Policies

[Metro] Seoul's Project for Sustainable Safety on the Subway

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Background to Seoul's Subway Project

In line with the rapid industrial and social development of the early 1970s, Korea’s population began to concentrate in urban areas. The huge increase in urban population density eventually led to severe traffic congestion, and the city began to construct a subway system as part of the measures to cope with the problem. After opening nine subway stations on Line 1 in 1974, the city added lines 2, 3 and 4 by 1985. By the time the secondary subway lines (5, 6, 7 and 8) were opened, the subway system was carrying over 6.3 million passengers per day, or 50% of Seoul's population. Each year, Seoul's subway system accounts for 35% of the transportation share in the city; while the number of passengers has more than doubled, and both the number of areas served and the number of subway stations have increased significantly.

However, accidents related to safety on station platforms soared with the dramatic expansion of the subway lines along with the increase in the system’s share of city transportation. Simple incidents such as engine breakdowns or delays were replaced by falls from subway platforms, passengers getting caught in subway doors, collisions, fires, and equipment failures. Furthermore, environmental pollution and noise in subway trains and on platforms have also increased, but the installation of safety equipment has been insufficient to keep up with the rapid expansion of the subway system and the poor management of equipment.

<Table 1> Accidents on the Seoul Subway System (prior to 2003)

	Total	1998	1999	2000	2001	2002	2003
Total	652	85	93	87	92	148	147
Fatalities	296	39	49	34	54	50	70
Injuries	356	46	44	53	38	98	77

Source: Kim Sang-woon et al. (2004)

With increasing public awareness on subway safety and pollution, the Seoul Metro and Metropolitan Rapid Transit Corporation received KRW 36 billion from the city government in 2005 to begin the construction of platform screen doors that same year. As well as dramatically improving the environment around subway platforms, Platform Screen Doors (PSDs) prevent people from accessing the rail areas, thereby preventing rail-related fatalities, and also improve the air quality by helping to contain fine dust. They also decrease noise and train-induced winds and the spread of fire, and save energy. Besides installing PSDs, Seoul Metro, the Metropolitan Rapid Transit Corporation, and Seoul Metro 9 (three main Seoul subway operators) provide training and equipment to effectively respond to environmental changes and improve safety as part of the ongoing subway safety project.

Subway Safety Systems

PSDs (Platform Screen Doors)

Seoul City injected emergency funds into Seoul Metro and the Metropolitan Rapid Transit Corporation to rush the construction of PSDs due to concerns about subway safety – particularly after the Daegu Subway Fire in 2003. As a result, the first PSDs were installed at Sadang Station towards the end of 2005, and the city announced plans to install PSDs at all subway stations by 2010. However, with the ongoing and relatively frequent occurrence of fatalities and casualties during the PSD construction period, the city was compelled to accelerate its plans, installing them on 120 Seoul Metro platforms (Lines 1-4), 148 Seoul Metropolitan Rapid Transit platforms (Lines 5-8), and 25 Seoul Metro 9 platforms in 2009.

There are four main benefits attributable to the installation of PSDs, the first of which is greater passenger safety. Due to the increase in demand for transportation, the existing platforms had become congested, and the close proximity between passengers and rail lines

led to frequent contact with subways or to falls from the platform as a train approached a station. Such risks, however, can be prevented if PSDs are installed between platform and passengers. In the event of a fire in a subway train, the PSDs can be closed to restrict the spread of gases and smoke while allowing passengers to evacuate the train. Second, PSDs facilitate safer operation of the subway trains. Since passenger safety has been secured, the train operator is better able to concentrate on operating the trains, which helps to ensure their own safety. Third, PSDs provide a pleasant station environment, as passengers know that both contamination and noise levels are reduced. Fourth, PSDs assist energy saving efforts. The doors keep the heat generated by the trains out of the platform area and prevent the outflow of cool air from the train into the tunnel, thereby reducing the cooling load.

In general, the main structural components of PSDs are fixed partitions, doors, driving gears, safety devices, a central control panel, and a display console. Fixed partitions are designed to withstand pressure from both crowds of passengers and from trains; the design also combines supports and transparent glass to ensure open visibility of the tracks and platforms. Each PSD consists of a set of two sliding power doors with pressure-resistant transparent glass. The driving gear receives signals from the control panel to open and close the system through automatic interlocking; the initial design also considers maintenance, durability, and precision. Safety devices are designed to set off an alarm and open the doors in the event of safety issues, such as when a passenger's clothes or belongings get caught in the door while getting on or off the train. The gap between the platform and PSD is generally less than 10 cm; however, this gap widens to 10 cm or more at curves in the platform structure, at both ends of a platform where the PSD control equipment and monitors are installed, and at platforms that service both passengers and freight.

As shown in Figure 1 below, there are three types of PSDs: hermetic, semi-hermetic, and open railing. The hermetic PSD is used at most subway stations. Although the initial investment and maintenance costs are high, this type is most suitable for blocking train and mechanical ventilation noise and maintaining air conditioning efficiency. As for semi-hermetic and open railing screen doors, these are used at ground level stations and entail lower initial investment costs than hermetic PSDs. These types of PSDs are used where additional air conditioning systems are not in operation, and are focused more on passenger safety and less on blocking train-induced wind and noise.

<Figure 1> PSD Types

Hermetic PSDs: This system stretches from platform floor to ceiling, completely separating it from the track area. This type of door can dramatically reduce noise, train-induced wind, and dust in the platform area, as well as improve air conditioning efficiency.

Semi-hermetic PSDs: This is also installed at a height of approximately 2m, similar to the hermetic PSD, but with the top open between the track area and platform. While less effective at reducing noise and train-induced wind, it prevents passengers from falling onto the track. Understandably, construction costs are lower than for the hermetic PSD.

Open Railing PSDs: These are about half the height of the hermetic PSD. Installation is cheaper than other PSDs, but it does not provide complete protection for passengers as they can put their heads over the PSD.

Crime Prevention through Environmental Design (CPTED)

Seoul City endeavors to prevent subway crimes – of which there are over 2,000 cases each year - to enhance station comfort and safety. In June 2014, it announced that it would introduce the CPTED program at five stations on Line 9 (thus making it the first public transit locations applying CPTED) and establish the Subway Station Crime Prevention Guidelines. Seoul City established safety zones (5m long and 2m wide) on train platforms, and is now planning to install CCTVs (closed-circuit television), emergency phones, emergency alarms, large mirrors, and monitors to discourage crime and to respond promptly when they occur.

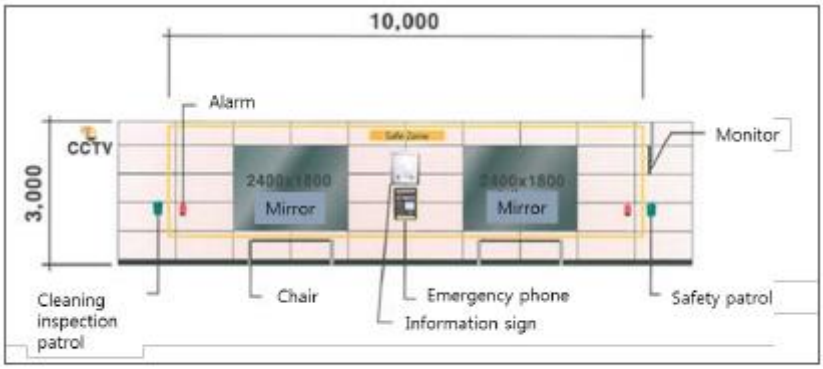
In order to enhance the effectiveness of the CPTED program, an analysis of the correlation between crimes recorded at 209 stations on subway lines 1-8 during the period 2009-2012 and station space was conducted, and consultations with experts were held to identify potential countermeasures. The proven effectiveness of the CPTED program in preventing crime beings peace of mind to late night/early morning subway travelers. Based on its experience of installing platform safety zones, the city government will apply the CPTED program to Line 9 Phase 3 stations and light railway platforms after establishing the Subway Station Crime Prevention Guidelines.

<Figure 2> Crime Prevention through Environmental Design

(a) Before (b) After

Source: Seoul City Press Release (2014)

<Figure 3> Crime Prevention through Environmental Design Proposal



Source: Seoul City press release (2014)

Subway Sheriff System

The Subway Sheriff System is another response to subway crimes that was established by the city to promote public order, create a more pleasant subway environment, and help the elderly and the disabled. Subway sheriffs undergo a broad training program that includes countermeasures against crime, firefighting, first aid, and crime and accident prevention. Since 2011, of the four subway lines (lines 1-4) operated by Seoul Metro under the control of Seoul City, approximately forty subway sheriffs have been dispatched to lines 1 and 2. In 2012, the subway sheriff system was expanded to the lines run by the Seoul Metropolitan Rapid Transit Corporation, and the number of sheriffs was doubled. Seoul Metro 9 also adopted the system after its opening in 2009. Among the diverse illegal activities dealt with by subway sheriffs between 2011 and January 2012 were soliciting (6,726 cases), public drunkenness (4,759 cases), newspaper collection (3,854 cases), begging (2,211 cases), and sleeping out in the open (1,997 cases). Any person apprehended by a subway sheriff for committing an illegal activity is taken to the Police Task Force and freed after admonition or paying a fine.

<Figure 4> Subway Sheriffs on Duty

Source: Seoul City Press Release (2011)

Station Safety: Hands-on Experience

The Seoul Metropolitan Rapid Transit Corporation operates a hands-on program for vulnerable transportation users such as children and the elderly who are frequently exposed to safety issues or inconveniences. The Metro Safety Experience Class provides training on theory and practical experience on subway safety, general use of the subway, fire extinguisher handling, emergency phones, ticket vending machines, and public transportation etiquette. Through visits to urban rail facilities such as stations and depots, participants in the program are able to increase their understanding of subway operations and safety regulations. Other topics include the operation of

subway emergency doors in the event of a fire, and advice on what to do in the event of an actual accident or disaster.

CBTC (Communication Based Train Control)

The CBTC of Seoul subway lines 5-8 operated by the Seoul Metropolitan Rapid Transit Corporation was using a fixed block for train detection on the main section. While the method offers excellent stability, it also creates a loss of distance equivalent to - at times - as much as the track circuit's full length in terms of the detection of the absolute position of a train; thus it is rather inaccurate, causing higher maintenance costs due to the need for more equipment onsite and in the signal machine room. In order to overcome these limitations and actively convert to a new system, the Seoul Metropolitan Rapid Transit Corporation developed a new radio-based train control system and has begun operating it on a trial basis in three areas of Line 8. This new Train Control System consists of a train detection system that can accurately and continuously relay a train's location and speed, and a system that controls trains using information transmitted via radio communication. The system is still in the pilot phase, but once it is fully developed, all train control will become fully automated (and thus unmanned), which is expected to result in improved cost savings, safety, efficiency, maintainability, and passenger convenience compared with the existing block systems. Continuous developments in railway system engineering are also expected to continue effectively decreasing safety problems.

Main Achievements

As a result of a variety of subway safety measures, PSDs have been installed in all subway stations in Seoul as of 2009, providing a comfortable subway environment for subway users and workers. Starting with Sadang Station in 2006, PSDs have since been installed on 120 platforms on Lines 1-4 (Seoul Metro), 148 platforms on lines 5-8 (Metropolitan Rapid Transit Corporation), and 25 platforms on Seoul Metro Line 9. Prior to their installation, over 30 people were injured or killed annually, either as a result of suicide attempts or falls from subway platforms. Since their installation, however, platforms and tracks have been separated and the number of deaths and injuries due to suicides and falls on the tracks has decreased dramatically.

<Table 2> PSDs on the Seoul Subway System (as of July 2012)

Total No. of stations	Total No. of stations fitted with PSDs	Ground Subway Stations		Underground Subway Stations	
		Hermetic PSDs	Semi-hermetic PSDs	Hermetic PSDs	Semi-hermetic PSDs
293	293	269	0	22	2

<Table 3> Accidents on the Seoul Subway System

	Total	2009	2010	2011	2012
Total	65	57	8	3	4
Fatalities	31	29	2	1	
Injuries	34	28	6	2	

Source: Rail Safety Information System (http://www.railsafety.or.kr)

<Table 4> Suicides on the Seoul Subway System

Year	2007	2008	2009	2010	2011	2012
No. of Suicides	56	37	44	0	2	0

Source: Korea Railroad Corporation (2012)

Seoul Metro, the Seoul Metropolitan Rapid Transit Corporation, and Seoul Metro 9 have installed a variety of safety equipment on their trains and platforms, and provide guidance and training programs on their websites and Internet blogs. In terms of safety equipment, three portable emergency flashlights are made readily available every 25m, while fire extinguishers are placed every 20m on platforms and in transit lounges. A total of 334 gas masks are available at each station, and 792 sprinkler heads are placed at intervals of 4.6m on transit lounge ceilings to assist subway users in evacuation during a fire or emergency.

Air quality in subway stations has also been improved, as has the station environment, by reducing noise and fine dust. The city also endeavors to monitor the air quality by measuring the temperature, humidity, and fine dust in real time via sensors installed on platforms and in transit lounges. The fine particle readings in Seoul Metro's transit lounges showed an average of 131.4㎍/㎥ before the PSDs were installed, and an average of 80.4㎍/㎥ after their installation, representing a decrease of 35.3%. The amount of radon (a radioactive element) has also fallen each year. The lowest measurements at Seoul subway stations were recorded in 2010, i.e. the year after the introduction of the PSDs, and these levels are still being maintained today. The average concentration of radon for the ten years between 2000 and 2009 stood at 2.76pCi/L, while the measurements taken after the installation of the PSDs in 2010 and 2011 showed concentrations of 1.12pCi/L, representing a reduction of 59.4%. Noise, too, has decreased at all stations, although the degree varied depending on the type of PSD installed. Specifically, stations installed with hermetic PSDs recorded average noise levels some 7.3 dB less than before. In Seoul Metro stations, noise levels dropped from 78.3 dB to 72.1 dB, i.e. a reduction of 7.9%. Ventilation and air

conditioning costs also decreased by 18%, while electricity costs dropped by 33%, from KRW 19.447 billion to KRW 13.055 billion.

Limitations & Necessary Improvements

The safety of Seoul Subway has reached the level of advanced nations thanks to the projects that have been promoted by various organizations and higher awareness of the importance of safety among the general public. However, certain incidents with the potential to lead to larger events continue to occur, such as derailments caused by the malfunctioning of stop signals, passengers who cause fires in trains, and passengers who get caught in the screen doors among others. Other problems are also being pointed out besides safety issues, such as the high costs and heavy workload required to maintain the PSDs.

Several important steps need to be taken to prevent the recurrence of accidents: First, it is necessary to build a safety management system to prevent the kinds of errors and accidents that are frequently caused by human error, which is an ongoing problem. Enhanced surveillance and alarm systems are needed, particularly remote monitoring and alarm systems for facilities and unmanned machinery rooms in tunnels and bridges, which are difficult for personnel to constantly monitor. Second, aging trains need to be replaced. As of 2013, 600 of the 1,945 vehicles running on lines 1-4 are at least 21 years old, which has been pointed out as the main cause of the recent rise in breakdowns. Trains deemed to be at high risk of causing incidents need to be repaired or replaced, even if they have not passed their intended service term. Third, as Seoul's subway system is managed by separate operating entities, an integrated control center is necessary to resolve inadequate safety measures and unsafe operations. Fourth, the Golden Time Targeting Program should be introduced to ensure that safety actions are taking promptly in the subway system in the event of an emergency. A system needs to be designed that will reduce the emergency response time to five minutes or less to contain serious situations, protect the public, and allow other emergency actions to be taken promptly. This system would also include better training for employees, and the standardization of working procedures.

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PPT

PSD(Screen Door) from simrc

관련 자료

SMG to Replace the Entire Subway Platform Screen Door Sensors

SMRT’s Platform Screen Door & IT Technology

첨부파일

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