational right is set to expire (As for the facility whose operational right permanently belongs to a private operator, N refers to a period subject to analysis)

CC_i: Costs spent every year for facility completion (excluding state subsidy)

OR_i: Annual operating revenue

OC_i: Annual operating costs (excluding corporate tax)

ANR_i: Annual pre-tax net revenue from affiliated businesses (revenue-cost)

r: Pre-tax internal rate of return (IRR) of a project

The tolls for private-funded expressways are determined based on provisions of the Private Investment Act, which stipulate that “concessionaires may impose monetary obligations on users in order for the recovery of investment costs.” According to these provisions, candidate concessionaires present project proposals, which include suggestions on toll levels, to a competent authority. After reviewing the proposed toll levels, the authority selects the priority negotiation partner. The toll rates are determined through negotiations for concession agreement. The toll levels presented by candidate concessionaires during the process of selecting the priority negotiation partner serve as the upper limits[2] of the tolls. The actual toll rates are determined through the negotiations for concession agreement by

2) Pursuant to the 2003 Basic Plan for Private Investment Projects, the competent authority can present the upper limits for facility usage fees by considering the usage fees of substitute facilities and the characteristics of the projects concerned.

considering the free usage period, the rate of return and state subsidies after the confirmation of such factors as the project costs, operating expenses, and demand predictions.

The final toll rates are set through adjustment of the size of state subsidies and the rate of return, based on the premise that the concessionaire would have the right to use the facility for 30 years free of charge. In this process, the toll levels proposed by the candidate concessionaire should serve as the ceiling, which would be 1.5 to 2 times as high as the tolls collected on publicly financed expressways. The key factors in toll rate negotiations are the total private-sector investments, excluding state financial support, the promised yield, and the free usage period. Normally, a road project concessionaire is granted 30 years during which it can exercise the right to operate the facility free of charge. Consequently, it can be said that the toll rates are determined by the state subsidy size and the rate of return. According to the "Basic Plan for Private Investment Projects," the toll levels for roads built as a private finance initiative project should have the ceiling, which is 1.5 to 2 times the level of tolls for expressways operated by KEC. There can be exceptions only for bridges constructed for special purposes.

The rate of return, the level of facility usage fees, and the state subsidies are closely related to each other. Their correlations are shown in the following table, which is based on the assumption that one of the three factors is fixed at a certain level. Here, "+" and "-" represent positive and negative correlations, respectively. This table shows that there is a positive correlation between the rate of return and the level of usage fees, and between the rate of return and the state subsidy. In contrast, there exists a negative correlation between the usage fee level and the state subsidy.

Table 9.10. Correlations between the rate of return, the usage fee level, and the state subsidy

Category	Rate of return	Usage fee level	State subsidy
Rate of return	N/A	+	+
Usage fee level	+	N/A	-
State subsidy	+	-	N/A

• Source: *A Study on the Execution and Management of Negotiations, and the Development of Guidelines*

CHAPTER 09

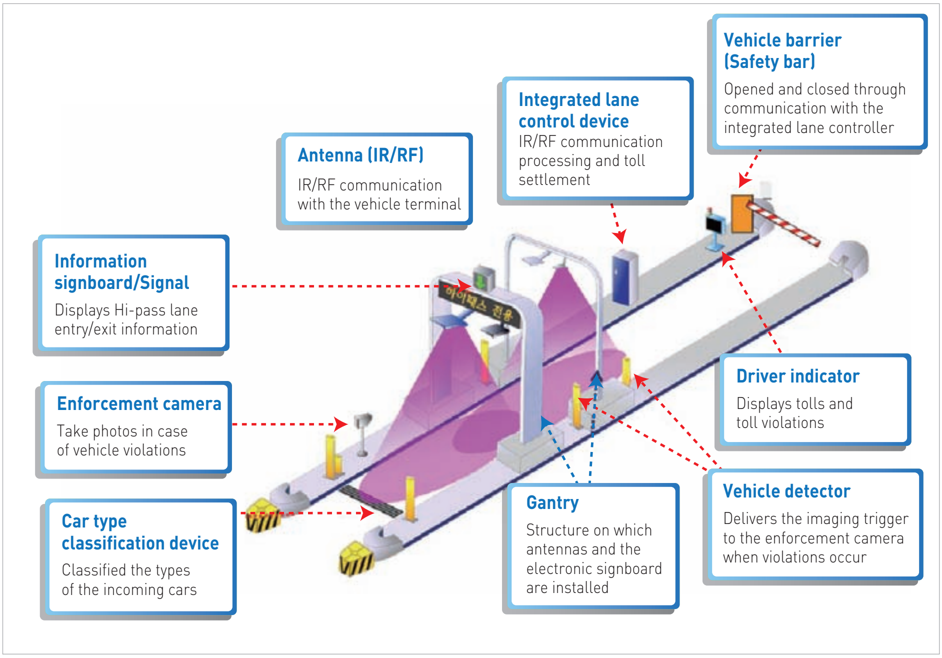
04

Toll Collection System

TCS (Toll Collection System)

TCS is a toll collection system that automatically calculates the tolls for vehicles entering and existing the expressway based on the recognition of vehicle types and the distance travelled through the use of various electronic devices. Once a car enters the expressway, electronic devices installed on lanes classify the vehicle type by recognizing the vehicle width, the wheelbase, and the number of axles. At the same time, the height of the vehicle is also detected, thereby making it possible to give optimal convenience to motorists when pulling out the toll ticket. Information on entry gates, vehicle types and the entry time is magnetically stored on the ticket. Tolls are collected at the exit gate where an electronic ticket identification device reads the contents recorded on the ticket.

Figure 9.5. A conceptual drawing of the Hi-pass system



Hi-Pass

Hi-pass (Hipass) refers to a cutting-edge electronic toll collection system (ETCS) that allows drivers to pay the tolls without stopping the vehicle by using wireless communication (radio frequency or infrared ray method). When motorists drive their cars on Hi-pass lanes after inserting an electronic card into the onboard terminal, the tolls are automatically collected. Dual antennas for handling both frequency- and infrared ray-based communication methods are installed on Hi-pass lanes, making it possible for a single integrated lane controller to execute the toll collection function.

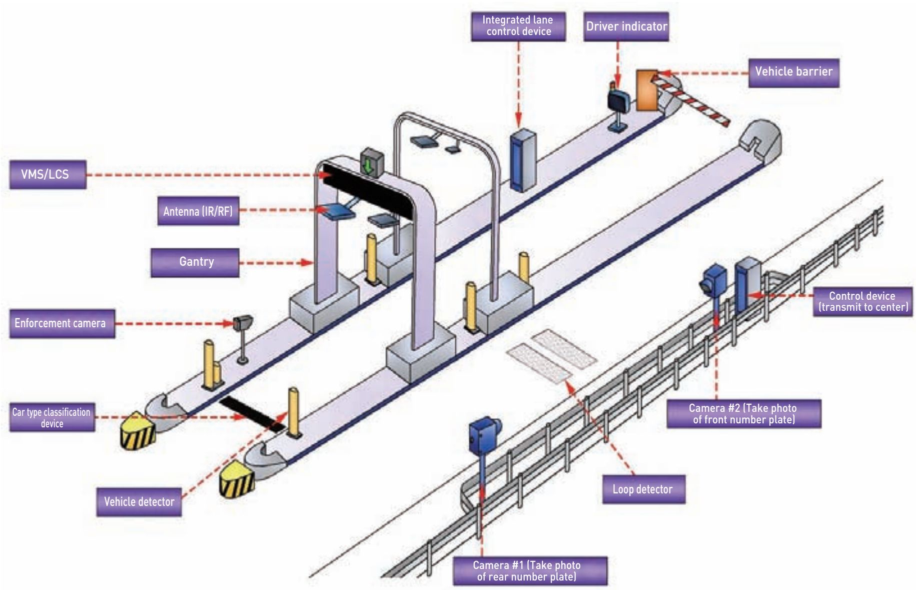
Unmanned Toll Collection System (AET, All Electronic Toll)

Discussions are underway for the introduction of an all electronic toll (AET) collection system as a smart scheme that can cut cost and minimize time delay, pursuant to the government's policy of promoting low-carbon green growth. ART represents a toll collection scheme by using the automatic number plate recognition (ANPR) system as well as the Hi-pass system. It allows the collection of tolls while traffic keeps moving. Currently, two options are under consideration. The first option calls for separate operation of the Hi-pass and ANPR systems, while the second one envisages simultaneously installing both systems in a mixed scheme. An appropriate unmanned toll collection system is to be introduced by considering the strengths and weaknesses of both systems.

Table 9.11. Merits and demerits of toll collection systems

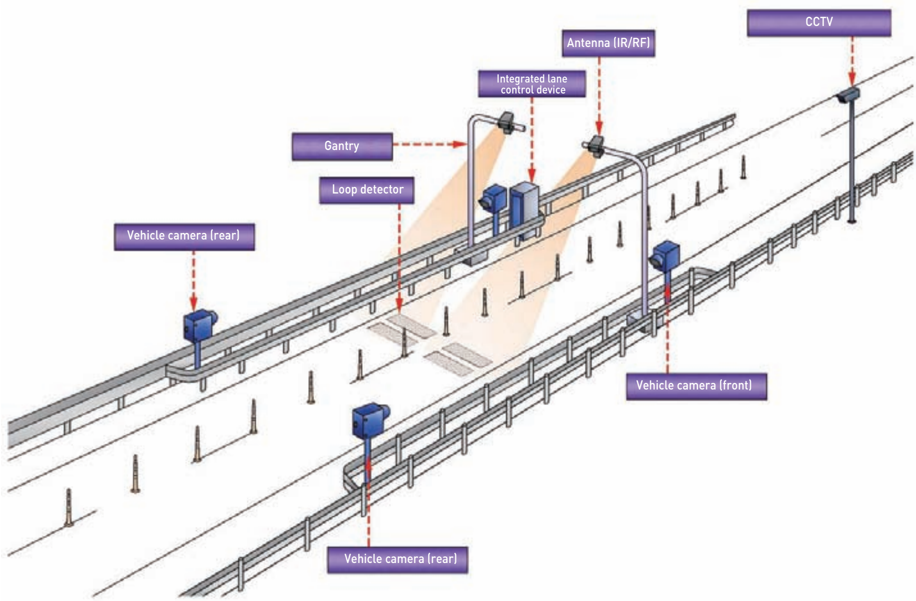
Category	Advantages	Disadvantages
Mixed system	• Possible to use all lanes, increasing driver convenience and traffic safety	• As for the closed system tollgates, there is need to reinforce systems for all lanes: high project costs
Separate system	• As for the closed system tollgates, there is need to reinforce systems just for TCS lanes: low project costs	• Restrictions on lane use by collection systems, lowering driving convenience and traffic safety

Figure 9.6. Toll collection system



Separation system

(Separate installation of Hi-pass and plate recognition systems)



Mixed system

(Integrated installation of Hi-pass and plate recognition systems)

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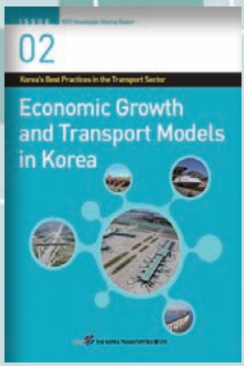

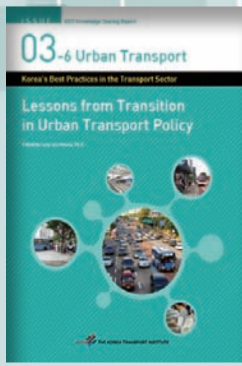

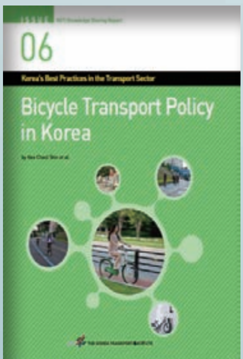

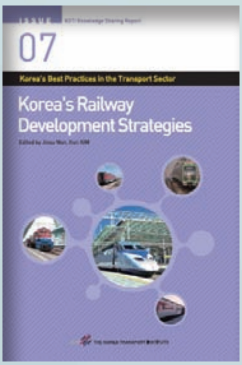

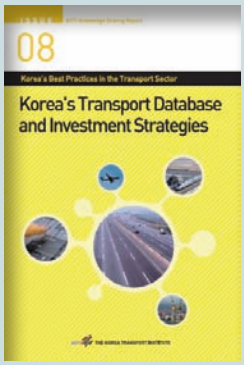

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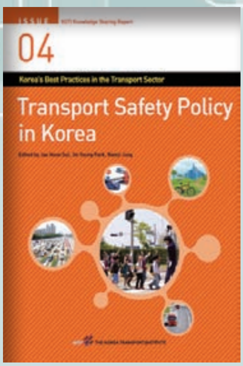

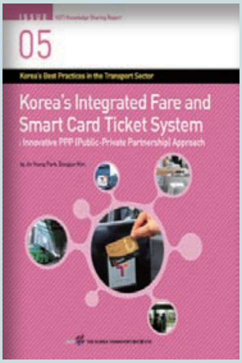

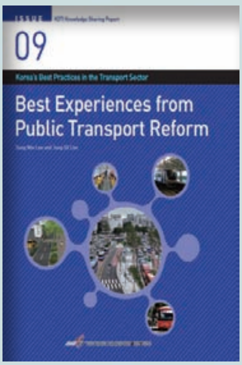

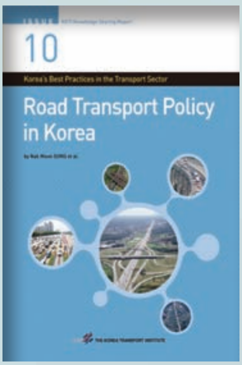

Road Transport Policy in Korea

The Korea Transport Institute (KOTI) is a comprehensive research institute specializing in national transport policies. As such, it has carried out numerous studies on transport policies and technologies for the Korean government.

Based on this experience and related expertise, KOTI has launched a research and publication series entitled "Knowledge Sharing Report: Korea's Best Practices in the Transport Sector." The project is designed to share with developing countries lessons learned and implications experienced by Korea in implementing its transport policies. The 10th output of this project deals with the theme of "Road Transport Policy in Korea."

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