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Rational Method to Estimate the Flood Peak Formulas

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List of 20 Rational Method to Estimate the Flood Peak Formulas

Rational Method to Estimate the Flood Peak

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

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

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

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

2) Coefficient of Runoff when Peak Value is Considered

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

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

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



3) Drainage Area given Peak Discharge for Field Application

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

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

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

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

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

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

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

5) Drainage Area when Peak Discharge is Considered

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

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

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



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

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

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

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

7) Intensity of Rainfall when Peak Discharge is Considered

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

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

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

8) Peak Discharge Equation based on Field Application

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

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

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



9) Peak Discharge for Field Application

[Open Calculator !\[\]\(bd1a142de767a21e5362c595f844a4ff_img.jpg\)](#)

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

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

10) Peak value of runoff

[Open Calculator !\[\]\(830769b31eeeaca920791081939ff8ba_img.jpg\)](#)

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

$$ex \quad 4m^3/s = 0.5 \cdot 18km^2 \cdot 1.6mm/h$$

11) Value of Peak Discharge

[Open Calculator !\[\]\(47734e4656765d20df4fdbd5b7aff048_img.jpg\)](#)

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

$$ex \quad 4m^3/s = 0.5 \cdot 18km^2 \cdot 1.6mm/h$$

Kirpich Equation(1940)

12) Kirpich Adjustment Factor

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

$$fx \quad K_1 = \sqrt{\frac{L^3}{\Delta H}}$$

$$ex \quad 54772.26 = \sqrt{\frac{(3km)^3}{9m}}$$



13) Kirpich Equation

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

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

$$ex \quad 86.70769s = 0.01947 \cdot (3km)^{0.77} \cdot (0.003)^{-0.385}$$

14) Kirpich equation for Time of Concentration

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

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

$$ex \quad 86.70769s = 0.01947 \cdot ((3km)^{0.77}) \cdot (0.003)^{-0.385}$$

15) Maximum Length of Travel of Water

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

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

$$ex \quad 3.013141km = \left(\frac{87s}{0.01947 \cdot (0.003)^{-0.385}} \right)^{\frac{1}{0.77}}$$

16) Slope of Catchment about given Time of Concentration

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

[Open Calculator !\[\]\(5abce1a84a655b073239ab33e1199487_img.jpg\)](#)

$$ex \quad 0.002974 = \left(\frac{87s}{0.01947 \cdot (3km)^{0.77}} \right)^{-\frac{1}{0.385}}$$



17) Time of Concentration from Kirpich Adjustment Factor

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

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

$$\text{ex } 86.7077\text{s} = 0.01947 \cdot (54772.26)^{0.77}$$

US Practice

18) Basin Lag for Foot Hill Drainage Area

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

[Open Calculator !\[\]\(3cb60d42b10e53f9522bb0b392c1c4cd_img.jpg\)](#)

$$\text{ex } 6.093265\text{h} = 1.03 \cdot \left(9.4\text{km} \cdot \frac{12.0\text{km}}{\sqrt{1.1}} \right)^{0.38}$$

19) Basin Lag for Mountainous Drainage Areas

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

[Open Calculator !\[\]\(0d7ca0919e6c47bbd874bfa0189fe22e_img.jpg\)](#)

$$\text{ex } 10.14558\text{h} = 1.715 \cdot \left(9.4\text{km} \cdot \frac{12.0\text{km}}{\sqrt{1.1}} \right)^{0.38}$$



20) Basin Lag for Valley Drainage Areas

[Open Calculator !\[\]\(3d8c13c92b853674f749aac6fa869926_img.jpg\)](#)

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

$$\text{ex } 2.957896\text{h} = 0.5 \cdot \left(9.4\text{km} \cdot \frac{12.0\text{km}}{\sqrt{1.1}} \right)^{0.38}$$



Variables Used

- 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

- **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 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 



Check other formula lists

- **Empirical Formulae for Flood-Peak Area Relationships Formulas** 
- **Gumbel's Method for Prediction of Flood's Peak Formulas** 
- **Rational Method to Estimate the Flood Peak Formulas** 
- **Risk, Reliability and Log-Pearson Distribution Formulas** 

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