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Bernoulli theorem demonstration lab report

Energy appears in the form of pressure, speed and height in liquids that do not exchange energy due to viscous dissipation, heat transfer or axle work (pump or other device). The relationship between these three forms of energy was first stated by Daniel Bernoulli (1700-1782), based on the energy preservation principle. Bernoulli's lot regarding flow is streamlinedly based on three assumptions: constant flow, unpressible liquid, and no loss of fluid friction. The validity of Bernoulli's equation will be examined in this experiment. 2. Practical application bernoulli-theorem provides mathematical tools to understand the mechanics of liquids. It has many real-world applications, ranging from understanding the aerodynamics of the aircraft; calculation of wind load on buildings; design of water supply and sewerage networks; measurement of flow by means such as weirs, parshall flumes and venturimeters; and soil leakage estimates, etc. Although the term the Bernoulli theorem is simple, the principle involved in the equation plays a vital role in technological advancements designed to improve the quality of human life. Objective 3 The purpose of this experiment is to examine the validity of the Bernoulli equation when it is applied to continuous water flow through a conical channel. Method In this experiment, the validity of the Bernoulli equation is checked using a channel (Venturi system) connected to manometers to measure the pressure head and the entire head at known points of flow. 5. Equipment For the demonstration of the Bernoulli equation experiment, the following equipment is required: F1-10 hydraulic pad, F1-15 Bernoulli apparatus test equipment, and stopwatch for the timing of flow measurement. 6. Equipment description The Bernoulli test equipment consists of a conical tube (Venturi), a series of manometers that are inserted into the Venturi tube to measure the pressure head, and an

injectable probe passing through the middle of the test phase to measure the entire head. The test section shall be a circular circular, variable diameter, with an angle of inclination of 14° on one side and an angle of inclination of 21° on the other side. A series of side hole pressure taps provide manometers for connecting to the test phase (Figure 2.1). Figure 2.1: Armfield F1-15 Bernoulli apparatus testing equipment Manometers allow simultaneous measurement of pressure heads on each of the six sections along the channel. The dimensions of the test phase, the tap position and the diameter of the test section shall be as set out in 2.2. The test phase consists of two one-part ones which facilitate the reversal of convergent or different tests. The test line shall be measured so that the entire pressure head is located along the test section on any section of the channel. This probe can be moved after you loosen the gland nut, which must be pulled again by hand. To avoid injury, the probe be fully inserted during transport/storage. The pressure threads are connected to manometers mounted on a motherboard. The flow through the test phase can be adjusted by the control valve of the device or by the bench control valve (2). Figure 2.2: Test sections, manometer positions and channel diameter as shown in Figure 7. Theory Bernoulli the theorem assumes that the flow is frictionless, constant, and unpressible. These assumptions are also based on laws on the preservation of mass and energy. Thus, the input mass and energy of a given control volume are the same as the output mass and energy: These two laws, as well as the determination of work and pressure, form the basis of the Bernoulli theorem and can be expressed as follows for any two points located on the same streamlining in the flow: where: P: pressure, g: gravitational acceleration, v: liquid velocity and z: vertical height of liquid. In this experiment, since the channel is horizontal, the height difference can be ignored, i.e. z1=z2 The hydrostatic pressure (P) along the flow is measured by manometers introducing into the channel. The pressure head (h) is calculated as follows: Therefore, Bernoulli's equation for the test phase can be written as follows: in which the speed head (hd) is named. The whole head (ht) can be measured by means of the injection probe passing through. This probe is inserted into the channel so that the end hole is facing the flow so that the flow stagnates locally at this end; thus: The energy conservation or Bernoulli equation can be expressed as follows: The flow rate is measured by collecting the volume of liquid (V) over a given period of time (t). The flow rate shall be calculated as follows: The flow rate of any section of the channel with any cross-sectional area can be determined as follows: In the case of the intangible liquid, the preservation of the mass has also been achieved through the test phase (Equation 1a), i.e. 8. Experimental procedure Place the device on the hydraulic bench and make sure that the spill pipe is above the volume tank to facilitate timed volume collection. Balance the base of the device by adjusting the foot. (For this purpose, a sprite level is attached to the base.) To measure the exact height of the manometers, the device must be horizontal. Install the test part so that the 14° conical section is in the direction of flow. If the test phase is to be reversed, the entire head probe shall be re-pulled before the connectors are released. Connect the device input to the dynamometer flow supply, close the pad valve and the device's flow control valve, and start the pump. Gradually open the test valve to fill the test phase with water. The following steps shall be taken to clean the air from the pressure points and manometers: both the bench valve and the device's flow control valve. Remove the cap from the air valve, attach a small tube from the air valve to the volumetric tank and open the venting screw. Open the bench bench and allow it to flow through the manometers to clean all air, then tighten the vent screw and partially open the pad valve and the flow control valve of the device. Open the venting screw slightly so that the air enters the top of the manometers (to achieve this, you need to adjust both valves) and tighten the screw again when the manometer level reaches the correct height. The maximum flow rate on the board shall be determined by reading the maximum (h1) and minimum (h5) manometers. If necessary, the manometer levels can be adjusted by means of an air pump to pressurly. This can be achieved by connecting the hand pump tube to the air vent valve, opening the screw and pumping air into the manometers. After pumping, close the screw to maintain the pressure in the system. Take the measurement of manometers h1-h6 when the water level of the manometers is constant. The entire pressure sensor shall be pulled back from the test phase during reading. Measure the entire head by passing the entire pressure probe along the test phase from h1 to h6. Measure the flow rate with a timed volume collection. To do this, close the ball cover and use a stopwatch to measure the time required to accumulate a known amount of liquid in the container, which is read from the sight glass. To minimize timing errors, you need to collect the liquid for at least one minute. Repeatable process measurement can be repeated twice to check repeatability. During the measurement, make sure that the entire pressure sensor is pulled back from the test phase. Reduce the flow rate so that the head difference is approximately 50 mm between manometers 1 and 5 (h1-h5). This is the minimum flow attempt. Measure the pressure head, the entire head, and the flow. Repeat the process at one more flow rate with the difference (h1 to h5) approximately halfway between the values obtained for the minimum and maximum flows. It's the average process experiment. In order to observe the effects of the faster converging phase, the test phase (with the 21° conical section in the direction of flow) was reversed. Make sure that the entire pressure sensor is fully subtracted from the test phase, but does not pull it out of its guide line in the later connector. Unscrep the two connectors, remove the test section and reverse it, then reassemble by tightening the connectors. Carry out the three flow sequences and carry out the pressure and flow measurements shown above. 9. Results and calculations Please visit this link to access the excel workbook required for your experiment. 9.1. Results Enter the test results in the raw data tables. Position of raw data table 1: volume of test phase 14° to 21° (litres) time (sec) Pressure head (mm) Full (mm) h1 h2 h3 h4 h4 h4h4h6 h4 h4 h4 h4 h4 h4 h4 h4 2. Position: Thinning of 21° to 14° Volume of test phase (litres) Time (sec) Pressure head (mm) Full head (mm) h1 h2 h2 h4 h1 h1 h2 h4 h2 h4 h4 h4 h5 h.2 Calculations Calculate the flow rate for each set of measurements; Flow Flow head and the entire head (pressure head+ speed head). Record the calculations in the Eredmény table. Scoreboard position 1: Thinning from 14° to 21°. Test section distance to channel (m) Flow area (m²) Flow rate (m³/s) Pressure head (m) Speed head (m) Calculated Total head (m) Measured total head (m) 1 h1 0 0 0.00049 h2 0.06028 0.00015 h3 0.068 68 0.00011 h4 0.0 07318 0.00009 h5 0.08108 0.000079 h6 0.14154 0.00049 2 h1 0.00049 h2 0.06028 0.00015 h 3 0.06868 0.0 0.07318 0.00009 h5 0.08108 0.000079 h6 0.14154 0.00049 3 h1 0 0.00049 h2 0.06028 0.0.0.0.0 0 0 0.00015 h3 0.06868 0.00011 h4 0.07318 0.00009 h5 0.08108 0.000079 h6 0.14154 0.00049 Position 2:21° to 14°. Test section distance to channel (m) Flow area (m²) Flow rate (m³/s) Pressure head (m) Speed head (m) Calculated Total head (m) Measured total head (m) 1 h1 0 0,00049 h2 0,06028 0,00015 h3 0.0.0. 06868 0.00011 h4 0.07318 0.00009 h5 0.08108 0.000079 h6 0.14154 0.00049 2 h1 0.00049 h2 0.06028 0.. 00015 h3 0.06868 0.00011 h4 0.07318 0.00009 h5 0.08108 0.000079 h6 0.14154 0.00049 3 h1 0.00049 h2 0.06028 0.00015 h3 0.06868 0.00011 h4 0.07318 0.00009 h5 0.08108 0.000079 h6 0.14154 0.00049 10. Report: Use the template you specify to create the lab report for your experiment. The report shall include: Table(s) of raw data Table(s) Table(s) of results(s) For each test, plot the entire head (calculated and measured), the pressure head and the speed head (y axis) against the distance in the channel (x axis) to the manometer 1-6, a total of six graphs. Connect the data points to observe the trend on each graph. Note that the direction of flow in tube 1 is from manometer 1 to manometer 6; in position 2 from manometer 61. Comment on the validity of Bernoulli's equation when the flow converges and deviates along the channel. Note to compare all heads calculated and measured in the experiment. Discuss the results, referring in particular to the following: energy loss and its results as shown by the results of the experiment, as well as the components of the Bernoulli equation () and the length of the test phase. Enter the maximum speed and minimum pressure points. Pressure.

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