calculatoratoz.com

unitsconverters.com

Hydroelectric Power Plant Formulas

Calculators! Examples! Conversions!

List of 23 Hydroelectric Power Plant Formulas

Hydroelectric Power Plant

1) Angular Velocity of Wheel

Open Calculator

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

ex $$3.838179\text{rad/s} = \frac{2 \cdot \pi \cdot 350\text{r/min}}{60}$$

2) Diameter of Bucket

Open Calculator

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

ex $$1.22975\text{m} = \frac{60 \cdot 2.36\text{m/s}}{\pi \cdot 350\text{r/min}}$$

3) Dimensionless Specific Speed

Open Calculator

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

ex $$0.004819 = \frac{350\text{r/min} \cdot \sqrt{\frac{5145\text{kW}}{1000}}}{\sqrt{1000\text{kg/m}^3} \cdot ([g] \cdot 250\text{m})^{\frac{5}{4}}}$$

4) Efficiency of Turbine given Energy

Open Calculator

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

ex $$0.799454 = \frac{36056\text{MW*h}}{[g] \cdot 1000\text{kg/m}^3 \cdot 2.1\text{m}^3\text{/s} \cdot 250\text{m} \cdot 8760\text{h}}$$

5) Energy Produced by Hydroelectric Power Plant

Open Calculator

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

ex $$36080.63\text{MW*h} = [g] \cdot 1000\text{kg/m}^3 \cdot 2.1\text{m}^3\text{/s} \cdot 250\text{m} \cdot 0.8 \cdot 8760\text{h}$$

6) Energy Produced by Hydroelectric Power Plant given Power

Open Calculator

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

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

7) Flow Rate of Water given Power

Open Calculator

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

ex $$2.098576\text{m}^3\text{/s} = \frac{5145\text{kW}}{[g] \cdot 1000\text{kg/m}^3 \cdot 250\text{m}}$$

8) Head or Height of Fall of Water given Power

Open Calculator

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

ex $$249.8305\text{m} = \frac{5145\text{kW}}{[g] \cdot 1000\text{kg/m}^3 \cdot 2.1\text{m}^3/\text{s}}$$

9) Height of Fall of Pelton Wheel Turbine Power Plant

Open Calculator

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

ex $$250.049\text{m} = \frac{(68.63\text{m/s})^2}{2 \cdot [g] \cdot (0.98)^2}$$

10) Hydroelectric Power

Open Calculator

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

ex $$5148.491\text{kW} = [g] \cdot 1000\text{kg/m}^3 \cdot 2.1\text{m}^3/\text{s} \cdot 250\text{m}$$

11) Jet Ratio of Hydroelectric Power Plant

Open Calculator

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

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

12) Number of Jets

Open Calculator

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

ex $$6 = \left(\frac{73.49\mathrm{r/\,min}}{30\mathrm{r/\,min}}\right)^2$$

13) Power given Unit Power

Open Calculator

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

ex $$5138.701\mathrm{kW} = 1.3 \cdot 1000 \cdot (250\mathrm{m})^{\frac{3}{2}}$$

14) Specific Speed of Multi Jet Machine

Open Calculator

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

ex $$73.48469\mathrm{r/\,min} = \sqrt{6} \cdot 30\mathrm{r/\,min}$$

15) Specific Speed of Single Jet Machine

Open Calculator

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

ex $$30.00217\mathrm{r/\,min} = \frac{73.49\mathrm{r/\,min}}{\sqrt{6}}$$

16) Specific Speed of Turbine of Hydroelectric Power Plant

Open Calculator

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

ex $$25.25432\text{r/min} = \frac{350\text{r/min} \cdot \sqrt{\frac{5145\text{kW}}{1000}}}{(250\text{m})^{\frac{5}{4}}}$$

17) Speed of Bucket given Angular Velocity and Radius

Open Calculator

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

ex $$2.35545\text{m/s} = 3.83\text{rad/s} \cdot \frac{1.23\text{m}}{2}$$

18) Speed of Bucket given Diameter and RPM

Open Calculator

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

ex $$2.36048\text{m/s} = \frac{\pi \cdot 1.23\text{m} \cdot 350\text{r/min}}{60}$$

19) Speed of Turbine given Unit Speed

Open Calculator

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

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

20) Tidal Energy

Open Calculator

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

ex $$7.7E\hat{}8kW = 0.5 \cdot 2500m^2 \cdot 1000kg/m^3 \cdot [g] \cdot (250m)^2$$

21) Unit Power of Hydroelectric Power Plant

Open Calculator

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

ex $$1.301593 = \frac{\frac{5145kW}{1000}}{(250m)^{\frac{3}{2}}}$$

22) Unit Speed of Turbine

Open Calculator

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

ex $$2.318071 = \frac{350r/\min}{\sqrt{250m}}$$

23) Velocity of Jet from Nozzle

Open Calculator

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

ex $$68.62327m/s = 0.98 \cdot \sqrt{2 \cdot [g] \cdot 250m}$$

Variables Used

- **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 Specific Speed *(Revolution per Minute)*
- N_s' Dimensionless Specific Speed
- 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

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[g]**, 9.80665 Meter/Second²
  Gravitational acceleration on Earth
- Function: **sqrt**, sqrt(Number)
  Square root function
- 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 (r/min)
  Angular Velocity Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion

Check other formula lists

- Diesel Engine Power Plant Formulas
- Hydroelectric Power Plant Formulas
- Power Plant Operational Factors Formulas
- Thermal Power Plant Formulas

Feel free to SHARE this document with your friends!

PDF Available in

English Spanish French German Russian Italian Portuguese Polish Dutch

5/17/2023 | 6:08:57 AM UTC

Please leave your feedback here...