EXPERIMENTAL STUDY OF UNSTEADY TURBINE BLADE TRAILING EDGE FLOW

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The blade wake is characterised by the presence of large coherent structures well-known as the von Karman vortices (see Figure 1). This vortex shedding activity is recognized nowadays as an important loss mechanism that can represent an important fraction of the total loss in turbines.

A blade equipped with a rotatable trailing edge cylinder instrumented with a pressure tap and installed in the VKI-C3 test facility has allowed to see a difference in the behaviour of the pressure distribution on the trailing edge surface when the flow regime varies from subsonic to supersonic, showing several instabilities at high subsonic/transonic regime. A graph of this pressure evolution can be seen in Figure 2. A first flat region in the centre of the trailing edge (S/D=0) can be observed at low subsonic and supersonic regime with the appearance of a third peak in the centre of the trailing edge in the transonic domain.

Another important finding is the behaviour of the two peaks associated with the over-expansion at the suction and pressure sides before separation from the trailing edge. From $Ma_{2,is}$=0.4 up to $Ma_{2,is}$=0.93 these over-expansion peaks are situated in the same place, but starting from this point both start to be displaced towards each other. This fact is explained by the Prandtl-Meyer expansion effect of the shock system on both sides of the trailing edge. Because of the shock system at this Mach number, a dead air closed region was put in evidence between the shocks, and therefore an isobaric region was obtained again. In order to find out more information about the loss mechanism, C_p calculations have been done with the results of the pressure measurements.

In order to link the base pressure region and the wake activity, PIV measurements were done on the same blade for two different characteristic flow Mach numbers. The wake dynamic characteristics have been extracted by the means of this technique in the wake traverses at different distances from the trailing edge, showing a coherent behaviour in turbulence intensity and vorticity for both Mach numbers.

Additionally, it has been possible to see by flow visualisations the relation between the shear layer activity and the vortex shedding process (Figure 1).

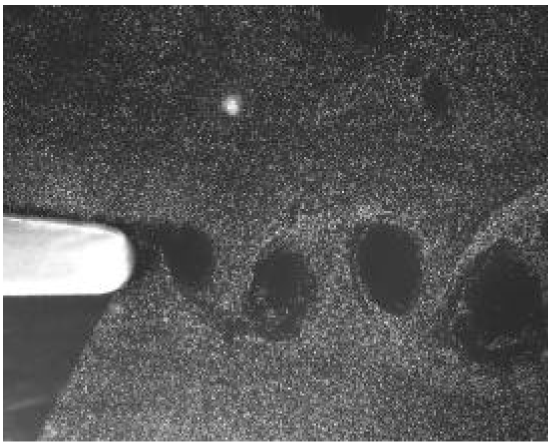

Figure 1: Flow visualisation around trailing edge region

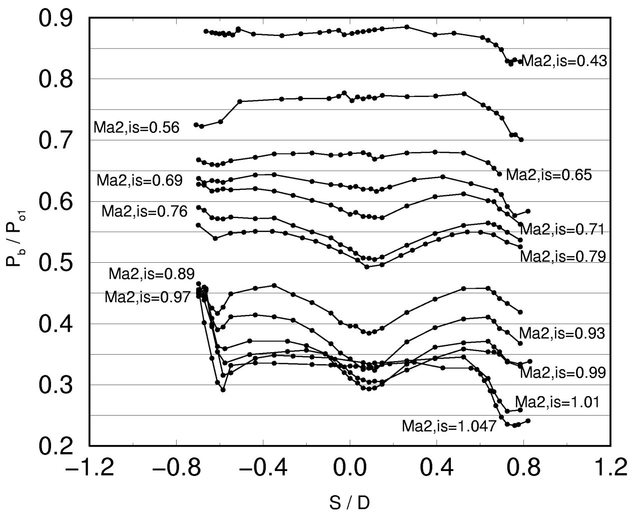

Figure 2: Static pressure evolution along the trailing edge surface and Mach number