Appendix to "Fire whirls due to surrounding flame sources and the influence of the rotation speed on the flame height"

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On the validity of the numerical simulation

The codes of the FDS (fire dynamics simulator), developed by NIST, USA, have been released publicly and checked by various users (Ryder *et al.* (2006, 2004); Christensen & Icove (2004); Chow & Yin (2004); Chow & Zou (2005); Yi *et al.* (2005), etc.) to be reliable.

In order to see that the simulations are used realistically here, we reproduce the computations by Farouk *et al.* (2000) and the experimental observations by Satoh & Yang (1996).

Farouk *et al.* (2000) computed a fire source centrally located at the base of a square channel with corner gaps and vertical clearance. We have computed the same model. In figure 1, we display the time-averaged entrainment flux through the lateral gap, compared with figure 4 of Farouk *et al.* (2000). In figure 2, we display the velocity fields for a partially enclosed plume with the same gap ($d_c = 0.1$ m) width but different vertical clearances ($Z_c = 0.25$ and $Z_c = 0.125$ m), compared with figure 7 and figure 9 of Farouk *et al.* (2000), respectively. In figure 3, we display the time-averaged axial velocity profiles along the vertical direction with different d_c and Z_c, compared with figure 2, figure 5, figure 6 and figure 10 of Farouk *et al.* (2000). Our numerical results are in good agreement with those of Farouk *et al.* (2000), showing that we have used FDS correctly.

Satoh & Yang (1996) conducted experimental studies of a fire itself located in a square enclosure with symmetrical open gaps and measured the temperatures at two points: one near the bottom of the floor and the second well above the floor. For the first point, the measured temperatures oscillate about a mean value close to 700°C. For the second point, the mean of the temperatures was approximately 900°C. We have computed flow for the same configuration using FDS. In figure 4 we display the temperature history for the above two points obtained by our numerical simulation. These results are close to the experimental results of Satoh & Yang (1996), displayed in their figure 4.

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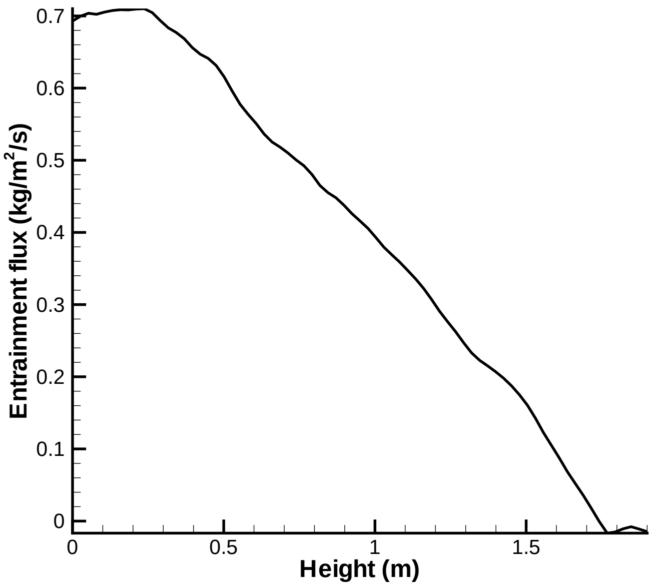

FIGURE 1. Time-averaged entrainment flux through the lateral gap for a partial enclosed plume ($d_c = 0.1m$, $Z_c = 0.0$).

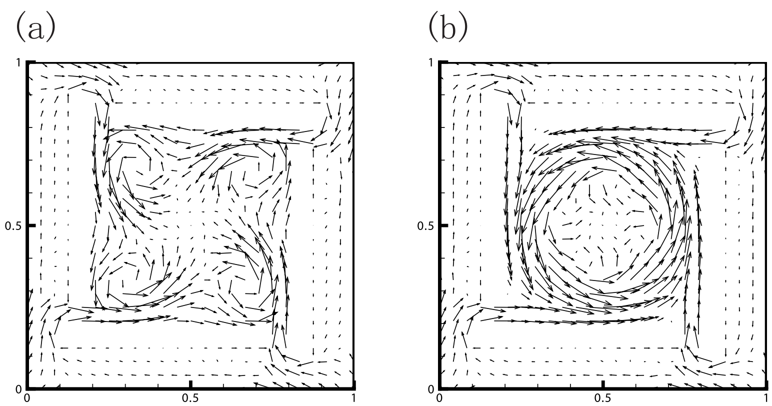

FIGURE 2. Time-averaged velocity field at $z = 0.6m$ for a partially enclosed plume. (a) $d_c = 0.1m$, $Z_c = 0.25m$. (b) $d_c = 0.1m$, $Z_c = 0.125m$.

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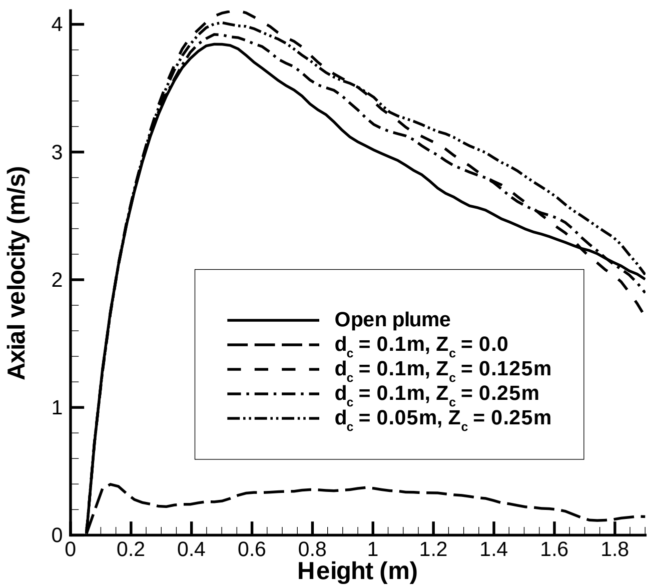

FIGURE 3. Time-averaged axial velocity profiles along the vertical direction ($x = 0.5m$, $y = 0.5m$) for partial enclosed plums with different d_c and Z_c.

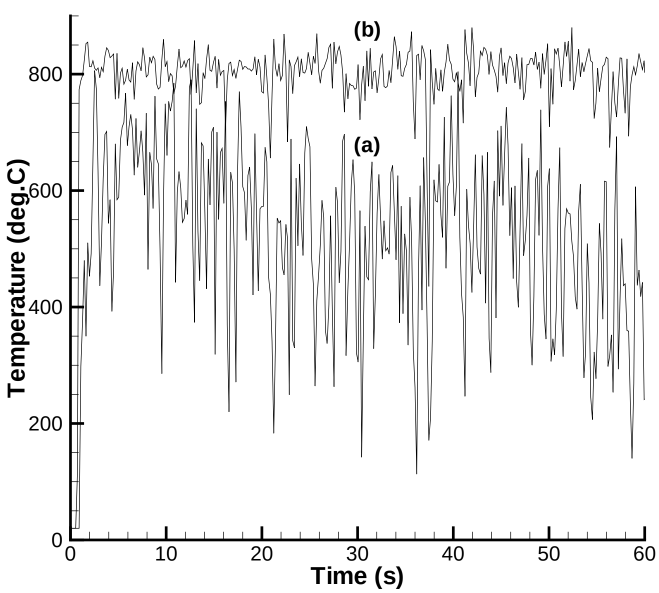

FIGURE 4. Flame temperature after ignition. (a) First point (close to the floor). (b) Second point (well above the floor).