E-Course on Fluid Mechanics and Hydraulic Machines
Subject code : 3141906

Subject: Fluid Mechanics and Hydraulic machine

Chapter : Flow Through Pipe

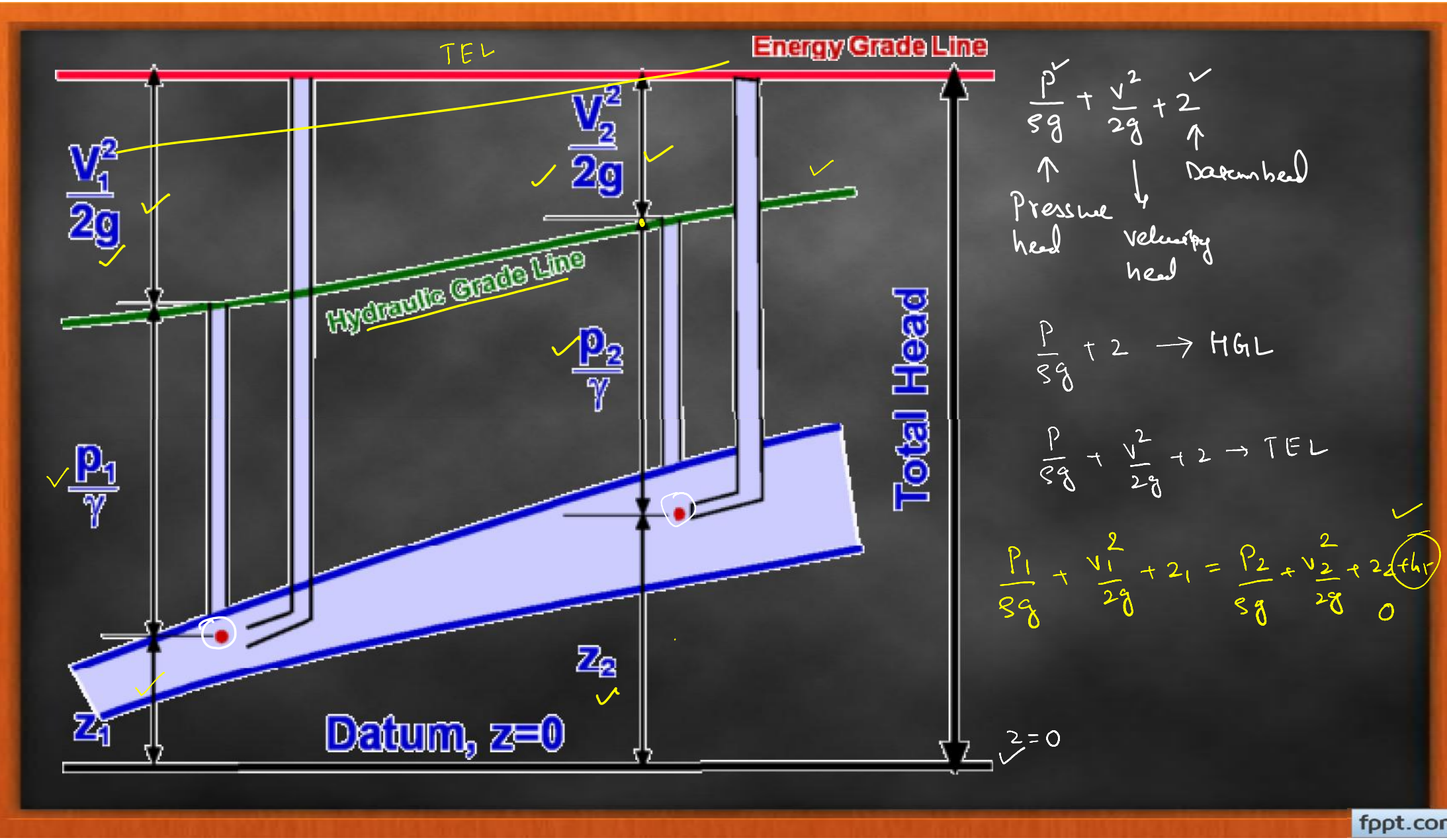
Topic : HGL and TGL

Hydraulic gradient Line (H.G.L)

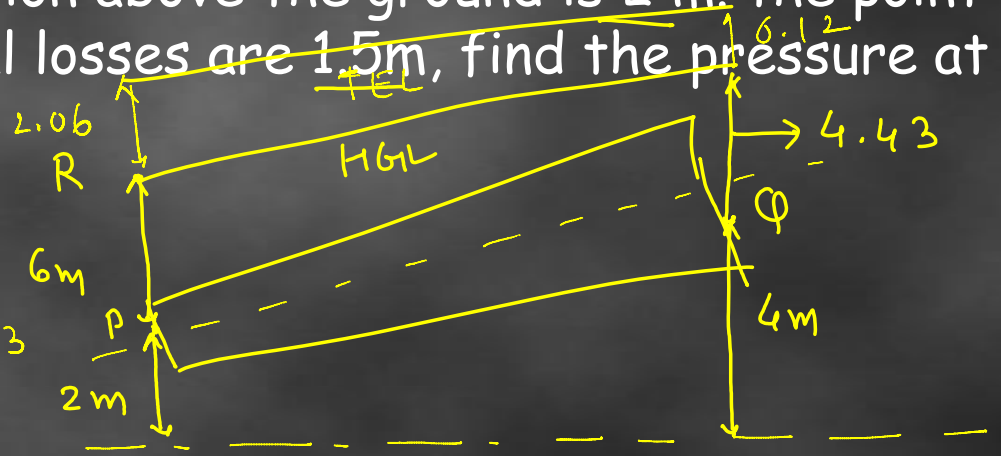
Line **representing the sum** of pressure head [p/w] and datum head [Z] of a flowing fluid in a pipe with respect to some reference line is known as hydraulic gradient line .

Total energy **line** (T.E.L)

Line **representing the sum** of pressure head [p/w], datum head [Z] **and** velocity head [V^2/2g] of a flowing fluid in a pipe with respect to some reference line is known as Total energy line line .


TEL
Energy Grade Line
$\frac{V_1^2}{2g}$
$\frac{V_2^2}{2g}$
Hydraulic Grade Line
$\frac{p_2}{\gamma}$
$\frac{p_1}{\gamma}$
Total Head
z_2
z_1
Datum, z=0
$\frac{p}{sg} + \frac{v^2}{2g} + z$
Datum head
Pressure head
Velocity head
$\frac{p}{sg} + z \rightarrow$ HGL
$\frac{p}{sg} + \frac{v^2}{2g} + z \rightarrow$ TEL
$\frac{p_1}{sg} + \frac{v_1^2}{2g} + z_1 = \frac{p_2}{sg} + \frac{v_2^2}{2g} + z_2 + h_f$
$z = 0$

Q. A Diverging duct PQ, the diameter at P and Q are 20 cm and 40 cm respectively, in which water flows at the rate of 0.2 m3/s. the pressure head at P is 6m of water and its elevation above the ground is 2 m. the point Q is 4m above the ground. If frictional losses are 1.5m, find the pressure at point Q and Draw HGL and TEL.



given Data

$D_P = 20cm = 20 \times 10^{-2} m$

$D_Q = 40cm = 40 \times 10^{-2} m$

$Q = 0.2 m^3/sec$

$P_P/\rho g = 6m$

$P_Q = ?$

$Z_P = 2m$

$Z_Q = 4m$

$h_f = 1.5m$

$Q = A_P V_P = A_Q V_Q$

$V_P = \frac{Q}{A_P} = \frac{0.2}{\pi/4 (0.2)^2} = 6.3$

$V_Q = \frac{Q}{A_Q} = \frac{0.2}{\pi/4 \times (0.4)^2} = 1.59$

$\frac{P_P}{\rho g} + \frac{V_P^2}{2g} + Z_P = \frac{P_Q}{\rho g} + \frac{V_Q^2}{2g} + Z_Q + h_f$

$6 + \frac{(6.3)^2}{2 \times 9.81} + 2 = \frac{P_Q}{\rho g} + \frac{(1.59)^2}{2 \times 9.81} + 4 + 1.5$

$\frac{P_Q}{\rho g} = 4.43m$

$P_Q = 43.52 kN/m^2$