EXPERIMENTAL STUDY OF THE INFLUENCE OF THE WIND TUNNEL BLOCKAGE ON THE AERODYNAMICS OF OCTAGONAL CYLINDERS

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The effect of the constraints imposed by wind tunnel test section boundaries on the flow around bluff-bodies – those bodies having leading-edges separation without reattachment or having large zone of separated flow further aft on the body – are even now not fully understood. The physics of the interaction of the boundaries of a wind tunnel test section and these wake flows was explored by Maskell[1], based on the analysis of measurements made on three dimensional flat plates mounted normal to the flow.

In this work the applicability of blockage corrections for bluff-bodies characterised by movable separation points and presence of reattached flow is presented. In particular an experimental investigation has been carried out on circular and octagonal cylinders with different geometrical characteristics (roughness and radius of curvature of the edges) at three blockage ratios (6.3%, 9.3% and 15%). The present study has been restricted to the influence of wind tunnel blockage on the mean flow past cylinders spanning the tunnel operating at Reynolds number ranging between $Re=10^5$ and $Re=5\cdot10^5$.

Performing measurements of the base pressure and drag forces in the L1-A wind tunnel, the influence of the blockage ratio on the drag coefficients for circular and octagonal cylinders and the influence of the geometric parameters (surface roughness, curvature) on the blockage correction coefficients has been pointed out.

The availability of the base pressure allowed to correct the data using Maskell's theory. This theory appears to perform quite adequately insofar as the corrected values of the drag coefficient and the base pressure coefficient are of the same order of magnitude as the measurement accuracy.

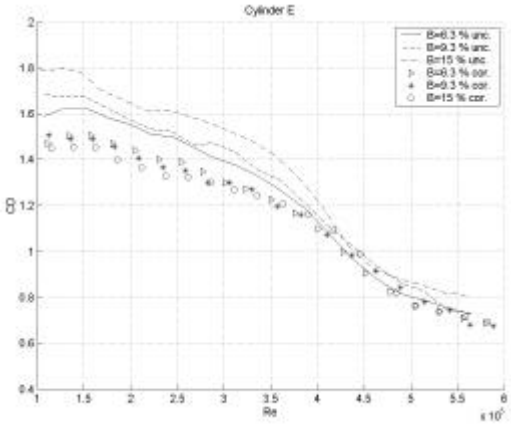

Figure 1: Example of correction for an octagonal cylinder with smooth surface and rounded edges ($r/d=0.156$, $k_S=1.49\times10^{-4}$)

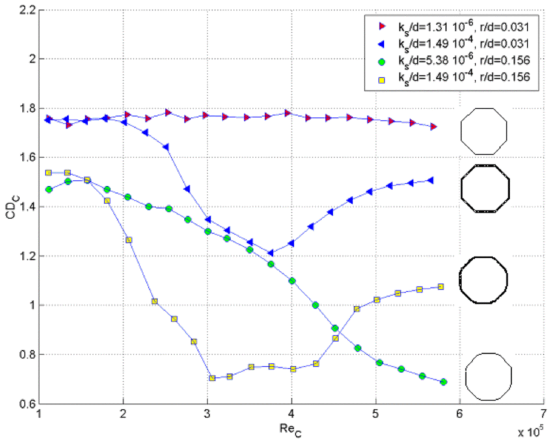

Figure 2: Corrected Drag coefficient profiles for octagonal poles – r/d: dimensionless edge-curvature, k_S/d: dimensionless roughness

[1] Maskell, E.C., "A theory of blockage effect on bluff-bodies and stalled wings in a closed wind tunnel", RAE Report AERO 2685, November 1963