Bernoulli' s theorem lab manual

(1 review) Habib Amari, University of Texas at Arlington Shah Md Imran Kabir, University of Texas at Arlington Ginny Bowers Copyright Year: 2019 ISBN 13: 9781648169977 Publisher: Mavs Open Press Language: English Formats Available Attribution CC Learn more about reviews. Reviewed by Isaac Chotapalli, Professor, Rio Grande Valley University on 11/20/20, the text covers most major areas in fluid experimental mechanics. Read more Content Experiment #1: Hydrostatic pressure experiment #2: Bernoulli's theorem experiment #3: Energy loss in pipe fittings Experiment #4: Energy loss in pipe experiment #5: Impact of jet experiment #6: Or Free flow experiment and free jet flow #7: Osborne Reynolds demonstration experiment #8: Free and Forced Looking Experiment #9: Flow Over Weirs Experiment #10: Pumps references to the book This lab guide provides students with theory, practical applications, of the objectives set out in laboratory procedure from ten experiments. The guide also includes educational videos showing how the student should conduct each experiment and workbook to organize the data collected in the laboratory and prepare tables and score charts. Habib Amari, University of Texas at Arlington Shah Imran Kabyar, University of Texas at Arlington editor Ginny Bowers Energy presents in the form of pressure, speed and fluid enhancement without energy exchange due to viscous dissipation, heat transfer or shaft operation (pump or any other device). The relationship between these three types of energy was first said by Daniel Bernoulli (1700-1782), based on the preservation of the energy principle. Bernoulli's theorem refers to streamlining the flow is based on three assumptions: constant flow, non-compressive fluid and no losses from fluid friction. This experiment will examine the validity of bernoulli's equation. 2. Practical application Bernoulli theores provide mathematical means for understanding the mechanics of fluids. It has many applications in the real world, ranging from understanding the aerodynamics of an aircraft; calculation of the coil of buildings; design of ic networks; measurement flow using devices such as water, Parshal flu, and enturimeters; Although the expression for Bernoulli theorem is simple, the principle included in the equation plays an important role in technological advances designed to improve the quality of human life. 3. The purpose of this experiment is to examine the validity of the Bernoulli equation when applied to a constant flow of water through a pointed channel. 4. Method In this experiment, the validity of the Bernoulli equation will be verified using a pointed channel (Menturi system) connected to pressure gauges to measure the pressure head and general head at known points along the current. 5. The following equipment is necessary to complete the demonstration of the Bernoulli Bernoulli equation F1-10 hydraulic bench, F1-15 apparatus, Bernoulli test apparatus and flow meter. 6. Equipment Description Bernoulli test apparatus consists of a pointed channel (Enturi), a series of pressure gauges inserted into the pressure head measuring enturi, and a hypodermic probe that can be crossed through the centre of the test section for measuring the common head. The test section is a circular channel of different diameters with an angle of 14° on one side and an angle of inclination on the other side of 21°. To connect the pressure gauges to the test section, a series of pressure pressures are provided in the lateral openings (Figure 2.1). Figure 2.1: Armfield F1-15 apparatus, Bernoulli test apparatus, Pressure gauges allow the simultaneous measurement of pressure heads at all six sections of the tube. The dimensions of the test section, the knock positions and the diameters of the test section are shown in Figure 2.2. The test section includes two slits, one at both ends, to facilitate conversion for convergent or divergent tests. The probe shall be equipped with a probe to measure the total pressure head along the test section, positioning itself on each section of the tube. This probe can be moved after relaxing the nut of the gland, which must be re-tightened by hand. To prevent damage, the probe must be fully inserted during transport/storage. Pressure pressure pressures are connected to pressure gauges, which are mounted on the ledge. The flow through the test section can be adjusted by the control valve of the apparatus or by the bench control valve [2]. Figure 2.2: Test sections, pressure gauge and tube diameters along the test point 7. Bernoulli's theory suggests that the flow is friction-free, constant and uncompromising. These assumptions are also based on the laws of mass and energy conservation. Thus, the input mass and energy for a given control volume are equal to the starting mass and energy: These two laws and the definition of operation and pressure are the basis for bernoulli theorem and can be expressed as follows for each two points located on the same gas flow: where: P: pressure, g: acceleration due to gravity, v: liquid speed and z: the vertical ascent of the liquid. In this experiment, since the channel is horizontal, the height difference may not be ignored, i.e. $z1=z2$ Hydrostatic pressure (P) along the current is measured by pressure gauges. Thus, the pressure head (h) is calculated as: Therefore, the Bernoulli equation for the test section can be written as: in which it is called the speed head (hd). The common head (ht) can be measured by crossing the hypodermic probe. This probe is inserted into the tube with the hole directed to the stream so that the flow is locally located at this end; in this way: the Bernoulli equation can be expressed as: The flow rate is measured by collecting a volume of fluid (V) over a period of time (t). The flow rate is calculated as: the speed of the In each section of the transverse zone pipe, it is determined: For the non-compression fluid, the storage of the mass through the test area should also be observed (equation 1a), i.e.: 8. An experimental procedure shall be placed on the hydraulic bench and ensure that the output tube is located above the volumetric tank in order to facilitate the collection of volumes during. Adjust the base of the apparatus by adjusting the legs. (For this purpose, a savings level is attached to the base.) To accurately measure the height of the pressure gauges, the apparatus must be horizontal. Install the test section with 14° convergence at 14° in the direction of flow. If the test section is to be reversed, the entire head probe must be intercepted before release of the mounting joints. Glue the inlet of the apparatus to the bench flow supply, close the wall valve and the flow control valve of the apparatus and the pump is released. Gradually, the bench valve is opened to fill the test section with water. The following steps must be taken to flush the air from the pressure and pressure gauge points: Close both the bench valve and the flow control valve of the apparatus. Remove the cap from the air valve, connect a small tube from the air valve to the volumetric tank and open the air flow screw. Open the bench and allow the pressure gauges to blow all the air out of them, then tighten the tread screw and partially open the bench and valve to control the flow of the apparatus. Open the air screw slightly to allow the air to enter the top of the pressure gauges (you may need to adjust both valves to achieve this), and tighten the screw again when the pressure gauge levels reach a comfortable height. The maximum flow rate is determined by maximum (h1) and minimum (h5) pressure gauges on the ledge. If necessary, the pressure gauge levels can be adjusted using an air pump to ensure. This can be achieved by attaching the manual pump pipe to the air valve, opening a screw and pumping the air into the pressure gauges. Close the screw after pumping to keep the pressure in the system. Take the indications of pressure gauges h1 to h6, when the water level in the pressure gauges is stable. In this reading, the total pressure probe must be removed from the test area. Measure the total head by crossing the total pressure probe along the test section from h1 to h6. Measure the flow rate during volume collection. To do this, close the spherical tap and use a stopwatch to measure the time it takes to accumulate a certain volume of liquid in the tank, which is read from the glass of vision. You need to collect liquid for at least one minute to minimize synchronization errors. You can repeat the flow measurement twice to check for repeatability. During this measurement, the that the total pressure probe has been picked up from the test area. Reduce the flow rate to give the head difference of about 50 mm between the pressure gauges 1 and 5 (h1-h5). This is the minimal flow experiment. Measure the pressure head, pressure, and flow. Repeat the process for one more flow rate, the difference (h1-h5) differing approximately by half between those obtained for the minimum and maximum flows. This is the middle-class experiment. Turn the test section (with the 21° condensation section in the direction of the flow) to observe the effects of faster convergence. Make sure that the total pressure probe is fully withdrawn from the test area but not removed by the driver in the downstream clutch. Unscrew the two joints, remove the test section and twist it, then reassemmm it by tightening the connectors. Perform three sets of flow rate and perform pressure and flow measurements as indicated above. 9. Results and Calculations please visit this link to access an Excel workbook for this experiment. 9.1. Results Enter the test results in the raw data tables. Primary data Heading 1: Pointed 14° to 21° Test Sec Section volume (litre) Head pressure (mm) General Head (mm) h1 h2 h2 h3 h5 h6 h2 h3 h3 h6 h1 h2 h2 h3 h4 h6 Raw base Data mass 2: Pointed 2 2 1° to 14° Test section Volume (l)Time (s) Head pressure (mm) General Head (mm) h1 h2 h3 h5 h5 h1 h2 h2 h3 h4 h6 h2 h2 h2 h5 h6 9.2 Calculations For each set of measurements, flow calculation; speed, head of speed and general head (pressure speed head). Save your calculations to the result table. Result Table Item 1: shrinks 14° to 21° Test No. Изпитвателна сечение На разстояние в канал (m) Поток (m²) Дебит (m³/s) Скорост (m/s) Глава на скоростта (m/s) Главата на скоростта (m) Изчислено общо главата (m) Измерена обща глава (m) 1 h1 0.00049 h2 0,06028 0,00015 h3 0,06868 0,0 011 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 0.0.00015 h3 06868 0,00011 h4 0,07318 0,00009 h5 0,08108 0,000079 h6 0,14154 0,00049 3 h1 0 0 0,00049 h2 0,06028 0.0.00 00015 h3 0.06868 0.00011 h4 0.07318 0.00009 h5 0.08108 0.000079 h6 0.14154 0.00049 Позиция 2: заострени 21° до 14° Тест No. Test section Distance in channel (m) Flow rate (m²) Flow rate (m³/s) Pressure head (m/s) Speed head (m) Total head calculated (m) Measured total head (m) 1 h1 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 2 h1 0,00049 h2 0,06028 0,000 0 15 h3 0.06868 0.00011 h4 0.07318 0.00009 h5 0.08108 0.000079 h6 0.14154 0.00049 3 h1 0 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 Using the provided template to prepare your lab report for this experiment. Your report must include the following: Table(s) of raw data Table(s) of results For each test, draw the total chapter (calculated and measured), the pressure head and the speed head (y axis) relative to the in channel (x axis) from pressure gauge from 1 to 6, a total of six graphs. Connect the data points to monitor the trend in each graph. It should be noted that the direction of flow in channel item 1 is from pressure gauge 1 to 6; Inches Inches 2, it's from a 6-to-1 pressure gauge. Comment on the validity of the Bernoulli equation when the flow merges and deviates along the current. Comment on the comparison of calculated and measured common chapters in this experiment. Discuss your results by referring in particular to the following: loss of energy and how it is visible from the results of this experiment, as well as the components of the Bernoulli equation and how they differ along the length of the test section. Indicate the points of maximum speed and minimum pressure. Pressure.