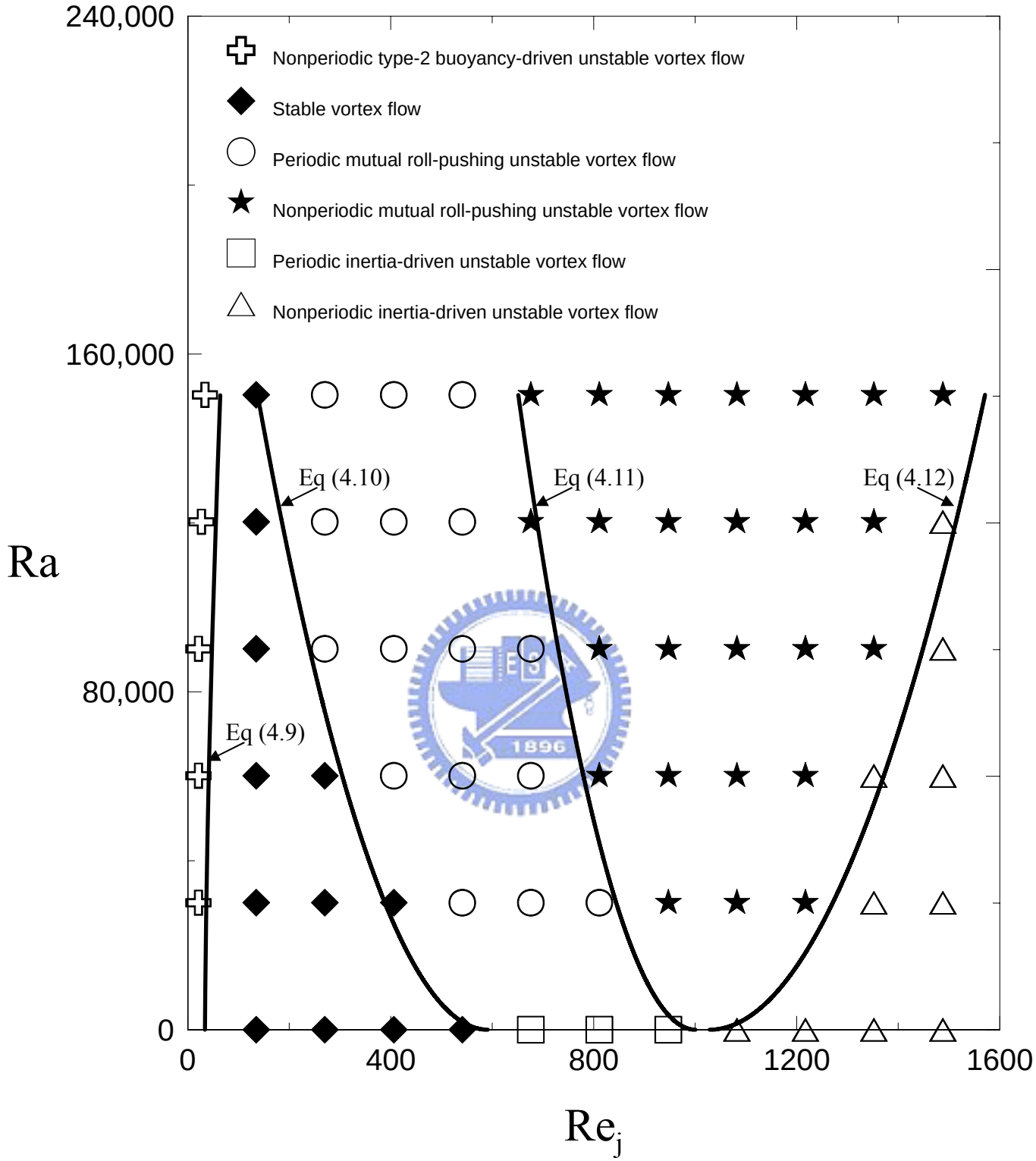


Fig. 4.96 Flow regime map delineating the temporal state of the vortex flow for H = 40.0 mm.

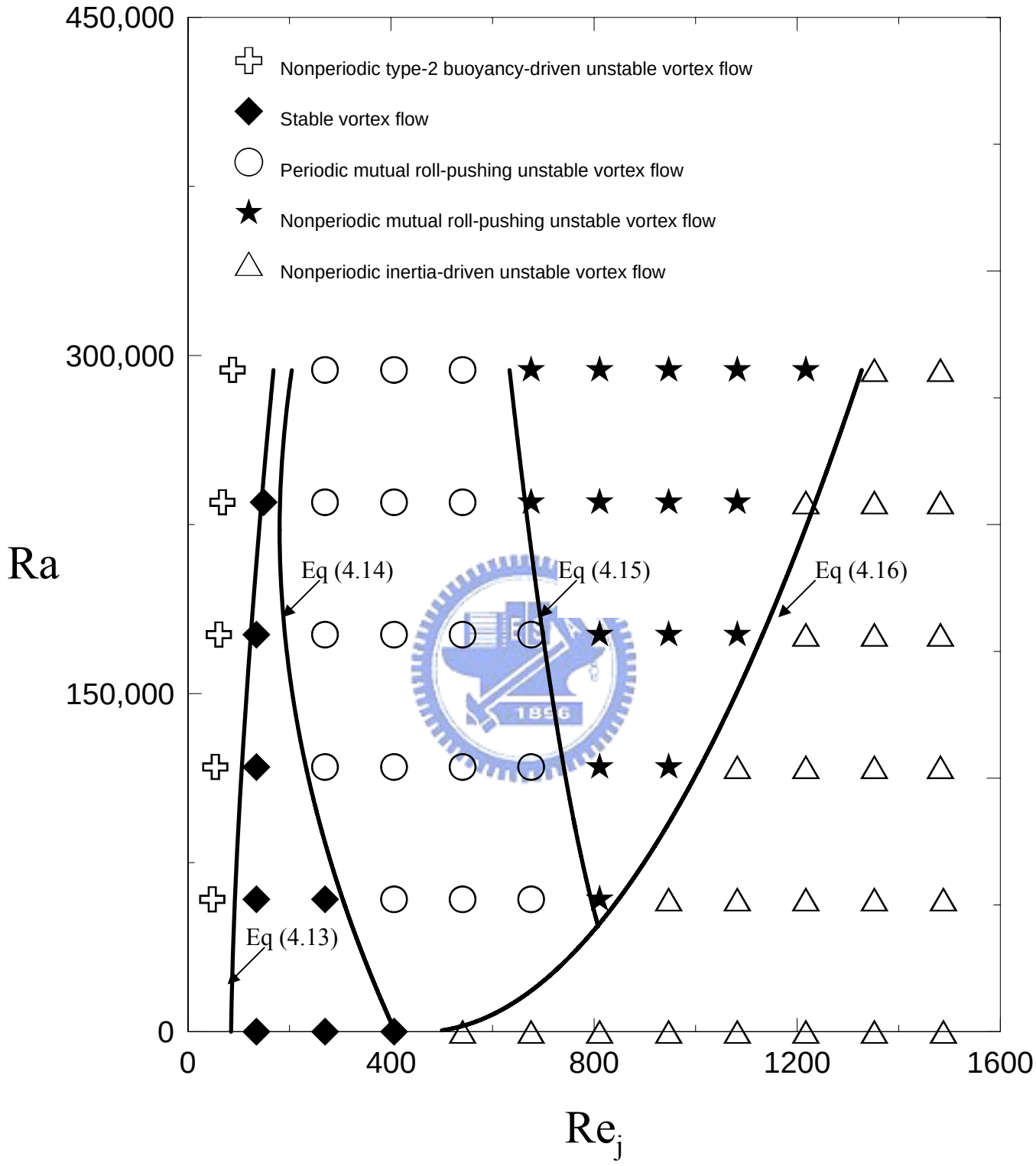


Fig. 4.97 Flow regime map delineating the temporal state of the vortex flow for H = 50.0 mm.

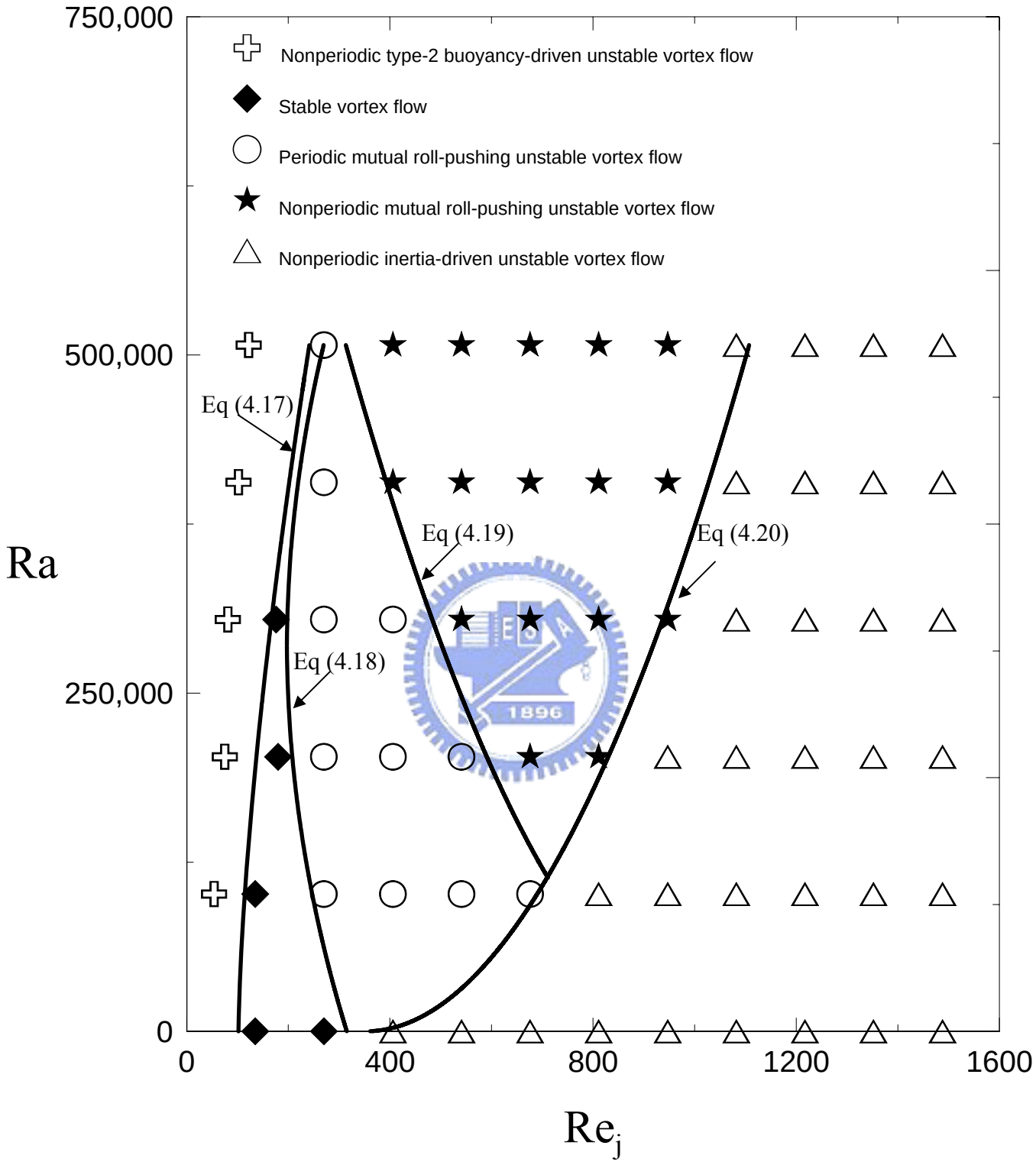


Fig. 4.98 Flow regime map delineating the temporal state of the vortex flow for H = 60.0 mm.

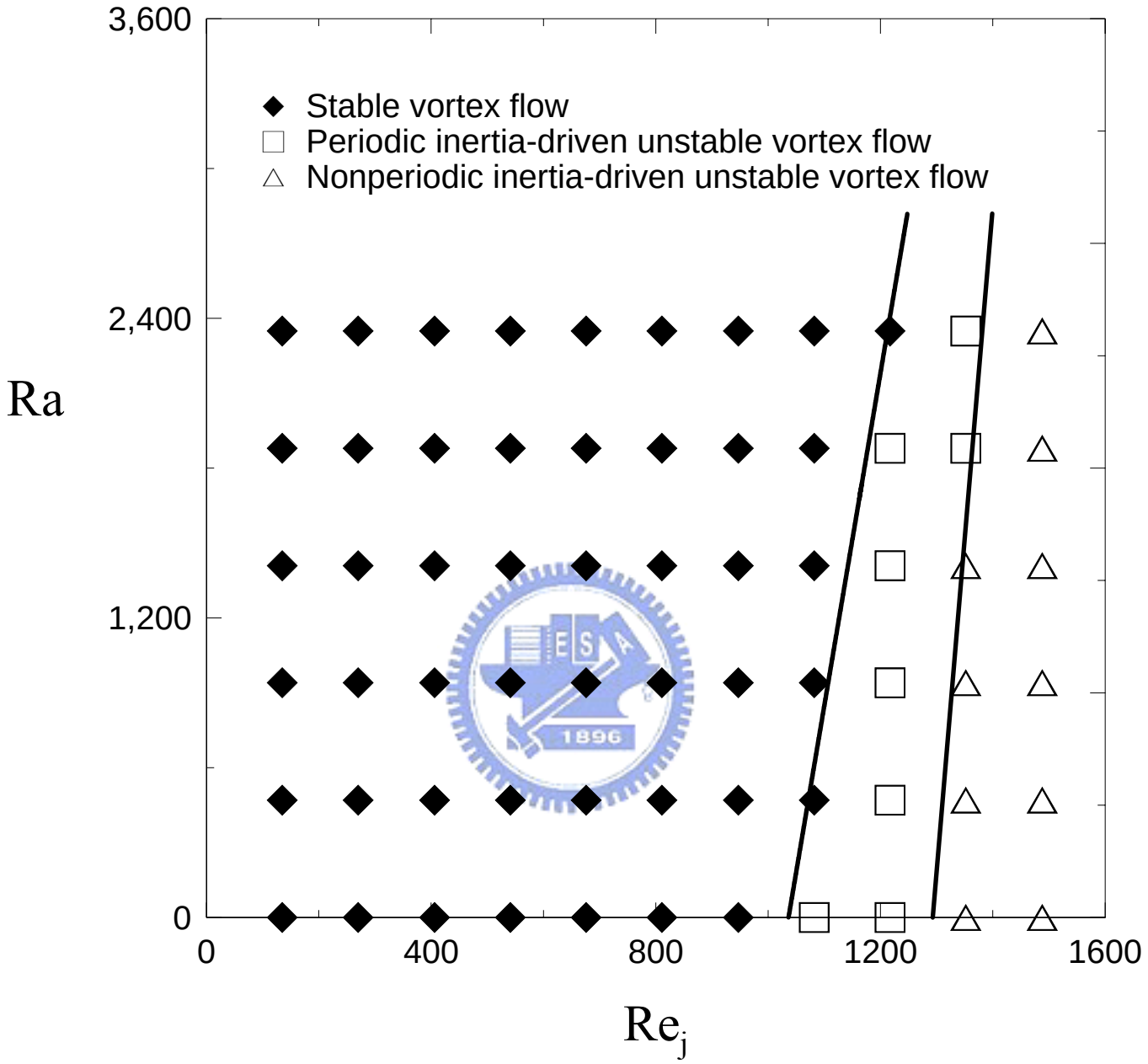


Fig. 4.99 Flow regime map delineating the temporal state of the vortex flow for H = 10.0 mm.

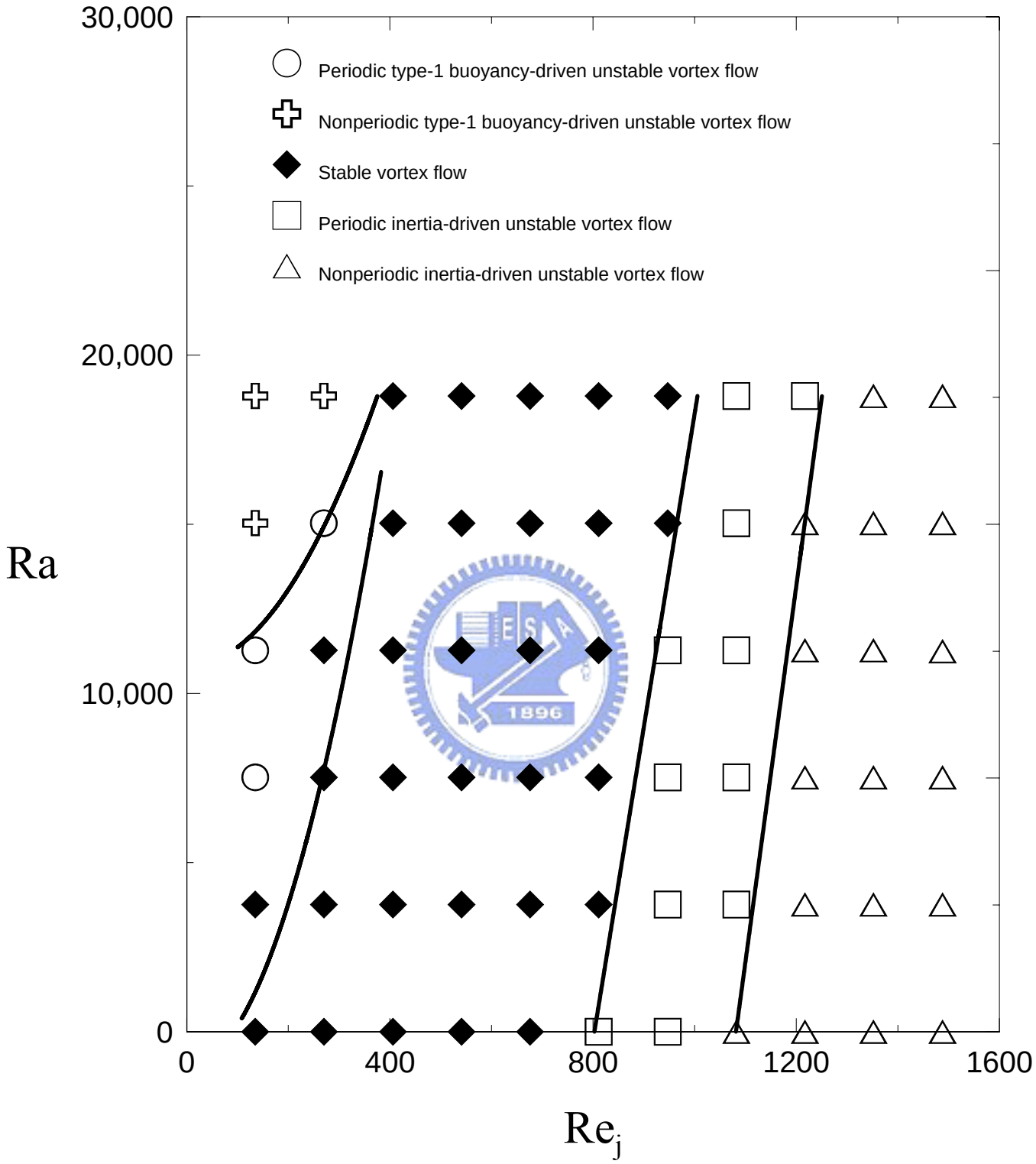


Fig. 4.100 Flow regime map delineating the temporal state of the vortex flow for H = 20.0 mm.

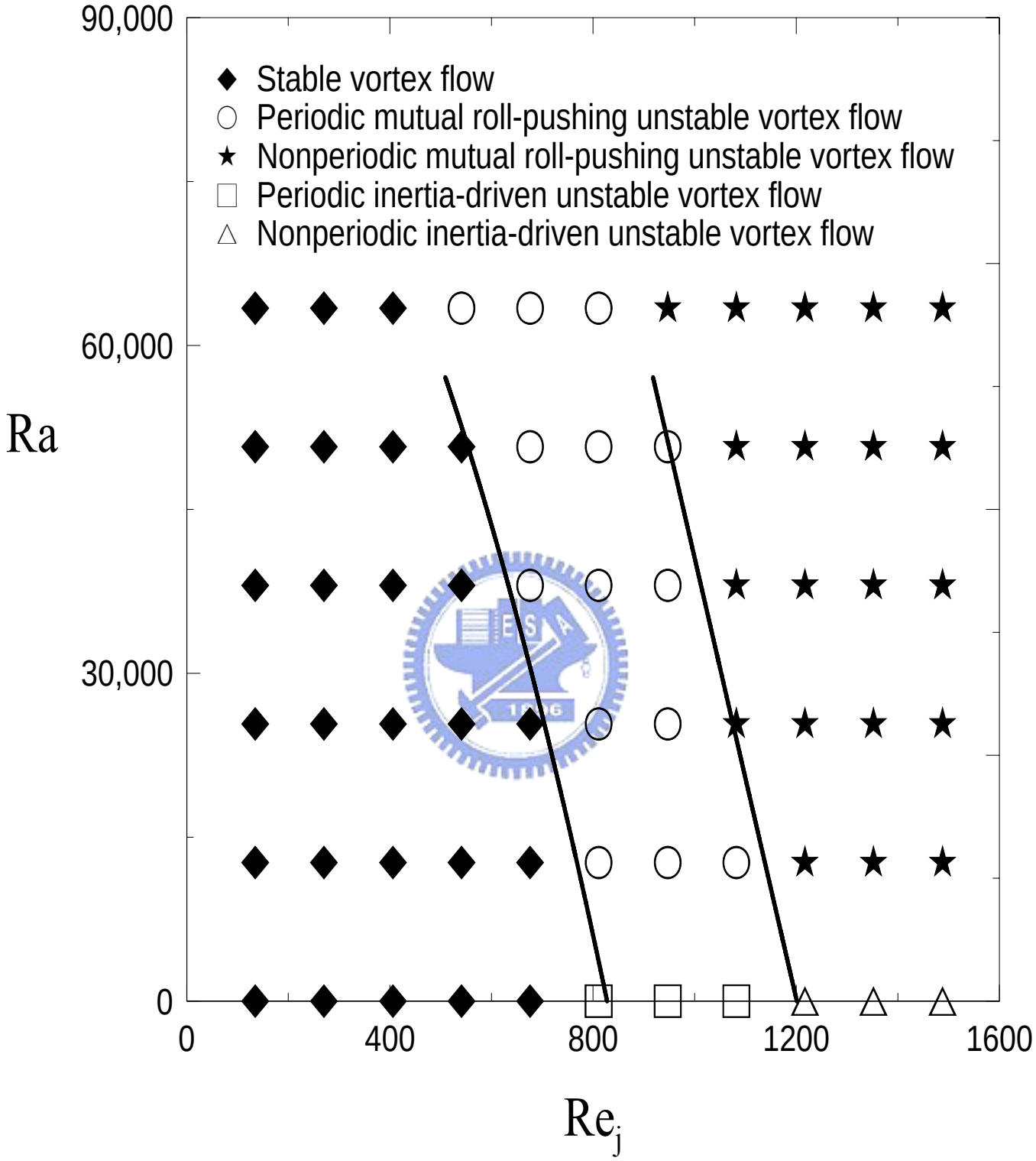


Fig. 4.101 Flow regime map delineating the temporal state of the vortex flow for H = 30.0 mm.

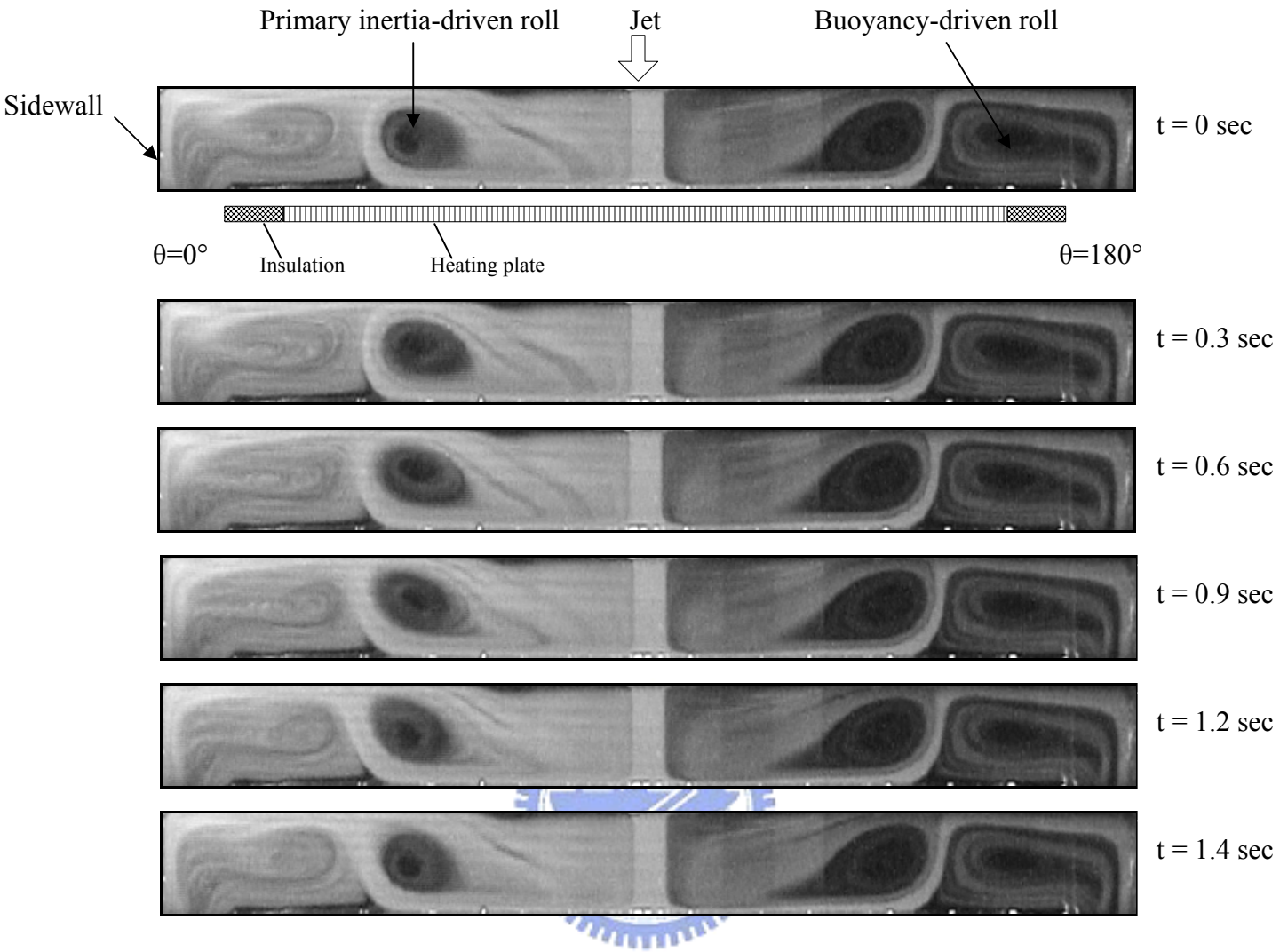


Fig. 4.102 Time-periodic vortex flow for H = 30.0 mm and Ra = 38,051 (ΔT=15℃) at Re_j=676 (Q_j=5.0 slpm) illustrated by side view flow photos taken at the cross plane θ=0° & 180° at selected time instants in a typical periodic cycle (t_p = 1.43 sec).

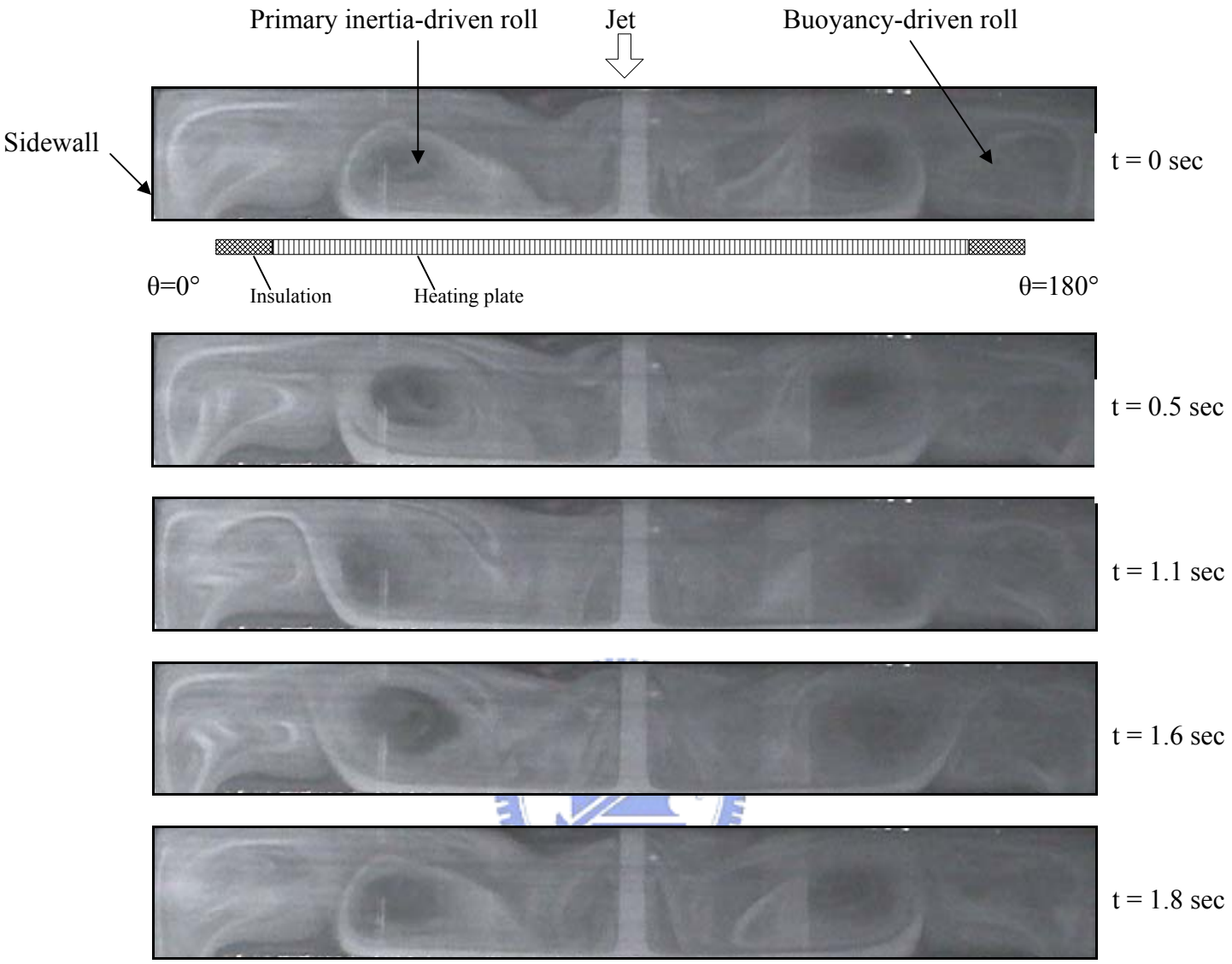


Fig. 4.103 Time-periodic vortex flow for H = 40.0 mm and Ra = 90,195 (ΔT=15℃) at Re_j=676 (Q_j=5.0 slpm) illustrated by side view flow photos taken at the cross plane θ=0° & 180° at selected time instants in a typical periodic cycle (t_p = 1.82 sec).

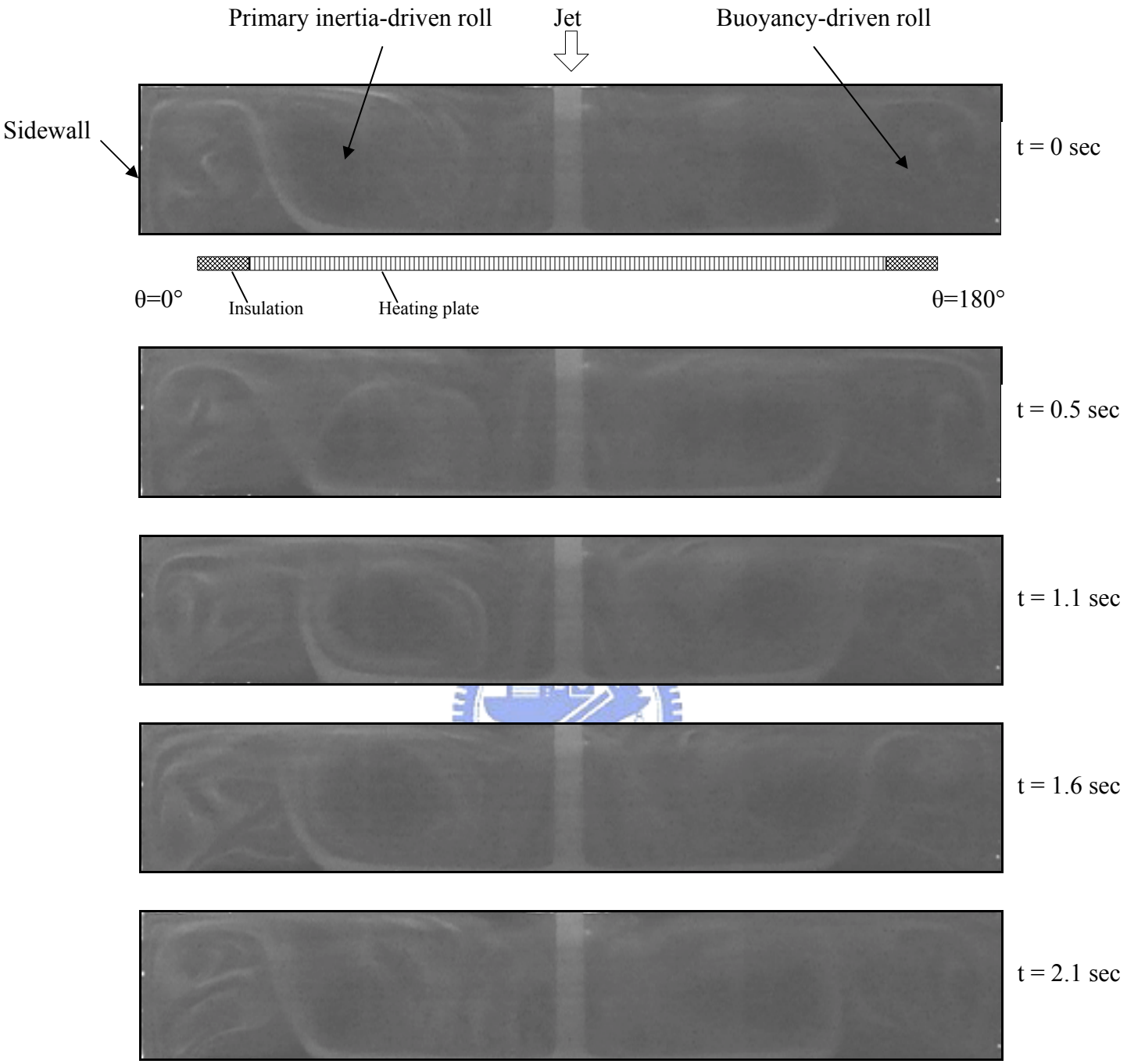


Fig. 4.104 Time-periodic vortex flow for H = 50.0 mm and Ra = 176,162 (ΔT=15℃) at Re_j=676 (Q_j=5.0 slpm) illustrated by side view flow photos taken at the cross plane θ=0° & 180° at selected time instants in a typical periodic cycle (t_p = 2.17 sec).

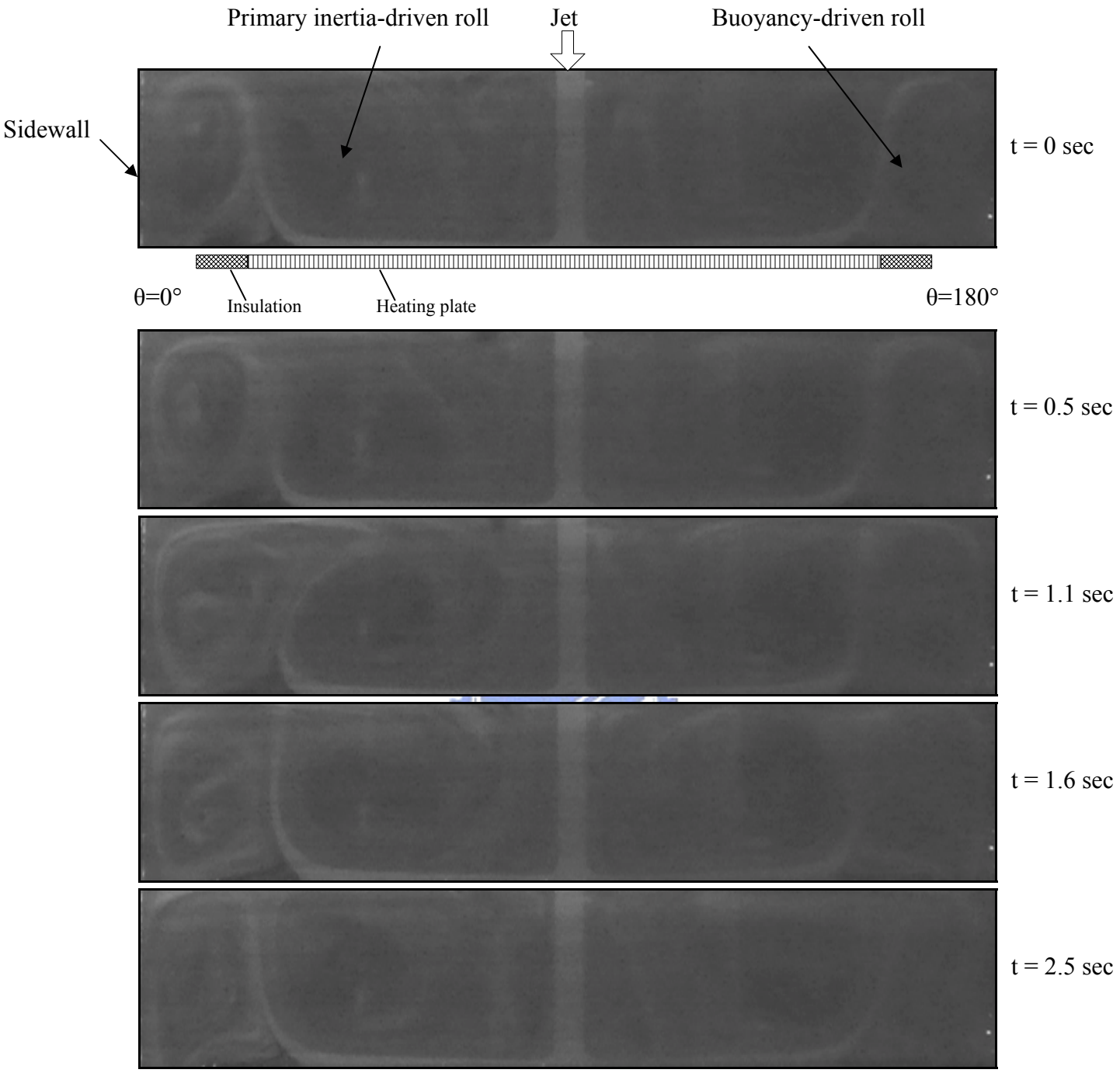


Fig. 4.105 Nonperiodic vortex flow for H = 60.0 mm and Ra = 304,409 (ΔT=15℃) at Re_j=676 (Q_j=5.0 slpm) illustrated by side view flow photos taken at the cross plane θ=0° & 180° at selected time instants in a typical periodic cycle.

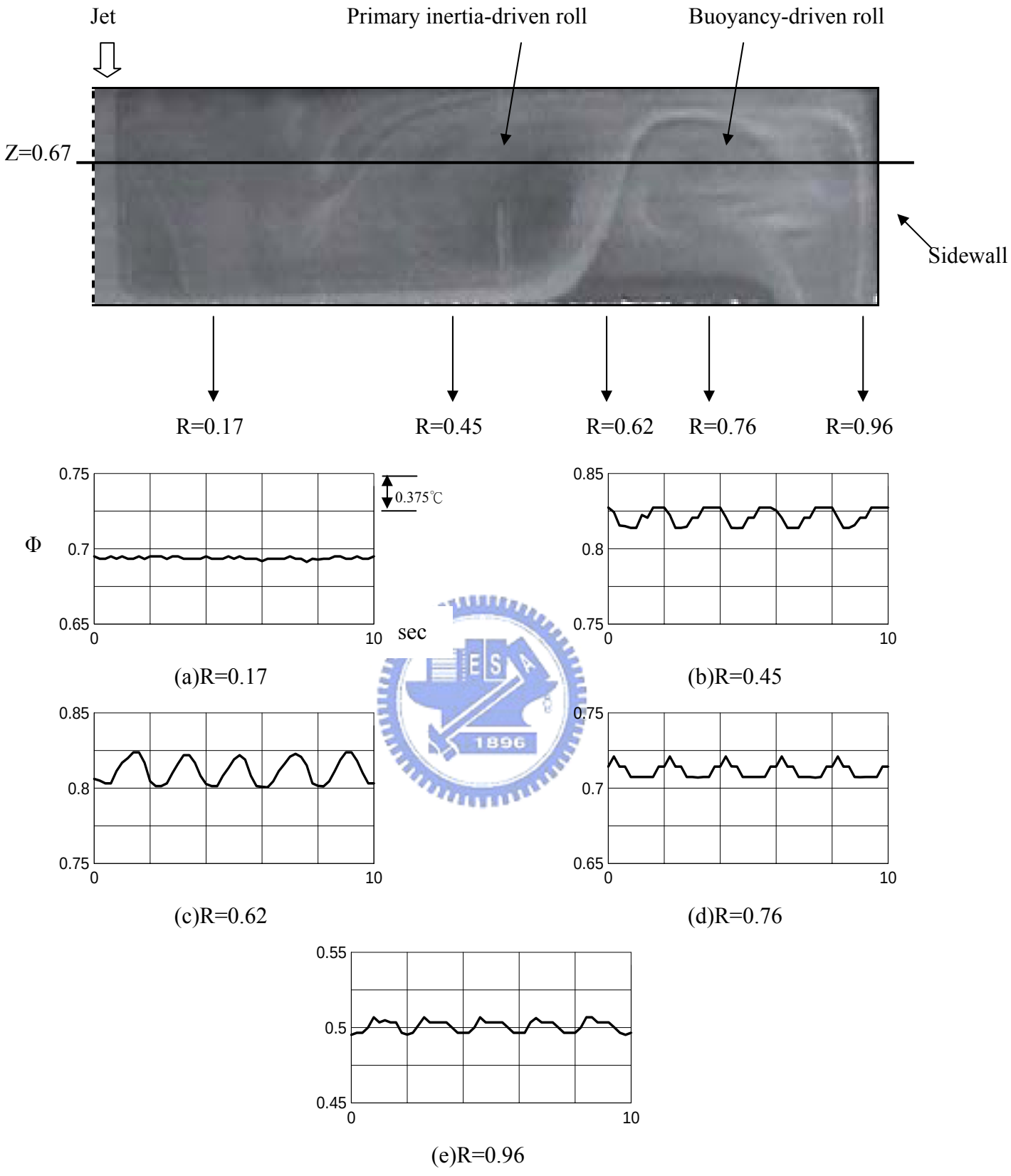


Fig. 4.106 The time records of non-dimensional air temperature for Ra=90,195($\Delta T = 15.0$ ℃) and Re_j=676 (Q_j=5.0 slpm) with H=40.0 mm measured at selected locations on the vertical plane $\theta = 0°$ at Z = 0.67 for R = r/R_c = (a) 0.17, (b) 0.45, (c) 0.62, (d)0.76, and (e) 0.96 (t_p=1.82 sec).

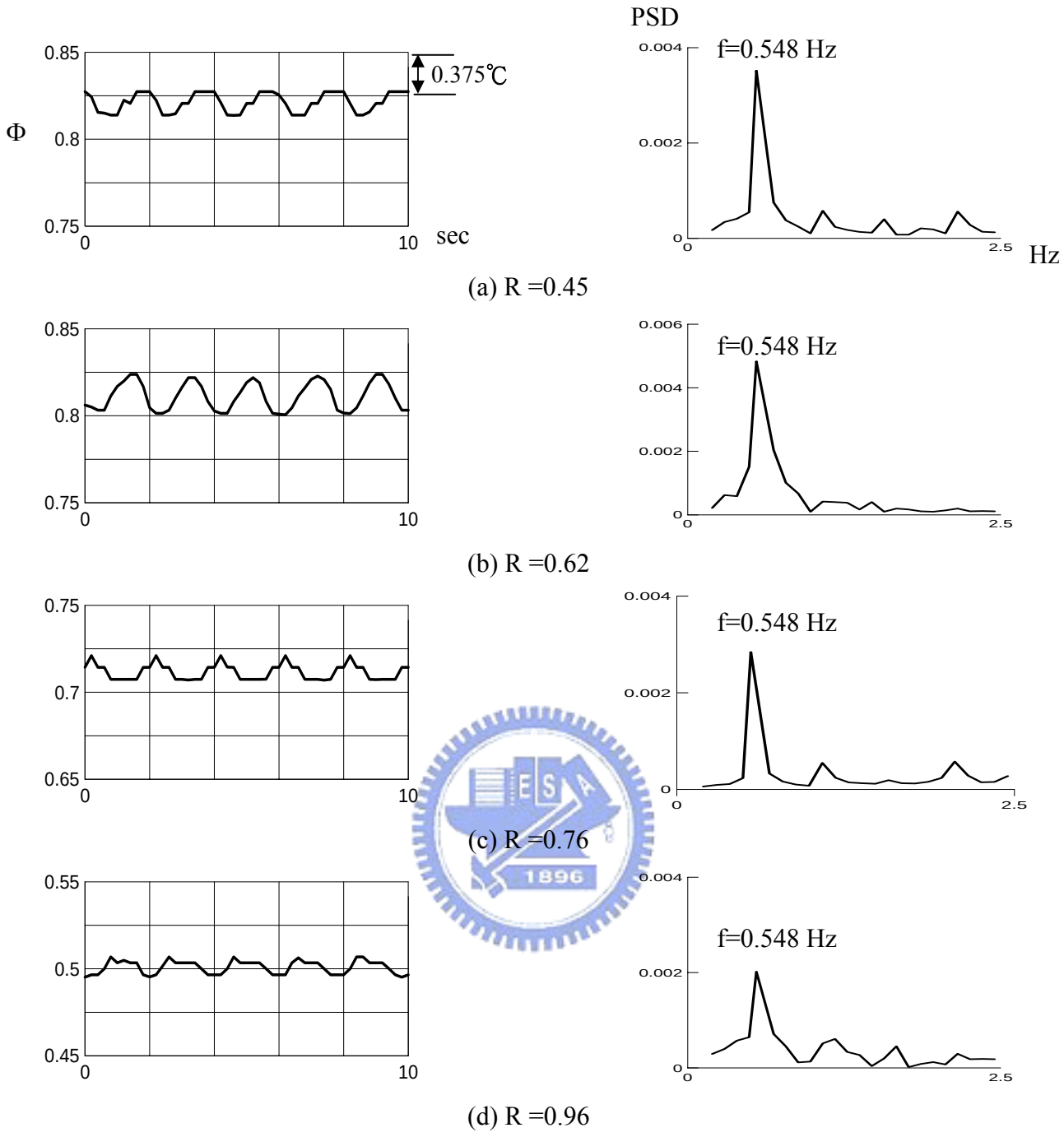


Fig. 4.107 The time records of non-dimensional air temperature and the corresponding power spectrum densities for Ra=90,195 ($\Delta T = 15.0$ ℃) and Re_j=676 (Q_j=5.0 slpm) with H=40.0 mm measured at selected locations on the vertical plane $\theta = 0°$ at Z = 0.67 fo $R = r/R_c$ = (a)0.45, (b)0.62, (c)0.76,and (d)0.96 (t_p=1.82 sec).

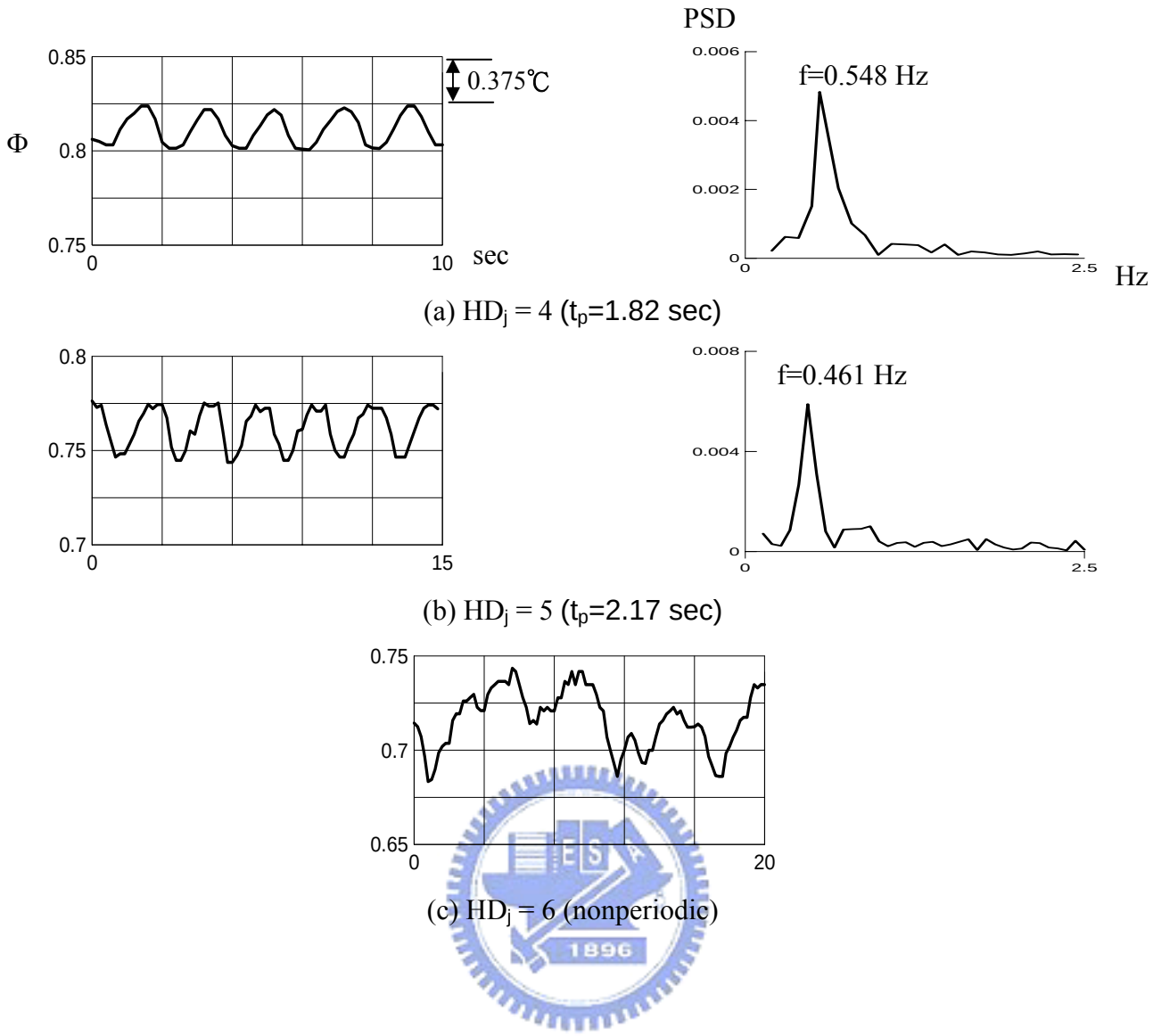
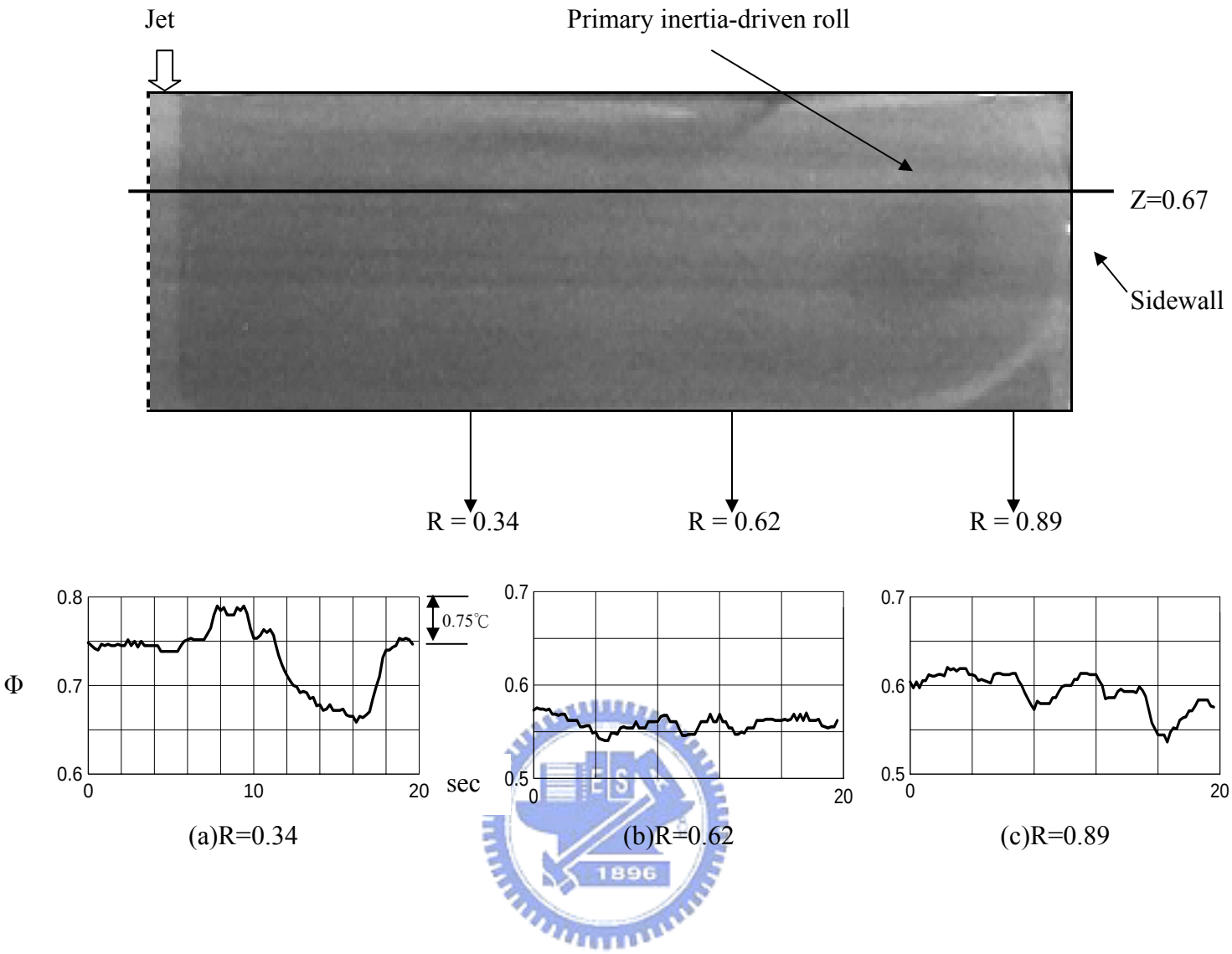
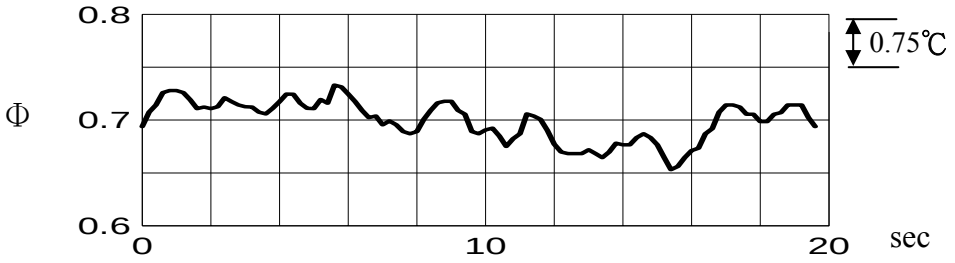


Fig. 4.108 The time records of non-dimensional air temperature and the corresponding power spectrum densities for $\Delta T = 15.0$℃ and Re_j=676 (Q_j=5.0 slpm) with measured at selected locations on the vertical plane $\theta = 0°$ at $Z = 0.67$ and $R = r/R_c = 0.62$ for various HD_j = (a)4, (b)5, and (c)6.

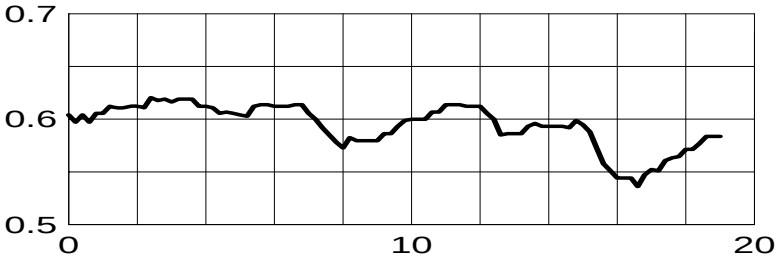


(a)R=0.34 (b)R=0.62 (c)R=0.89

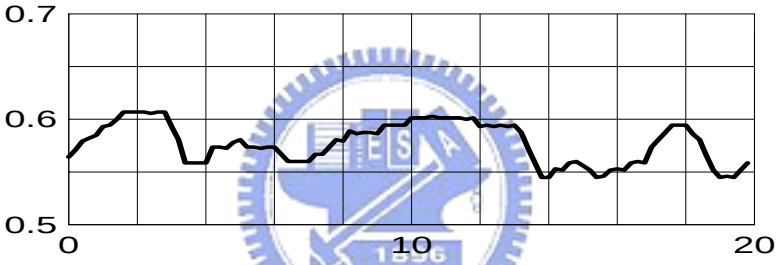
Fig. 4.109 The time records of non-dimensional air temperature for Ra=176.162 ($\Delta T = 15.0$℃) and Re_j=1,488 (Q_j=11.0 slpm) with H=50.0 mm measured at selected locations on the vertical plane $\theta = 0°$ at Z = 0.67 for $R = r/R_c$ = (a) 0.34, (b) 0.62, and (c) 0.96.



(a) $HD_j = 4$

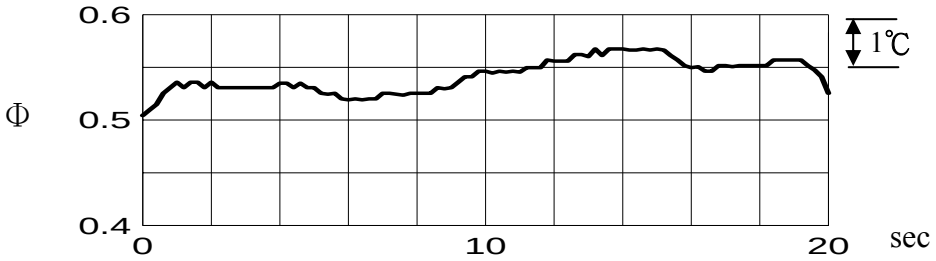


(b) $HD_j = 5$

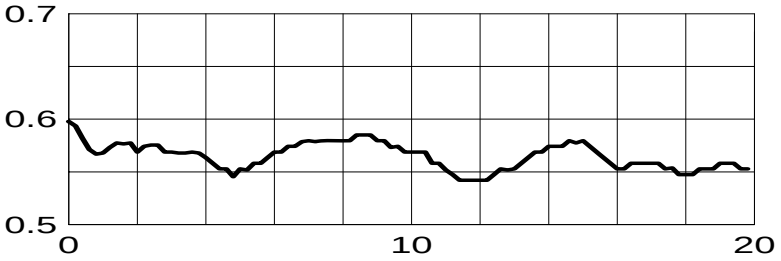


(c) $HD_j = 6$

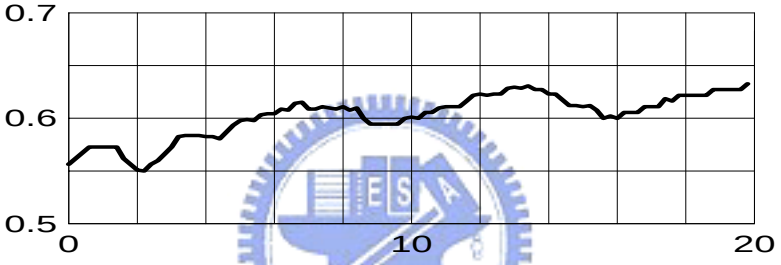
Fig. 4.110 The time records of non-dimensional air temperature for $\Delta T = 15.0$℃ and Re_j=1,488 (Q_j=11.0 slpm) with measured at selected locations on the vertical plane $\theta = 0°$ at $Z = 0.67$ and $R = r/R_c = 0.62$ for HD_j = (a)4, (b)5, and (c)6.



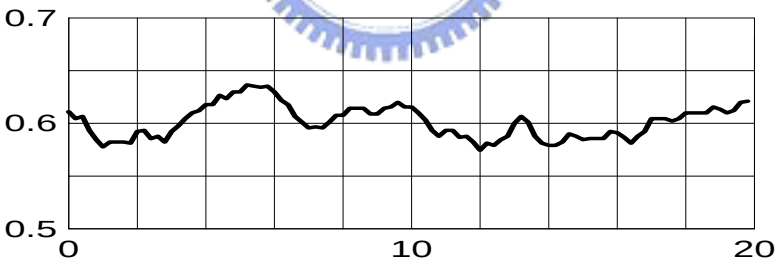
(a) Q_j = 8.8(Re_j =1,190)



(b) Q_j = 10(Re_j =1,352)



(c) Q_j = 11(Re_j =1,488)



(d) Q_j = 12(Re_j =1,623)

Fig. 4.111 The time records of non-dimensional air temperature for ΔT = 20.0℃ and Ra=234,883 at H = 50.0 mm with measured at selected locations on the vertical plane $\theta = 0°$ at Z = 0.67 and R = r/R_c =0.89 for Re_j = (a) 1,190, (b) 1,352, (c) 1,488, and (d) 1,623.

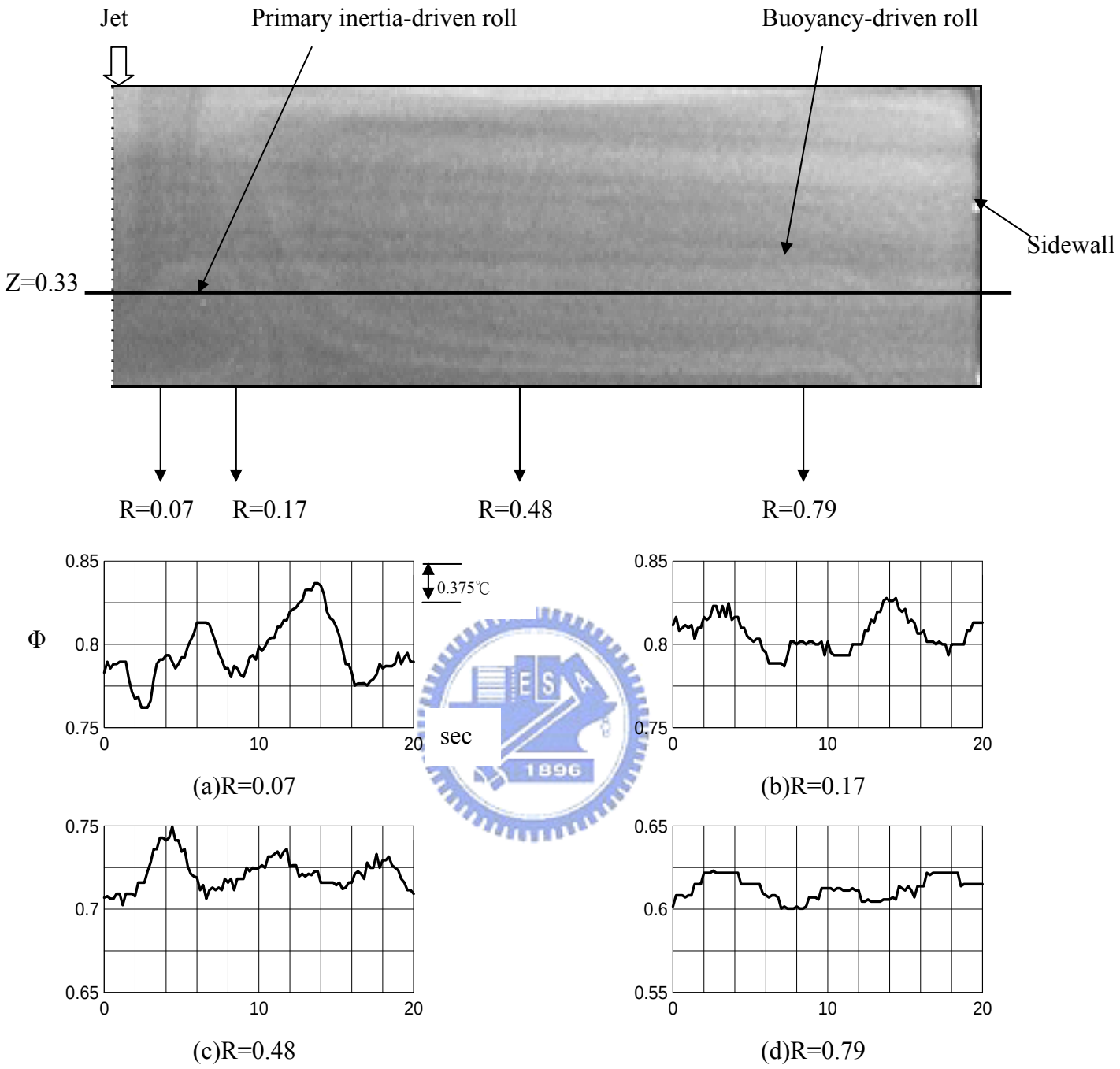


Fig. 4.112 The time records of non-dimensional air temperature for Ra=176,162 ($\Delta T = 15.0$ ℃) and Re_j=47 (Q_j=0.3 slpm) with H=50.0 mm measured at selected locations on the vertical plane $\theta = 0°$ at Z = 0.33 for various $R = r/R_c$ = (a) 0.07, (b) 0. 17, (c) 0.48, and (d) 0.79.

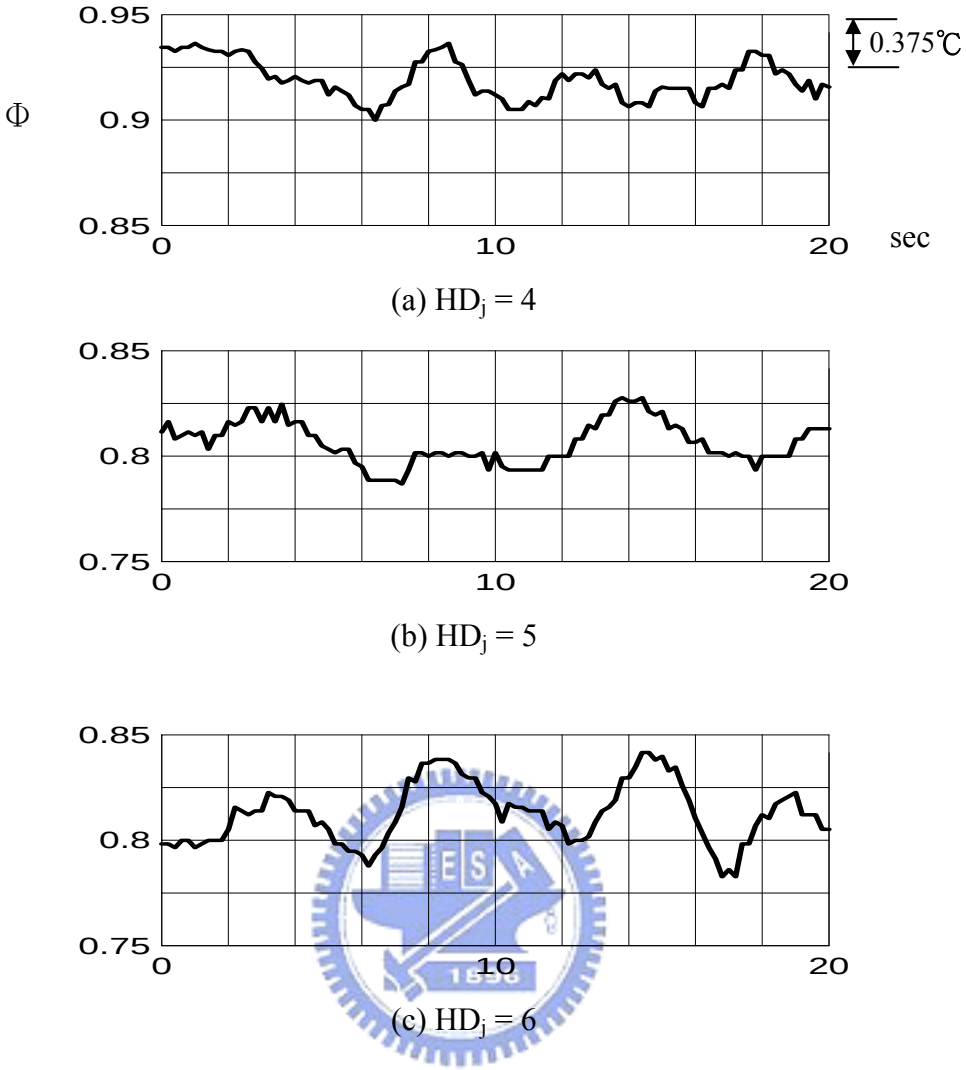
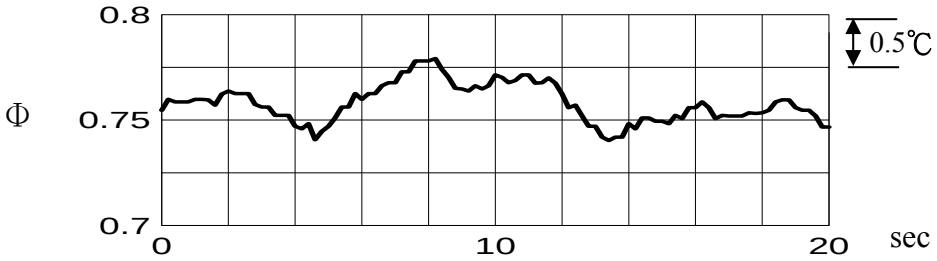
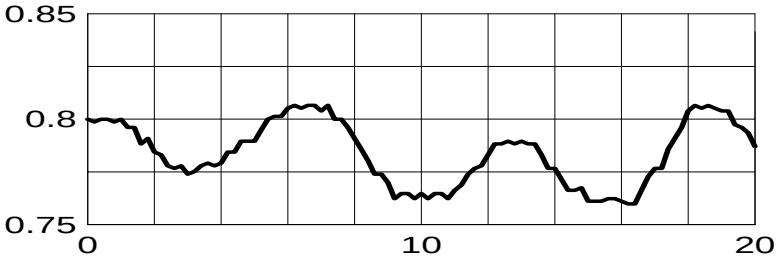


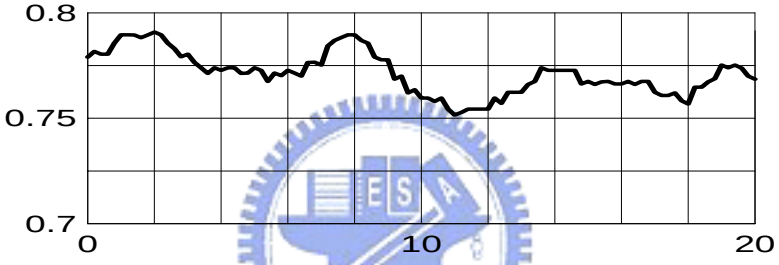
Fig. 4.113 The time records of non-dimensional air temperature for $\Delta T = 15.0$℃ and Re_j=47(Q_j=0.3 slpm) with measured at selected locations on the vertical plane $\theta = 0°$ at Z = 0.33 and $R = r/R_c = 0.17$ for HD_j = (a)4, (b)5, and (c)6.



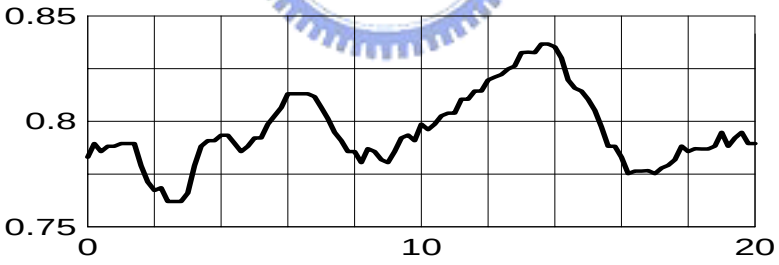
(a) Q_j = 1 slpm(Re_j =135)



(b) Q_j = 0.8 slpm(Re_j =108)



(c) Q_j = 0.5 slpm(Re_j =68)



(d) Q_j = 0.2 slpm(Re_j =27)

Fig. 4.114 The time records of non-dimensional air temperature for ΔT = 20.0 ℃ and Ra=234,883 at H = 50.0 mm with measured at selected locations on the vertical plane $\theta = 0°$ at Z = 0.33 and $R = r/R_c$ = 0.17 for Re_j = (a) 135, (b) 108, (c) 68, and (d) 27.