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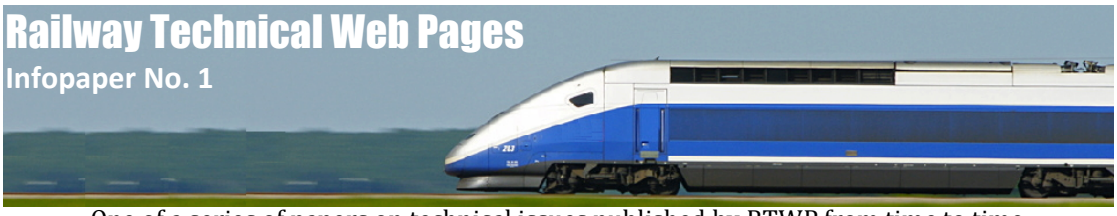

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Platform Protection Systems

A review of platform/train interface protection systems on railways.

by

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Background

From the very earliest years of railway operation, a problematic relationship has existed between the moving train and the fixed structure or the railway station. The need for a safe and reliable means of loading and unloading passengers has vexed the minds of railway managers for the last 150 years. Many railways around the world simply provided a smooth, ground level area and steps attached to the train to allow passengers to climb up into the coaches to board while others, notably the British, used a built-up platform that reached almost to the level of the vehicle floor.

The raised platform offered a somewhat easier access to the train but it tended to isolate the passengers from the track, a situation reinforced by the British tradition of fencing off all railway property and restricting access across railway tracks to fixed "level crossing" points. Many other railway administrations around the world left lines unfenced for the most part and passengers and the general public were expected to treat the railway much as they would a roadway, looking after themselves and crossing under their own judgement.

Figure 1: Fixed barriers provided on metro platform edge of Sangwangsimni Station of Line 2 Seoul Metro. These are simple to erect and provide a degree of protection but cannot prevent falls and have a large gap between train and screens where a person could be trapped. Photo: Marc Daouani, Wikipedia 19th December 2007.

For the platform/train interface, the traditional arrangements described above have generally sufficed for conventional railways, with little change up to the present time, but for fully automated systems like airport people movers and heavily used urban routes, a more protective approach has been considered necessary. This led to the development of various forms of platform edge doors.

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[1] PRC Rail Consulting Ltd.

Origins

In the case of airport people movers, the desire to use trains under unattended automatic operation, suggested that some form of protection was required for passengers waiting on a station platform, so the idea of installing powered doors along the platform edge was born.

Figure 2: Enclosed platform structure showing platform screen doors at a station on the Taipei Metro. Here the screen doors provide both safety enhancement and climate control. Photo: Wikipedia, 6th November 2010.

In the more recent past, driven by increasing crowding and a more pro-active approach towards safety, together with concerns about climate control within stations and air conditioning energy costs, metro designs have moved towards systems to physically separate passengers on platforms from the track and its moving trains. These systems have included both fixed barriers and various designs of powered doors, generally described as Platform Screen Doors or Platform Edge Doors.

In one case, in St. Petersburg, Russia, platform doors were installed as part of the engineering requirements. The track tunnels were bored separately from the station tunnels and the two were joined by transverse openings at the train doorway positions. The openings were sealed by unglazed, elevator-type doors once train loading/unloading was completed. The design was known as the "horizontal elevator".

The design was restricted to 10 stations on one line constructed in the early 1960s. The reasons for the design were said[2] to be because it was cheaper to bore tunnels with

Figure 3: Half-height doors at Paris Metro Line 13 station showing several typical features. Glazing is used for main part of the screen; doors open are indicated by lights on the structure; additional pillars are provided on the train side of the doors to reduce risk of passengers being caught between doors and train; tactile band provided on platform surface inside the door structures. Photo: Pline photo personnelle; Wikipedia, June 2006.

[2] Metrobits.org (accessed 30th June 2011) http://mic-ro.com/metro/platform-screen-doors.html

rotary machines and to construct station tunnels separately. The retention of walls between platform and track assisted with the spreading of ground loads in the very deep tunnels required by the poor ground conditions in the city.

The plain steel doors were found to be unpopular with passengers and were not repeated for subsequent construction in St Petersburg.

Definitions

The simplest form of platform/train protection is a fixed barrier (Figure 1). These provide a degree of protection but cannot prevent falls onto the track and they really do little more than provide an indication of the location the train doors.

The term "Platform Screen Doors" (PSDs) is used here and elsewhere to describe the provision of full height door systems including additional panels to provide a complete seal between the platform and the track area of a station. Such systems are normally required where climate control is the principal purpose of the system but they also provide a safety improvement as an additional benefit.

Another type of system is known as "Platform Edge Doors" (PEDs), so-called because they do not form a complete division between platform and track. Rather, the design forms a full- or half-height barrier along the platform edge but does not provide the air seal required for full climate control.

In some cases, like the Jubilee Line extension in London opened in 1999, the full height PEDs were installed partly to provide additional ventilation control, partly as an anti-suicide measure and partly to convince Londoners that they were getting a modern metro[3]. Strangely, the stations were also equipped with anti-suicide pits, like all other deep level tube stations in London.

Reasons for PSDs

There are three basic reasons for the installation of platform screen doors (PSDs) as follows:

- Safety – prevention of conflicts between passengers and moving trains at stations;
- Climate Control – maintaining comfortable temperatures within platform zones;
- Ventilation Control – Reduction of discomfort generated by underground station draughts.

Figure 4: Japanese high speed platform at Shin Kobe with safety fence and gates provided to reduce the risk of people being dragged off platforms by the pressure waves generated by passing trains. Other stations, where all trains stop, have the fence closer to the platform edge. Photo: Jason Kaechler, Wikipedia 1st April 2008.

[3] Mitchell, B (2003), Jubilee Line Extension, Thomas Telford, London, p 250.

In Japan, some stations, where high speed trains pass through without stopping, have fences fitted along the platforms at about 2m distance from the edge[4] to prevent passengers being sucked off the platform by the vortices created by the fast moving trains. The fences have gates at suitable locations to allow access to stopping trains.

PSDs will also have additional benefits. They can reduce the level of train noise, create a cleaner platform environment, prevent rubbish blowing into train tunnels and they can, if designed carefully and sympathetically, improve the visual aspects of the platform area. They can also be used to reduce risks caused by fire and smoke.

The Case for PSDs

Justification for the installation of PSDs originated in the early 1970s as a result of the decision to operate unattended automatic trains, such as airport people movers, and then later for the French designed VAL (Véhicule Automatique Léger) system built in such cities as Lille, Toulouse and Rennes, and at Airports like Chicago O'Hare and Paris Orly and de Gaulle. More recent installations have been derived from issues such as high ambient temperatures in underground stations or safety for heavily crowded platforms.

Many modern systems have been built with PSDs in the tunnel sections but not at open stations, the logic being that the underground stations, with higher passenger loads than open stations, present a better business case in terms of both safety and climate control. However, this logic has more recently been overcome in some cities, where selected stations have been provided with half-height gates in place of full height doors at both open and tunnel stations.

Figure 5: Platform Edge Doors installed at Sacomo station on Line 2 of the Sao Paulo (Brazil) metro. The equipment is full height but does not allow for climate control. Photo: Leo M Santos, Wikipedia, 7th May 2010.

In Tokyo, large scale retrofitting of half-height gates has been carried out on a number of metro lines, in addition to provision on any new builds. Half-height gates are simply added as a safety measure, since they cannot realistically affect ambient temperature in the station. Hong Kong has also started retrofitting half-height gates at some stations. There, the cost of the installation is around £6.6k per metre[5]. They also installed them from new on the MTR line to Disneyland.

[4] Muraki et al (2010), Effect of Train Draft [sic] on Platforms and in Station Houses, JR EAST Technical Review-No.16, Spring 2010, Tokyo, Japan.

[5] "The Standard" Newspaper, Hong Kong, January 08, 2008.

Benefits

Although the installation of PSDs is expensive – in the range of £6k - £10k per metre[6] for a full-height screen and doors, depending on location – there are considerable and quantified benefits. In one study carried out on the Hong Kong Mass Transit organisation[7], where PSDs were retrofitted along platforms in tunnel stations between 2002 and 2006, it was determined that, after installation, death and injuries due to suicides and accidental falls onto the track fell by 75% across the system and the service disruptions from such incidents fell by 69.4%. The original reason for the installation was to improve climate control within platform areas and to save energy used in station air conditioning and tunnel ventilation.

Interestingly, one of the arguments against the fitting PSDs as a means of preventing suicides was that the potential suicidees would merely seek an open station to commit the act. In the Hong Kong study, this proved to be largely unfounded, since the recorded incidents at open stations rose by only 12% during the post installation period.

Climate control and energy savings form a large part of any business case for platform screen doors but cannot be counted for platform edge doors and half-height systems. In these cases, safety will be the primary factor, with the additional benefits of easier crowd control at peak times.

Design Issues

The installation of PSDs in any form is necessarily a complex project, particularly if a retrofit is involved. In the case of new build, matters can be made easier by ensuring that the design parameters are understood at an early stage and that all the necessary interfaces with rolling stock, train control, communications, power supplies, emergency procedures, maintenance systems and the infrastructure are included. System engineering is an important part of the process, especially since train control must be linked with door control.

The door structure and glazing must be designed to allow emergency break-in to permit passengers to escape from the trackside. There must also be the facility to allow

Figure 6: A novel type of platform screen system using cables suspended from steel pillars fixed along the platform edge. The cables, shown here in the raised position, are lowered to provide a screen between train and platform. Photo: Noropdoropi, Wikipedia, 14th July 2009.

[6] Calculated using known prices in London and Hong Kong and uplifted to 2011 values.

[7] Law, C K, Yip, P S F (2011); An economic evaluation of setting up physical barriers in railway stations for preventing railway injury: evidence from Hong Kong, Journal of Epidemiol Community Health, 2011.

controlled evacuation from the train tunnel walkway to the platform. This is usually achieved by the provision of a separate end door.

The station control room will be equipped with a remote alarm system to alert staff to door failures or intrusions. A local control panel will be provided for each platform face, usually at the end of the platform where the train or platform staff can reach it quickly and have sight of the door line. Doors will be fitted with open indicator lights and with means to bypass local interlocking with train systems in case of failure. One feature of the design that must not be forgotten is the necessity for a proper electrical bonding and earthing system.

Appendix 1

MTR PSD Retrofit Project Description from MTRC Press Release, 2006.

MTR Corporation is the first railway in the world to undertake the complex task of retrofitting platform screen doors under a live passenger railway operation environment. The project is the largest of its kind in the world covering 74 platforms, three MTR lines; namely Tsuen Wan Line, Kwun Tong Line and Island Line, 2,960 sets of PSDs and 30 air-conditioned underground stations.

To ensure a zero disruption to our millions of passengers carried per day by MTR, retrofitting works are carried out only during non-passenger service hours between 2 am and 5 am every day.

The primary objectives of this retrofit project is to improve the air-conditioning performance to meet passenger expectations.

Main elements of the works
The scope of works consist of Environmental Control System (ECS) modifications at 30 underground stations, and Platform Screen Doors installations at 74 platforms. These include:

*
Modification of air-conditioning and tunnel ventilation equipment in 94 plant rooms
*
Modification of some 27 km of air ducts
*
Replacement of 170 air handling units of capacities from 400 kW to 1.5 MW
*
Installation of an over-track PSD support structure and environmental seal
*
Installation of 13.5 km of PSDs to provide, at each platform:
*
40 bi-parting doors-sets
- Controls and power supplies
- 10 emergency doorways
- Head and tail wall driver's and tunnel access doors
- Platform lighting & signage integrated into PSD header

It cost 2.3bn HK$ by 2006 = £12k per metre[8]. This includes additional air conditioning works.

[8] Hong Kong Government Quote Nov 3rd 2010, http://7thspace.com/headlines/362353/lcq14_retrofitting_of_platform_screen_doors_and_automatic_platform_gates_at_mtr_stations.html (accessed 30th June 2011)