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Transonic Flow Over A Symmetric Double Wedged Airfoil

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***Abstract*—Pressure distribution over an airfoil is an important consideration to ensure good performance of the aircraft. In the present work a double wedge airfoil present in a wind tunnel is considered and simulated at transonic speeds for a given angle of attack to find the variation of coefficient of pressure using ANSYS 18.1.**

Keywords—Transonic; Airfoil; coefficient of pressure

INTRODUCTION

Pressure distribution over an aerofoil is responsible for lift produced by the aerofoil. The objective of this experiment was to find the variation of coefficient of pressure over a symmetrical double wedged aerofoil. This analysis involves a 2-Dimensional double wedged aerofoil model with a half wedge angle of 4.5 degrees and a chord length of 12.7 centimetre. The angle of attack chosen is 2 degrees and the flow Mach number is 1.002. Experimental results provided in [1] for pressure distribution over a double wedge aerofoil are compared with result obtained through simulation. dimensionless number which describes the relative pressure throughout the flow-field is known as the coefficient of pressure.

MODELLING

Figure 1 shows the geometry of the symmetric double wedge aerofoil. Figure 2 shows the position of the aerofoil with respect to the wind tunnel.

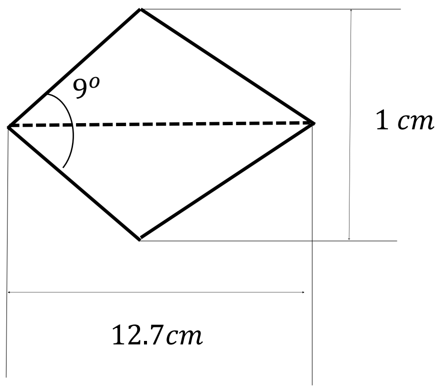

Fig 1. Aerofoil

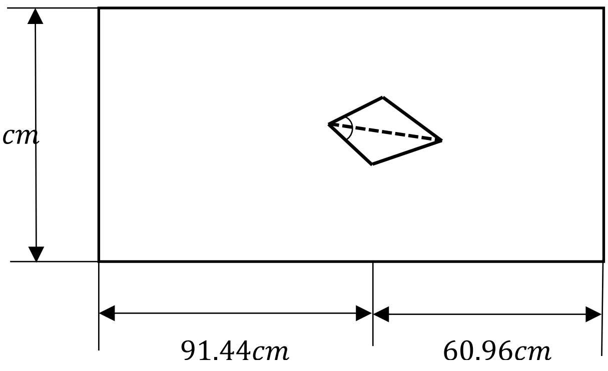

Fig 2. Wind tunnel

MESHING

The model was designed using the inbuilt design modeller present in ANSYS Workbench. Meshing the 2d geometry was performed by providing edge sizing to the four edges of the aerofoil with no biasing. Inflation is also provided by choosing the boundary as the sides of the aerofoil. Figure 3 shows the final mesh obtained. The named selections are the inlet, outlet, top wall and bottom wall of the wind tunnel as shown in Figure 4.

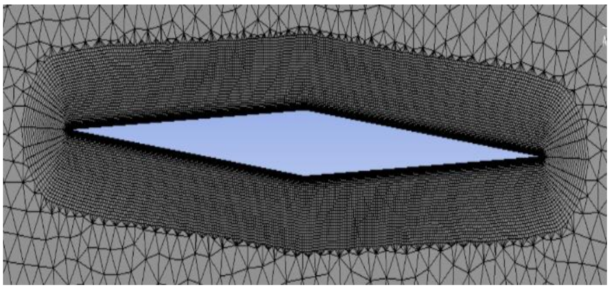

Fig 3. Mesh

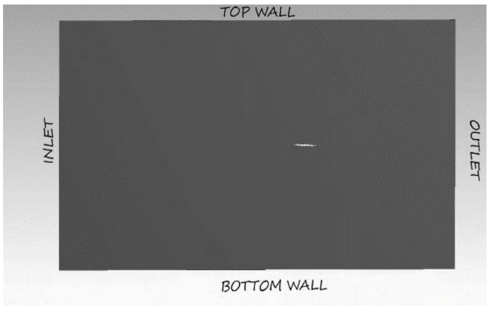

Fig 4. Named selections

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SOLVER SETUP

The type of solver used is pressure-based solver. Ideal gas equation was used for the properties of air. Using pressure far field with Mach number 1.002 at inlet boundary conditions are provided. Calculations where performed for 10000 iterations and it was observed that the residuals became constant (horizontal line) hence it was concluded that the solution was converged as shown in Figure 5.

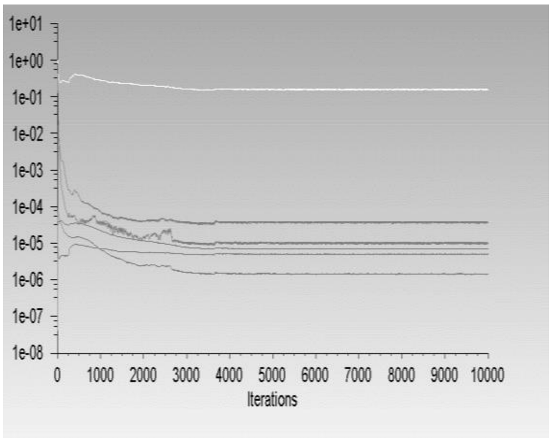

Fig 5. Convergence

RESULTS AND DISCUSSIONS

Plot of coefficient of pressure (Cp) against chord of aerofoil (x/c) for both top and bottom surface of aerofoil is obtained from simulation and compared with graph which is experimentally obtained [1] as shown in Figure 6. There is close resemblance between experimental and values obtained from simulation. Coefficient of pressure decreases and suddenly increases at the middle section of the aerofoil. Y+ values obtained is as close to 1 as possible along the top and bottom walls of the aerofoil as shown in Figure 7.

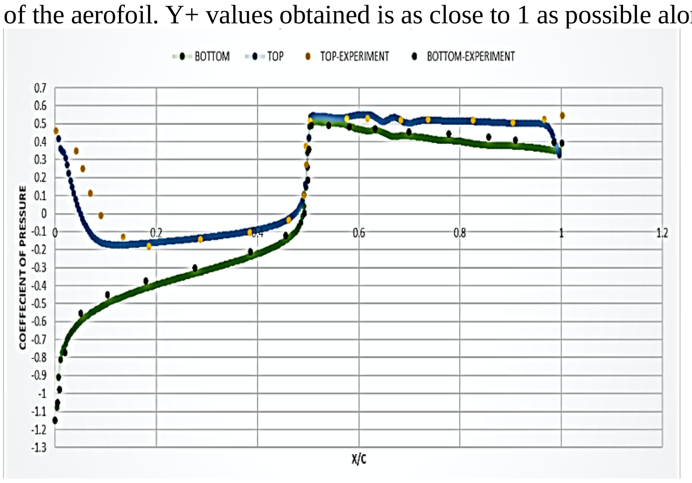

Fig 6. Variation in Cp with x/c

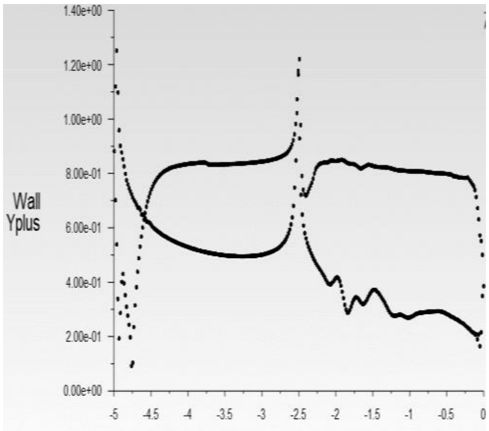

Fig 7. Y+ values over the aerofoil

CONCLUSION

The pressure distribution over a double wedge aerofoil inside a wind tunnel at an angle of attack of 2 degrees and a Mach number of 1.002 is obtained and it is observed that the coefficient of pressure increases suddenly at the middle of the aerofoil.

REFERENCES

[1] ED Knechtel, "Experimental Investigation at Transonic Speeds of Pressure Distributions Over Wedge and Circular-arc Airfoil Sections and Evaluation of Perforated-wall Interference", NASA Technical notes, August 1959.