Important Hydrostatics Formulas PDF

Formulas
Examples
with Units

List of 28
Important Hydrostatics Formulas

1) Coordinate measured Downward from Top given Effective Tension Formula

Evaluate Formula

Formula

$$z = -\left(\frac{T_e}{\left(\rho_s - \rho_m\right) \cdot [g] \cdot A_s} - L_{Well}\right)$$

Example with Units

$$6\,\text{m} = -\left(\frac{402.22\,\text{kN}}{\left(7750\,\text{kg/m}^3 - 1440\,\text{kg/m}^3\right) \cdot 9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2} - 16\,\text{m}\right)$$

2) Coordinate measured Downward from Top given Tension on Vertical Drill String Formula

Evaluate Formula

Formula

$$z = -\left(\left(\frac{T}{\rho_s \cdot [g] \cdot A_s}\right) - L_{Well}\right)$$

Example with Units

$$6\,\text{m} = -\left(\left(\frac{494.01\,\text{kN}}{7750\,\text{kg/m}^3 \cdot 9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2}\right) - 16\,\text{m}\right)$$

3) Cross Section Area of Steel given Effective Tension Formula

Evaluate Formula

Formula

$$A_s = \frac{T_e}{\left(\rho_s - \rho_m\right) \cdot [g] \cdot \left(L_{Well} - z\right)}$$

Example with Units

$$0.65\,\text{m}^2 = \frac{402.22\,\text{kN}}{\left(7750\,\text{kg/m}^3 - 1440\,\text{kg/m}^3\right) \cdot 9.8066\,\text{m/s}^2 \cdot \left(16\,\text{m} - 6\right)}$$

4) Cross Section Area of Steel in Pipe given Tension on Vertical Drill String Formula

Evaluate Formula

Formula

$$A_s = \frac{T}{\rho_s \cdot [g] \cdot \left(L_{Well} - z\right)}$$

Example with Units

$$0.65\,\text{m}^2 = \frac{494.01\,\text{kN}}{7750\,\text{kg/m}^3 \cdot 9.8066\,\text{m/s}^2 \cdot \left(16\,\text{m} - 6\right)}$$

5) Effective Tension given Buoyant Force acts in Direction opposite to Gravity Force Formula

Evaluate Formula

Formula

$$T_e = \left(\rho_s - \rho_m \right) \cdot [g] \cdot A_s \cdot \left(L_{Well} - z \right)$$

Example with Units

$$402.2197\,\text{kN} = \left(7750\,\text{kg/m}^3 - 1440\,\text{kg/m}^3 \right) \cdot 9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2 \cdot \left(16\,\text{m} - 6 \right)$$

6) Length of Pipe Hanging given Lower Section of Drill String Length in Compression Formula

Evaluate Formula

Formula

$$L_{Well} = \frac{L_c \cdot \rho_s}{\rho_m}$$

Example with Units

$$15.9844\,\text{m} = \frac{2.97 \cdot 7750\,\text{kg/m}^3}{1440\,\text{kg/m}^3}$$

7) Length of Pipe Hanging in Well given Effective Tension Formula

Evaluate Formula

Formula

$$L_{Well} = \left(\left(\frac{T_e}{\left(\rho_s - \rho_m \right) \cdot [g] \cdot A_s} + z \right) \right)$$

Example with Units

$$16\,\text{m} = \left(\left(\frac{402.22\,\text{kN}}{\left(7750\,\text{kg/m}^3 - 1440\,\text{kg/m}^3 \right) \cdot 9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2} + 6 \right) \right)$$

8) Length of Pipe Hanging in Well given Tension on Vertical Drill String Formula

Evaluate Formula

Formula

$$L_{Well} = \left(\frac{T}{\rho_s \cdot [g] \cdot A_s} \right) + z$$

Example with Units

$$16\,\text{m} = \left(\frac{494.01\,\text{kN}}{7750\,\text{kg/m}^3 \cdot 9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2} \right) + 6$$

9) Length of Pipe Hanging in Well given Vertical Force at Bottom End of Drill String Formula

Evaluate Formula

Formula

$$L_{Well} = \frac{f_z}{\rho_m \cdot [g] \cdot A_s}$$

Example with Units

$$15.9995\,\text{m} = \frac{146.86\,\text{kN}}{1440\,\text{kg/m}^3 \cdot 9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2}$$

10) Lower Section of Drill String Length that is in Compression Formula

Evaluate Formula

Formula

$$L_c = \frac{\rho_m \cdot L_{Well}}{\rho_s}$$

Example with Units

$$2.9729 = \frac{1440\,\text{kg/m}^3 \cdot 16\,\text{m}}{7750\,\text{kg/m}^3}$$

11) Mass Density of Drilling Mud for Lower Section of Drill String Length in Compression Formula

Evaluate Formula

Formula

$$\rho_m = \frac{L_c \cdot \rho_s}{L_{Well}}$$

Example with Units

$$1438.5938\,\text{kg/m}^3 = \frac{2.97 \cdot 7750\,\text{kg/m}^3}{16\,\text{m}}$$

12) Mass Density of Drilling Mud given Vertical Force at Bottom End of Drill String Formula

Evaluate Formula

Formula

$$\rho_m = \frac{f_z}{[g] \cdot A_s \cdot L_{Well}}$$

Example with Units

$$1439.957\,\text{kg/m}^3 = \frac{146.86\,\text{kN}}{9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2 \cdot 16\,\text{m}}$$

13) Mass Density of Drilling Mud when Buoyant Force acts in Direction opposite to Gravity Force Formula

Evaluate Formula

Formula

$$\rho_m = -\left(\left(\frac{T_e}{[g] \cdot A_s \cdot \left(L_{Well} - z\right)} - \rho_s\right)\right)$$

Example with Units

$$1439.9961\,\text{kg/m}^3 = -\left(\left(\frac{402.22\,\text{kN}}{9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2 \cdot \left(16\,\text{m} - 6\right)} - 7750\,\text{kg/m}^3\right)\right)$$

14) Mass Density of Steel for Lower Section of Drill String Length in Compression Formula

Evaluate Formula

Formula

$$\rho_s = \frac{\rho_m \cdot L_{Well}}{L_c}$$

Example with Units

$$7757.5758\,\text{kg/m}^3 = \frac{1440\,\text{kg/m}^3 \cdot 16\,\text{m}}{2.97}$$

15) Mass Density of Steel for Tension on Vertical Drill String Formula

Evaluate Formula

Formula

$$\rho_s = \frac{T}{[g] \cdot A_s \cdot \left(L_{Well} - z\right)}$$

Example with Units

$$7750.0001\,\text{kg/m}^3 = \frac{494.01\,\text{kN}}{9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2 \cdot \left(16\,\text{m} - 6\right)}$$

16) Mass Density of Steel when Buoyant Force acts in Direction opposite to Gravity Force Formula

Evaluate Formula

Formula

$$\rho_s = \left(\frac{T_e}{[g] \cdot A_s \cdot \left(L_{Well} - z \right)} + \rho_m \right)$$

Example with Units

$$7750.0039\,\text{kg/m}^3 = \left(\frac{402.22\,\text{kN}}{9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2 \cdot \left(16\,\text{m} - 6 \right)} + 1440\,\text{kg/m}^3 \right)$$

17) Tension on Vertical Drill String Formula

Evaluate Formula

Formula

$$T = \rho_s \cdot [g] \cdot A_s \cdot \left(L_{Well} - z \right)$$

Example with Units

$$494.01\,\text{kN} = 7750\,\text{kg/m}^3 \cdot 9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2 \cdot \left(16\,\text{m} - 6 \right)$$

18) Vertical Force at Bottom End of Drill String Formula

Evaluate Formula

Formula

$$f_z = \rho_m \cdot [g] \cdot A_s \cdot L_{Well}$$

Example with Units

$$146.8644\,\text{kN} = 1440\,\text{kg/m}^3 \cdot 9.8066\,\text{m/s}^2 \cdot 0.65\,\text{m}^2 \cdot 16\,\text{m}$$

19) Static Loads Formulas

19.1) Archimedes Law and Buoyancy Formulas

19.1.1) Buoyant Force of Body Submerged in Fluid Formula

Evaluate Formula

Formula

$$F_B = \nabla \cdot \rho \cdot [g]$$

Example with Units

$$4888.615\,\text{N} = 0.5\,\text{m}^3 \cdot 997\,\text{kg/m}^3 \cdot 9.8066\,\text{m/s}^2$$

19.1.2) Mass Density of Fluid for Buoyant Force Submerged in Fluid Formula

Evaluate Formula

Formula

$$\rho = \frac{F_B}{[g] \cdot \nabla}$$

Example with Units

$$997\,\text{kg/m}^3 = \frac{4888.615\,\text{N}}{9.8066\,\text{m/s}^2 \cdot 0.5\,\text{m}^3}$$

19.1.3) Volume of Submerged Part of Object given Buoyant Force of Body Submerged in Fluid Formula

Evaluate Formula

Formula

$$\nabla = \frac{F_B}{\rho \cdot [g]}$$

Example with Units

$$0.5\,\text{m}^3 = \frac{4888.615\,\text{N}}{997\,\text{kg/m}^3 \cdot 9.8066\,\text{m/s}^2}$$

19.2) Drill String Buckling Formulas

19.2.1) Column Slenderness Ratio for Critical Buckling Load Formula

Evaluate Formula

Formula

$$Lcr_{ratio} = \sqrt{\frac{A \cdot \pi^2 \cdot E}{P_{cr}}}$$

Example with Units

$$160 = \sqrt{\frac{0.0688\,m^2 \cdot 3.1416^2 \cdot 2E11\,N/m^2}{5304.912\,kN}}$$

19.2.2) Critical Buckling Load Formula

Evaluate Formula

Formula

$$P_{cr} = A \cdot \left(\frac{\pi^2 \cdot E}{Lcr_{ratio}^2}\right)$$

Example with Units

$$5304.9124\,kN = 0.0688\,m^2 \cdot \left(\frac{3.1416^2 \cdot 2E11\,N/m^2}{160^2}\right)$$

19.2.3) Cross Section Area of Column for Critical Buckling Load Formula

Evaluate Formula

Formula

$$A = \frac{P_{cr} \cdot Lcr_{ratio}^2}{\pi^2 \cdot E}$$

Example with Units

$$0.0688\,m^2 = \frac{5304.912\,kN \cdot 160^2}{3.1416^2 \cdot 2E11\,N/m^2}$$

19.2.4) Flow Velocity given Reynolds Number in Shorter Length of Pipe Formula

Evaluate Formula

Formula

$$V_{flow} = \frac{Re \cdot v}{D_p}$$

Example with Units

$$1.1198\,m/s = \frac{1560 \cdot 7.25\,St}{1.01\,m}$$

19.2.5) Kinematic Viscosity of Fluid given Reynolds Number in Shorter Length of Pipe Formula

Evaluate Formula

Formula

$$v = \frac{V_{flow} \cdot D_p}{Re}$$

Example with Units

$$7.2513\,St = \frac{1.12\,m/s \cdot 1.01\,m}{1560}$$

19.2.6) Pipe Diameter given Reynolds Number in Shorter Length of Pipe Formula

Evaluate Formula

Formula

$$D_p = \frac{Re \cdot v}{V_{flow}}$$

Example with Units

$$1.0098\,m = \frac{1560 \cdot 7.25\,St}{1.12\,m/s}$$

19.2.7) Reynolds Number in Shorter Length of Pipe Formula

Evaluate Formula

Formula

$$Re = \frac{V_{flow} \cdot D_p}{v}$$

Example with Units

$$1560.2759 = \frac{1.12\,m/s \cdot 1.01\,m}{7.25\,St}$$

Variables used in list of Hydrostatics Formulas above

- ∇ Volume of Submerged part of Object *(Cubic Meter)*
- **A** Cross Section Area of Column *(Square Meter)*
- A_s Cross Section Area of Steel in Pipe *(Square Meter)*
- D_p Diameter of Pipe *(Meter)*
- **E** Elastic Modulus *(Newton per Square Meter)*
- F_B Buoyant Force *(Newton)*
- f_z Vertical Force at Bottom end of Drill String *(Kilonewton)*
- L_c Lower Section of Drill String Length
- L_{Well} Length of Pipe Hanging in Well *(Meter)*
- Lcr_{ratio} Column Slenderness Ratio
- P_{cr} Critical Buckling Load for Drill String *(Kilonewton)*
- **Re** Reynolds Number
- **T** Tension on Vertical Drill String *(Kilonewton)*
- T_e Effective Tension *(Kilonewton)*
- **v** Kinematic Viscosity *(Stokes)*
- V_{flow} Flow Velocity *(Meter per Second)*
- **z** Coordinate measured Downward from Top
- **ρ** Mass Density *(Kilogram per Cubic Meter)*
- ρ_m Density of Drilling Mud *(Kilogram per Cubic Meter)*
- ρ_s Mass Density of Steel *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used in list of Hydrostatics Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- constant(s): **[g]**, 9.80665 *Gravitational acceleration on Earth*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Meter (m) *Length Unit Conversion*
- Measurement: **Volume** in Cubic Meter (m^3) *Volume Unit Conversion*
- Measurement: **Area** in Square Meter (m^2) *Area Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s) *Speed Unit Conversion*
- Measurement: **Force** in Kilonewton (kN), Newton (N) *Force Unit Conversion*
- Measurement: **Mass Concentration** in Kilogram per Cubic Meter (kg/m^3) *Mass Concentration Unit Conversion*
- Measurement: **Kinematic Viscosity** in Stokes (St) *Kinematic Viscosity Unit Conversion*
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m^3) *Density Unit Conversion*
- Measurement: **Stress** in Newton per Square Meter (N/m^2) *Stress Unit Conversion*

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