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Pelton Turbine Formulas

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List of 14 Pelton Turbine Formulas

Pelton Turbine

1) Absolute Velocity of Pelton Jet

Open Calculator

fx $V_1 = C_v \cdot \sqrt{2 \cdot [g] \cdot H}$

ex $27.98367\text{m/s} = 0.975 \cdot \sqrt{2 \cdot [g] \cdot 42\text{m}}$

2) Bucket Velocity of Pelton Turbine

Open Calculator

fx $U = V_1 - V_{r1}$

ex $14.73\text{m/s} = 28\text{m/s} - 13.27\text{m/s}$

3) Coefficient of Velocity for Pelton Wheel

Open Calculator

fx $C_v = \frac{V_1}{\sqrt{2 \cdot [g] \cdot H}}$

ex $0.975569 = \frac{28\text{m/s}}{\sqrt{2 \cdot [g] \cdot 42\text{m}}}$

4) Energy per Unit Mass of Pelton

Open Calculator

fx $E_p = (V_{ti} - V_w) \cdot U$

ex $384.3057\text{m}^2/\text{s}^2 = (28.27\text{m/s} - 2.18\text{m/s}) \cdot 14.73\text{m/s}$

5) Energy per Unit Mass of Pelton Turbine

Open Calculator

fx $E_m = (V_{r1} + V_{r2} \cdot \cos(\beta_2)) \cdot U$

ex $369.8722\text{m}^2/\text{s}^2 = (13.27\text{m/s} + 12.6\text{m/s} \cdot \cos(20^\circ)) \cdot 14.73\text{m/s}$

6) Inlet Relative Velocity of Pelton

Open Calculator

fx $V_{r1} = V_1 - U$

ex $13.27\text{m/s} = 28\text{m/s} - 14.73\text{m/s}$

7) Outlet Relative Velocity of Pelton

Open Calculator

fx $V_{r2} = k \cdot V_{r1}$

ex $12.6065\text{m/s} = 0.95 \cdot 13.27\text{m/s}$

8) Pelton Head

Open Calculator

fx $H = \frac{V_1^2}{2 \cdot [g] \cdot C_v^2}$

ex $42.04905\text{m} = \frac{(28\text{m/s})^2}{2 \cdot [g] \cdot (0.975)^2}$

9) Power of Pelton Turbine

Open Calculator

fx $P_t = (1 + k \cdot \cos(\beta_2)) \cdot \rho \cdot Q_p \cdot U \cdot V_{r1}$

ex $553.2784\text{kW} = (1 + 0.95 \cdot \cos(20^\circ)) \cdot 997\text{kg/m}^3 \cdot 1.5\text{m}^3\text{/s} \cdot 14.73\text{m/s} \cdot 13.27\text{m/s}$

10) Power of Pelton Turbine given Velocity

Open Calculator

fx $P_t = (1 + k \cdot \cos(\beta_2)) \cdot \rho \cdot Q_p \cdot U \cdot (V_1 - U)$

ex $553.2784\text{kW} = (1 + 0.95 \cdot \cos(20^\circ)) \cdot 997\text{kg/m}^3 \cdot 1.5\text{m}^3\text{/s} \cdot 14.73\text{m/s} \cdot (28\text{m/s} - 14.73\text{m/s})$

11) Tangential Component of Inlet Velocity in Pelton Turbine

Open Calculator

fx $V_{ti} = V_{r1} + U$

ex $28\text{m/s} = 13.27\text{m/s} + 14.73\text{m/s}$

12) Tangential Component of Outlet Velocity in Pelton Turbine

Open Calculator

fx $V_w = U - V_{r2} \cdot \cos(\beta_2)$

ex $2.889873\text{m/s} = 14.73\text{m/s} - 12.6\text{m/s} \cdot \cos(20^\circ)$

13) Wheel Efficiency of Pelton Turbine

Open Calculator

fx $\eta_w = \frac{2 \cdot (1 + k \cdot \cos(\beta_2)) \cdot (V_1 - U) \cdot U}{V_1^2}$

ex $0.943781 = \frac{2 \cdot (1 + 0.95 \cdot \cos(20^\circ)) \cdot (28\text{m/s} - 14.73\text{m/s}) \cdot 14.73\text{m/s}}{(28\text{m/s})^2}$

14) Wheel Efficiency of Pelton Turbine given Power

Open Calculator

fx $\eta_w = \frac{2 \cdot P_t}{\rho \cdot Q_p \cdot V_1^2}$

ex $0.943306 = \frac{2 \cdot 553\text{kW}}{997\text{kg/m}^3 \cdot 1.5\text{m}^3\text{/s} \cdot (28\text{m/s})^2}$

Variables Used

- C_v Coefficient of Velocity for Pelton
- E_m Energy Per Unit Mass of Pelton Turbine *(Square Meter per Square Second)*
- E_p Energy Per Unit Mass of Pelton *(Square Meter per Square Second)*
- **H** Pelton Head *(Meter)*
- **k** K Factor for Pelton
- P_t Power of Pelton Turbine *(Kilowatt)*
- Q_p Volume Flow Rate For Pelton Turbine *(Cubic Meter per Second)*
- **U** Bucket Velocity of Pelton Turbine *(Meter per Second)*
- V_1 Velocity of Pelton Jet *(Meter per Second)*
- V_{r1} Inlet Relative Velocity of Pelton Turbine *(Meter per Second)*
- V_{r2} Outlet Relative Velocity of Pelton *(Meter per Second)*
- V_{ti} Tangential Inlet Velocity of Pelton *(Meter per Second)*
- V_w Tangential Outlet Velocity of Pelton *(Meter per Second)*
- β_2 Outlet Bucket Angle of Pelton *(Degree)*
- η_w Wheel Efficiency of Pelton Turbine
- ρ Mass Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665
  Gravitational acceleration on Earth
- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Power** in Kilowatt (kW)
  Power Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m^3/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Mass Concentration** in Kilogram per Cubic Meter (kg/m^3)
  Mass Concentration Unit Conversion
- Measurement: **Specific Energy** in Square Meter per Square Second (m^2/s^2)
  Specific Energy Unit Conversion

Check other formula lists

- **Pelton Turbine Formulas**

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