IDEAL PLASTIC

In an ideal plastic, shear stress is directly proportional to the shear strain.

It does not start from origin. (There is a yield value)

Slope = %mu

PRESSURE AND ITS MEASUREMENT

Pressure in a fluid is the force exerted per unit area

pressure = force per unit area

The force acts perpendicular to the surface of the fluid

SI Unit => N/{m^2} => Pa

1bar = 10^5 Pa

PASCAL’S LAW:

This states that pressure at a point in a fluid is equal in all directions

P\_x = P\_y = P\_z

One major application of the Pascal’s law is in the device called the Hydraulic Press.

Larger area indicates smaller pressure.

The force at the ramp of a hydraulic press is the weight.

QUESTIONS

1. A hydraulic press has a ramp of 30cm diameter and a planger of 4.5cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 500N

Solution:

F\_P = 500N

d\_R = 30cm

d\_P = 4.5cm

2. A hydraulic press has a ramp of 20cm diameter and a plunger of 3cm diameter. It is used for lifting a weight of 30kN. Find the force at the plunger

SOLUTION

d\_R = 20cm

d\_P = 3cm

F\_R = 30,000

HYDROSTATIC LAW: This states that the rate of change or increase in pressure in the vertical downward direction must be equal to the specific weight of the fluid.

--> Pressure increases with depth

On integrating,

Total Pressure = Atmospheric Pressure + Guage Pressure

Note: Whenever you hear negative pressure, they are talking about pressure in a vaccuum P\_vacuum

PRESSURE MEASUREMENT IN THE FLUID

\* Manometer

\* Convert to the right SI units

Guage Pressure: This is the pressure gotten from pressure measuring devices

Examples

Given that the barometer reading is 740mmHg; specific gravity of mercury is 13.6, intensity of Pressure is 40KPa. Express the intensity of pressure in head of water

Solution

For water,

Converting 740mmHg to Pa

Calculate the pressure at a point, 5m below the free water surface in a liquid that has a variable density {%rho}={left ( {350 + {Ay}} right )}{Kg/{m^3}} where A=8{{Kg}/{m^4}} and y is the distance in the meters measured from the free surface

Solution

On the section side of a pump, a guage shows a negative pressure of 0.35bar. Express this in terms of

1. Intensity of Pressure

2. Absolute pressure

3. Meter of water guage

4. Meters of oil (Specific gravity of 0.82) Absolute

5. Cm of mercury guage. Take atmospheric pressure to be 76cmHg and specific gravity of mercury is 13.6

P\_{absolute} = (136000 times 9.81 times {{76} over {100}})-(0.35 times {{10}^5})

P\_{absolute} = 66396.16Pa

P\_g = 0.35 times {{10}^5}

P = {%rho}hg

h = P over {{%rho}g}

SG = 0.82

Converting to density by multiplying by 1000

%rho = 820{{Kg}/{m^3}}

P = {%rho}hg

h = P over {{%rho}g} = {66396.16} over {{820} times {9.81}}

h = 8.254m of oil

A cylindrical tank of crosssectional area 600{m^2} and 2.6m height is filled with water up to a height of 0.5m and the remaining with oil of specific gravity of 0.78. The vessel is open to atmosphere pressure.

Calc.

1. Intensity of pressure at the interface

2. Absolute and guage pressure on the base of the tank in terms of water head, oil head and /{m^2}

3. The net force experimented by the base of the tank.

Assume atmospheric pressure at 1.0132bar

Intensity of pressure, h=>1.1.m

%rho = 0.78 times 1000

%rho = 780Kg/{m^3}

P = {%rho}hg

P = 780 times 1.1 times 9.81

P = 8416.98Pa

Base, P = {%rho}hg

P = {{{%rho}\_1}g{h\_1}} + {{{%rho}\_2}g{h\_2}}

P = {780 times 9.81 times 1.1} + {1000 times 9.81 times 1.5}

P\_q = 23131.98{N/{m^2}}

For water,

P = {%rho}hg

h = P over {{%rho}g} = {28131.98} over {1000 times 9.81} = 2.358m

For oil,

P = {%rho}hg

h = P over {{%rho}g} = {23131.98} over {780 times 9.81} = 3.023m of oil

P\_{absolute} = P\_{atm} + P\_g

P\_{atm} = 1.0132 times {{10}^5} Pa

P\_{absolute} = {1.0132 times {{10}^5}} + 23131.98

P\_{absolute} = 124451.98Pa