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A Conception of Rail Network in Northeast Asia and Location
of the High-Speed Rail Central Station in Greater Seoul

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I. Introduction

When the Seoul-Pusan high-speed rail goes into operation, Korea will plunge into an 'era of express railway'. Such an opening of high-speed rail would be truly a significant event because it will certainly bring the Northeast Asian economic zone into a single market and it will play leading roles in forming new economic relations in this region.

Since most of transportation facilities, once established, tend to carry long durability as well as 'development inertia', we must make very careful analyses before executing such a huge investment. For these reasons, construction of the Seoul-Pusan high-speed rail must be viewed in relation to such a broader implication as restructuring of nationwide spatial pattern rather as a simple traffic facility linking Seoul with Pusan. Once high-speed rail goes into operation, it will have considerable impacts on nationwide land uses patterns, and the cities having its starting and terminal stations will be greatly affected in spatial patterns both in direct and indirect ways. In case of France, they constructed their high-speed rail after a long period of preparation, which is evaluated to have favorable effects on various regional issues including balanced regional development in nationwide perspective.

Discussions on location of the central station of the Seoul-Pusan high-speed rail began in November, 1991. With the discussion beginning, Ministry of Construction and Transportation made inquiry to the Seoul Metropolitan Government about the feasibility of constructing the central station of the high-speed rail at the existing Seoul station building. The Seoul Metropolitan Government referred it to its City Planning Committee and Traffic Effects Evaluation Committee for their opinions in February, 1992. With the opinions gathered, the Seoul Metropolitan Government replied that the construction of the station would bring about adverse effects on traffic congestion around the Seoul Railway Station and on restructuring of desirable urban spatial form of Seoul. In June, 1993, the Ministry of Construction and Transportation announced a revised plan for the construction of Seoul-Pusan

high-speed rail. Important changes in the revised plan include utilizing the existing railways in Seoul Metropolitan Area and aboveground portions of the existing station buildings to save expenditure on construction of station buildings. From the judgement that the revised plan would not be able to make any contributions to desirable change in Seoul's spatial structure to cope with 21st century development, the Seoul Metropolitan Government insisted that the central station be located at the Yongsan Area, 3 Km South of the existing Seoul Railway Station.

As a resolution, the Ministry of Construction and Transportation presented a compromised plan for the high-speed rail construction in September, 1994. The plan states that the Seoul station be utilized as the central station at the first stage of the construction with minor repairs and improvement, while they keep constructing new South Seoul station (Iljik station) adjacent to the existing Seoul station in accordance with the current plan. At its second stage of construction, the revised plan suggests to make a comprehensive study on the feasibility of locating the central station at Yongsan Area. It was pointed out, however, that this compromised plan might pave the way for overlapped investments and that if the second stage of construction is delayed, a tremendous social loss would be occurred to passengers because of increased accessibility costs to high-speed rail.

<Table 1> Summary of Seoul-Pusan Line Project

● Length : 431 Km Between Seoul and Pusan	
● Construction Period : 1991 - 2001	
● Costs of the Project : Existing Plan (1989)	5,846.2 billion Won
Re-estimated costs(1993)	12,174.3 billion Won
Revised Plan	10,740.0 billion Won
	(Utilizing the existing rails)
● Actions by the Ministry of Construction and Transportation	
- June 5, 1992	Notification of route decision
- June 30, 1992	Starting 1st phase construction (Chonan-Taejon Line)
- Year 2001	Test-run
- Year 2002	Actual operation

The high-speed rail will surely play immense roles in remodeling spatial structure in the Korean peninsula, and will also have diverse impacts on the development of

cities where its stations are located and their surrounding areas. Based on the understanding of those important implications of the project, a long-term master plan for high-speed rail networks have to be drawn as soon as possible. Discussions on locations of its station should be made in relation to the comprehensive plan.

In the paper, long- and short-term plans for high-speed rail networks are presented which would affect spatial structures of Seoul City. The locations of the central and local stations are also discussed based on those plans. A set of criteria for locations of high-speed rail stations are suggested, and issues in each alternative are examined.

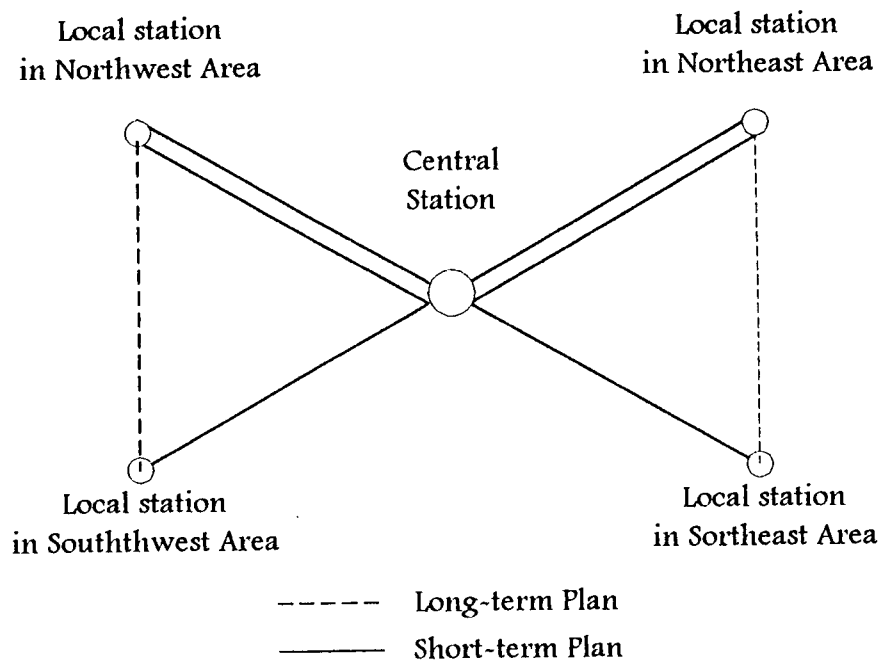
II. High-Speed Rail Route in Greater Seoul and Formulation of a Comprehensive Plan for Locations of station Building

It is expected that Seoul will play a central roles in Northeast Asia in the 21st century. In order to cope with them, the city is formulating plans to restructure spatial patterns through development of five key districts. Basic strategies of these plans include accommodating high-tech business activities in these districts, restructuring spatial structure through agglomeration and suburbanization of the activities in efficient ways, development of subcenters and strengthening functional linkage among the center and subcenters.

Various urban infrastructures are required in order to ensure efficient performance of various functions. Among them, traffic facilities, in particular the route of railway networks and location of high-speed rail station, are expected to have decisive impacts upon reformulation of Seoul's spatial structure. Social infrastructures such as high-speed rail has such characteristic of long durability that it is very difficult, once constructed, to change its route networks. High-speed rail would inevitably require a construction of stations for its stops. These stations will have direct and indirect impacts on peripheral areas as well as entire pertinent cities which have strong influence on 'frameworks' of spatial structures of the cities in the future.

Considering these diverse implications of the construction of high-speed rails, we strongly feel that a master plan for the route and location of high-speed rail station is required. The master plan shall be effectively utilized in deciding high-speed rail routes and in selecting locations of stations in the future.

< Figure 1 > Long- and Short-term Plans for High-Speed Rail Connection



For the convenience of high-speed rail passengers, it is necessary that its networks are linked to each other as much as possible. Therefore, it would be desirable if the transfers of trains on Seoul-Pusan high-speed rail, Honam high-speed rail, and New International Airport rail, etc. are made possible at the same spot. <Figure 1> suggests exemplary connections between those rails incorporating the idea of convenient transfers.

The high-speed rail network is crossed in an X-form with its center at the Seoul station. We might think of Northeast-to-Southwest line as <Seoul - Pyongyang - Shineuiju> line, and the other North-to-Southeast line as <Seoul - Hamyang - Vladivostok> line. In the long run, it would be required to construct direct lines linking local stations directly to avoid unnecessary transfers in the central station which may be increased after reunification of Korea. In case of France, they recently constructed routes linking local situations at outer blocks, thus, prevents unnecessary transits passing through downtown areas.

To induce a rapid progress in the metropolitan area that is doomed to play leading roles in a central zone for Northeast Asia, high-speed rail networks have to be constructed in a way to allow convenient links among Seoul-Pusan and Honam high-speed rails, and East-West high-speed rail as well as Northward routes after the

Koreas unification. In addition, high-speed rail networks should be arranged in a way that maximizes its positive effects through its close relation to traffic networks in Seoul and the Greater Seoul.

Based on these ideas, a conception of future railway networks in Northeast Asia including South and North Korea as well as mainland China is presented in the following section.

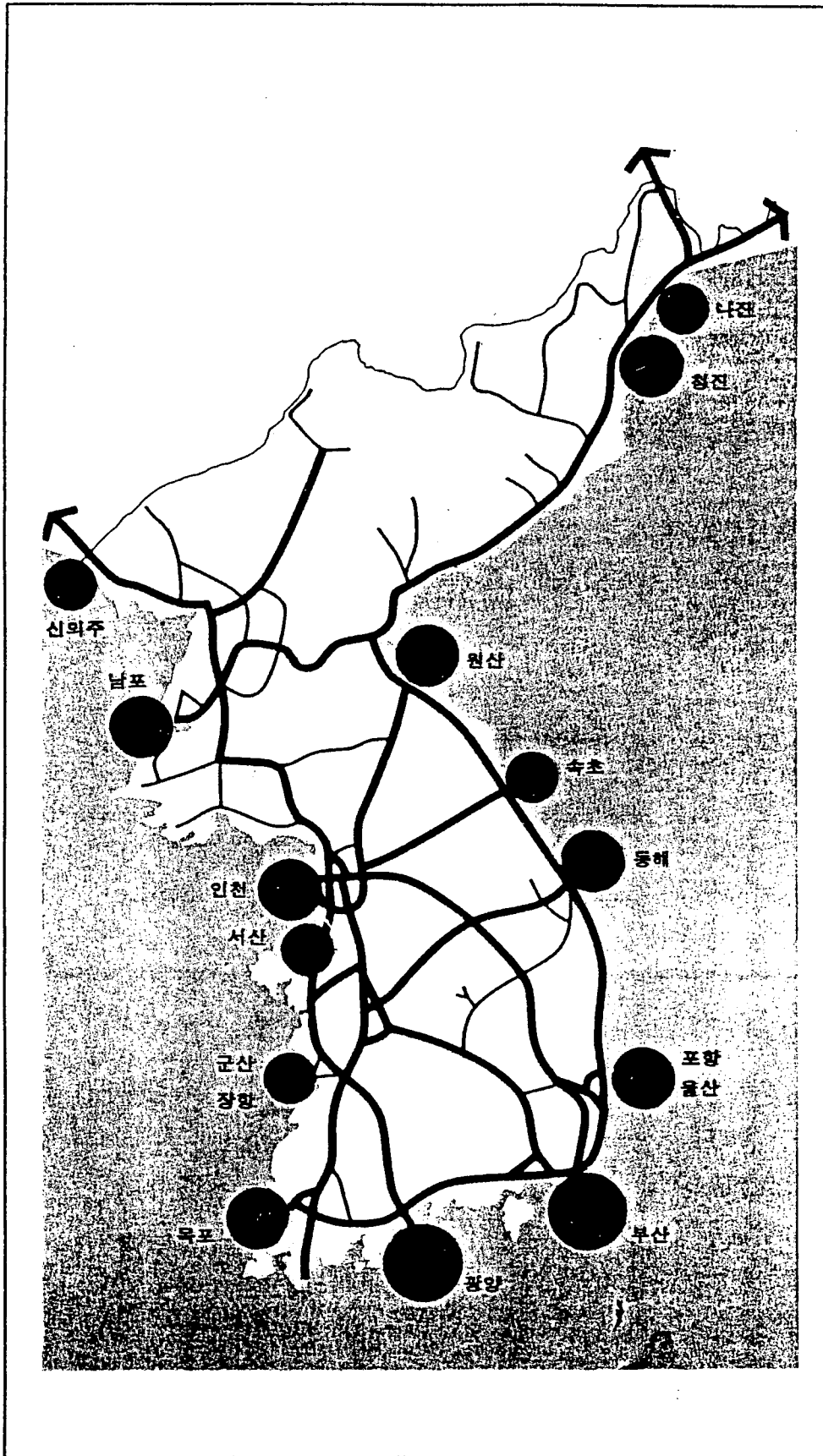
III. A Long-term Conception of Railway Networks in Northeast Asia

<Figure 2> represents a combined railway networks in the united Korea based on the mid-term and long-term Railway System Development Plan in Korea. The figure shows that four South-to-North axes and four East-to-West axes provide basic structure of railway system. The four South-to-North axes include the western coast axis which is a combination of the Kwanyang - Iri - Inchon line in South Korea and Pyongsan - Pyongyang - Sariwon line in North Korea and the east coast axis which is a combination of Pusan - Pohang - Donghae - Kangrung in South Korea and Wonsan - Hamheung - Najin in North Korea. The other two South-to-North axes are diagonal ones in the unified Korea crossed at Seoul. One is Mokpo - Seoul line in South Korea linked to Seoul - Wonsan - Najin line in North Korea. The other is Pusan - Seoul line linked to Keseong - Pyongyang - Shineuiju line. The East-to-West axes include Yongdong, Jungwon, and South coast Axes in South Korea and Nampo - Pyongyang - Wonsan Axis in North Korea.

Based on these eight basic traffic axes in the unified Korea, <Figure 3> represents alternative Trans China Railway(TCR), and Trans Siberian Railway(TSR) routes.

There are four alternative TCR routes originated from South Korea. The west coast, the Mokpo-Seoul, the Pusan-Seoul, and the central axes linking either to Inchon or to Seoul consist a part of TCR through connection to Keseong-Pyongyang-Shineuiju line in North Korea. There are three alternative TSR routes originated from South Korea. The Pusan-Seoul Axis and Mokpo-Seoul Axis consist a part of TSR route through connection to Wonsan-Najin Line. The East Coast Axis can be linked to another TSR through connection from Kangrung to Wonsan.

In sum, when a railway network system of eight axes is formed in South Korea in



<Figure 2> A Long-Term Plan for Rail Network in Korea after its Unification
 (Source) A Study on Master Plan

accordance with the mid- and long-term Master Plan for Railway network presented in this study, almost all areas in South Korea can be reasonably well linked TCR and TSR routes.

IV. Criteria for Location of Stations for High-Speed Rail

Until the 19th century, the railway stations generally performed transportation of passengers and freights by connecting major cities through railway networks. They have been regarded as nerves of regional economic development and pivots of nationwide linkages. Most of the traditional station buildings had been designed for purely genuine station functions and many of them are subject to redevelopment. Many of them are not equipped with appropriate transfer facilities and hinder ground traffic flows. With recognition of merits of railway systems such as mass transportation, environmental preference, and safeness, it is expected that investment on railway construction will be increased. The new stations are most likely to be constructed as comprehensive transit centers with an emphasis of convenient transfer to other means of transportation.

Considering the importance of transfers to other means of transportation, one of the most important requirements for railway station is that its site should be flat and spacious. In other words, the station should be located in a straight-line site that secures good railway services and that is free from mountainous landforms. We must also take such factors into consideration as relations to other city functions, and connections to, as well as competition with, other means of transportation. Since a high-speed railway station induces rise in land prices with emergence of a strong node, it should be suitable for diverse future land development to enhance the efficiency of land use in the area.

Under these coherences, the list of considerations in selecting location of the central station include the following factors.

1) Aspects of city functions

- Elevation of international functions
- Conformity with directions of city developments
- Not worsening the existing overconcentration problem

2) Aspects of transmutation planning

- Ensuring good accessibility from all districts of the metropolitan area
- Easiness in construction of such traffic facilities as roads and subways for meeting additional traffic flows induced by high-speed rail construction and related developments
- Minimizing traffic increase in surrounding areas

3) Technical aspects

- Ensuring safety in construction process
- Shortening of construction period, and reducing construction expenses
- Causing minimum inconveniences to citizens during construction period

4) Economic aspects

- Retrieval of windfall gains from the development
- Minimizing access costs

5) Environmental aspects

- Minimizing environmental damages
- Minimizing inter-regional separations by railway routes

V. Analyses on Central Station Locations

A station building of high-speed rail is one traffic facility. However, urban activities occurring around it do carry high centralities both qualitatively and quantitatively. Therefore, the central station should be located in an area that is close to CBD to allow easy accessibility from all areas, and at the same time enable to eliminate extra traffic flows passing through CBD. The area should be suitable to promote development in lagged regions to provide central function for international services of the 21st century, and to help formulating desirable urban spatial structure in the future. Given these criteria of evaluation, we can compare the Yongsan station with the Seoul station as an alternative of the central station of the Seoul-Pusan high-speed rail.

5-1. Comparison of Alternative Locations for the Central Station

<Table 1> Comparison of Alternatives for Location of the Central Station

Analysis Category		Yongsan Station	Seoul Station	
Quantitative Analyses	Size of Sites	65,050 Pyong	76,000 Pyong	
	Congestion costs	Traffic control expenses: 300 billion Won Development profits: 1,200 billion Won	Traffic control expenses: 750 billion Won Development profits: 440 billion Won	
	Passenger Access Time	98 minutes	104 minutes	
Qualitative Analyses	Urban planning aspects		Capable of development as a new subcenter Contribute to reformulating urban spatial structure Large rear-land to promote further developments	Close to the existing downtown. No rear-land for further development
	Access facilities	Subway	Now 2 lines(#1 & 4 line). 2nd term-1 line(#6), 3rd term-1 line(#10) via New Airport railway	Now 2 lines(near to #1 & 4) Add New Airport line. 3rd term subway-1 ling
		Roads	Han River road(50m, 10 lanes), Yongho road, Riverside road, Inner circular expressway (Riverside north road 8 lanes) is near, proximity be elevated when inner circular express way is opened.	Han River road, Chongpa road (25m, 6 lanes), Namdaemun road, Manlijae road are now over-saturated and difficult to add new roads
	Technical Aspects		When building high-speed rail's station buildings at Yongsan station square, open-cut works are possible.	Difficult to build underground station under existing station buildings(existing railway runs to same direction.)

5-2. Examination of Location at the Seoul Station.

Local station in Southwest Area

① Aspects of Urban Spatial Structure

When the central station of Seoul-Pusan high-speed rail is located at the Seoul station, the problem of overcentralization will get worse due to addition of high-speed rail station's functions to the Seoul station located at downtown districts, which will stifle the efforts to change the urban spatial structure from a mono-centric to poli-centric one. It is estimated that the share of passengers of the Seoul station is 72% and that of the South Seoul Station will be 28%, which will bring about serious congestion problem around them.

② Aspects of Traffic

When the Seoul-Pusan high-speed rail is opened in 2001, its daily passengers are estimated to be 1.3 million, and the number will increase to 1.8 million in 2011. Significant portion of passengers from the Kangnam area (Southern part of Seoul) will cause traffic congestion, and the increase in the number of passenger will slow down the average traffic speed to less than 10 Km/h in major roads around the station. Surrounding districts of the Seoul station has been already fully developed and the area consists of bottleneck blocks, therefore, new opening or expansion of roads will be very difficult. Any additional construction of traffic improvement is also difficult because of the lack of linkage to outer roads. An alternative to construct a new urban expressway linked to inner circular expressways designed control the outer traffic flows is not a good idea in the senses that it causes social loss and that it is technically infeasible.

As the high-speed rail is opened with its central station buildings located in the Seoul station in 2001, additional 209 thousand cars a day and 37 thousand cars in peak hours will be running on the roads surrounding Seoul station. In 2031, it is estimated that 263 thousands additional cars a day and 47 thousand cars in peak hours will take roads around the station. The increased number of traffic flows require to construct additional 18 lanes in 2001, and 23 lanes in 2031, respectively. Meanwhile, it would be quite difficult to construct underground developments or

Light Rapid Transit (LRT) construction on Namdaemun road. Since new Airport rail which is designed for exclusive use of terminal passengers does not make any contribution to relieve subway congestion, it is estimated that additional subway passengers in 2001 will be 440 thousand a day and 800 thousand in peak hours.

③ Aspects of Developments of the Surrounding Areas

The Seoul station's sites are rather narrow for developments (some 76,000 Pyong) and its surrounding districts have already been fully developed. There is little room to develop its surrounding areas in an efficient way. The total possible developments in its surrounding areas include:

- the size of high-speed rail's station buildings and related facilities that was presented by the Ministry of Construction and Transportation is 340,000 Pyong in 2012, which is two times as large as Chamsil Lotte World and Trade Center at Samsung-dong combined.
- the overall induced demand with the completion of Seoul station will be 1,269 thousand persons, which is 4.3 times as many as that of Chamsil Lotte World (310 thousand persons) and 6.2 times of that of Trade Center at Samsung-dong.

5-3. Examination of Location at Yongsan Station

① Urban Spatial Structure

It is expected that Seoul will play very important roles in the world society in the 21st century and the City government is formulating plans to induce changes in urban spatial structure through many developments projects to meet Korean unification and changes in postulates. Among them, the Yongsan area is expected to grow as a future-style urban space through inducing high-tech electronic and information industries with a strong relation to a folk park.

The entire Yongsan station areas are considered as the optimum location capable of displaying splendid wide-region accessibility in the future aspects of developments because it is in the vicinity of downtown districts. It can also eliminate traffic flows passing through downtown, formulate a future-type city space structure by promoting developments of retarded districts, and provide central functions for

international services.

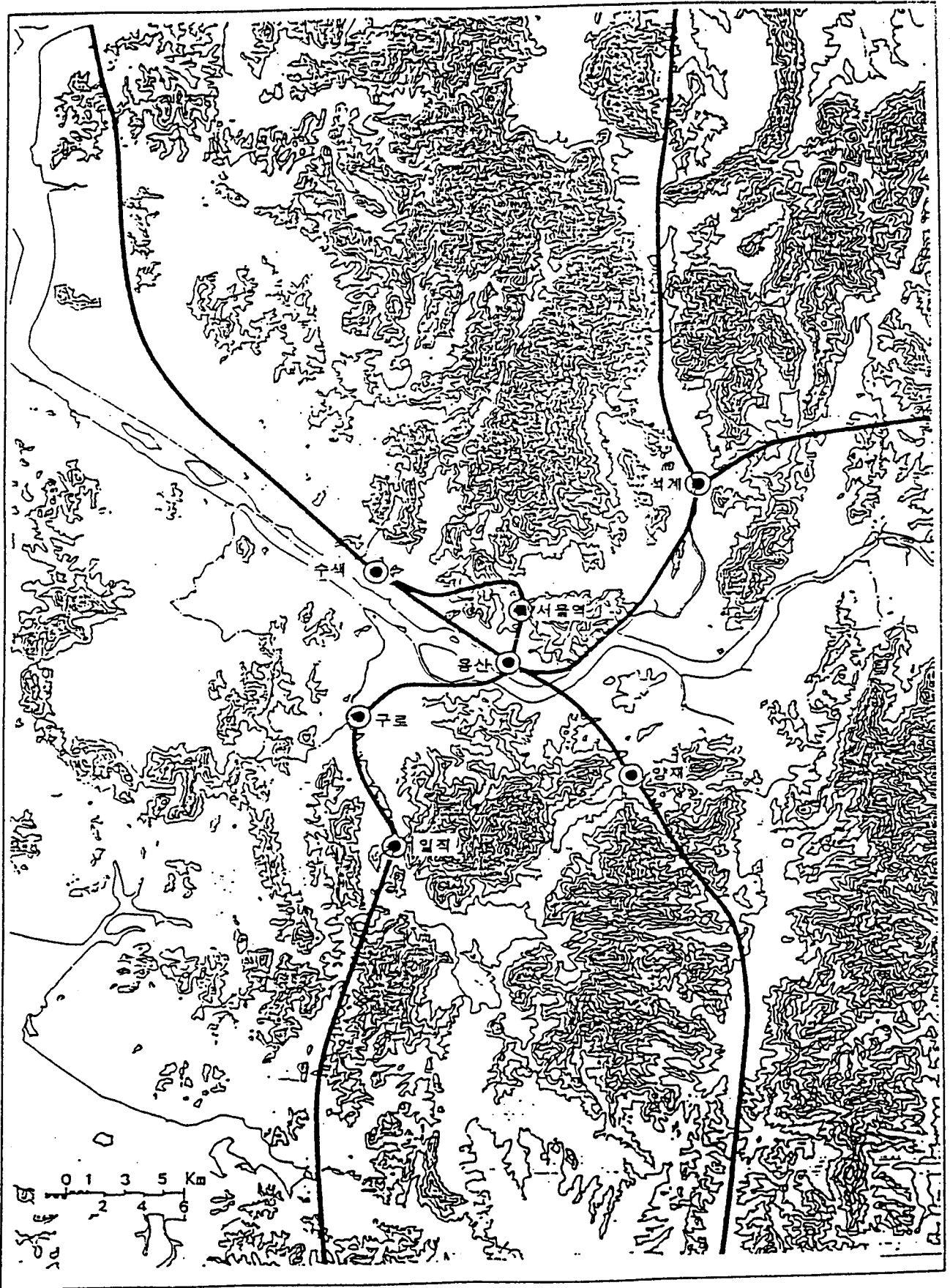
② Aspects of Traffic

Currently, the major roads passing through the Yongsan area are Han-river road (10 lanes), Banpo road (10 lanes), Itaewon road (6 lanes), Seobingoo road (8 lanes) and Riverside road. In addition, Chongpa, Yongho, Baekpum and Ichondong roads are playing supplementary roles. The railway networks passing through the area include the number four blue line of the Seoul Metropolitan Subway Network, the Yongsan Line and the New Airport Line. Those traffic connections in this area show locational advantages over Seoul station in providing better postulates for the construction of traffic facilities to manage traffic flows induced by locations of high-speed rail. Studies on the effects of high-speed rail locations on surrounding road networks show that Yongsan station is in a better position in addressing traffic congestion.

③ Aspects of Developments of the Surrounding Areas

The area of the Yongsan station is located 5 km southwest of downtown Seoul, 3 km south of the Seoul station and 5.5 km away from Yongsongpo, which shows relative vicinity to urban centers and subcenters. To the northeast of Yongsan the Namsan Hill stands, and the Han River flows in the south. The area does form a central zone for both railway and roads that link northern and southern districts of the Han River. From the point of land use, the most of development was completed by the 1960s, and the most of the area is taken by railway for the Yongsan station, repair shops, small-scale workshops, stores for old age as well as low-density living quarters, all mixed together. Therefore, a large-scale development is quite feasible by an activation of surrounding less-developed land (railway sites); and a creation of comfortable and vigorous spaces of new downtown is possible by promoting large-scale readjustment of less-developed rear land.

In conclusion, the Yongsan station does enjoy a comparative advantage over Seoul station as a location of the central station of high-speed rail. The above analyses lead to the conclusion that the central station should be located at the Yongsan station.



<Figure 4> The High-Speed Rail Routes and Alternative Station

VI. Conclusion

Since a high-speed rail has great impacts on changes in spatial structure, its construction has close relations not only with the surrounding areas of its stations, but also with developments of entire cities where the rail passes through. In this respect, a Master Plan for the high-speed rail construction should be built in no time. Considering that the rail has been already under construction, it might be too late even to mention it.

In 1993, a long-term plan with a gist of building the central station and four local stations was presented as an alternative plan. According to this plan, local stations in northwest areas, after the unification of Korea, are to be linked with Shineuiju and China via Kaesung and Pyongyang, those in northeast areas are to be linked with East-West high-speed rail and Wonsan-Siberia railways. The central station is to play functions as a knot for departure and arrival of the high-speed rail. Since these local stations also have as great impacts as that of the central station on the development of Seoul, their locations must be chosen in conformity with desirable spatial structure change in Seoul.

It is appropriate to develop the central station in Yongsan area rather than Seoul station from the point of desirable restructuring of urban spatial pattern, relieving traffic congestion, development effects, and environmental protection. In case of local stations, one will be established by each direction, and their locations are investigated in view of city development plans and railway re-adjustment plans of pertinent cities.

Lastly, as we consider that the central station of high-speed rail in Greater Seoul shall have to be a starting point for Northeast Asian railway networks, it is required to build close cooperative systems with such related countries as North Korea and China in the process of its development and choice of its location.