Important Hydrostatic Forces on Surfaces Formulas PDF

Formulas
Examples
with Units

List of 14
Important Hydrostatic Forces on Surfaces Formulas

1) Pressure Diagram Formulas

1.1) Depth of Center of Pressure Formula

Evaluate Formula

Formula

$$D = h_1 + \left(\frac{2 \cdot D_{h2} + h_1}{D_{h2} + h_1}\right) \cdot \left(\frac{b}{3}\right)$$

Example with Units

$$50.5\,\text{m} = 50\,\text{m} + \left(\frac{2 \cdot 50\,\text{m} + 50\,\text{m}}{50\,\text{m} + 50\,\text{m}}\right) \cdot \left(\frac{1000\,\text{mm}}{3}\right)$$

1.2) Length of Prism given Total Pressure by Volume of Prism Formula

Evaluate Formula

Formula

$$L = 2 \cdot \frac{P_T}{S \cdot \left(h_1 + D_{h2}\right)} \cdot b$$

Example with Units

$$0.0028\,\text{m} = 2 \cdot \frac{105\,\text{Pa}}{0.75\,\text{kN/m}^3 \cdot \left(50\,\text{m} + 50\,\text{m}\right)} \cdot 1000\,\text{mm}$$

1.3) Pressure Intensity for Bottom Edge of Plane Surface Formula

Evaluate Formula

Formula

$$P_2 = S \cdot D_{h2}$$

Example with Units

$$0.375\,\text{Bar} = 0.75\,\text{kN/m}^3 \cdot 50\,\text{m}$$

1.4) Pressure Intensity for Top Edge of Plane Surface Formula

Evaluate Formula

Formula

$$P_1 = S \cdot h_1$$

Example with Units

$$0.375\,\text{Bar} = 0.75\,\text{kN/m}^3 \cdot 50\,\text{m}$$

1.5) Total Pressure by Volume of Prism Formula

Evaluate Formula

Formula

$$P_T = \left(\frac{S \cdot \left(h_1 + D_{h2}\right)}{2}\right) \cdot b \cdot L$$

Example with Units

$$0.105\,\text{Pa} = \left(\frac{0.75\,\text{kN/m}^3 \cdot \left(50\,\text{m} + 50\,\text{m}\right)}{2}\right) \cdot 1000\,\text{mm} \cdot 0.0028\,\text{m}$$

1.6) Vertical Depth given Pressure Intensity for Bottom Edge of Plane Surface Formula

Evaluate Formula

Formula

$$D_{h2} = \frac{P_I}{S}$$

Example with Units

$$50\,\text{m} = \frac{37.5\,\text{kPa}}{0.75\,\text{kN/m}^3}$$

1.7) Vertical Depth given Pressure Intensity for Top Edge of Plane Surface Formula

Evaluate Formula

Formula

$$h_1 = \frac{P_I}{S}$$

Example with Units

$$50\,\text{m} = \frac{37.5\,\text{kPa}}{0.75\,\text{kN/m}^3}$$

2) Total Pressure on Curved Surface Formulas

2.1) Direction of Resultant Force Formula

Evaluate Formula

Formula

$$\theta = \frac{1}{\tan\left(\frac{P_v}{dH}\right)}$$

Example with Units

$$30.8072° = \frac{1}{\tan\left(\frac{44.3\,\text{N/m}^2}{10.5\,\text{N/m}^2}\right)}$$

2.2) Horizontal Force given Direction of Resultant Force Formula

Evaluate Formula

Formula

$$dH = \frac{dv}{\tan(\theta)}$$

Example with Units

$$8.6603\,\text{N/m}^2 = \frac{5\,\text{N/m}^2}{\tan(30°)}$$

2.3) Horizontal Pressure given Resultant Force Formula

Evaluate Formula

Formula

$$dH = \sqrt{P_n^2 - dv^2}$$

Example with Units

$$10.5778\,\text{N/m}^2 = \sqrt{11.7\,\text{N}^2 - 5\,\text{N/m}^2{}^2}$$

2.4) Resultant Force by Parallelogram of Forces Formula

Evaluate Formula

Formula

$$P_n = \sqrt{dH^2 + dv^2}$$

Example with Units

$$11.6297\,\text{N} = \sqrt{10.5\,\text{N/m}^2{}^2 + 5\,\text{N/m}^2{}^2}$$

2.5) Total Pressure on Elementary Area Formula

Evaluate Formula

Formula

$$p = S \cdot D \cdot A_{cs}$$

Example with Units

$$489.45\,\text{Pa} = 0.75\,\text{kN/m}^3 \cdot 50.2\,\text{m} \cdot 13\,\text{m}^2$$

2.6) Vertical Pressure given Direction of Resultant Force Formula

Evaluate Formula

Formula

$$dv = \tan(\theta) \cdot dH$$

Example with Units

$$6.0622\,\text{N/m}^2 = \tan(30°) \cdot 10.5\,\text{N/m}^2$$

2.7) Vertical Pressure given Resultant Force Formula

Evaluate Formula

Formula

$$dv = \sqrt{P_n^2 - dH^2}$$

Example with Units

$$5.1614\,\text{N/m}^2 = \sqrt{11.7\,\text{N}^2 - 10.5\,\text{N/m}^2{}^2}$$

Variables used in list of Hydrostatic Forces on Surfaces Formulas above

- A_{cs} Cross-Sectional Area *(Square Meter)*
- **b** Breadth of Section *(Millimeter)*
- **D** Vertical Depth *(Meter)*
- D_{h2} Vertical Depth h2 *(Meter)*
- **dH** Horizontal Pressure *(Newton per Square Meter)*
- **dv** Vertical Pressure *(Newton per Square Meter)*
- h_1 Vertical Depth h1 *(Meter)*
- **L** Length of Prism *(Meter)*
- **p** Pressure *(Pascal)*
- P_1 Pressure 1 *(Bar)*
- P_2 Pressure 2 *(Bar)*
- P_I Pressure Intensity *(Kilopascal)*
- P_n Resultant Force *(Newton)*
- P_T Total Pressure *(Pascal)*
- P_v Vertical Pressure 1 *(Newton per Square Meter)*
- **S** Specific Weight of Liquid in Piezometer *(Kilonewton per Cubic Meter)*
- **θ** Theta *(Degree)*

Constants, Functions, Measurements used in list of Hydrostatic Forces on Surfaces Formulas above

- 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.
- Functions: **tan**, tan(Angle)
  The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.
- Measurement: **Length** in Meter (m), Millimeter (mm)
  Length Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa), Bar (Bar), Kilopascal (kPa), Newton per Square Meter (N/m²)
  Pressure Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
  Specific Weight Unit Conversion

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