

Wind Engineering Joint Usage/Research Center FY2018 Research Result Report

Research Field: Environmental Wind Engineering
Research Year: FY2018
Research Number: 182007
Research Theme: Influence factors analysis of unorganized ventilation caused by piston effect in subway station

Representative Researcher: Xiaofeng LI

Budget [FY2018]: 260000Yen

- *There is no limitation of the number of pages of this report.
- *Figures can be included to the report and they can also be colored.
- *Submitted reports will be uploaded to the JURC Homepage.

1. Research Aim

Subway stations with platform screen doors (PSDs) are a common subway station design. PSDs separate the platform and the tunnel, which separates the heat dissipation of the train and the train air conditioner condenser from the platform, and it reduces the cooling load and energy consumption of the subway station. Therefore, subway station with PSDs are widely used in China because of their safety and energy savings. Although PSDs are full high platform screen doors, they have gaps in the structural connection parts, which results in air penetrates from the tunnel into the platform. The air leakage creates extra cooling load and worsens the air quality of subway stations. Because the air leakage of PSDs increases the energy consumption and pollutes the IAQ in the station, a study that examines the air leakage volume of PSDs is necessary.

This research concentrates on the unorganized ventilation caused by piston effect, the aim of the study is to figure out the mechanism, influencing factors of the unorganized ventilation. Based on this research, the ventilation and environment control system in subway station is able to be optimized.

2. Research Method

The method in this research is network simulation using STESS (Subway thermal environment simulation software). The air leakage volume at the entrance-and-exit and platform screen door (PSD) were studied. Also, the network simulation has been validated by field measurements.

3. Research Result

Based on the multiple factors analysis, a formula was created to calculate the air leakage volume of PSDs for different tunnel lengths, train departure density, and gap areas of PSDs. With the estimation formula, it is possible to quantitatively consider the extra cooling load brought by air leakage of PSDs in the design stage and to assist in the air quality research in subway stations.

4. Published Paper etc.

[Underline the representative researcher and collaborate researchers]

[Published papers]

1. Xiaofeng Li*, Ying Wang. Simulation study on air leakage of platform screen doors in subway stations, SUSTAINABLE CITIES & SOCIETY, NOV 2018, Vol 43, 350-365

2. Yue Zhang[&], Xiaofeng Li*. Research on airflow and energy performance in PBD, PSD and PBD PSD-combined environment control systems in subway. SUSTAINABLE CITIES & SOCIETY, OCT 1 2018, Vol 42, 434-443

[Presentations at academic societies]

/

[Published books]

/

[Other]

Intellectual property rights, Homepage etc.

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5. Research Group

1. Representative Researcher

Xiaofeng LI

2. Collaborate Researchers

1. Yue ZHANG

2. Ying WANG

6. Abstract (half page)

Research Theme: Influence factors analysis of unorganized ventilation caused by piston effect in subway station

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Summary • Figures

Unorganized ventilation is identified as the key element in subway environment and energy consumption. The subway network building structure and the train's movement make it hard to handled by field test and analytical solution, so network simulation using STESS was applied to analyze influencing factors of the air leakage.

Supported by simulation results, the air leakage volume in different tunnel lengths, train density and PSD airtightness are summarized as empirical formulas. These formulas is helpful in predicting the unorganized ventilation in different situations, which can serve a guidance in subway environment and energy management.

