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List of 20 Water Power Engineering Formulas

Water Power Engineering

1) Average Load given Load Factor for Turbo-generators

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

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

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

2) Energy Actually Produced given Plant Factor

$$fx \quad E = p \cdot w$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

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

3) Load Factor for Turbo-generators

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

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

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

4) Maximum Energy Produced using Plant Factor

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

[Open Calculator !\[\]\(83bbbd261710c59db0214aa27b2edc0d_img.jpg\)](#)

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



5) Maximum Power Developed given Utilization Factor

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 5001kW = 10 \cdot 500.1kW$$

6) Peak Load given Load Factor for Turbo-Generators

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

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

7) Plant Factor

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

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

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

8) Total Power that can be Developed given Utilization Factor

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

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

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



9) Utilization Factor

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

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

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

Assessment of Available Power

10) Amount of Hydropower

$$\text{fx } P = \frac{\gamma_f \cdot Q_{\text{flow}} \cdot (H_1 - H_{\text{Water}}) \cdot \eta}{1000}$$

[Open Calculator !\[\]\(aa53ad6fea213b8b2226d3077e30533a_img.jpg\)](#)

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

11) Effective Head given Energy through Hydraulic Turbines

$$\text{fx } H_{\text{eff}} = \frac{E_{\text{Turbines}}}{9.81 \cdot Q_{\text{flow}} \cdot \eta \cdot T_w}$$

[Open Calculator !\[\]\(626ce8ac21792b9405bfddfea8e0c96a_img.jpg\)](#)

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



12) Efficiency of Hydropower Station given Amount of Hydropower

$$\text{fx } \eta = \frac{P}{9.81 \cdot q_{\text{flow}} \cdot (H_1 - H_{\text{Water}})}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

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

13) Efficiency of Hydropower Station given Energy through Hydraulic Turbines

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

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

14) Energy through Hydraulic Turbines

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

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

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

15) Head given Amount of Hydropower

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

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80_img.jpg\)](#)

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



16) Head given Energy through Hydraulic Turbines

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

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

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

17) Head Loss given Amount of Hydropower

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

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

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

18) Head Loss given Energy through Hydraulic Turbines

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

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

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



19) Period of Flow given Energy through Hydraulic Turbines

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

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5_img.jpg\)](#)

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









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*)
- **Y_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 (m³/s)
Volumetric Flow Rate Unit Conversion 
- **Measurement: Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
Specific Weight Unit Conversion 



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