Flow Visualization of Flip-Flop Flows inside Streamwise Diverging Diamond-Shaped Cylinder Bundles

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ABSTRACT: Author et al [(1)] reported that flip-flop flows having the self-excited oscillations are induced by the rotation of the vortex in the concavities constructed on both sidewalls inside the diamond-shaped cylinder bundle. The aim of the present research is to develop the fundamental study on the control of the self-excited oscillations in diamond-shaped cylinder bundles. The previous experiment [(1)] employed the diamond-shaped cylinder bundle having an apex angle of 30°. The corresponding diamond-shaped cylinder bundle was modified in the present study, as shown in Fig.1. The PIV measurements were performed on the flow visualization in the horizontal cross section of the exit jet-stream flow field exiting from diamond-shaped cylinder bundles. The measured results were compared with the corresponding data [(1)] in the absence or presence of the concavities constructed on both sidewalls inside the diamond-shaped cylinder bundle. Figure 2 depicts one example of visualization results. Velocity vectors are mutually spread on left or right direction at the angle of 30°, that is the diverging angle of the jet-stream from the bundle becomes 60°. Figure 3 shows the mean absolute vlues of the jet-stream velocity-variation rate, |dV/dy|, at the cross-section of the channel versus Reynolds number, Re, for four different diamond-shaped cylinder bundles. One observes that the magnitude of |dV/dy| is increased for each bundle and a substantial enhancement of |dV/dy| takes place at Type D60c for the streamiwise diverging diamond-shaped bundle. It is found from the present study that the diffusion phenomenon in the jet-stream is quantitatively disclosed by different bundle shapes.

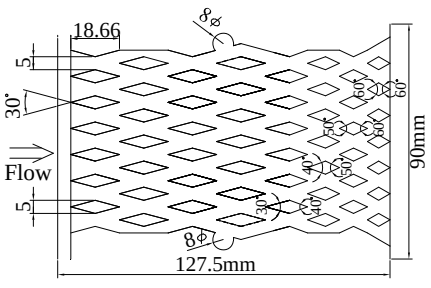

Fig. 1 Schematic diagram of the top view of the streamiwise diverging diamond-shaped bundle.

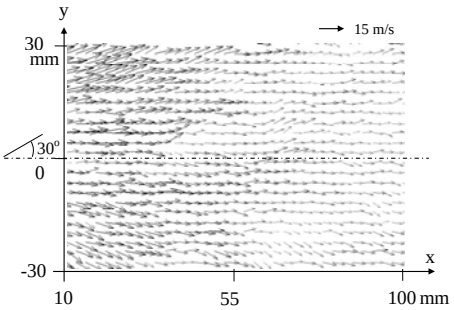

Fig. 2 Velocity vectors at an instant time in flow field for Type D60c (Re=8,400).

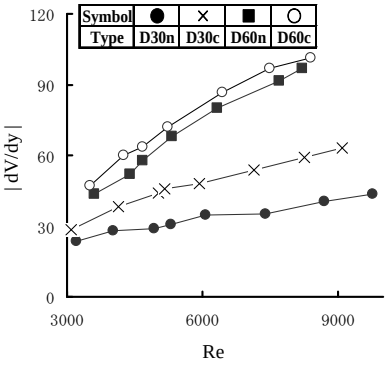

Fig. 3 Change of the jet-stream velocity-variation rate, |dV/dy| versus Reynolds number.

References

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