AN ANALYSIS OF TOPOLOGICAL INTERFACES IN THE TRANSFER PATH OF THE URBAN RAILWAY STATION

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Abstract - Recently the number of passengers on urban railways has been continuously increased, and the inconvenience of passengers has been increasing due to insufficient facility, transfer distance and time. Therefore, there is a need for a high-speed, large-scale moving system for smooth transportation of passengers at urban railway stations and transfer stations. Also, there is a need for linking with existing routes and optimizing transfer routes according to increase in the number of railway lines. The facilities improvement projects in the station of urban railways are focused on convenience of mobility and are implemented in parallel with aging and capacity limitations. However, it is difficult to continue the improvement project because of the enormous cost. In this study, we investigated the present conditions of the topological interface, i.e. space and structural interface, on Cachisan station through a field survey. Based on the results, the improvement in the transfer path for the general passengers and the passengers with a handicap are suggested.

Keywords - Transfer Path, Space and Structural Interface, Passengers with a handicap, Urban Railway Station

I. INTRODUCTION

Recently the number of passengers on urban railways has been continuously increased, and the inconvenience of passengers has been increasing due to insufficient facility, transfer distance and time. Therefore, there is a need for a high-speed, large-scale moving system for smooth transportation of passengers at urban railway stations and transfer stations. Also, there is a need for linking with existing routes and optimizing transfer routes according to increase in the number of railway lines. The facilities improvement projects in the station of urban railways are focused on convenience of mobility and are implemented in parallel with aging and capacity limitations. However, it is difficult to continue the improvement project because of the enormous cost [1]. In this study, we investigated the present conditions of the topological interface, i.e. space and structural interface, on Cachisan station through a field survey. Based on the results, the improvement in the transfer path for the general passengers and the passengers with a handicap are suggested.

II. THE PATH OF PASSENGERS WITH A HANDICAP

2.1. Analysis of the Passengers with a handicap

The utilization of passengers with a handicap is increasing due to aging, low fertility, and internationalization, and the passenger is diversifying. It is necessary to prepare measures for user-customized services, including the passengers with a handicap, rather than normal services [1]. According to the results of the survey on the convenience of passengers with a handicap in 2012, Korea's passengers with a handicap population is about 24.5%, which is about 24.1 million. Among the passengers with a handicap, the elderly (over 65 years old) occupied the highest proportion (45.9%) with 5.7 million [2].

2.2. Analysis of the Wheelchair Lift

In the case of urban railroad station where elevators cannot be installed, the wheelchair lift was installed on the stairs. However, the wheelchair lift is a facility in which the risk of accidents is high and a disabled person is avoided because a serious accident or fatal accident occurs. The number of wheelchair lift accidents has been one or two since 2000, but has soared to 13 in 2006 ~ 2009. Most accidents are motorized wheelchair accidents since 2006 [2]. The number of wheelchair lifts and elevators on which motorized wheelchairs can be boarded is limited. It is necessary to develop and disseminate a moving facility that allows the use of a motorized wheelchair through analysis of the size, weight and usage of motorized wheelchairs.

Division	Person	Proportion
Total	12,409,503	100.0%
The Disabled	1,561,417	12.6%
The Elderly	5,700,972	45.9%
Pregnant Woman	471,265	3.8%
Child	2,347,414	18.9%
Infant and Toddler Companion	2,328,435	18.8%

Table1: Status of the Passengers with a handicap in 2011

Year	Place	Accident Contents
2000	Jongno 3-ga Station	The Disabled using a motorized wheelchair fell to the rear during a lift operation and were injured.
2001	Oido Station	One of the elderly died and one of the elderly was seriously injured

2001	Hadan Station	The wheelchair lift was suddenly stopped during operation and the disabled fell down the stairs
2002	Balsan Station	The disabled using a motorized wheelchair crashed into the stairs while getting off the lift, suffered injuries and died
2004	Seoul Station	The 1st grade disabled using a motorized wheelchair goes over the lift front lamp and falls to the stairs and gets injured
2005	Toseong-dong Station	The wheelchair is pushed forward and injured by banging the neck and chest on the safety guard
2006	Hoegi Station	When the disabled carrying a motorized wheelchair was about to board a wheelchair lift, the wheelchair departed and went down the stairs after the front lift ramp and collision.
2006	Busan Station	The disabled who boarded a motorized wheelchair was going to board the wheelchair lift and went down the stairs after the front ramp of the lift.
2006	Haean Station	The motorized wheelchair crashed while trying to board a lift that ran on a motorized wheelchair
2008	Hwaseo Station	The disabled is killed by a motorized wheelchair with front stairs while using fixed wheelchair lift
2009	Samgakji Station	The 1st grade disabled using a motorized wheelchair goes down the stairs using a fixed manual wheelchair lift

Table2: Major wheelchair lift accident cases

III. THE STATUS OF TRANSFER PATH AND IMPROVEMENT PLAN OF CACHISAN STATION

3.1. The field survey and result of transfer path of Cachisan Station

The general passengers (person)	The passengers with a handicap (person)	The passengers with a handicap rate (%)	The transfer passengers (person)	Demand classification
35,121	8,624	20	7,725	Medium size

Table3:Passenger Demand Status of Cachisan Station

Cachisan Station is a parallel transfer station of the one-way platform of the No. 2 line (underground 5th floor) and the separate platform of the No. 5 line (underground 5th floor). For the general passengers, the transfer distance is approximately 379m, which takes up to 5 minutes and 16 seconds. In the case of the passengers with a handicap, the transfer distance is about 366m, but the transfer time is about 22 minutes and 50 seconds because of using a wheelchair lift. The number of general passengers is about 35,121 and the number of passengers with a handicap is about 8,624, and the number of transfer passengers is about 7,725 per day in 2014. There are four exits, two exits are installed with escalators, and one exit is installed with a wheelchair lift.

Exit number	The moving system	Exit Width (mm)	Presence of ramps
1	Escalator	2,180	None
2	Stairs+Wheelchair lift	2,180	Exist
3	Escalator	2,480	None
4	Stairs	2,510	None

Table4: Exit moving system status of Cachisan Station

3.2. Transfer path improvement plan

Due to structural characteristics of Cachisan Station, the platform is located on the underground 5th floor, so it is very uncomfortable to use because it is deep and has no elevator. The transfer time of No. 5 line to Sinjeong is short and transfer is easy due to a flat transfer. Whereas, Stairs or Escalator should be used for No. 5 line to Hwagok.

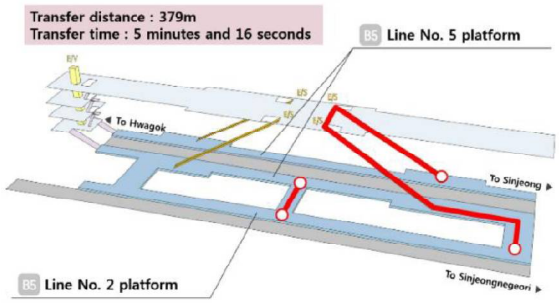

Fig.1. The transfer path for the general passengers of Cachisan Station

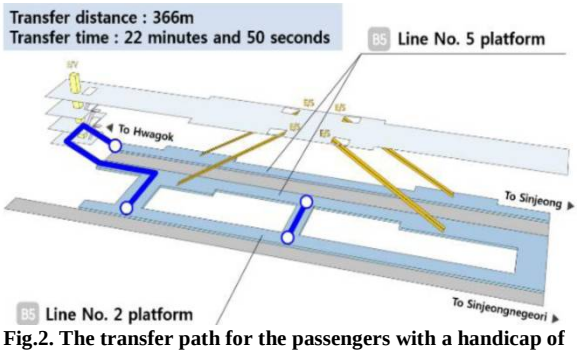

Fig.2. The transfer path for the passengers with a handicap of Cachisan Station

Using the stairs takes 1 minute 48 seconds to connect to the underground 4th floor passage. On the other hand, using the escalator takes 3 minutes 42 seconds

to connect to the 1st floor underground waiting room. The general passengers prefer stairs because of the time. The passengers who do not know the station structure cannot judge the path and congestion is generated for selecting the direction, so congestion can be improved by applying the reversible moving line guidance system linked with train time.

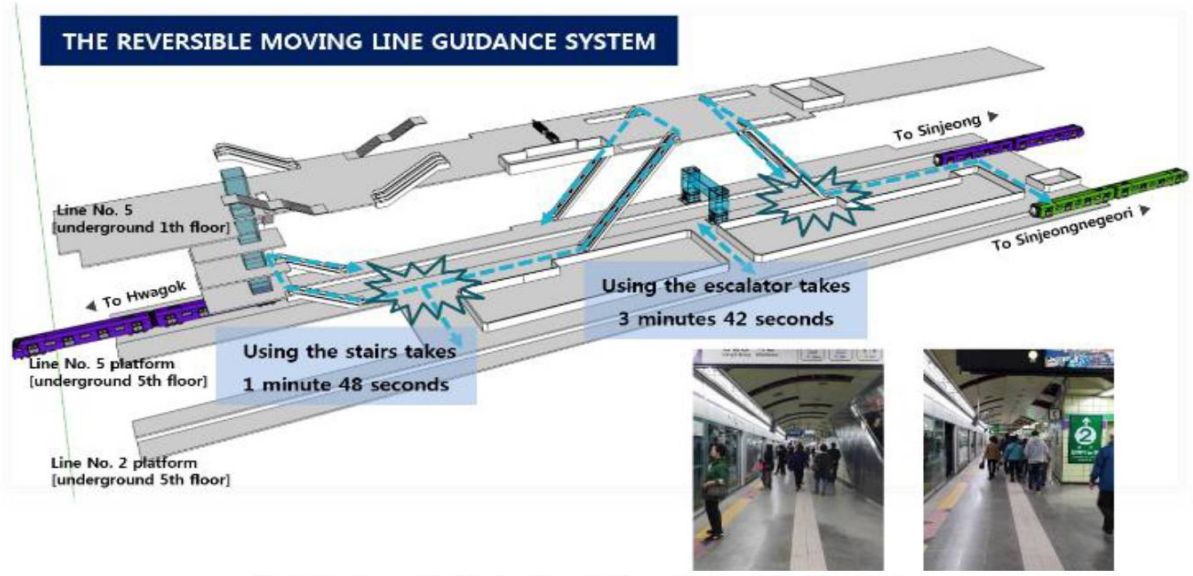

Fig.3. The Reversible Moving Line Guidance System of Cachisan Station

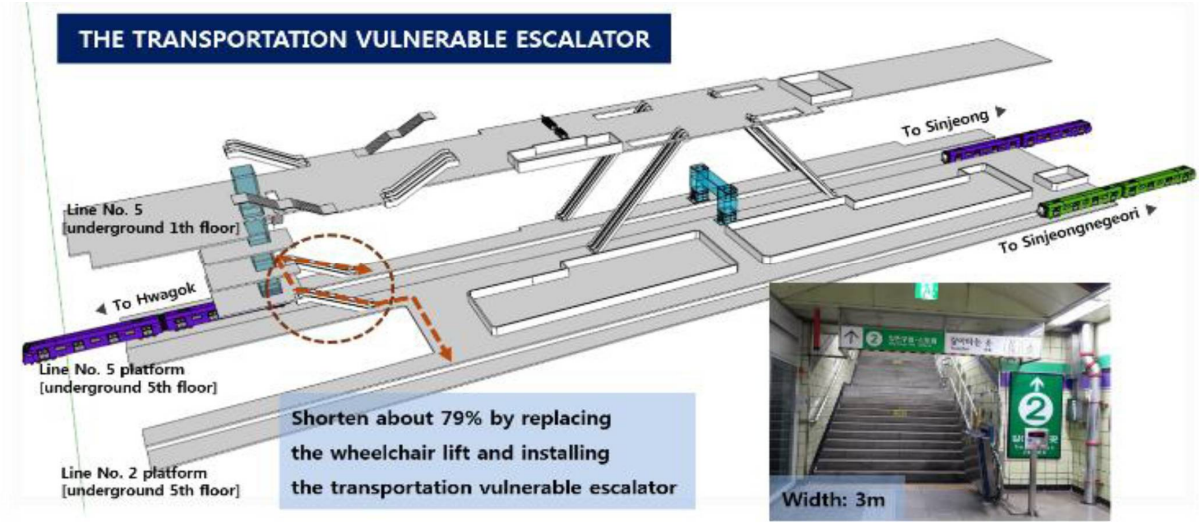

Fig.4. The passengers with a handicap escalator of CachisanStation

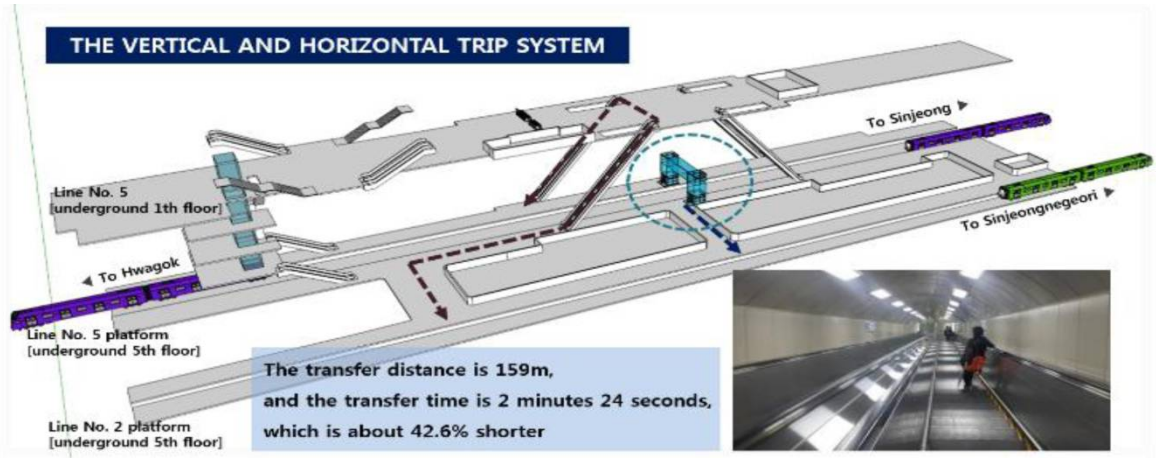

Fig.5.The vertical and horizontal trip system of Cachisan Station

Unlike the general passengers, the passengers with a handicap is very uncomfortable to have a transfer time of about 22 minutes and 50 seconds because they need to transfer using a wheelchair lift installed on the stairs.It is possible to shorten about 79% by replacing the wheelchair lift and installing the passengers with a handicap escalator.In addition, in case of installing the vertical and horizontal trip system without using stairs or escalator [3], the transfer distance is 159m, and the transfer time is 2 minutes 24 seconds, which is about 42.6% shorter.

CONCLUSIONS

This research was investigated the present conditions of space and structural interface on Cachisan station through a site inspection, and it presented the improvement plan through the analysis on the movement and transfer path for the general public and the disabled. Conclusions of this research are as follows:

1. Cachisan Station is a parallel transfer station of the one-way platform of the No. 2 line (underground 5th floor) and the separate platform of the No. 5 line (underground 5th floor). For the general passengers, the transfer distance is approximately 379m, which takes up to 5 minutes and 16 seconds. In the case of the passengers with a handicap, the transfer distance is about 366m, but the transfer time is about 22 minutes and 50 seconds because of using a wheelchair lift.
2. Due to structural characteristics of Cachisan Station, the platform is located on the underground 5th floor, so it is very uncomfortable to use because it is deep and has no elevator. The transfer time of No. 5 line to sinjeong is short and transfer is easy due to a flat transfer. Whereas, Stairs or Escalator should be used for No. 5 line to Hwagok. Using the stairs takes 1 minute 48 seconds to connect to the underground 4th floor passage. On the other hand, using the escalator takes 3 minutes 42 seconds to connect to the 1st floor underground waiting room. The general passengers prefer stairs because of the time. The passengers who do not know the station structure cannot judge the path and congestion is generated for selecting the direction, so congestion can be improved by applying the reversible moving line guidance system linked with train time.
3. Unlike the general passengers, the passengers with a handicap is very uncomfortable to have a transfer time of about 22 minutes and 50 seconds because they need to transfer using a wheelchair lift installed on the stairs. It is possible to shorten about 79% by replacing the wheelchair lift and installing the passengers with a handicap escalator. In addition, in case of installing the vertical and horizontal trip system without using stairs or escalator, the transfer distance is 159m, and the transfer time is 2 minutes 24 seconds, which is about 42.6% shorter.

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