Hot Issues in Fire Engineering

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Any Fire Suppression Systems in Subway Station Platforms?

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The two railway corporations, in which most of the shares are held by the government, underwent a merger in 2007. The two groups had different fire safety practices, and the merged corporation should be more vigilant in fire safety of crowded subway stations, particularly those deep underground [1-3]. Concerns were raised immediately by the public after the merger 5 years ago. Over 50 station platforms – which are not equipped with sprinklers –were identified [4].

It was roughly estimated that burning an empty train car would give [5] a peak heat release rate of 17 MW on the local Ma On Shan railway line. In-depth studies indicated that burning an empty train car can result in a peak heat release rate which is up to 20 MW, as suggested by Korean and Japanese experts [6]. Many passengers, known as 'parallel traders', carry a lot of luggage when they board the train as in Fig. 1, particularly from Sheung Shui Station [7] to Lo Wu Station. It should be noted that burning a Heavy Goods Vehicle (HGV) would give a peak heat release rate of 200 MW in full-scale burning tests [8]. Therefore, it is not exaggerating to say that burning a train car with luggage can induce a peak heat release higher than 50 MW, unless full-scale burning data on local combustible products is available.

The merged company did not inform the general public about the measures which are deployed to suppress big fires in the station platform. It is not clear how big fire resulted from burning a train car packed with luggage, if occurred in those subway station platforms, can be controlled by the railway management. Therefore, the daunting task of fighting big fires, presumably, would be left to our brave firemen. Some of the fire-fighters were killed in several disastrous fires, which broke out in buildings without sprinklers [9-11]. The management did not explain why sprinkler systems were not installed in all subway station platforms. Over 70,000 passengers were affected by fire and ventilation provision in the past 30 years [12]. An arson fire broke out [13] in 2004, fortunately it did not lead to disaster. The chance of having a fire is not low at all. There are hidden fire safety problems behind those projects, which do not comply with prescriptive fire codes [14], as raised recently by the author [15] after the Fa Yuen Street fire. The recommended peak heat release rate of design

fire in the draft new code, which is set at 6.5 MW, is far too low[16], when compared with 20 MW [6] suggested by Korean and Japanese experts for train fires.

Sprinkler systems are effective in controlling the scale of fire [17] and avoiding big disasters by:

- Direct action on the burning objects.
- Cooling the smoke layer to lower the chance of flashover.
- Pre-wetting the adjacent combustibles to delay ignition.
- Displacing oxygen from the burning objects.

Fire safety provisions in subway station platforms should be reviewed carefully with support from in-depth research, and a few demonstration tests [5] and simulation of emergency evacuation with robotic motions [18,19] are not sufficient. Installation of sprinkler system is also inadequate, though the fire statistics indicated that the system was effective in controlling big fires. Appropriate fire suppression system [1,20] should be set up accordingly. It should be noted that water mist systems had been installed in train cars and areas adjacent to platform screen doors in some subway stations of China [21]. The effectiveness of such systems should be further examined by systematic research.

In implementing performance-based design, it was assumed [20] that sufficient research on fire science and engineering had already been conducted. However, the research is only done in advanced countries. The applicability of such works in the Far East was not demonstrated by in-depth investigation. It should be noted that most of the performance-based design projects in the Far East were not carried out just because of difficulties to comply with the code. Cost reduction is a key factor [21] in using performance-based design. In this particular case of failing to provide fire suppression system in subway station platforms, a very small design fire below 5 MW was allowed in overseas advanced countries. However, very few advanced countries have huge volumes [22] of passengers, who have to stay in the platforms as in Figs. 2 and 3. In other countries, there were no ‘parallel traders’ as observed in Fig. 1. It should be noted that even advanced countries have only commenced research to study heat release rate in burning train cars with luggage recently [23]!

In conclusion, fire safety in crowded subway stations should be reviewed carefully to comply with fire codes [e.g. 14]. At least, sprinklers should be installed.

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Figure 1: Parallel traders (水貨客) gathering at Sheung Shui Station, Hong Kong (from The Sun, 16 December 2010)

Figure 2: At Zhengzhou Station, Zhengzhou, Henan, China (from Jiang et al. 2009)

Figure 3: At the north square outside the Beijing West Station, Beijing, China (from Jiang et al. 2009)