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EXPERIMENT # 01

DEMONSTRATION OF VARIOUS PARTS OF HYDRAULIC BENCH.

HYDRAULIC BENCH

Hydraulic bench is a very useful apparatus in hydraulics and fluid mechanics it is involved in majority of experiments to be conducted e.g. to find the value of co efficient of velocity ‘Cv’, coefficient of discharge ‘Cd’ and contraction ‘C’ to study the characteristics of flow over notches, to find met centric height, in finding head losses through pipes, verification of Bernoulli’s theorem etc

CENTIFUGAL PUMP

Centrifugal pump is used for drawing water form sump tank and supply it for performing experiments.

SUMP TANK

The fluid used in hydraulic bench is stored in sump tank located at the bottom of hydraulic bench. The water from the sump tank is supplied through pump. Sump tank has the capacity of 160 liters.

VERTICAL PIPE

Water from the sump tank is supplied to the upper portion of bench through vertical transparent pipe using a pimp.

CONTROL VALVE

It is used to regulate the flow in the pipe i.e. to increase or decrease the inflow of water in hydraulic bench.

CONNECTOR

The connector allows flow for rapid substitution of accessories special purpose terminations may be connected to the pump supply by screwing connector. No hand tools are required for dong so.

CHANNEL

It is used in number of experiments .it provides passage in water for different experiments.

DRAIN VALVE

Drain valve is used for discharging of water form sump tank.

SIDE CHANNELS.

Side channels are provided to support the accessory on test.

VOLUMETRIC TANK

Water discharging form the accessory (channels) on test is collected in a volumetric measuring tank .this tank is stepped to accommodate low or high flow rates.

STILLING BAFFLE
Volumetric measuring tank incorporates a stilling baffle inclined to reduce turbulence.
SCALE AND TAPPING
A sight tube and scale is connected to tapping in the base of the volumetric tank and glass an instantaneous indication of water flow.

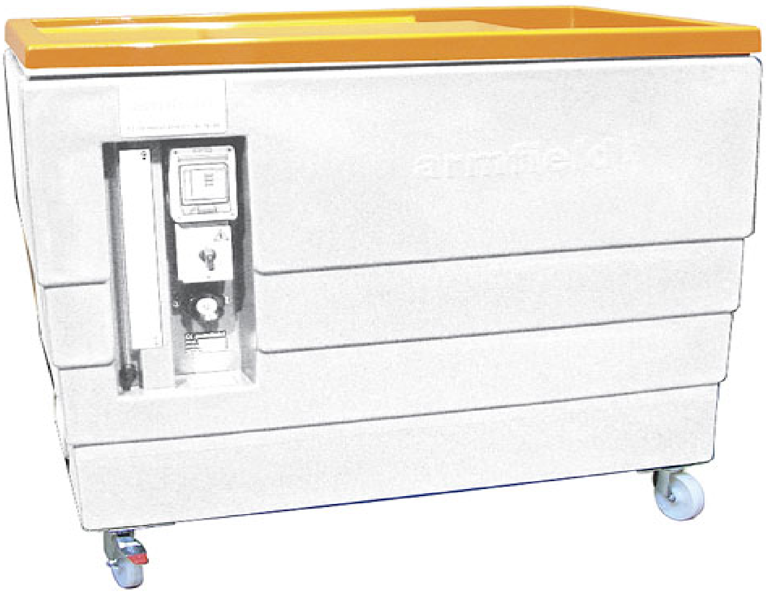
DUMP VALVE.
Dump valve is in the base of the volumetric tank opening the dump valve allows the entrained water to return to the sump tank to recycling.

ACTUATOR
Dump valve is operated by a remote actuator lifting actuator opens the damp valve. When lifted and twisted through 90* .the actuator will retain the dump valve in the open position.

OVERFLOW.
An over flow adjacent to the sump returns the water to the sump tank in the event of incorrect use of.

MEASURING CYLINDER.
A measuring cylinder is provided to measuring a very small flow rater the cylinder is stored in the compartment house e.g. the sump.

STARTER.
Electrical supply to the pump motor is via a starter.



EXPERIMENT # 02

CALIBERATION OF PESSURE GAUGE USING DEAD WEIGHT PRESSURE GAUGE CALIBRATION

APPARATUS
Dead weight calibrator, weights, hydraulic bench and calibrator.

CALIBERATION
To check error with comparison to some standard device is called calibration..

ABSOLUTE PRESSURE
The pressure that is taken with reference to absolute zero is called absolute pressure. and at absolute zero there is a perfect vacuum means no air.

$$P=rh$$

GAUGE PRESSURE
The pressure that is taken with reference to atmospheric pressure is called gauge pressure. gauge pressure may be positive or negative .
Gauge pressure when taken above the atmospheric pressure then it is positive and when taken below atmospheric pressure then its is negative .gauge pressure is always measured with atmospheric pressure that is why when gauge pressure is at atmospheric pressure it results zero.

$$\mathbf{Pabs=Patm + Pgauge}$$

PROCEDURE
- I placed the pressure gauge and calibrator assembly on bench top then I connected the inlet tube to the gauge manifold
- A length of tube was connected to the calibrator drain and laid into the channel to prevent spillage of water on the bench top.
- The calibrator was leveled by the adjustable feet level observing the sprit level
- I removed the piston and accurately determine its mass and the mass of calibrator weights.
- I closed the control valve of bench and open both corks then operate the pump starter, to open the valve and admitted water to cylinder
- After the removal of air bubbles from the table connecting the gauge and calibrator I closed both corks simultaneously along with the flow control valve on bench and switched off the pump.
- I noted the gauge reading corresponding to the piston mass of 0.5 kg while the piston is spinning (to minimize the friction effect).then I added .05kg of mass each time and noted the corresponding gauge readings using above procedure
- Then a graph was plotted between percentage gauge error and cylinder.

Observations and calculations

Piston Mass (Kg)	Area of Piston (M^2)	Pressure in Cylinder(KN/m^2)	Gauge readings (KN/M^2)	Abs Gauge error= $P_{cylinder}-P_{gas}$	% gauge error= Abs gauge error/$P_{cylinder}$*100
0.5	244.8*E-6	20	10	10	50
1.0	244.8*E-6	40	30	10	25
1.5	244.8*E-6	60	50	10	16.67
2.0	244.8*E-6	80	70	10	12.5
2.5	244.8*E-6	100	88	12	12

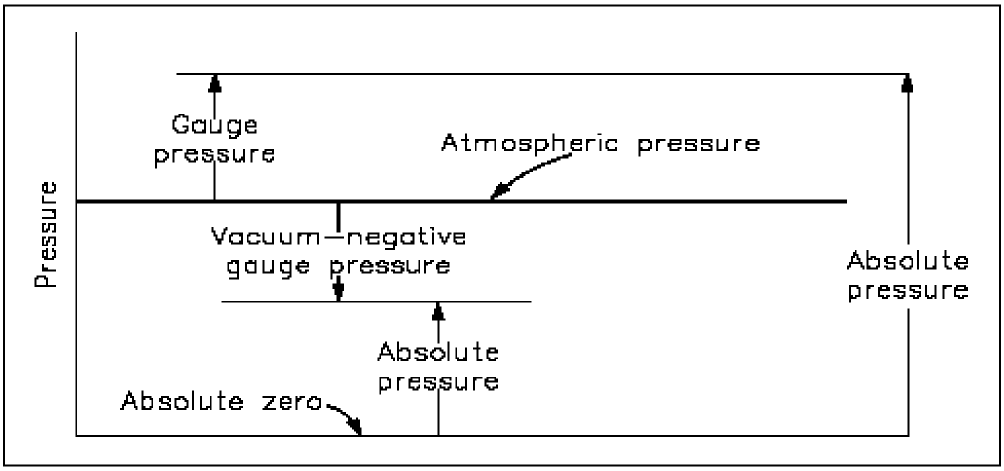
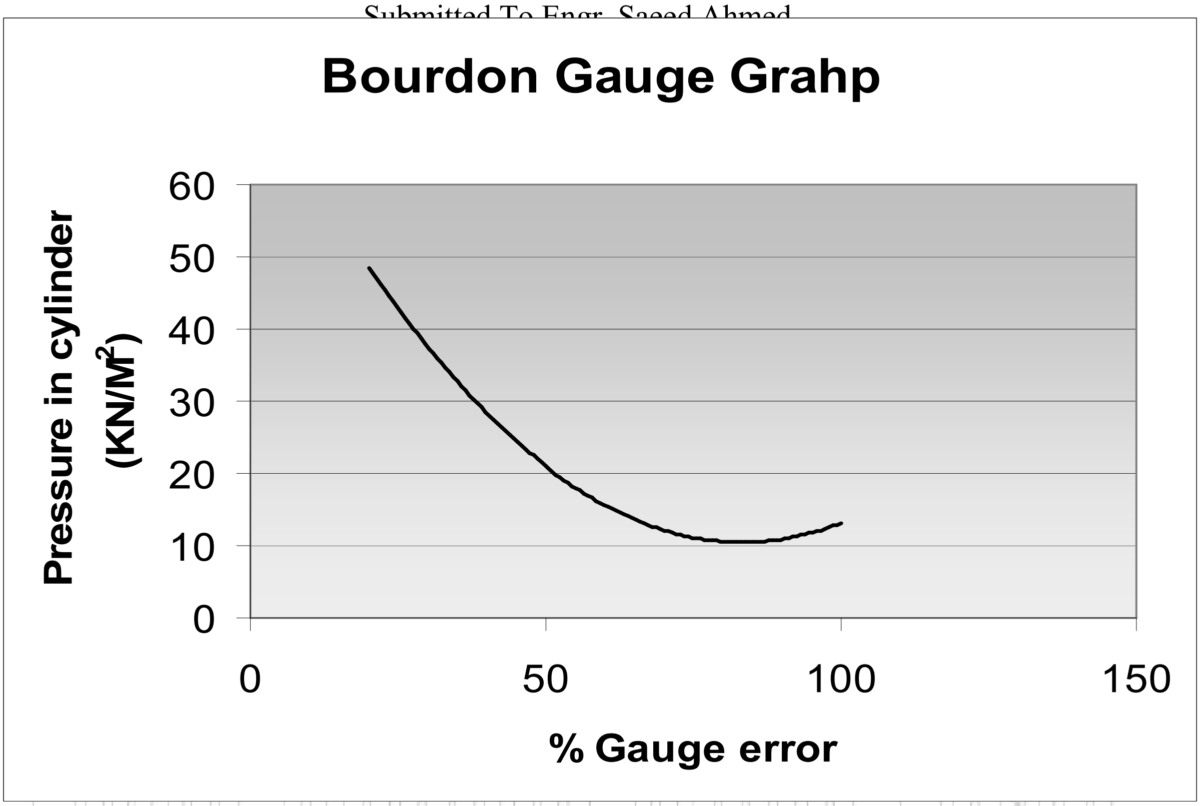
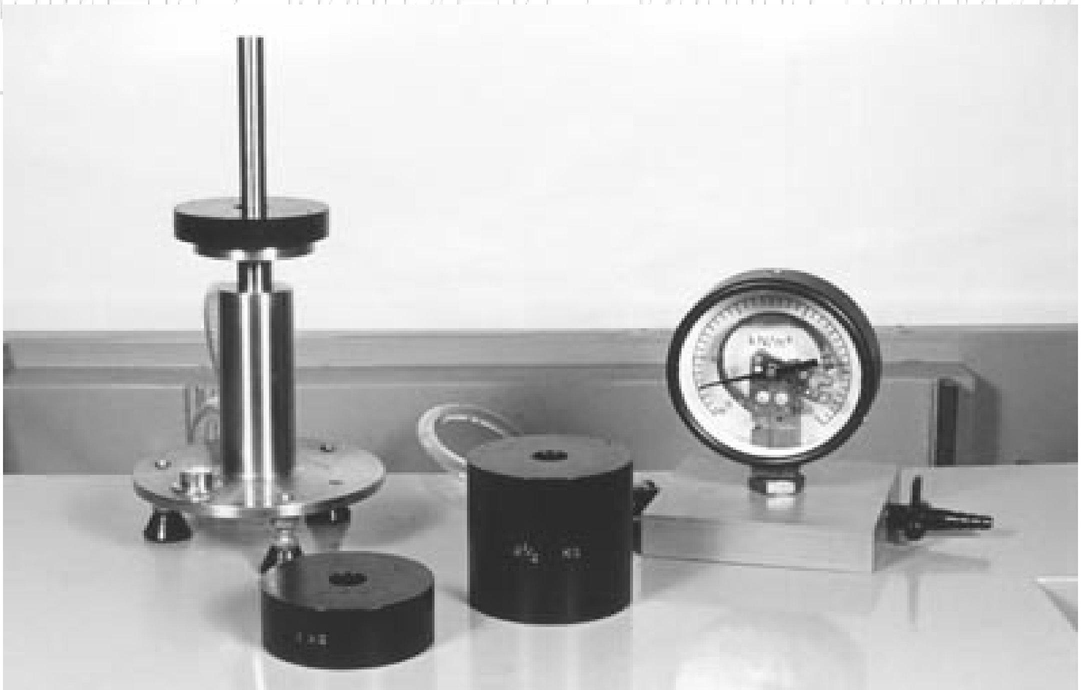


Figure 2 Pressure Relationships

ABSOLUTE PRESSURE,ATMOSHPERIC PRESSURE AND GAUGE PRESSURE RELATION





WEIGHT PRESSURE GAUGE CALIBRATOR

EXPERIMENT # 03

EXPERIMENTAL STUDY OF LAMINAR, TURBULENT AND TRANSITIONAL FLOWS.(VISUAL ANALYSIS)

APPARATUS
Osborne Reynold apparatus, hydraulic bench and glass marbles.

LAMINAR FLOW
The flow in which fluid moves in liquid particles moves in form of thin sheets in which the particles are not intersecting the path lines of each other such type of flow is known as laminar flow.

TURBULENT FLOW
The flow in which liquid particles move in zig zag path and intersecting the path lines of each other is called as turbulent flow.

TRANSITION FLOW
The flow that takes place during the inter conversion of laminar and turbulent flow is called transition flow or
Transition zone between laminar flow and turbulent flow is called transition flow.

Laminar flow ←-→ Transition flow ←-→ turbulent flow

RYNOLD NUMBER
It is the ratio of inertial force to viscous force
R_N = Inertial force / viscous force

$R_N = VL/\gamma$
For Laminar flow Reynold number = 0—2000
For Transition flow Reynold number = 2000—4000
For Turbulent flow Reynold number = 4000— on ward.

PIP FLOW
When liquid is touching a solid surface from all side then such type of flow is called as pipe flow. i.e. full flow in a pipe

CHANNEL FLOW
When the flowing liquid is not touching a solid boundary form any one side such kind of is called as channel flow, i.e. flow in a channel ,partial flow in a pipe.

VISUAL ANALYSIS

As it is a visual test is no need to take any reading the visual analysis of these flows is given below.

A device Osborne Reynolds is used in this test and is observed for different types of flow. The equipment operates in a vertical mode. A header tank containing stilling media A dye usually KMNO4 provides a constant head of water through a bellmouth entry to the flow visualization pipe. Flow through this pipe is regulated using a control valve at the discharge end.

The operation of valve increases and decreases the flow through the visualization pipe. First it was observed that when the velocity of flow was small the dye appears like a very narrow needle flow in between the water showing laminar flow and when the velocity of water was increased gradually using control valve the dye appears to move little randomly showing transition flow and when velocity is more increased dye starts moving in zig zag path which show the turbulent flow.

OSBORNE REYNOLDS APPARATUS.

EXPERIMENT # 04

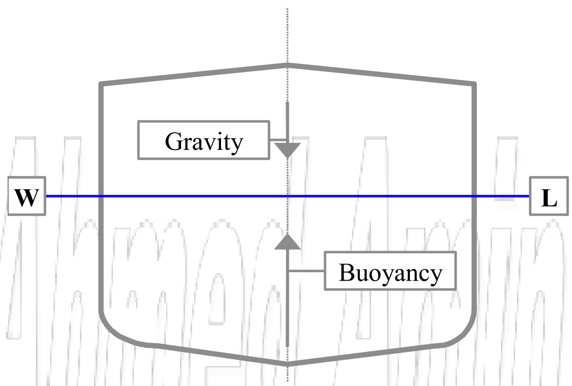
TO DETERMIN THE METACENTRIC HEIGHT OF A SHIP MODLE

APPARTUS

Metacentric height apparatus, hydraulic bench, movable weights and meter rod.

CENTER OF BUOYANCY

It is the point through which the force of buoyancy is supposed to act. It is always the center of gravity of the volume of liquid displaced.
In other words the center of buoyancy is the center of area (centeroid) of the immersed section



WL = Water line
G =Center of Gravity
B =Center of Buoyancy of water displaced by the ship

METACENTER

When a body Is floating in a liquid is given a small angular displacement it starts oscillation about some point this point about which the body is oscillating is called metacenter.
In other words metacenter may also be define as the intersection of line passing through the original centre of buoyancy and center of gravity (G) of the body and the vertical line through the new center of buoyancy (B').as shown in figure 2

METACENTRIC HEIGHT

The distance between centre of gravity of a floating and metacenter is called metacenteric height (GM).as shown in figure 2

NEURAL STABLE / EQUILIBRIUM.

The body will remain inclined at point G=M

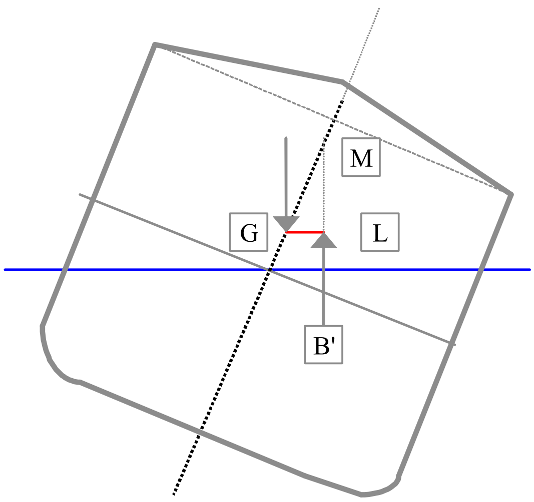


Figure 2
G = Center of Gravity. The position of G has not changed, assuming the cargo has not shifted.
B' = New position of center of buoyancy. Owing to the change of the immersed part of the ship, the position of B has shifted to the lower side (B').
M = Metacenter, being the point of intersection of the perpendicular line drawn from B' and the plane amidships.
GM = Metacentric Height

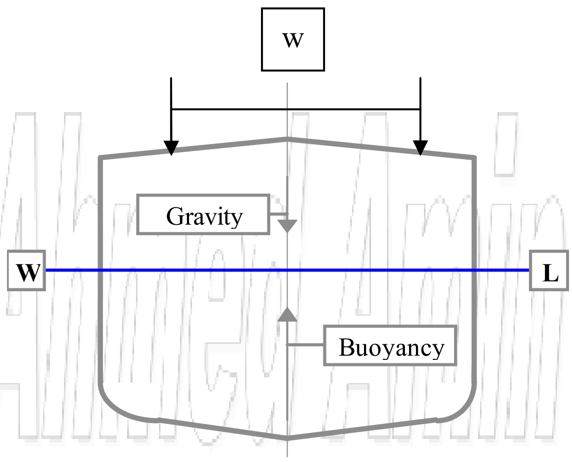
UTILITY
As a matter of fact that the metacentric height o f a floating body is the direct measurement of its stability or in other words more the metacentric height more will be the stability of the body. And hence more will be restoring couple

METHODS

There are two methods of determining the metacentric height .

1. Analytic method
2. Experimental method.

EXPERIMENTAL METHOD



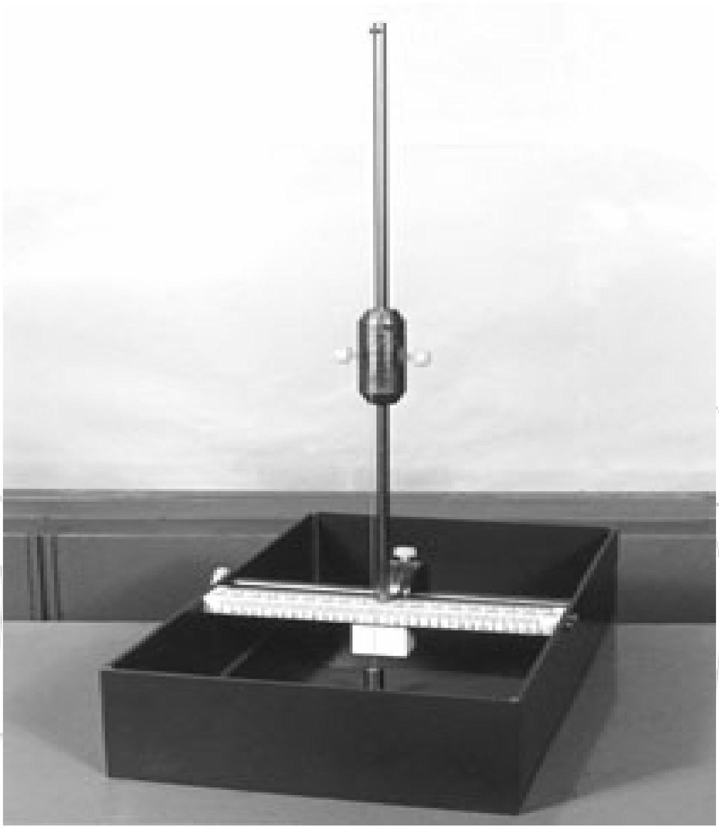
The metacentric height of a floating body like a ship may also be calculated experimentally provided G of floating body is known. Let all the articles on ship be arranged in such a way that the ship is perfectly horizontal.
Let W=weight of ship and G=center of gravity of ship.
Let a movable weight w be moved right across the ship through a distance D shown in figure due to this movement of w the boat will tilt let this angle of tilt be @ .so moment will produce while moving w through distance d.
M=wd
For floating bodies
GM = w*d/W*tanφ
Where
W= small movable weight
W= weight of the ship
GM= Metacentric height.
φ=angle of tilt.

PROCEDURE

- First of all I took the ship model and made it in equilibrium and then I applied a movable load to the right side of the ship and noted the angle of tilt for that specific load.
- Similarly I moved the movable load to the left side of the ship and determined the angle of tilt for similar load.
- After noting the angle of tilt both for both the side of ship model. I find the center of gravity of gravity for that specific load. This completes one cycle of the process.
- I repeat similar procedure for three different loads and calculate their corresponding angles of tilt and center of gravity.
- By using these values I calculate Metacentric height GM for each load.

S.No	Dist of movable load to right of ship(mm)	Angle of heel/tilt to right			Dist of movable load To left of ship. (mm)	Angle of heel/tilt to left.			Center of Gravity (cm)	Movable Load (w) (Kg)	Total (W) Weight of Ship (Kg)
		Y1	Y2	Y3		Y1	Y2	Y3			
1	20	3*	2.75*	3.9*	20	2.5*	2.75*	3.5*	7.5	0.3	1.478
2	40	5*	6*	7*	40	5*	5.5*	6.75*	8	0.3	1.478
3	60	8*	8.75*	10*	60	7.5*	8.5*	10.5*	9.75	0.3	1.478

Metacentric height To right of ship (mm)			Metacentric height To left of ship(mm)		
Y1	Y2	Y3	Y1	Y2	Y3
77.6	84.5	59.5	93	84.5	66.4
92.8	77.2	66.1	92	84.3	68.6
86.6	79	69	92	81	65.7



METACENTRIC HEIGHT APPARATUS