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Hydrostatic Forces on Surfaces Formulas

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List of 14 Hydrostatic Forces on Surfaces Formulas

Hydrostatic Forces on Surfaces

Pressure Diagram

1) Depth of Center of Pressure

Open Calculator

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

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

2) Length of Prism given Total Pressure by Volume of Prism

Open Calculator

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

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

3) Pressure Intensity for Bottom Edge of Plane Surface

Open Calculator

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

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

4) Pressure Intensity for Top Edge of Plane Surface

Open Calculator

fx $P_1 = S \cdot h_1$

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

5) Total Pressure by Volume of Prism

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

Total Pressure on Curved Surface

8) Direction of Resultant Force

Open Calculator

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

ex $$30.80724^\circ = \frac{1}{\tan\left(\frac{44.3\text{N/m}^2}{10.5\text{N/m}^2}\right)}$$

9) Horizontal Force given Direction of Resultant Force

Open Calculator

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

ex $$8.660254\text{N/m}^2 = \frac{5\text{N/m}^2}{\tan(30^\circ)}$$

10) Horizontal Pressure given Resultant Force

Open Calculator

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

ex $$10.57781\text{N/m}^2 = \sqrt{(11.7\text{N})^2 - (5\text{N/m}^2)^2}$$

11) Resultant Force by Parallelogram of Forces

Open Calculator

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

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

12) Total Pressure on Elementary Area

Open Calculator

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

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

13) Vertical Pressure given Direction of Resultant Force

Open Calculator

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

ex $$6.062178\text{N/m}^2 = \tan(30^\circ) \cdot 10.5\text{N/m}^2$$

14) Vertical Pressure given Resultant Force

Open Calculator

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

ex $$5.161395\text{N/m}^2 = \sqrt{(11.7\text{N})^2 - (10.5\text{N/m}^2)^2}$$

Variables Used

- 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

- Function: **sqrt**, sqrt(Number)
  Square root function
- Function: **tan**, tan(Angle)
  Trigonometric tangent function
- 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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