An experimental study for thermal efficiency and indoor air quality in a subway

K.M. Koo, H.S. Park and Y. Seo[1]

[1]Department of Mechanical Engineering, Kumoh National Institute of Technology,
Gumi, 730-701, South Korea
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Presenting author email: yjseo@kumoh.ac.kr

Heating and air-conditioning system in subway is run almost all the time in summer and winter and energy loss due to frequently opened door is significant. In addition, air-quality in subway station is often reported as poor. Thus, thermal effieiciency and indoor air-quality in subway are experimentally characterized in this study. In addition, an air curtain is added into the system and verified whether it could enhance thermal efficiency and prevent contaminants from entering a subway.

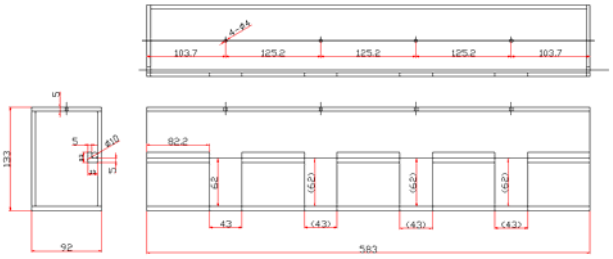

Figure 1. Specification of tested subway model.

For experiments, 30 times smaller model was constructed and Figure 1 displays the schematic. The detailed dimensions were determined using laws of similarity and the Reynolds number was used. According to ANSI/ASHRAE 55-1992, temperatures were measured 0.003(ch1), 0.02(ch2), 0.036 (ch3) and 0.056(ch4) m above the bottom of the model. Tested wind speed due to the movement of subway was 0.3 m/s. 30° and 90° angles of air curtain were tested and the test result with vertically downward case (90°) was shown as a representative.

Table 1. Temperature comparison between no presence of air curtain (a) and presence of vertically downward air curtain (b).

(a)

Mea. loc. / Time, s	ch1	ch2	ch3	ch4
0	22.9	22.2	21.4	20.6
30	25.6	25.0	25.1	24.9
60	25.9	25.8	25.7	25.4
90	25.9	25.8	25.8	25.5
120	25.8	25.7	25.8	25.4
150	26.0	25.9	26.1	25.8
180	26.1	26.1	26.2	26.0
210	26.2	26.2	26.2	26.1
240	26.2	26.1	26.3	26.1
270	26.1	26.1	26.3	26.3
300	26.1	26.1	26.3	26.4
Averaged	25.7	25.5	25.6	25.3

(b)

Mea. loc. / Time, s	ch1	ch2	ch3	ch4
0	22.3	22.2	21.8	21.4
30	22.5	22.3	22.2	21.8
60	22.7	22.4	22.2	21.8
90	22.5	22.6	22.2	22.0
120	22.5	22.8	22.7	22.3
150	22.8	22.8	22.9	22.5
180	22.9	23.0	23.0	22.6
210	22.9	22.9	22.9	22.6
240	22.8	22.8	22.8	22.6
270	22.9	23.0	22.9	22.8
300	22.9	23.0	23.0	22.7
Averaged	22.7	22.7	22.6	22.3

As shown in Table 1, temperature in the subway was continuously increased when there was no air curtain. Initial temperature was approximately 22 °C and temperature after 300 sec was about 26.3 °C. However, subway's inner temperature remained with the presence of air curtain. Temperature was approximately 22.5 °C throughout the experiment.

As near future works, 3 μm polystyrene latex particle will be measured in the subway model with and without presence of two types of air curtain. Its efficiency will be reported in the EAC conference.

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