INVESTIGATION OF HYSTERESIS OF THE COANDA EFFECT AT THE FLAT PLATE

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Summary: The hysteresis of the Coanda effect was investigated with the 2D stream coming from the slot in the neighbourhood of the plate at the experimental rig at the UWM, Olsztyn. The measurements were made for different Reynolds numbers based on the slot dimension and stream velocity. The measurement of the free stream, the wall jet velocity profiles and the pressure distribution on the plate were accomplished. The angles of the plate arrangement (hysteresis angle) according to the stream axis were measured where the stream separate and attached the plate when the plate was approaching or walking away the stream axis. The hysteresis angle is equal to the 15 to 20 degrees depending on the Reynolds number. The visualization of hysteresis of the Coanda effect was also made by means of the smoke.

1. **Introduction**   The Coanda effect is observed as a tendency of the stream coming from the slot to stay attached to the plate or convex surface. The Coanda effect is well known in the ventilation as an undesirable phenomenon changing the designed air distribution in the ventilated room. It also sometimes used to change the air direction at the outlet of the vent in a well-thought- up way.
It is known that there is the hysteresis of Coanda effect which is rather not well investigated [1]. The aim of this paper is - to some extent – to fill out this gap. In [1] the hysteresis is shown as a function of l/b, where l=length of the plate and the width of the air outlet orifice and for the so called high Reynolds number i.e. Re=50000. In the ventilation problems the Reynolds number is often much smaller and in our investigations it is in the range of Re= 7000 till almost 40000.   A little more distant target of our investigation is the application of the hysteresis phenomenon to enhance the mixing ventilation in a room.

2. **Experimental rig**   The investigation was carried out in the experimental rig in the lab of the Chair of Environmental Engineering at the UWM in Olsztyn. The stream air was coming from the twodimensional Witoszynski nozzle of dimensions h*b, where h=0.6 m = const and b = 5, 10 and 20 mm was changing. The length of the plate of length l = 1.0 m was placed at the edge of slot and the plate can be turned of the angle 0 to 90 degrees was, thus investigations were made for three different values of l/b = 50, 100 and 200.
 The velocity range used during the investigation was 5 m/s to 32 m/s so the Reynolds numbers determined as by Newman was Re= 7000 till almost 40000.
Firstly, the histeresis of the Coanda affect at the plate was investigated by measuring the limiting angle when the stream is attached and detached [3]. The visualisation of the hysteresis of the Coamda effect were also made. Than the measurements of the free stream from the twodimensional slot was made, and next the wall jet for the angle α=0 and the critical maximum angle of attachment and separation [2]. Furthermore the measurements of static pressure in 50 points at the plate surface were made. Additionally, the pressure force acting on the plate was calculated by means of the integration of static pressure. For the critical angle of plate deflection also the separation

bubble length at the beginning of plate was measured by means of visualisation (threads).

3. Results of investigation

The limited angles of hysteresis for different Reynolds numbers and l/b are presented, Fig.1 and 2.
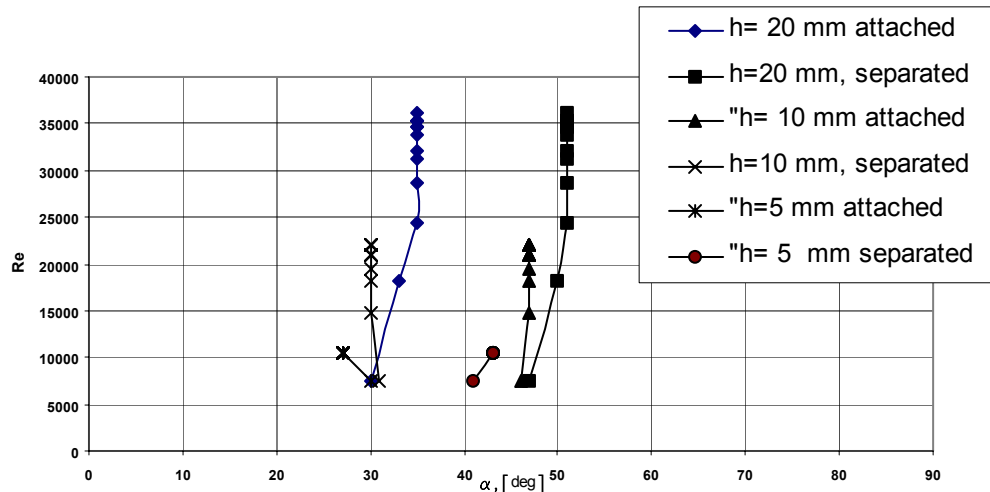

Fig.1 Hysteresis limits of the Coanda effect versus Reynolds number
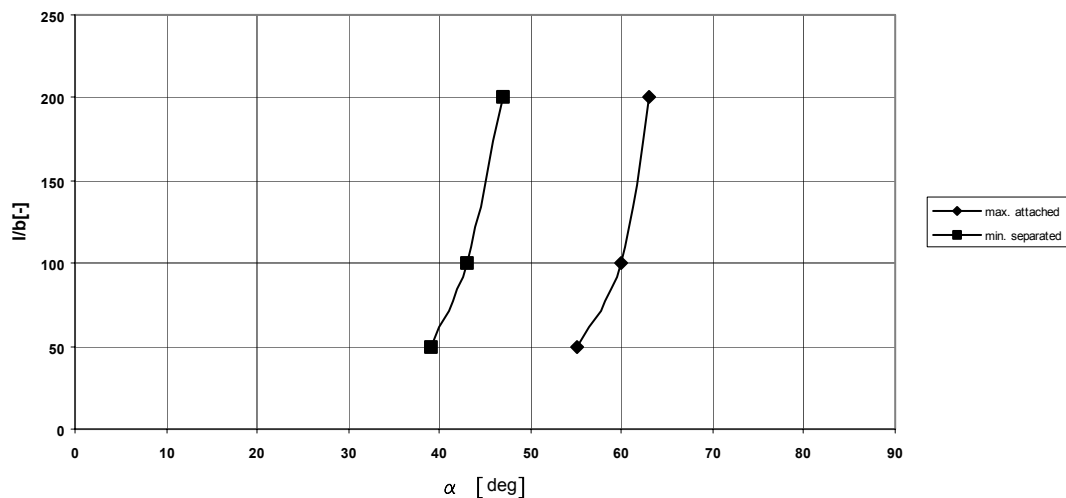

Fig. 2. Hysteresis limits of the Coanda effect versus nondimensional length of plate l/b

4. Conclusions Results in Fig.1 show that the hysteresis phenomenon is Reynolds number dependant, while results in the Fig. 2, given as the limited angle for the highest Reynolds number used in experiment (for each width orifice applied), are very similar to results given by Newman [1] for the Reynolds number Re>50000.

References:

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