Important Water Power Engineering Formulas PDF

Formulas
Examples
with Units

List of 20
Important Water Power Engineering Formulas

1) Average Load given Load Factor for Turbo-generators Formula

Evaluate Formula

Formula

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

Example with Units

$$400\,\text{W} = 0.1 \cdot 4\,\text{kW}$$

2) Energy Actually Produced given Plant Factor Formula

Evaluate Formula

Formula

$$E = p \cdot w$$

Example with Units

$$250\,\text{kW*h} = 0.5 \cdot 500\,\text{kW*h}$$

3) Load Factor for Turbo-generators Formula

Evaluate Formula

Formula

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

Example with Units

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

4) Maximum Energy Produced using Plant Factor Formula

Evaluate Formula

Formula

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

Example with Units

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

5) Maximum Power Developed given Utilization Factor Formula

Evaluate Formula

Formula

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

Example with Units

$$5001\,\text{kW} = 10 \cdot 500.1\,\text{kW}$$

6) Peak Load given Load Factor for Turbo-Generators Formula

Evaluate Formula

Formula

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

Example with Units

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

7) Plant Factor Formula

Evaluate Formula

Formula

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

Example with Units

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

8) Total Power that can be Developed given Utilization Factor Formula

Evaluate Formula

Formula

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

Example with Units

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

9) Utilization Factor Formula

Evaluate Formula

Formula

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

Example with Units

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

10) Assessment of Available Power Formulas

10.1) Amount of Hydropower Formula

Evaluate Formula

Formula

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

Example with Units

$$0.6781\,\text{kW} = \frac{9.81\,\text{kN/m}^3 \cdot 32\,\text{m}^3\text{/s} \cdot \left(5\,\text{m} - 2.3\,\text{m} \right) \cdot 0.80}{1000}$$

10.2) Effective Head given Energy through Hydraulic Turbines Formula

Evaluate Formula

Formula

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

Example with Units

$$0.8\,\text{m} = \frac{522.36\,\text{N*m}}{9.81 \cdot 32\,\text{m}^3\text{/s} \cdot 0.80 \cdot 2.6\,\text{s}}$$

10.3) Efficiency of Hydropower Station given Amount of Hydropower Formula

Evaluate Formula

Formula

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

Example with Units

$$0.9085 = \frac{0.77\,\text{kW}}{9.81 \cdot 32\,\text{m}^3\text{/s} \cdot \left(5\,\text{m} - 2.3\,\text{m} \right)}$$

10.4) Efficiency of Hydropower Station given Energy through Hydraulic Turbines Formula

Evaluate Formula

Formula

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

Example with Units

$$0.8 = \frac{522.36\,\text{N*m}}{9.81 \cdot 32\,\text{m}^3/\text{s} \cdot \left(2.3\,\text{m} - 1.5\,\text{m} \right) \cdot 2.6\,\text{s}}$$

10.5) Energy through Hydraulic Turbines Formula

Evaluate Formula

Formula

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

Example with Units

$$522.3629\,\text{N*m} = \left(9.81 \cdot 32\,\text{m}^3/\text{s} \cdot \left(2.3\,\text{m} - 1.5\,\text{m} \right) \cdot 0.80 \cdot 2.6\,\text{s} \right)$$

10.6) Head given Amount of Hydropower Formula

Evaluate Formula

Formula

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

Example with Units

$$4.5661\,\text{m} = \left(\frac{0.77\,\text{kW}}{9.81 \cdot 32\,\text{m}^3/\text{s} \cdot 0.80} \right) + 1.5\,\text{m}$$

10.7) Head given Energy through Hydraulic Turbines Formula

Evaluate Formula

Formula

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

Example with Units

$$2.3\,\text{m} = \left(\frac{522.36\,\text{N*m}}{9.81 \cdot 32\,\text{m}^3/\text{s} \cdot 0.80 \cdot 2.6\,\text{s}} \right) + 1.5\,\text{m}$$

10.8) Head Loss given Amount of Hydropower Formula

Evaluate Formula

Formula

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

Example with Units

$$0.7661\,\text{m} = \left(\left(\frac{0.77\,\text{kW}}{9.81 \cdot 32\,\text{m}^3/\text{s} \cdot 0.80} \right) - 2.3\,\text{m} \right)$$

10.9) Head Loss given Energy through Hydraulic Turbines Formula

Evaluate Formula

Formula

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

Example with Units

$$1.5\,\text{m} = -\left(\left(\frac{522.36\,\text{N*m}}{9.81 \cdot 32\,\text{m}^3/\text{s} \cdot 0.80 \cdot 2.6\,\text{s}}\right) - 2.3\,\text{m}\right)$$

10.10) Period of Flow given Energy through Hydraulic Turbines Formula

Evaluate Formula

Formula

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

Example with Units

$$2.6\,\text{s} = \frac{522.36\,\text{N*m}}{9.81 \cdot 32\,\text{m}^3/\text{s} \cdot \left(2.3\,\text{m} - 1.5\,\text{m}\right) \cdot 0.80}$$

10.11) Rate of Flow of Water given Energy through Hydraulic Turbines Formula

Evaluate Formula

Formula

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

Example with Units

$$31.9998\,\text{m}^3/\text{s} = \frac{522.36\,\text{N*m}}{9.81 \cdot \left(2.3\,\text{m} - 1.5\,\text{m}\right) \cdot 0.80 \cdot 2.6\,\text{s}}$$

Variables used in list of Water Power Engineering Formulas above

- **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 in list of Water Power Engineering Formulas above

- 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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