Trolley 1

K.1.2. Air curtain: Curvature of a planar free jet due to pressure difference; investigation on an air curtain applied to an industrial hall

For "non-contact closing" a door of an industrial hall that is otherwise to be open because of transportation reasons, i.e. for moderation of heat and mass transfer between the hall and the surroundings, cold air curtain is used. The difference between the internal and ambient pressure is balanced by means of the curvature of the vertical, planar free jet introduced on one side of the door.

Assignment: investigation on the behavior of the air curtain model, as function of outlet velocity, outlet slot width, outlet angle, door width, and pressure difference. The air volume flow rate entering the protected enclosure is also to be determined as function of pressure difference. The mass and heat transfer is to be observed on the basis of oil smoke flow visualization.

In the 45 min of the measurement,

a) The entering flow rate is to be determined, for a given rounded outlet slot geometry, door width, outlet velocity and angle, and depression. The parameters of operating state related to zero inflow are also to be determined.
b) Assignment a) is to be repeated for another outlet angle and outlet velocity.
c) At a given outlet angle, the effect of door width is to be examined.
d) By means of introduction of oil smoke and carrying out photography, the shape of the curved jet and the mass transfer through the jet are to be studied.

Availabilities:

- Equipment for generation of an air curtain,
- Industrial hall model, with variable free jet outlet angle, door width, and depression (using a fan of variable speed), and with an inlet element calibrated for flow rate measurements,
- Pitot and Pitot-static probes for velocity measurements,
- Oil smoke generator,
- Pipe and probe for introduction of the oil smoke,
- Manometer.

A camera is to be provided by the measurement group.

Expected background information (chapters from Lajos, T.: Fundamentals of Fluid Mechanics, 2004, 3rd Edition):
2.1.1. Pathline, streakline, streamline, 2.1.3. Flow visualization, 3.3.3. Static, dynamic, total pressure, 3.4.1. Euler component equations in the natural coordinate system, 3.4.2. Applications, 6.2.4. Instruments based on the deformation of a flexible body, 6.2.5. Practical pressure measurement problems, 6.3.1. Determination of velocity based on the measurement of dynamic pressure, 8.5.2. Preconditions for similarity of flows, 9.1.1. Characteristics of boundary layers, 9.2.2. Development of the boundary layer in streamwise direction, 9.3.1. Development of shear stresses in the boundary layer, 9.3.2. Boundary layer separation, 9.3.3. Flow past a cylinder, 9.3.5. Control and elimination of boundary layer separation, 10.1.2. Dimensional analysis, 10.1.3. Application of dimensional analysis, 11.1.1. Development of aerodynamic forces, 11.1.2. Aerodynamic force acting on a cylinder, 11.2.2. Aerodynamic force acting on bluff bodies.
Further recommendations: From 4th Edition: 6.4.1. The aim of application of wind tunnels, 6.4.2. Types of wind tunnels, considering velocity and layout, 6.4.3. Structural elements of wind tunnels, layouts for measurement sections, 6.4.4. Practice of wind tunnel measurements, and/or Bradshaw, P., Mehta, R.: Wind tunnel design www-htgl.stanford.edu/bradshaw/tunnel/

Expected further background information –
For measurements regarding air curtains:
3rd Edition, or 4th Edition: 7.5. Free jets, Air curtains