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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 $P_{max} = UF \cdot m$

ex $5001kW = 10 \cdot 500.1kW$

6) Peak Load given Load Factor for Turbo-Generators

Open Calculator

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

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

7) Plant Factor

Open Calculator

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

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

8) Total Power that can be Developed given Utilization Factor

Open Calculator

fx $m = \frac{P_{max}}{UF}$

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

9) Utilization Factor

Open Calculator

$$UF = \frac{P_{max}}{m}$$

$$9.998 = \frac{5000kW}{500.1kW}$$

Assessment of Available Power

10) Amount of Hydropower

Open Calculator

$$P = \frac{\gamma_f \cdot q_{flow} \cdot (H_l - H_{Water}) \cdot \eta}{1000}$$

$$0.678067kW = \frac{9.81kN/m^3 \cdot 32m^3/s \cdot (5m - 2.3m) \cdot 0.80}{1000}$$

11) Effective Head given Energy through Hydraulic Turbines

Open Calculator

$$H_{eff} = \frac{E_{Turbines}}{9.81 \cdot q_{flow} \cdot \eta \cdot T_w}$$

$$0.799996m = \frac{522.36N*m}{9.81 \cdot 32m^3/s \cdot 0.80 \cdot 2.6s}$$

12) Efficiency of Hydropower Station given Amount of Hydropower

Open Calculator

fx $$\eta = \frac{P}{9.81 \cdot q_{flow} \cdot (H_l - H_{Water})}$$

ex $$0.908465 = \frac{0.77kW}{9.81 \cdot 32m^3/s \cdot (5m - 2.3m)}$$

13) Efficiency of Hydropower Station given Energy through Hydraulic Turbines

Open Calculator

fx $$\eta = \frac{E_{Turbines}}{9.81 \cdot q_{flow} \cdot (H_{Water} - h_{location}) \cdot T_w}$$

ex $$0.799996 = \frac{522.36N*m}{9.81 \cdot 32m^3/s \cdot (2.3m - 1.5m) \cdot 2.6s}$$

14) Energy through Hydraulic Turbines

fx

Open Calculator

$$E_{Turbines} = (9.81 \cdot q_{flow} \cdot (H_{Water} - h_{location}) \cdot \eta \cdot T_w)$$

ex $$522.3629N*m = (9.81 \cdot 32m^3/s \cdot (2.3m - 1.5m) \cdot 0.80 \cdot 2.6s)$$

15) Head given Amount of Hydropower

Open Calculator

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

ex $$4.566068m = \left(\frac{0.77kW}{9.81 \cdot 32m^3/s \cdot 0.80}\right) + 1.5m$$

16) Head given Energy through Hydraulic Turbines

Open Calculator

$$H_{Water} = \left(\frac{E_{Turbines}}{9.81 \cdot q_{flow} \cdot \eta \cdot T_w} \right) + h_{location}$$

$$2.299996\text{m} = \left(\frac{522.36\text{N*m}}{9.81 \cdot 32\text{m}^3/\text{s} \cdot 0.80 \cdot 2.6\text{s}} \right) + 1.5\text{m}$$

17) Head Loss given Amount of Hydropower

Open Calculator

$$h_{location} = \left(\left(\frac{P}{9.81 \cdot q_{flow} \cdot \eta} \right) - H_{Water} \right)$$

$$0.766068\text{m} = \left(\left(\frac{0.77\text{kW}}{9.81 \cdot 32\text{m}^3/\text{s} \cdot 0.80} \right) - 2.3\text{m} \right)$$

18) Head Loss given Energy through Hydraulic Turbines

Open Calculator

$$h_{location} = -\left(\left(\frac{E_{Turbines}}{9.81 \cdot q_{flow} \cdot \eta \cdot T_w} \right) - H_{Water} \right)$$

$$1.500004\text{m} = -\left(\left(\frac{522.36\text{N*m}}{9.81 \cdot 32\text{m}^3/\text{s} \cdot 0.80 \cdot 2.6\text{s}} \right) - 2.3\text{m} \right)$$

19) Period of Flow given Energy through Hydraulic Turbines

Open Calculator

fx
$$T_w = \frac{E_{Turbines}}{9.81 \cdot q_{flow} \cdot (H_{Water} - h_{location}) \cdot \eta}$$

ex
$$2.599986s = \frac{522.36N*m}{9.81 \cdot 32m^3/s \cdot (2.3m - 1.5m) \cdot 0.80}$$

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

Open Calculator

fx
$$q_{flow} = \frac{E_{Turbines}}{9.81 \cdot (H_{Water} - h_{location}) \cdot \eta \cdot T_w}$$

ex
$$31.99982m^3/s = \frac{522.36N*m}{9.81 \cdot (2.3m - 1.5m) \cdot 0.80 \cdot 2.6s}$$

Variables Used

- **E** Energy Actually Produced *(Kilowatt-Hour)*
- $E_{Turbines}$ Energy through Hydraulic Turbines *(Newton Meter)*
- H_{eff} Effective Head *(Meter)*
- H_l Head loss *(Meter)*
- $h_{location}$ Head Loss due to Friction *(Meter)*
- H_{Water} Head of Water *(Meter)*
- L_{Avg} Average Load *(Watt)*
- **LF** Load Factor
- **m** Total Power that can be Developed *(Kilowatt)*
- **p** Plant Factor
- **P** Amount of Hydropower *(Kilowatt)*
- P_L Peak Load *(Kilowatt)*
- P_{max} Max Power Developed *(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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