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Water Power Engineering Formulas

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List of 20 Water Power Engineering Formulas

Water Power Engineering

1) Average Load given Load Factor for Turbo-generators

Open Calculator

fx $$L_{Avg} = LF \cdot P_L$$

ex $$400W = 0.1 \cdot 4kW$$

2) Energy Actually Produced given Plant Factor

Open Calculator

fx $$E = p \cdot w$$

ex $$250kW*h = 0.5 \cdot 500kW*h$$

3) Load Factor for Turbo-generators

Open Calculator

fx $$LF = \frac{L_{Avg}}{P_L}$$

ex $$0.1 = \frac{400W}{4kW}$$

4) Maximum Energy Produced using Plant Factor

Open Calculator

fx $$w = \frac{E}{p}$$

ex $$500kW*h = \frac{250kW*h}{0.5}$$

5) Maximum Power Developed given Utilization Factor

Open Calculator

fx $$P = UF \cdot m$$

ex $$5000\text{kW} = 10 \cdot 500\text{kW}$$

6) Peak Load given Load Factor for Turbo-Generators

Open Calculator

fx $$P_L = \frac{L_{Avg}}{LF}$$

ex $$4\text{kW} = \frac{400\text{W}}{0.1}$$

7) Plant Factor

Open Calculator

fx $$p = \frac{E}{w}$$

ex $$0.5 = \frac{250\text{kW*h}}{500\text{kW*h}}$$

8) Total Power that can be Developed given Utilization Factor

Open Calculator

fx $$m = \frac{P}{UF}$$

ex $$500\text{kW} = \frac{5000\text{kW}}{10}$$

9) Utilization Factor

Open Calculator

fx $$UF = \frac{P}{m}$$

ex $$10 = \frac{5000kW}{500kW}$$

Assessment of Available Power

10) Amount of Hydropower

Open Calculator

fx $$P = \frac{\gamma_f \cdot q_{flow} \cdot (h_{location} - H) \cdot \eta}{1000}$$

ex $$0.113011kW = \frac{9.81kN/m^3 \cdot 24m^3/s \cdot (2.9m - 2.3m) \cdot 0.80}{1000}$$

11) Effective Head given Energy through Hydraulic Turbines

Open Calculator

fx $$H = \frac{E}{9.81 \cdot q_{flow} \cdot \eta \cdot T_w}$$

ex $$1.099925m = \frac{538.65N*m}{9.81 \cdot 24m^3/s \cdot 0.80 \cdot 2.6s}$$

12) Efficiency of Hydropower Station given Amount of Hydropower

Open Calculator

fx $$\eta = \frac{P}{9.81 \cdot q_{flow} \cdot (h_{location} - H)}$$

ex $$5.09684 = \frac{0.72kW}{9.81 \cdot 24m^3/s \cdot (2.9m - 2.3m)}$$

13) Efficiency of Hydropower Station given Energy through Hydraulic Turbines

Open Calculator

fx $$\eta = \frac{E}{9.81 \cdot q_{flow} \cdot (H - h_f) \cdot T_w}$$

ex $$0.799945 = \frac{538.65N*m}{9.81 \cdot 24m^3/s \cdot (2.3m - 1.2m) \cdot 2.6s}$$

14) Energy through Hydraulic Turbines

Open Calculator

fx $$E = (9.81 \cdot q_{flow} \cdot (H - h_f) \cdot \eta \cdot T_w)$$

ex $$538.6867N*m = (9.81 \cdot 24m^3/s \cdot (2.3m - 1.2m) \cdot 0.80 \cdot 2.6s)$$

15) Head given Amount of Hydropower

Open Calculator

fx $$H = \left(\frac{P}{9.81 \cdot q_{flow} \cdot \eta}\right) + h_{location}$$

ex $$6.72263m = \left(\frac{0.72kW}{9.81 \cdot 24m^3/s \cdot 0.80}\right) + 2.9m$$

16) Head given Energy through Hydraulic Turbines

Open Calculator

$$H = \left(\frac{E}{9.81 \cdot q_{flow} \cdot \eta \cdot T_w}\right) + h_f$$

$$2.299925\text{m} = \left(\frac{538.65\text{N*m}}{9.81 \cdot 24\text{m}^3/\text{s} \cdot 0.80 \cdot 2.6\text{s}}\right) + 1.2\text{m}$$

17) Head Loss given Amount of Hydropower

Open Calculator

$$h_f = \left(\left(\frac{P}{9.81 \cdot q_{flow} \cdot \eta}\right) - H\right)$$

$$1.52263\text{m} = \left(\left(\frac{0.72\text{kW}}{9.81 \cdot 24\text{m}^3/\text{s} \cdot 0.80}\right) - 2.3\text{m}\right)$$

18) Head Loss given Energy through Hydraulic Turbines

Open Calculator

$$h_f = -\left(\left(\frac{E}{9.81 \cdot q_{flow} \cdot \eta \cdot T_w}\right) - H\right)$$

$$1.200075\text{m} = -\left(\left(\frac{538.65\text{N*m}}{9.81 \cdot 24\text{m}^3/\text{s} \cdot 0.80 \cdot 2.6\text{s}}\right) - 2.3\text{m}\right)$$

19) Period of Flow given Energy through Hydraulic Turbines

Open Calculator

$$T_w = \frac{E}{9.81 \cdot q_{flow} \cdot (H - h_f) \cdot \eta}$$

$$2.599823\text{s} = \frac{538.65\text{N*m}}{9.81 \cdot 24\text{m}^3/\text{s} \cdot (2.3\text{m} - 1.2\text{m}) \cdot 0.80}$$

20) Rate of Flow of Water given Energy through Hydraulic Turbines

Open Calculator

fx $$q_{flow} = \frac{E}{9.81 \cdot (H - h_f) \cdot \eta \cdot T_w}$$

ex $$23.99836 m^3/s = \frac{538.65 N*m}{9.81 \cdot (2.3m - 1.2m) \cdot 0.80 \cdot 2.6s}$$

Variables Used

- **E** Energy Actually Produced *(Kilowatt-Hour)*
- **E** Energy through Hydraulic Turbines *(Newton Meter)*
- **H** Head of Water *(Meter)*
- **H** Effective Head *(Meter)*
- h_f Head Loss *(Meter)*
- $h_{location}$ Head Loss due to Friction *(Meter)*
- L_{Avg} Average Load *(Watt)*
- **LF** Load Factor
- **m** Total Power that can be Developed *(Kilowatt)*
- **p** Plant Factor
- **P** Max Power Developed *(Kilowatt)*
- **P** Amount of Hydropower *(Kilowatt)*
- P_L Peak Load *(Kilowatt)*
- q_{flow} Rate of Flow *(Cubic Meter per Second)*
- T_w Time Period of Progressive Wave *(Second)*
- **UF** Utilization Factor
- **w** Max Energy Produced *(Kilowatt-Hour)*
- γ_f Specific Weight of Liquid *(Kilonewton per Cubic Meter)*
- η Efficiency of Hydropower

Constants, Functions, Measurements used

- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Energy** in Kilowatt-Hour (kW*h), Newton Meter (N*m)
  Energy Unit Conversion
- Measurement: **Power** in Watt (W), Kilowatt (kW)
  Power Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m^3/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m^3)
  Specific Weight Unit Conversion

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- Flow Over Notches and Weirs Formulas
- Fluid Pressure and Its Measurement Formulas
- Fundamentals of Fluid Flow Formulas
- Hydroelectric Power Generation Formulas
- Hydrostatic Forces on Surfaces Formulas
- Impact of Free Jets Formulas
- Impulse Momentum Equation and its Applications Formulas
- Liquids in Relative Equilibrium Formulas
- Most Economical or Most Efficient Section of Channel Formulas
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