BME 332
Biomaterials and Biomechanics Lab

Lab 8
Investigation of Bernoulli's Equation

Doç. Dr. Pınar Yılgör Huri
phuri@ankara.edu.tr

Ankara University
Department of Biomedical Engineering

Aim of This Experiment

This experiments aim the use Bernoulli's Equation on air flow system.

Procedure

Connection to the Airflow System

Care must be exercised when connecting the manometer to the airflow system and its optional accessories. The following method is suggested to prevent the manometer liquid from being either driven out of the manometer tubes or drawn into the tubes connected to the accessories.

Before starting the fan, connect the pressure hoses to the accessory in use and to the manometer. Note that the two outer tubes (left and right) are not normally connected/used.

Experimental Setup

Experimental system has some essential items needed for the experimental use. It features a large capacity **airflow system, a plenum chamber, multi-tube monometer** and **Bernoulli investigation duct**.

The **Airflow System** has been specifically designed to allow students to investigate a wide range of and low speed air flow phenomena and fundamental aerodynamics. Airflow System base unit consists of a large capacity variable speed centrifugal fan with a separate aerodynamically designed plenum chamber containing multiple screens, flow straightener and acceleration section. The fan and plenum chamber are connected by a length of flexible hose and this allows the two components to be arranged in a variety of convenient locations either at bench or floor level.

Set the manometer to the vertical or inclined condition as required and adjust the reservoir to
about mid-height.

Record the atmospheric datum or zero level. Then start the fan and slowly increase the speed, at the same time monitoring the manometer levels.

As the pressures in the various tubes move up and/or down adjust the reservoir level also up or down, so that the liquid levels are kept within the range of the manometer.

Once the fan is running at the desired speed make any final adjustments to the reservoir level to set the atmospheric datum to a convenient value using the two outer tubes as a reference.

Record this atmospheric datum as the reference value. It is this value that will be either taken from, or added to the other levels recorded on the manometer tubes.

Then set the manometer so that the static pressure tapping is located at the intake position
(approximately x = 315mm from the duct exit) and record the following:

Po, Plenum Chamber Pressure

P, Total Pressure

p Static Pressure

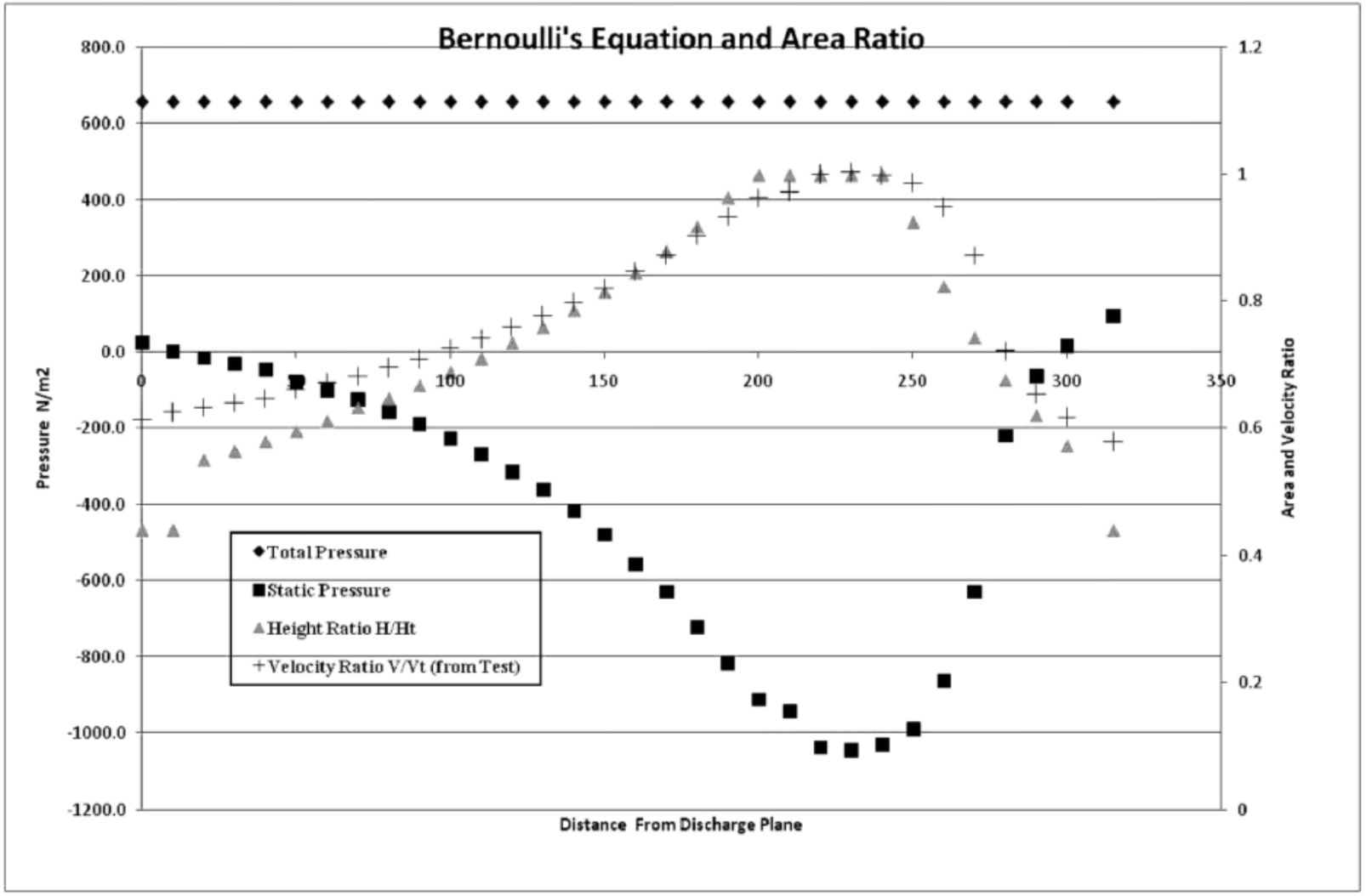
Refer to the useful data on appendix and retract the pitot-static tube a convenient distance, for
which towards the discharge (say 10 or 15mm), record the location X and repeat the three
pressure measurements Po, P, and p.

Continue retracting the pitot-static tube at regular intervals (data on appendix) record the
location X and the three pressures until the tube is at the exit plane of the duct.

Typical Data

The table below shows data as recorded from the manometer. The readings are all measured
in mm height on the manometer scales. The table on the following page shows the data
processed using the method shown below.

Distance from Exit Plane	Liners Normal Configuration	Total Pressure P	Static Pressure p	Plenum Pressure P_o	Atmospheric Datum
X mm	$\frac{H}{H_t}$	mm	mm	mm	mm
315	0.440	168	240	138	252
300	0.573	168	250	138	252
290	0.620	168	260	138	252
280	0.676	168	280	138	252
270	0.743	168	332	138	252
260	0.824	168	362	138	252
250	0.926	168	378	138	252
240	1.000	168	383	138	252
230	1.000	168	385	138	252
220	1.000	168	384	138	252
210	1.000	168	372	138	252
200	1.000	168	368	138	252
190	0.965	168	356	138	252
180	0.919	168	344	138	252


Bernoulli's Equation and Area Ratio
800.0
600.0
400.0
200.0
0.0
-200.0
-400.0
-600.0
-800.0
-1000.0
-1200.0
Pressure N/m2
0
100
150
200
250
300
350
Distance From Discharge Plane
1.2
1
0.8
0.6
0.4
0.2
0
Area and Velocity Ratio
Total Pressure
Static Pressure
Height Ratio H/Ht
Velocity Ratio V/Vt (from Test)