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Synder's Synthetic- Unit Hydrograph Formulas

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List of 34 Synder's Synthetic- Unit Hydrograph Formulas

Synder's Synthetic- Unit Hydrograph

1) Basin Lag given Modified Basin Lag

Open Calculator

fx $$t_p = \frac{t'_p - \left(\frac{t_R}{4}\right)}{\frac{21}{22}}$$

ex $$5.992381\text{h} = \frac{6.22\text{h} - \left(\frac{2\text{h}}{4}\right)}{\frac{21}{22}}$$

2) Basin Lag given Modified Basin Lag for Effective Duration

Open Calculator

fx $$t_p = \frac{4 \cdot t'_p + t_r - t_R}{4}$$

ex $$6.22\text{h} = \frac{4 \cdot 6.22\text{h} + 2\text{h} - 2\text{h}}{4}$$

3) Basin Lag given Peak Discharge

Open Calculator

fx $$t_p = 2.78 \cdot C_p \cdot \frac{A}{Q_p}$$

ex $$5.616162\text{h} = 2.78 \cdot 0.6 \cdot \frac{3.00\text{km}^2}{0.891\text{m}^3/\text{s}}$$

4) Basin Lag given Standard Duration of Effective Rainfall

Open Calculator

fx $t_p = 5.5 \cdot t_r$

ex $11\text{h} = 5.5 \cdot 2\text{h}$

5) Basin Length Measured along Water Course given Basin Lag

Open Calculator

fx $L_{basin} = \frac{\left(\frac{t_p}{C_r}\right)^1}{0.3} \cdot \left(\frac{1}{L_{ca}}\right)$

ex $1.141553\text{km} = \frac{\left(\frac{6\text{h}}{1.46}\right)^1}{0.3} \cdot \left(\frac{1}{12.0\text{km}}\right)$

6) Basin Length Measured along Water Course given Modified Equation for Basin Lag

Open Calculator

fx $L_{basin} = \left(\frac{t_p}{C_{rL}}\right)^{\frac{1}{n_B}} \cdot \left(\frac{\sqrt{S_B}}{L_{ca}}\right)$

ex $9.026084\text{km} = \left(\frac{6\text{h}}{1.03}\right)^{\frac{1}{0.38}} \cdot \left(\frac{\sqrt{1.1}}{12.0\text{km}}\right)$

7) Basin Slope given Basin Lag

Open Calculator

$$S_B = \left(\frac{L_{basin} \cdot L_{ca}}{\left(\frac{t_p}{C_{rL}} \right)^{\frac{1}{n_B}}} \right)^2$$

$$1.193025 = \left(\frac{9.4\text{km} \cdot 12.0\text{km}}{\left(\frac{6\text{h}}{1.03} \right)^{\frac{1}{0.38}}} \right)^2$$

8) Catchment Area given Peak Discharge for Nonstandard Effective Rainfall

Open Calculator

$$A = Q_p \cdot \frac{t'_p}{2.78 \cdot C_r}$$

$$1.365433\text{km}^2 = 0.891\text{m}^3/\text{s} \cdot \frac{6.22\text{h}}{2.78 \cdot 1.46}$$

9) Catchment Area given Peak Discharge of Unit Hydrograph

Open Calculator

$$A = Q_p \cdot \frac{t_p}{2.78 \cdot C_p}$$

$$3.205036\text{km}^2 = 0.891\text{m}^3/\text{s} \cdot \frac{6\text{h}}{2.78 \cdot 0.6}$$

10) Distance along Main Water Course from Gauging Station given Basin Lag

Open Calculator

fx $$L_{ca} = \left(\left(\frac{t_p}{C_r}\right)^{\frac{1}{0.3}}\right) \cdot \left(\frac{1}{L_{basin}}\right)$$

ex $$11.82679\text{km} = \left(\left(\frac{6\text{h}}{1.46}\right)^{\frac{1}{0.3}}\right) \cdot \left(\frac{1}{9.4\text{km}}\right)$$

11) Distance along Main Water Course from Gauging Station to Watershed

Open Calculator

fx $$L_{ca} = \frac{\left(\frac{t_p}{C_{rL}} / \left(\frac{L_b}{\sqrt{S_B}}\right)^{n} - \{B\}\right)^{1}}{n_B}$$

ex $$15.43091\text{km} = \frac{\left(\frac{6\text{h}}{1.03} / \left(\frac{30\text{m}}{\sqrt{1.1}}\right)^{0.38}\right)^{1}}{0.38}$$

12) Equation for Catchment Parameter

Open Calculator

fx $$C = L_b \cdot \frac{L}{\sqrt{S_B}}$$

ex $$1430.194 = 30\text{m} \cdot \frac{50\text{m}}{\sqrt{1.1}}$$

13) Modified Basin Lag for Effective Duration

Open Calculator

fx $$t'_p = \left(21 \cdot \frac{t_p}{22}\right) + \left(\frac{t_R}{4}\right)$$

ex $$6.227273\text{h} = \left(21 \cdot \frac{6\text{h}}{22}\right) + \left(\frac{2\text{h}}{4}\right)$$

14) Modified Basin Lag given Peak Discharge for Nonstandard Effective Rainfall

Open Calculator

fx $$t'_p = 2.78 \cdot C_r \cdot \frac{A}{Q_p}$$

ex $$0.003796\text{h} = 2.78 \cdot 1.46 \cdot \frac{3.00\text{km}^2}{0.891\text{m}^3/\text{s}}$$

15) Modified Basin Lag given Time Base

Open Calculator

fx $$t'_p = \frac{t_b - 72}{3}$$

ex $$6\text{h} = \frac{90\text{h} - 72}{3}$$

16) Modified Equation for Basin Lag

Open Calculator

$$t_p = C_{rL} \cdot \left(L_b \cdot \frac{L_{ca}}{\sqrt{S_B}} \right)^n - \{B\}$$

$$0.036313\text{h} = 1.03 \cdot \left(30\text{m} \cdot \frac{12.0\text{km}}{\sqrt{1.1}} \right)^{0.38}$$

17) Modified Equation for Basin Lag for Effective Duration

Open Calculator

$$t'_p = t_p + \frac{t_R - t_r}{4}$$

$$6\text{h} = 6\text{h} + \frac{2\text{h} - 2\text{h}}{4}$$

18) Non-Standard Rainfall Duration given Modified Basin Lag

Open Calculator

$$t_R = \left(t'_p - \left(\frac{21}{22} \right) \cdot t_p \right) \cdot 4$$

$$1.970909\text{h} = \left(6.22\text{h} - \left(\frac{21}{22} \right) \cdot 6\text{h} \right) \cdot 4$$

19) Peak Discharge for Nonstandard Effective Rainfall

Open Calculator

$$Q_p = 2.78 \cdot C_p \cdot \frac{A}{t'_p}$$

$$0.804502\text{m}^3/\text{s} = 2.78 \cdot 0.6 \cdot \frac{3.00\text{km}^2}{6.22\text{h}}$$

20) Peak Discharge per Unit Catchment Area

Open Calculator

fx $$Q = \frac{Q_p}{A_{catchment}}$$

ex $$0.4455 m^3/s = \frac{0.891 m^3/s}{2.0 m^2}$$

21) Peak discharge per unit Catchment Area given Unit Hydrograph Width at 50 percent Peak Discharge

Open Calculator

fx $$Q = \left(\frac{5.87}{W_{50}}\right)^{\frac{1}{1.08}}$$

ex $$2.987711 m^3/s = \left(\frac{5.87}{1.8 mm}\right)^{\frac{1}{1.08}}$$

22) Regional Constant given Peak Discharge

Open Calculator

fx $$C_r = Q_p \cdot \frac{t_p}{2.78} \cdot A_{catchment}$$

ex $$3.846043 = 0.891 m^3/s \cdot \frac{6 h}{2.78} \cdot 2.0 m^2$$

23) Regional Constant given Peak Discharge for Nonstandard Effective Rainfall

Open Calculator

fx $$C_p = Q_p \cdot \frac{t'_p}{2.78 \cdot A}$$

ex $$0.664511 = 0.891\text{m}^3/\text{s} \cdot \frac{6.22\text{h}}{2.78 \cdot 3.00\text{km}^2}$$

24) Regional Constant representing Watershed Slope and Storage Effects

Open Calculator

fx $$C_r = \frac{t_p}{(L_b \cdot L_{ca})^{0.3}}$$

ex $$0.129199 = \frac{6\text{h}}{(30\text{m} \cdot 12.0\text{km})^{0.3}}$$

25) Snyder's Equation

Open Calculator

fx $$t_p = C_r \cdot (L_b \cdot L_{ca})^{0.3}$$

ex $$1.074592\text{h} = 1.46 \cdot (30\text{m} \cdot 12.0\text{km})^{0.3}$$

26) Snyder's Equation for Peak Discharge

Open Calculator

fx $$Q_p = 2.78 \cdot C_p \cdot \frac{A}{t_p}$$

ex $$0.834\text{m}^3/\text{s} = 2.78 \cdot 0.6 \cdot \frac{3.00\text{km}^2}{6\text{h}}$$

27) Snyder's Equation for Standard Duration of Effective Rainfall

Open Calculator

fx $t_r = \frac{t_p}{5.5}$

ex $1.090909\text{h} = \frac{6\text{h}}{5.5}$

28) Snyder's Equation for Time Base

Open Calculator

fx $t_b = (72 + 3 \cdot t'_p)$

ex $90.66\text{h} = (72 + 3 \cdot 6.22\text{h})$

29) Standard Duration of Effective Rainfall given Modified Basin Lag

Open Calculator

fx $t_r = t_R - 4 \cdot (t'_p - t_p)$

ex $1.12\text{h} = 2\text{h} - 4 \cdot (6.22\text{h} - 6\text{h})$

30) Standard Effective Duration given Modified Basin Lag

Open Calculator

fx $t_r = -(4 \cdot (t'_p - t_p) - t_R)$

ex $1.12\text{h} = -(4 \cdot (6.22\text{h} - 6\text{h}) - 2\text{h})$

31) Taylor and Schwartz Equation for Time Base

Open Calculator

fx $$t_b = 5 \cdot \left(t'_p + \frac{t_R}{2} \right)$$

ex $$36.1\text{h} = 5 \cdot \left(6.22\text{h} + \frac{2\text{h}}{2} \right)$$

32) Width of Unit Hydrograph at 50 percent Peak Discharge

Open Calculator

fx $$W_{50} = \frac{5.87}{Q^{1.08}}$$

ex $$1.792038\text{mm} = \frac{5.87}{(3.0\text{m}^3/\text{s})^{1.08}}$$

33) Width of Unit Hydrograph at 50 percent Peak Discharge given 75 percent Discharge

Open Calculator

fx $$W_{50} = W_{75} \cdot 1.75$$

ex $$1.785\text{mm} = 1.02\text{mm} \cdot 1.75$$

34) Width of Unit Hydrograph at 75 percent Peak Discharge

Open Calculator

fx $$W_{75} = \frac{W_{50}}{1.75}$$

ex $$1.028571\text{mm} = \frac{1.8\text{mm}}{1.75}$$

Variables Used

- **A** Area of Catchment *(Square Kilometer)*
- **$A_{catchment}$** Catchment Area *(Square Meter)*
- **C** Catchment Parameter
- **C_p** Regional Constant (Snyder)
- **C_r** Regional Constant
- **C_{rL}** Basin Constant
- **L** Watershed Length *(Meter)*
- **L_b** Length of Basin *(Meter)*
- **L_{basin}** Basin Length *(Kilometer)*
- **L_{ca}** Distance along Main Water Course *(Kilometer)*
- **n_B** Basin Constant 'n'
- **Q** Discharge *(Cubic Meter per Second)*
- **Q_p** Peak Discharge *(Cubic Meter per Second)*
- **S_B** Basin Slope
- **t_b** Time Base *(Hour)*
- **t_p** Basin Lag *(Hour)*
- **t'_p** Modified Basin Lag *(Hour)*
- **t_r** Standard Duration of Effective Rainfall *(Hour)*
- **t_R** Non-standard rainfall duration *(Hour)*
- **W_{50}** Width of Unit Hydrograph at 50% Peak Discharge *(Millimeter)*
- **W_{75}** Width of Unit Hydrograph at 75% Peak Discharge *(Millimeter)*

Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Kilometer (km), Meter (m), Millimeter (mm)
  Length Unit Conversion
- Measurement: **Time** in Hour (h)
  Time Unit Conversion
- Measurement: **Area** in Square Kilometer (km²), Square Meter (m²)
  Area Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion

Check other formula lists

- **SCS Triangular Unit Hydrograph Formulas**
- **Synder's Synthetic- Unit Hydrograph Formulas**
- **The Indian Practice Formulas**

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