Experiment -2 Hydrostatic Bench

The ***Hydrostatic Bench*** enables the study of the main properties and the behavior of such liquids under hydrostatic conditions, with the aid of some accessories to make the different experiments.

Equipment Description

The equipment consists of a metallic structure assembled on wheels with a panel at the top. In the lower part of the bench there is a tank where water is stored. Water is then sent to a methacrylate tank placed at the upper part of the bench and to other plastic deposit. Two hand-operated pumps are used for such distribution. The methacrylate tank is connected to two communicating tubes on the front panel, enabling to perform some practices; the other deposit placed on the horizontal surface of the bench is necessary for performing the rest of the practices. All water in excess is sent back to the storage tank by the drain. The rest of the equipment consists of the following different elements and independent accessories:

- Barometer (10)
- Thermometer (3)
- Ubbelohde capillary viscosimeter, 0.6-3 cp (0c)
- Ubbelohde capillary viscosimeter, 2-10 cp (I)
- Ubbelohde capillary viscosimeter, 10-50 cp (Ia)
- Ubbelohde capillary viscosimeter, 60-300 cp (IIc)
- 3 graduated cylinders
- Accessory for demonstration of free surface in static conditions (7)
- Bourdon manometers calibration (13)
- Mercury manometers (9)
- Accessory to determine the metacentric height (FME11)
- Accessory for studying Archimedes´ principle
- Accessory for studying the hydrostatic pressure (FME08) (14)
- Fluid level gauge calibrator (16)
- Set of weights (5, 10, 20, 50, 100, 400, 1000, 2000, 5000 gr.)
- Air pump

- 2 water pumps (11 and 12)
- Universal hydrometer (1)
- Chronometer
- Set of measurement cylinders (2 of 600 ml) (4)
- Spare parts for the viscosimeter elements

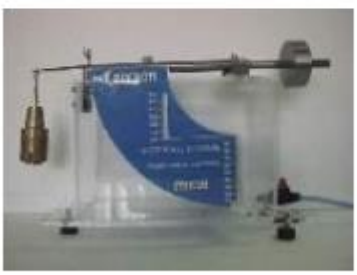


Figure 2.0.1. Main parts of the Hydraulic Bench

Experiment -2.1

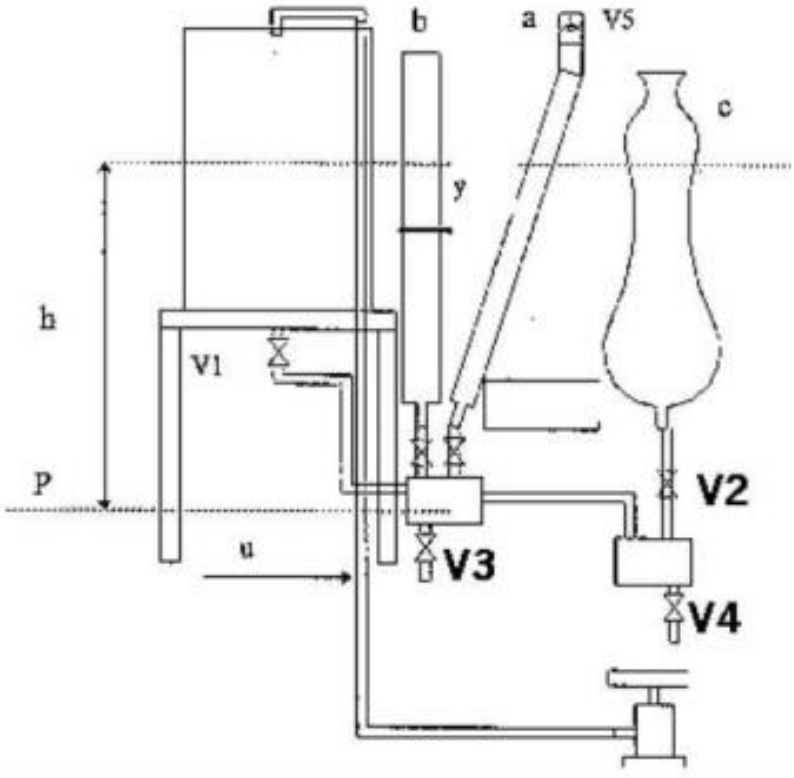
Free surface of a static liquid

Aim of this Experiment

To demonstrate that the surface of a static liquid is horizontal

Necessary devices

We have to use tanks "1" and "2" and tubes "a", "b" and "c".



Procedure

1. Make sure that V1 communicates the receiver with the tubes.
2. Make sure that valves V3 and V4 are closed and open valves V1, V2 and V5.
3. Using the hand operated pump B, pump water from tank 1 to tank 2 until the level coincides with the first horizontal line in the wall.
4. Repeat for the second, third, and fourth horizontal lines, check that the water level is always horizontal, regardless of the size and the form of the tube.
5. Empty tank 2 by opening valve V1. Change the position of valve V5 in the upper part of tube "b" (tube "b" shall not have a free surface).
6. Using the hand operating pump A, fill tank 2 up to the level of the second, third and fourth line.
7. Observe that the level in tube "b" remains constant, while the level of the tank is followed in tubes "a" and "c".

Experiment -2.2

Pressure center in a smooth surface

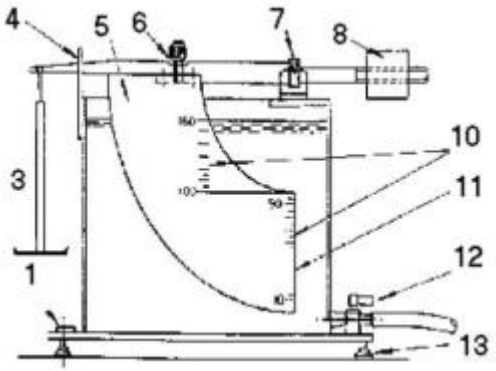
Aim of this Experiment

To determine the position of the pressure center on the rectangular face

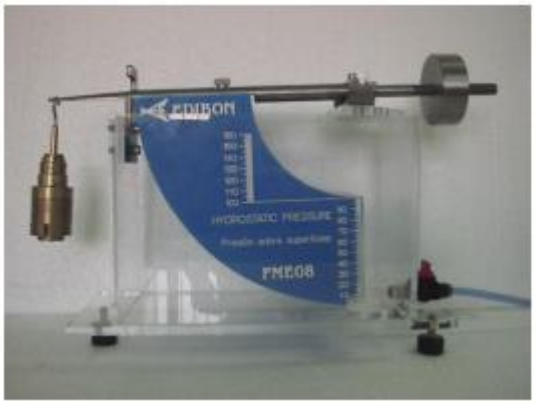
of the float

Necessary devices

Hydrostatic Pressure device or hydrostatic device.

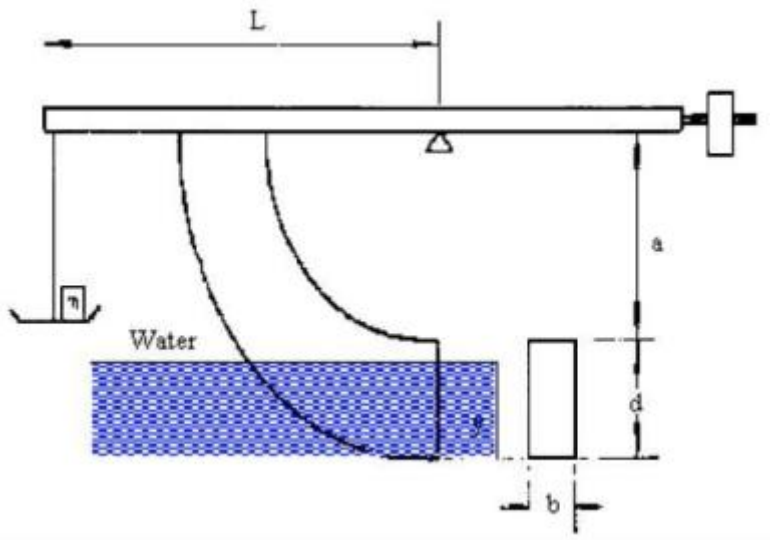


1..-Receiver
3.- Pan
4.- Balance indicator or pointer
5.- Quadrant
6.- Set screw
7.- Arm
8.- Support;
9.- Adjustable counterweight
10.-Graduated scale
11.-Font flat surface
12.-Cock
13.- support feet



Procedure

1. Measure and note down the dimensions designed as a, L, d, and b; the last corresponding to the flat surface placed at the end of the quadrant.
2. With the receiver placed on the bench, place the balance arm on the support (sharp profile). Hang the pan at the end of the arm.
3. Connect a length of flexible hose to the receiver draining cock and connect the other end to drain.
4. Level the receiver by properly acting on the support feet, which is adjustable, while the "bubble level" is observed.
5. Displace the counterweight of the arm until getting the arm to be horizontal.
6. Close the drain cock in the bottom of the receiver.
7. Introduce water in the receiver until its free surface is tangent to the lower edge of the quadrant. The fine adjustment of that level can be achieved by slightly overreaching the established filling and then slowly draining through the cock.
8. Place a calibrated weight on the balance pan and slowly add water until the balance arm recovers the horizontal position. Record the water level, indicated in the quadrant, and the value of the weight placed on the pan.
9. Repeat the operation above several times, increasing progressively the weight in the pan until, the balance arm is at level, the level of the free water surface becomes flush with the upper edge of the flat rectangular surface that the end of the quadrant presents.
10. From this point on, and in the order inverse to the operation above of placing the weights on the pan, the weight increments given in each step are removed, the arm is leveled (after every removal) by using the drain cock and the weight in the pan and the water level values are recorded.



For y < d (partial immersion), calculate the practical ant the theoretical value of m/y^2 using the equation:

$m/y^2 = p.b/2L\ (a+d-y/3)$.

The slope of this graph must be $-p.b/2L$, and its intersection with the coordinate axis $p.b\ (a+d)/2L$.

See the discrepancies in a reasoned way, if any, between the average values measured and the values obtained with the equations above

Weight	Height (y)	y/3	m/y^2

Appendix – I Useful Data

Table 1. Table of the atmospheric pressure in function of the height

HEIGHT (m)	LEVEL OF THE VARIABLE	HEIGHT (m)	LEVEL OF THE VARIABLE	HEIGHT (m)	LEVEL OF THE VARIABLE
0	760	680	700.8	1360	645.2
20	758.2	700	698.9	1380	643.6
40	756.4	720	697.3	1400	642
60	754.6	740	695.5	1420	640.4
80	752.9	760	693.9	1440	638.8
100	751	780	692.4	1460	637.2
120	749.2	800	690.7	1480	635.6
140	747.4	820	689	1500	634
160	745.7	840	687.2	1520	632.5
180	744	860	685.5	1540	630.9
200	742.1	880	683.9	1560	629.4
220	740.2	900	682.4	1580	627.9
240	738.4	920	680.7	1600	626.4
260	736.8	940	679	1620	624.9
280	735	960	677.2	1640	623.3
300	733.4	980	675.6	1660	621.8
320	731.8	1000	674	1680	620.3
340	730	1020	672.4	1700	618.8
360	728.3	1040	670.8	1720	617.3
380	726.5	1060	669.1	1740	615.7
400	724.7	1080	667.5	1760	614.2
420	723	1100	666	1780	612.7
440	721.3	1120	664.3	1800	611.2
460	719.5	1140	662.6	1820	609.7
480	717.7	1160	661	1840	608.2
500	716	1180	659.3	1860	606.6
520	714.2	1200	657.9	1880	605.2
540	712.5	1220	656.4	1900	603.6
560	710.9	1240	654.8	1920	602.1
580	709.3	1260	653.2	1940	600.6
600	707.5	1280	651.6	1960	599
620	705.8	1300	650	1980	597.5
640	704.1	1320	648.3	2000	596
660	702.5	1340	646.7		