Important Precipitation Formulas PDF

Formulas
Examples
with Units

List of 19
Important Precipitation Formulas

1) Correction Ratio in Test for Consistency of Record Formula

Evaluate Formula

Formula

$$C.R = \frac{M_c}{M_a}$$

Example

$$1.3333 = \frac{1.2}{0.9}$$

2) Depth of rainfall given volume of rainfall Formula

Evaluate Formula

Formula

$$d = \frac{V}{A}$$

Example with Units

$$20\,\text{mm} = \frac{50\,\text{m}^3}{25\,\text{m}^2}$$

3) Dredge or Burge Formula Formula

Evaluate Formula

Formula

$$Q_p = 19.6 \cdot \frac{A_{catchment}}{\left(L_b\right)^{\frac{2}{3}}}$$

Example with Units

$$4.0601\,\text{m}^3/\text{s} = 19.6 \cdot \frac{2.0\,\text{m}^2}{\left(30\,\text{m}\right)^{\frac{2}{3}}}$$

4) Total Runoff over Catchment Formula

Evaluate Formula

Formula

$$Q_V = S_r + I + B + C$$

Example with Units

$$19.11\,\text{m}^3 = 0.05\,\text{m}^3/\text{s} + 2\,\text{m}^3/\text{s} + 16.96\,\text{m}^3/\text{s} + 100\,\text{mm}$$

5) Volume of rainfall Formula

Evaluate Formula

Formula

$$V = A \cdot d$$

Example with Units

$$50\,\text{m}^3 = 25\,\text{m}^2 \cdot 20\,\text{mm}$$

6) Maximum Intensity-Duration-Frequency Relationship Formulas

6.1) Duration given Maximum Intensity Formula

Evaluate Formula

Formula

$$D = \left(\left(K \cdot \frac{T_r^{\,x}}{i_{max}}\right) - a^{\,n}\right)^{\frac{1}{n}}$$

Example with Units

$$3.0121\,\text{h} = \left(\left(4 \cdot \frac{150^{\,1.5}}{266.794\,\text{cm/h}}\right) - 0.6^{\,3}\right)^{\frac{1}{3}}$$

6.2) Maximum Intensity in General Form Formula

Evaluate Formula

Formula

$$i_{max} = \frac{K \cdot T_r^{\ x}}{(D + a)^{n}}$$

Example with Units

$$266.794\,\text{cm/h} = \frac{4 \cdot 150^{1.5}}{(2.42\,\text{h} + 0.6)^{3}}$$

6.3) Return Period given Maximum Intensity Formula

Evaluate Formula

Formula

$$T_r = \left(\frac{i_{max} \cdot (D + a)^{n}}{K}\right)^{\frac{1}{x}}$$

Example with Units

$$150 = \left(\frac{266.794\,\text{cm/h} \cdot (2.42\,\text{h} + 0.6)^{3}}{4}\right)^{\frac{1}{1.5}}$$

7) Measurement of Precipitation Formulas

7.1) Radar measurement of Rainfall Formulas

7.1.1) Intensity of Rainfall given Radar Echo Factor Formula

Evaluate Formula

Formula

$$i = \left(\frac{Z}{200}\right)^{\frac{1}{1.6}}$$

Example with Units

$$1.6\,\text{mm/h} = \left(\frac{424.25}{200}\right)^{\frac{1}{1.6}}$$

7.1.2) Radar Echo Factor using Intensity Formula

Evaluate Formula

Formula

$$Z = 200 \cdot i^{1.6}$$

Example with Units

$$424.2501 = 200 \cdot 1.6\,\text{mm/h}^{1.6}$$

7.1.3) Radar Measurement of Rainfall Formula

Evaluate Formula

Formula

$$P_r = \frac{C_{radar} \cdot Z}{r^{2}}$$

Example with Units

$$2.1212 = \frac{2.00 \cdot 424.25}{20000\,\text{mm}^{2}}$$

8) Preparation of Data Formulas

8.1) Test for Consistency of Record Formulas

8.1.1) Corrected Precipitation at any Time Period at Station 'X' Formula

Evaluate Formula

Formula

$$P_{cx} = P_x \cdot \frac{M_c}{M_a}$$

Example with Units

$$16\,\text{mm} = 12\,\text{mm} \cdot \frac{1.2}{0.9}$$

8.1.2) Corrected Slope of Double Mass Curve Formula

Evaluate Formula

Formula

$$M_c = \frac{P_{cx} \cdot M_a}{P_x}$$

Example with Units

$$1.2 = \frac{16\,\text{mm} \cdot 0.9}{12\,\text{mm}}$$

8.1.3) Original Recorded Precipitation given Corrected Precipitation at any Time Period Formula

Evaluate Formula

Formula

$$P_x = \frac{P_{cx} \cdot M_a}{M_c}$$

Example with Units

$$12\,\text{mm} = \frac{16\,\text{mm} \cdot 0.9}{1.2}$$

8.1.4) Original Slope of Double Mass Curve given Corrected Precipitation Formula

Evaluate Formula

Formula

$$M_a = \frac{P_x \cdot M_c}{P_{cx}}$$

Example with Units

$$0.9 = \frac{12\,\text{mm} \cdot 1.2}{16\,\text{mm}}$$

9) Probable Maximum Precipitation (PMP) Formulas

9.1) Duration given Extreme Rainfall Depth Formula

Evaluate Formula

Formula

$$D = \left(\frac{P_m}{42.16}\right)^{\frac{1}{0.475}}$$

Example with Units

$$2.42\,\text{h} = \left(\frac{641.52\,\text{mm}}{42.16}\right)^{\frac{1}{0.475}}$$

9.2) Extreme Rainfall Depth Formula

Evaluate Formula

Formula

$$P_m = 42.16 \cdot D^{0.475}$$

Example with Units

$$641.524\,\text{mm} = 42.16 \cdot 2.42\,\text{h}^{0.475}$$

9.3) Statistical Approach of PMP by using Chow's Equation Formula

Evaluate Formula

Formula

$$PMP = P + K_z \cdot \sigma$$

Example with Units

$$59.01\,\text{mm} = 49.7\,\text{mm} + 7 \cdot 1.33$$

10) Raingauge Network Formulas

10.1) Optimum number of rain gauge stations Formula

Evaluate Formula

Formula

$$N = \left(\frac{C_v}{E}\right)^2$$

Example

$$2.7778 = \left(\frac{10}{6}\right)^2$$

Variables used in list of Precipitation Formulas above

- **a** Coefficient a
- **A** Area of Accumulated Rain *(Square Meter)*
- $A_{catchment}$ Catchment Area *(Square Meter)*
- **B** Baseflow *(Cubic Meter per Second)*
- **C** Channel Precipitation *(Millimeter)*
- C_{radar} A Constant
- C_v Coefficient of Variation of Rainfall
- **C.R** Correction Ratio
- **d** Depth of Rainfall *(Millimeter)*
- **D** Duration of Excess Rainfall in Hours *(Hour)*
- **E** Allowable Degree of Error
- **i** Intensity of Rainfall *(Millimeter per Hour)*
- **I** Interflow *(Cubic Meter per Second)*
- i_{max} Maximum Intensity *(Centimeter per Hour)*
- **K** Constant K
- K_z Frequency Factor
- L_b Length of Basin *(Meter)*
- M_a Original Slope of Double-Mass Curve
- M_c Corrected Slope of Double-Mass Curve
- **n** Constant n
- **N** Optimum Number of Rain Gauge Stations
- **P** Mean Precipitation of Annual Maximum Values *(Millimeter)*
- P_{cx} Corrected Precipitation *(Millimeter)*
- P_m Extreme Rainfall Depth *(Millimeter)*
- P_r Average Echo Power
- P_x Original Recorded Precipitation *(Millimeter)*
- **PMP** Probable Maximum Precipitation *(Millimeter)*
- Q_p Peak Discharge *(Cubic Meter per Second)*
- Q_V Runoff Volume *(Cubic Meter)*
- **r** Distance to Target Volume *(Millimeter)*
- S_r Surface Runoff *(Cubic Meter per Second)*

Constants, Functions, Measurements used in list of Precipitation Formulas above

- Measurement: **Length** in Millimeter (mm), Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Hour (h)
  Time Unit Conversion
- Measurement: **Volume** in Cubic Meter (m^3)
  Volume Unit Conversion
- Measurement: **Area** in Square Meter (m^2)
  Area Unit Conversion
- Measurement: **Speed** in Centimeter per Hour (cm/h), Millimeter per Hour (mm/h)
  Speed Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m^3/s)
  Volumetric Flow Rate Unit Conversion

- T_r Return Period
- V Volume of Rainfall *(Cubic Meter)*
- x Coefficient x
- Z Radar-Echo Factor
- σ Standard Deviation

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