LECTURE – 4.2 META-CENTRIC HEIGHT **DATE**: 23/09/2023

Meta- Centric height

$$GM = \frac{I}{V} - BG$$

1. A body has the cylindrical upper portion of 3m diameter and 1.8 m deep. The lower portion is a curved one, which displaces a volume of 0.6 m^3 of water. The centre of buoyancy of the curved portion is at a distance of 1.95 m below the top of the cylinder.
   The centre of gravity of the whole body is 1.20 is 1.20 m below the top of the cylinder. The total displacement of water is 3.9 tonnes. Find the meta-centric height of the body.

Ans. Meta centric height $GM = \frac{I}{V} - BG$

$$I = \frac{\pi R^4}{4}$$

$$= \frac{3.14 \times (1.5)^4}{4}$$

$$= 3.98\ m^4$$

Total volume displaced V = 3.9 tonnes

= 3.9 x 1.133 m^3

= 4.42 m^3

Volume displaced by cylindrical part = 4.42 - .6 = 3.82 m^3

Volume displaced by cylindrical part = area of cross section x depth of height immersed into liquid

A x h = 3.82

$$h = \frac{3.82}{\pi r^2} = \frac{3.82}{3.14 \times 1.5^2} = 0.54\ m$$

Location of centre of buoyancy from interface of water

$$\bar{y} = \frac{V_1 y_1 + V_2 y_2}{V_1 + V_2}$$

$$= \frac{3.82 \times \frac{h}{2} + 0.6 \times (1.95 - 1.8 + 0.54)}{4.42}$$

= 0.327

BG = 0.327 + 0.06 = 0.387 m

GM = $\frac{3.98}{4.42} - 0.387 = 0.513$