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THE INFLUENCE OF SUCTION INTENSITY THROUGH PERFORATED WALL ON TURBULENT BOUNDARY LAYER

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A constant need for improving flow machinery and aircraft performance besides of typical airfoil and wing configuration improvements sometimes implies necessity for flow control. One of the method of flow control is application of porous walls in areas, where there is a strong need for shock wave stabilization, reduction of separation area or noise reduction. The ventilation through porous plate may be divided into passive control where transpiration is forced by a rapid pressure changes above model's surface and active by sucking into or blowing out of the model.

This paper is a continuation of research on transpiration through perforated plates. This particular work concentrates on influence of suction on turbulent boundary layer.

An experimental setup consists of nozzle shaped to maintain constant Mach number above perforated plate, a K3 perforated plate mounted on cavern. The plate is of approx. 5.6% porosity achieved with 0,3mm holes laser drilled holes perpendicular to the surface. Plate used was previously investigated in Karslsruhe during EUROSHOCK2 project. Tangential flow regime was set to maintain constant Mach number upstream of the plate independently from the suction intensity. The measurements concerned several Mach number cases. Definition of the suction intensity - Cq number which represents percentage of mass flow rate through porous plat at certain flow conditions – was realized with a set of sonic nozzles. Pressure distribution inside the nozzle, in a cavern and on the plate's surface as well as static pressure inside sonic nozzle throat was measured with PSI9010 scanner. Boundary layer profiles were measured in three traverses along the perforated plate by means of a Pitot probe. Bondary layer profile and integral parameters have been determined. A Clauser approach was used to assess shear stresses (cf) and scope of suction influence on boundary layer profile and its development in the vicinity of the plate's surface.