

1. Introduction

When a vehicle travels at high speed, the specular surface of a door(side) mirror may start vibrating due to the fluid-dynamic force which disturbs the rear view field. CFD (Computational Fluid Dynamics) was used to analyze this phenomenon and study a door mirror shape that will not vibrate.

2. Computational Method

A model of a door mirror mounted on a flat board was used as the object of analysis (**Fig. 1**) and computed under condition of a vehicle traveling at 162 km/h. "COSMOS-V"¹⁾, unsteady flow analysis software developed by our laboratory, was used for computation. The time history of the force exerted on the mirror surface was obtained from the calculation results and the vibration caused by the fluid-dynamic force was evaluated. In addition, the state of flow was visualized by animation to investigate the cause of the vibration.

3. Computational Result

Fig. 2 shows two shapes of the door mirror in Cases A and B, the velocity vectors of the time-averaged field of flow and the distribution of pressure on the mirror surface. **Fig. 3** shows the time history of the fluid-dynamic force exerted on the mirror surface

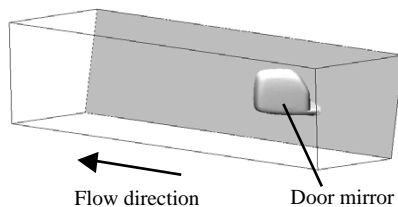


Fig. 1 Calculation model.

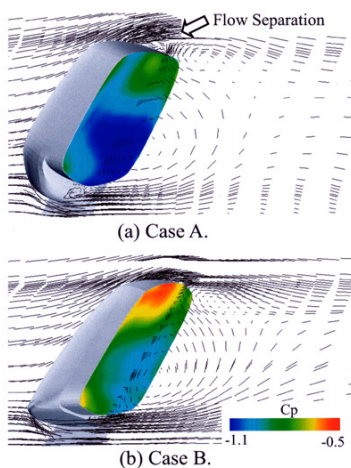


Fig. 2 Time averaged velocity vectors and pressure maps (top view).

obtained from the computational result. According to **Fig. 3**, Case B had a smaller amplitude of fluctuation of the fluid-dynamic force, making it difficult for vibrations to be generated. When the time-averaged flow fields are compared in **Fig. 2**, the separation occurs at the outer end in Case A and the pressure on the mirror surface is, on the whole, lower compared with Case B. In particular, a large low-pressure region was observed in Case A that was caused by the flow that occurs from the vehicle-body side. In such a time-averaged field, it is not possible to determine the direct cause of the vibration. Therefore, the flow fields were compared through animation. According to the animation, a large vortex from the inside occurs due to the effect of a major separation at the outer end in Case A, which was seen to increase the pressure fluctuation on the mirror surface. On the other hand, in Case B, fluctuation induced by the flow separation at the outer end was smaller. In addition, since the door mirror shape of the vehicle-body side is formed along the flow, the pressure fluctuation was not as great as in Case A. From these observations, we can evaluate that the pressure fluctuation for Case B is small, hence, it is a more desirable shape for reducing vibration.

4. Conclusion

The vibration caused by the fluid-dynamic force exerted on a door mirror surface was analyzed by CFD, then two shapes of door mirror were given a relative evaluation. In addition, we could clarify the association of the flow by visualization and could indicate that a shape like Case B helps to suppress vibration.

Reference

- 1) Inagaki, M., et al. : Proceedings of Tenth Numerical Fluid Symposium, (1996), 410
(Report received on Nov. 1, 2000)

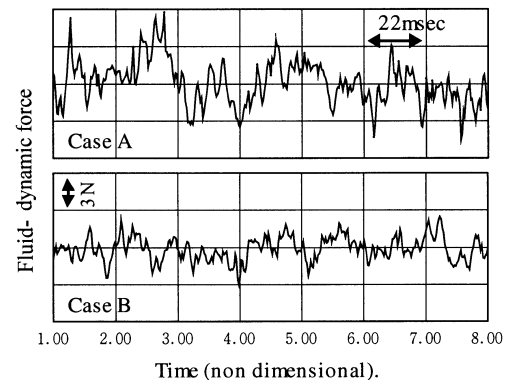


Fig. 3 Time history of fluid-dynamic force exerted on the mirror surface.