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The effect of diffuser angle on modified generic side view mirror

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ABSTRACT – In this paper, an aerodynamics effect of modified generic side view mirror with different diffuser angle, fix foot height and constant foot width are discussed. The numerical simulation is done by using Hyperworks software. The results obtained are discussed in term of drag coefficient, turbulence separated region and pressure distribution around the side mirror and at side mirror surface. With all these results, the effect of different diffuser angle on modified generic side view mirror has been understood.

1. INTRODUCTION

Side view mirror primary function is to provide a clear vision outside the vehicle during driving, so that the driver does not need to divert his/her attention from vehicle's direction of motion. Side view mirror aerodynamics analysis is common in automotive vehicle development. Although the effect of drag is considerably small compared to the total vehicle drag, it is critical in terms of noise induced by the side view mirror and also in case where water entrains around the door glass during raining. At high speed (e.g. > 100 km/h), atmospheric air flow in reality is turbulent; during car moving, it cause the car body to withstand the impact of air and when it couples by external shape such as the side mirror, the flow becomes chaotic which lead to intermittent wind noise. Furthermore, during raining the effect of side mirror is imminent that it cause the water droplet to stale around the door glass. This is due to vortex generated behind the side view mirror as well as low pressure induced around the area [1].

2. METHODOLOGY

To understand the basic fundamental of aerodynamics phenomenon on side mirror, it is well known that one has to start with a simple model in order to reduce the complexity of the model. A simple geometry known as generic side mirror geometry is quarter of a sphere mounted on a half-cylinder with its dimension as shown in Figure 1.

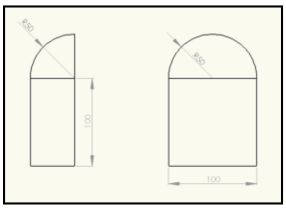

Figure 1 Generic Side Mirror Geometry.

Three parameters which are the most important to noise generation from a side view mirror are foot height, foot width and diffuser angle [2]. On this simulation, all above factors are considered with fix foot height and foot width with different diffuser angles.

The entire model has been designed based on defined parameters using CATIA software as shown in Table 1.

Table 1: Designed model

Name of model	Foot height (mm)	Foot width (mm)	Diffuser angle (°)
40-30-00	40	30	0
40-30-05	40	30	5
40-30-10	40	30	10
40-30-15	40	30	15

Then, it will be analyzed using Hyperworks Virtual Wind Tunnel software. The parameters used as shown in Figure 2.

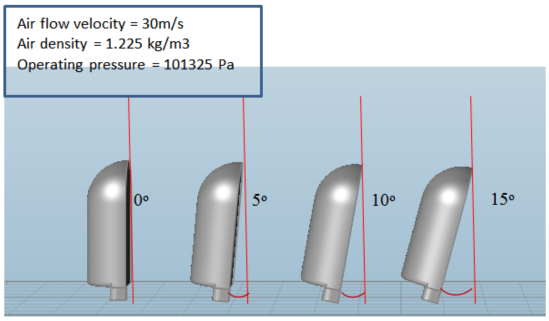

Figure 2: Diffuser angle parameter

3. RESULTS AND DISCUSSION

The results were divided into 3 sections:

(i) Drag coefficient (Cd)

Figure 3 shows the drag coefficient between these four models. Clearly, the 40-30-00 model has the highest drag coefficient compared to others.

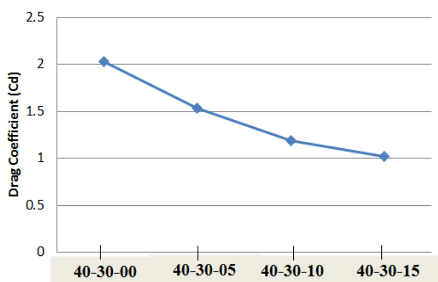

Figure 3 Drag coefficient (Cd) of four models

(ii) Streamlines

Figure 4 shows the comparison of turbulence separated region in term of streamlines between these four models at the top view. By looking at 40-30-00 streamlines pattern, big area of turbulence separated region was created behind the side view mirror. When the diffuser angle has increases, the separated region will become smaller. Therefore, 40-30-15 proved that 15° angle was the good angle where it shown that it only created the smallest turbulence separated region area than the other models.

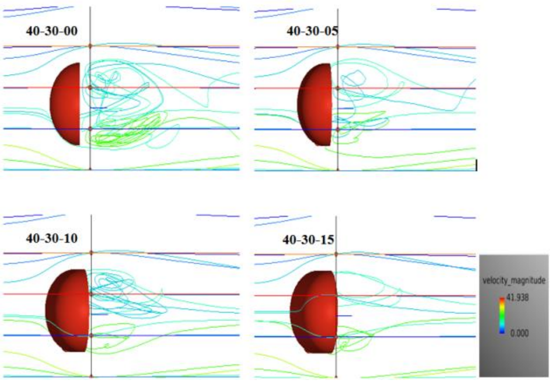

Figure 4 The turbulence separated region in term of streamlines around the side mirror at the top view.

The other view which was the side view of the turbulence separated region in term of streamlines can be seen at Figure 5. The 40-30-00 has complex and large turbulence separated region flow behind the side mirror. As diffuser angle become larger, the turbulence separated region become smaller and less complex. The more turbulence separated region appeared, the more drag generated.

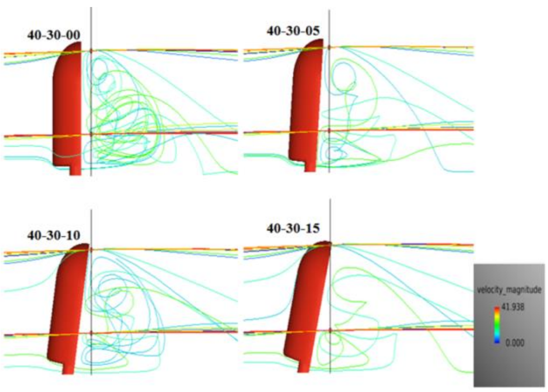

Figure 5 The turbulence separated region in term of streamlines at side view of the side mirror.

(iii) Pressure Distribution

Figure 6 shows the contour of pressure distribution at the mirror. It shows that the high pressure distribution area was at approximately center of the side mirror and the region become bigger when the diffuser angle increases.

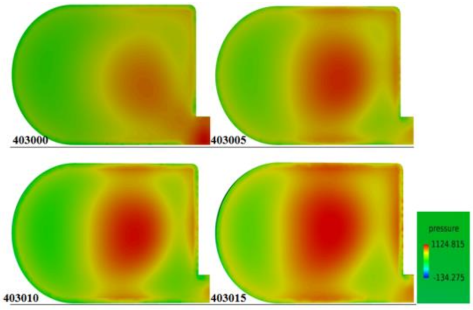

Figure 6: The pressure distribution at the mirror.

Next, the pressure distribution on the housing of the side mirror can be seen in Figure 7. It shows that the high and low pressure area were distributed uniformly even when diffuser angle become larger.

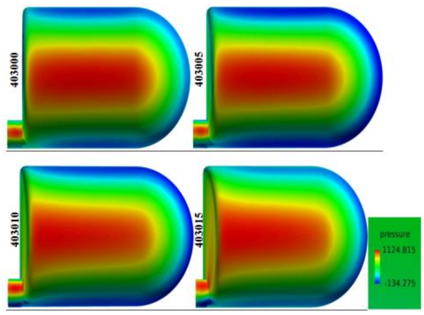

Figure 7 The pressure distribution on the housing of side mirror.

4. CONCLUSIONS

After comparing results obtained by simulations using different diffuser angle, fix foot height and constant foot width, it can be summarized that 40-30-15 model which has 15 ° diffuser angle, 40 mm of foot height and 30 mm of foot width was better model compared with other models in term of small turbulence separated area and low drag coefficient. Moreover, this model has larger high pressure distribution at the mirror.

5. ACKNOWLEDGEMENT

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6. REFERENCES

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