Important Rational Method to Estimate the Flood Peak Formulas PDF

Formulas
Examples
with Units

List of 20
Important Rational Method to Estimate the Flood Peak Formulas

1) Coefficient of Runoff when Peak Discharge for Field Application is Considered Formula

Evaluate Formula

Formula

$$C_r = \frac{Q_p}{\left(\frac{1}{3.6}\right) \cdot i_{tcp} \cdot A_D}$$

Example with Units

$$0.5 = \frac{4\,\text{m}^3/\text{s}}{\left(\frac{1}{3.6}\right) \cdot 5.76\,\text{mm/h} \cdot 18\,\text{km}^2}$$

2) Coefficient of Runoff when Peak Value is Considered Formula

Evaluate Formula

Formula

$$C_r = \frac{Q_p}{A_D \cdot i}$$

Example with Units

$$0.5 = \frac{4\,\text{m}^3/\text{s}}{18\,\text{km}^2 \cdot 1.6\,\text{mm/h}}$$

3) Drainage Area given Peak Discharge for Field Application Formula

Evaluate Formula

Formula

$$A_D = \frac{Q_p}{\left(\frac{1}{3.6}\right) \cdot i_{tcp} \cdot C_r}$$

Example with Units

$$18\,\text{km}^2 = \frac{4\,\text{m}^3/\text{s}}{\left(\frac{1}{3.6}\right) \cdot 5.76\,\text{mm/h} \cdot 0.5}$$

4) Drainage Area when Peak Discharge for Field Application is Considered Formula

Evaluate Formula

Formula

$$A_D = \frac{Q_p}{\left(\frac{1}{3.6}\right) \cdot i_{tcp} \cdot C_r}$$

Example with Units

$$18\,\text{km}^2 = \frac{4\,\text{m}^3/\text{s}}{\left(\frac{1}{3.6}\right) \cdot 5.76\,\text{mm/h} \cdot 0.5}$$

5) Drainage Area when Peak Discharge is Considered Formula

Evaluate Formula

Formula

$$A_D = \frac{Q_p}{i \cdot C_r}$$

Example with Units

$$18\,\text{km}^2 = \frac{4\,\text{m}^3/\text{s}}{1.6\,\text{mm/h} \cdot 0.5}$$

6) Intensity of Precipitation when Peak Discharge for Field Application is Considered Formula

Evaluate Formula

Formula

$$i_{tcp} = \frac{Q_p}{\left(\frac{1}{3.6}\right) \cdot C_r \cdot A_D}$$

Example with Units

$$5.76\,\text{mm/h} = \frac{4\,\text{m}^3/\text{s}}{\left(\frac{1}{3.6}\right) \cdot 0.5 \cdot 18\,\text{km}^2}$$

7) Intensity of Rainfall when Peak Discharge is Considered Formula

Evaluate Formula

Formula

$$i = \frac{Q_p}{C_r \cdot A_D}$$

Example with Units

$$1.6\,\text{mm/h} = \frac{4\,\text{m}^3/\text{s}}{0.5 \cdot 18\,\text{km}^2}$$

8) Peak Discharge Equation based on Field Application Formula

Evaluate Formula

Formula

$$Q_p = \left(\frac{1}{3.6}\right) \cdot C_r \cdot i_{tcp} \cdot A_D$$

Example with Units

$$4\,\text{m}^3/\text{s} = \left(\frac{1}{3.6}\right) \cdot 0.5 \cdot 5.76\,\text{mm/h} \cdot 18\,\text{km}^2$$

9) Peak Discharge for Field Application Formula

Evaluate Formula

Formula

$$Q_p = \left(\frac{1}{3.6}\right) \cdot C_r \cdot i_{tcp} \cdot A_D$$

Example with Units

$$4\,\text{m}^3/\text{s} = \left(\frac{1}{3.6}\right) \cdot 0.5 \cdot 5.76\,\text{mm/h} \cdot 18\,\text{km}^2$$

10) Peak value of runoff Formula

Evaluate Formula

Formula

$$Q_p = C_r \cdot A_D \cdot i$$

Example with Units

$$4\,\text{m}^3/\text{s} = 0.5 \cdot 18\,\text{km}^2 \cdot 1.6\,\text{mm/h}$$

11) Value of Peak Discharge Formula

Evaluate Formula

Formula

$$Q_p = C_r \cdot A_D \cdot i$$

Example with Units

$$4\,\text{m}^3/\text{s} = 0.5 \cdot 18\,\text{km}^2 \cdot 1.6\,\text{mm/h}$$

12) Kirpich Equation(1940) Formulas

12.1) Kirpich Adjustment Factor Formula

Evaluate Formula

Formula

$$K_1 = \sqrt[3]{\frac{L^3}{\Delta H}}$$

Example with Units

$$54772.2558 = \sqrt[3]{\frac{3\,\text{km}^3}{9\,\text{m}}}$$

12.2) Kirpich Equation Formula

Evaluate Formula

Formula

$$t_c = 0.01947 \cdot L^{0.77} \cdot S^{-0.385}$$

Example with Units

$$86.7077\,\text{s} = 0.01947 \cdot 3\,\text{km}^{0.77} \cdot 0.003^{-0.385}$$

12.3) Kirpich equation for Time of Concentration Formula

Evaluate Formula

Formula

$$t_c = 0.01947 \cdot \left(L^{0.77}\right) \cdot S^{-0.385}$$

Example with Units

$$86.7077\,\text{s} = 0.01947 \cdot \left(3\,\text{km}^{0.77}\right) \cdot 0.003^{-0.385}$$

12.4) Maximum Length of Travel of Water Formula

Evaluate Formula

Formula

$$L = \left(\frac{t_c}{0.01947 \cdot S^{-0.385}}\right)^{\frac{1}{0.77}}$$

Example with Units

$$3.0131\,\text{km} = \left(\frac{87\,\text{s}}{0.01947 \cdot 0.003^{-0.385}}\right)^{\frac{1}{0.77}}$$

12.5) Slope of Catchment about given Time of Concentration Formula

Evaluate Formula

Formula

$$S = \left(\frac{t_c}{0.01947 \cdot L^{0.77}}\right)^{-\frac{1}{0.385}}$$

Example with Units

$$0.003 = \left(\frac{87\,\text{s}}{0.01947 \cdot 3\,\text{km}^{0.77}}\right)^{-\frac{1}{0.385}}$$

12.6) Time of Concentration from Kirpich Adjustment Factor Formula

Evaluate Formula

Formula

$$t_c = 0.01947 \cdot K_1^{0.77}$$

Example with Units

$$86.7077\,\text{s} = 0.01947 \cdot 54772.26^{0.77}$$

13) US Practice Formulas

13.1) Basin Lag for Foot Hill Drainage Area Formula

Evaluate Formula

Formula

$$t_p = 1.03 \cdot \left(L_{basin} \cdot \frac{L_{ca}}{\sqrt{S_B}}\right)^{0.38}$$

Example with Units

$$6.0933\,\text{h} = 1.03 \cdot \left(9.4\,\text{km} \cdot \frac{12.0\,\text{km}}{\sqrt{1.1}}\right)^{0.38}$$

13.2) Basin Lag for Mountainous Drainage Areas Formula

Evaluate Formula

Formula

$$t_p = 1.715 \cdot \left(L_{basin} \cdot \frac{L_{ca}}{\sqrt{S_B}}\right)^{0.38}$$

Example with Units

$$10.1456\,\text{h} = 1.715 \cdot \left(9.4\,\text{km} \cdot \frac{12.0\,\text{km}}{\sqrt{1.1}}\right)^{0.38}$$

13.3) Basin Lag for Valley Drainage Areas Formula

Evaluate Formula

Formula

$$t_p = 0.5 \cdot \left(L_{basin} \cdot \frac{L_{ca}}{\sqrt{S_B}} \right)^{0.38}$$

Example with Units

$$2.9579\,\text{h} = 0.5 \cdot \left(9.4\,\text{km} \cdot \frac{12.0\,\text{km}}{\sqrt{1.1}} \right)^{0.38}$$

Variables used in list of Rational Method to Estimate the Flood Peak Formulas above

- A_D Drainage Area *(Square Kilometer)*
- C_r Runoff Coefficient
- i Intensity of Rainfall *(Millimeter per Hour)*
- i_{tcp} Mean Intensity of Precipitation *(Millimeter per Hour)*
- K_1 Kirpich Adjustment Factor
- L Maximum Length of Travel of Water *(Kilometer)*
- L_{basin} Basin Length *(Kilometer)*
- L_{ca} Distance along Main Water Course *(Kilometer)*
- Q_p Peak Discharge *(Cubic Meter per Second)*
- S Slope of Catchment
- S_B Basin Slope
- t_c Time of Concentration *(Second)*
- t_p Basin Lag *(Hour)*
- ΔH Difference in Elevation *(Meter)*

Constants, Functions, Measurements used in list of Rational Method to Estimate the Flood Peak Formulas above

- Functions: **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 Kilometer (km), Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Second (s), Hour (h)
  Time Unit Conversion
- Measurement: **Area** in Square Kilometer (km²)
  Area Unit Conversion
- Measurement: **Speed** in Millimeter per Hour (mm/h)
  Speed Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion

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