

Important Hydroelectric Power Plant Formulas PDF



Formulas Examples with Units

List of 23 Important Hydroelectric Power Plant Formulas

1) Angular Velocity of Wheel Formula ↻

Formula

$$\omega = \frac{2 \cdot \pi \cdot N}{60}$$

Example with Units

$$3.8382 \text{ rad/s} = \frac{2 \cdot 3.1416 \cdot 350 \text{ rev/min}}{60}$$

Evaluate Formula ↻

2) Diameter of Bucket Formula ↻

Formula

$$D_b = \frac{60 \cdot V_b}{\pi \cdot N}$$

Example with Units

$$1.2297 \text{ m} = \frac{60 \cdot 2.36 \text{ m/s}}{3.1416 \cdot 350 \text{ rev/min}}$$

Evaluate Formula ↻

3) Dimensionless Specific Speed Formula ↻

Formula

$$N_s' = \frac{N \cdot \sqrt{\frac{P_h}{1000}}}{\sqrt{\rho_w \cdot ([g] \cdot H)^{\frac{5}{4}}}}$$

Example with Units

$$0.0048 = \frac{350 \text{ rev/min} \cdot \sqrt{\frac{5145 \text{ kW}}{1000}}}{\sqrt{1000 \text{ kg/m}^3 \cdot (9.8066 \text{ m/s}^2 \cdot 250 \text{ m})^{\frac{5}{4}}}}$$

Evaluate Formula ↻

4) Efficiency of Turbine given Energy Formula ↻

Formula

$$\eta = \frac{E}{[g] \cdot \rho_w \cdot Q \cdot H \cdot t}$$

Example with Units

$$0.7995 = \frac{36056 \text{ MW}\cdot\text{h}}{9.8066 \text{ m/s}^2 \cdot 1000 \text{ kg/m}^3 \cdot 2.1 \text{ m}^3/\text{s} \cdot 250 \text{ m} \cdot 8760 \text{ h}}$$

Evaluate Formula ↻

5) Energy Produced by Hydroelectric Power Plant Formula ↻

Formula

$$E = [g] \cdot \rho_w \cdot Q \cdot H \cdot \eta \cdot t$$

Evaluate Formula ↻

Example with Units

$$36080.6267 \text{ MW}\cdot\text{h} = 9.8066 \text{ m/s}^2 \cdot 1000 \text{ kg/m}^3 \cdot 2.1 \text{ m}^3/\text{s} \cdot 250 \text{ m} \cdot 0.8 \cdot 8760 \text{ h}$$

6) Energy Produced by Hydroelectric Power Plant given Power Formula ↻

Formula

$$E = P_h \cdot \eta \cdot t$$

Example with Units

$$36056.16 \text{ MW}\cdot\text{h} = 5145 \text{ kW} \cdot 0.8 \cdot 8760 \text{ h}$$

Evaluate Formula ↻



7) Flow Rate of Water given Power Formula ↻

Formula

$$Q = \frac{P_h}{[g] \cdot \rho_w \cdot H}$$

Example with Units

$$2.0986 \text{ m}^3/\text{s} = \frac{5145 \text{ kW}}{9.8066 \text{ m/s}^2 \cdot 1000 \text{ kg/m}^3 \cdot 250 \text{ m}}$$

Evaluate Formula ↻

8) Head or Height of Fall of Water given Power Formula ↻

Formula

$$H = \frac{P_h}{[g] \cdot \rho_w \cdot Q}$$

Example with Units

$$249.8305 \text{ m} = \frac{5145 \text{ kW}}{9.8066 \text{ m/s}^2 \cdot 1000 \text{ kg/m}^3 \cdot 2.1 \text{ m}^3/\text{s}}$$

Evaluate Formula ↻

9) Height of Fall of Pelton Wheel Turbine Power Plant Formula ↻

Formula

$$H = \frac{V_J^2}{2 \cdot [g] \cdot C_v^2}$$

Example with Units

$$250.049 \text{ m} = \frac{68.63 \text{ m/s}^2}{2 \cdot 9.8066 \text{ m/s}^2 \cdot 0.98^2}$$

Evaluate Formula ↻

10) Hydroelectric Power Formula ↻

Formula

$$P_h = [g] \cdot \rho_w \cdot Q \cdot H$$

Example with Units

$$5148.4912 \text{ kW} = 9.8066 \text{ m/s}^2 \cdot 1000 \text{ kg/m}^3 \cdot 2.1 \text{ m}^3/\text{s} \cdot 250 \text{ m}$$

Evaluate Formula ↻

11) Jet Ratio of Hydroelectric Power Plant Formula ↻

Formula

$$J = \frac{D_b}{D_n}$$

Example with Units

$$15 = \frac{1.23 \text{ m}}{0.082 \text{ m}}$$

Evaluate Formula ↻

12) Number of Jets Formula ↻

Formula

$$n_j = \left(\frac{N_{SMJ}}{N_{SSJ}} \right)^2$$

Example with Units

$$6 = \left(\frac{73.49 \text{ rev/min}}{30 \text{ rev/min}} \right)^2$$

Evaluate Formula ↻

13) Power given Unit Power Formula ↻

Formula

$$P_h = P_u \cdot 1000 \cdot H^{\frac{3}{2}}$$

Example with Units

$$5138.7012 \text{ kW} = 1.3 \cdot 1000 \cdot 250 \text{ m}^{\frac{3}{2}}$$

Evaluate Formula ↻



14) Specific Speed of Multi Jet Machine Formula

Formula

$$N_{SMJ} = \sqrt{n_J \cdot N_{SSJ}}$$

Example with Units

$$73.4847 \text{ rev/min} = \sqrt{6 \cdot 30 \text{ rev/min}}$$

Evaluate Formula 

15) Specific Speed of Single Jet Machine Formula

Formula

$$N_{SSJ} = \frac{N_{SMJ}}{\sqrt{n_J}}$$

Example with Units

$$30.0022 \text{ rev/min} = \frac{73.49 \text{ rev/min}}{\sqrt{6}}$$

Evaluate Formula 

16) Specific Speed of Turbine of Hydroelectric Power Plant Formula

Formula

$$N_S = \frac{N \cdot \sqrt{\frac{P_h}{1000}}}{H^{\frac{5}{4}}}$$

Example with Units

$$25.2543 \text{ rev/min} = \frac{350 \text{ rev/min} \cdot \sqrt{\frac{5145 \text{ kW}}{1000}}}{250 \text{ m}^{\frac{5}{4}}}$$

Evaluate Formula 

17) Speed of Bucket given Angular Velocity and Radius Formula

Formula

$$V_b = \omega \cdot \frac{D_b}{2}$$

Example with Units

$$2.3554 \text{ m/s} = 3.83 \text{ rad/s} \cdot \frac{1.23 \text{ m}}{2}$$

Evaluate Formula 

18) Speed of Bucket given Diameter and RPM Formula

Formula

$$V_b = \frac{\pi \cdot D_b \cdot N}{60}$$

Example with Units

$$2.3605 \text{ m/s} = \frac{3.1416 \cdot 1.23 \text{ m} \cdot 350 \text{ rev/min}}{60}$$

Evaluate Formula 

19) Speed of Turbine given Unit Speed Formula

Formula

$$N = N_u \cdot \sqrt{H}$$

Example with Units

$$348.7814 \text{ rev/min} = 2.31 \cdot \sqrt{250 \text{ m}}$$

Evaluate Formula 

20) Tidal Energy Formula

Formula

$$P_t = 0.5 \cdot A \cdot \rho_w \cdot [g] \cdot H^2$$

Example with Units

$$7.7\text{E}+8 \text{ kW} = 0.5 \cdot 2500 \text{ m}^2 \cdot 1000 \text{ kg/m}^3 \cdot 9.8066 \text{ m/s}^2 \cdot 250 \text{ m}^2$$

Evaluate Formula 



21) Unit Power of Hydroelectric Power Plant Formula

Formula

$$P_u = \frac{\frac{P_h}{1000}}{H^{\frac{3}{2}}}$$

Example with Units

$$1.3016 = \frac{\frac{5145 \text{ kW}}{1000}}{250 \text{ m}^{\frac{3}{2}}}$$

Evaluate Formula 

22) Unit Speed of Turbine Formula

Formula

$$N_u = \frac{N}{\sqrt{H}}$$

Example with Units

$$2.3181 = \frac{350 \text{ rev/min}}{\sqrt{250 \text{ m}}}$$

Evaluate Formula 

23) Velocity of Jet from Nozzle Formula

Formula

$$V_j = C_v \cdot \sqrt{2 \cdot [g] \cdot H}$$

Example with Units

$$68.6233 \text{ m/s} = 0.98 \cdot \sqrt{2 \cdot 9.8066 \text{ m/s}^2 \cdot 250 \text{ m}}$$

Evaluate Formula 



Variables used in list of Hydroelectric Power Plant Formulas above

- **A** Area of Base (Square Meter)
- **C_v** Coefficient of Velocity
- **D_b** Bucket Circle Diameter (Meter)
- **D_n** Nozzle Diameter (Meter)
- **E** Energy (Megawatt-Hour)
- **H** Fall Height (Meter)
- **J** Jet Ratio
- **N** Working Speed (Revolution per Minute)
- **n_J** Number of Jets
- **N_s'** Dimensionless Specific Speed
- **N_S** Specific Speed (Revolution per Minute)
- **N_{SMJ}** Specific Speed of Multi Jet Machine (Revolution per Minute)
- **N_{SSJ}** Specific Speed of Single Jet Machine (Revolution per Minute)
- **N_u** Unit Speed
- **P_h** Hydroelectric Power (Kilowatt)
- **P_t** Tidal Power (Kilowatt)
- **P_u** Unit Power
- **Q** Flow Rate (Cubic Meter per Second)
- **t** Operating Time per Year (Hour)
- **V_b** Bucket Velocity (Meter per Second)
- **V_J** Velocity of Jet (Meter per Second)
- **η** Turbine Efficiency
- **ρ_w** Water Density (Kilogram per Cubic Meter)
- **ω** Angular Velocity (Radian per Second)

Constants, Functions, Measurements used in list of Hydroelectric Power Plant 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: Time** in Hour (h)
Time Unit Conversion 
- **Measurement: Area** in Square Meter (m²)
Area Unit Conversion 
- **Measurement: Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement: Energy** in Megawatt-Hour (MW*h)
Energy Unit Conversion 
- **Measurement: Power** in Kilowatt (kW)
Power Unit Conversion 
- **Measurement: Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
Volumetric Flow Rate Unit Conversion 
- **Measurement: Angular Velocity** in Radian per Second (rad/s), Revolution per Minute (rev/min)
Angular Velocity Unit Conversion 
- **Measurement: Density** in Kilogram per Cubic Meter (kg/m³)
Density Unit Conversion 



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