Detention Storage Volume (Modified Rational Method)

Storage volume of a detention pond or tank so that outflow is limited to a set rate, by the modified rational method over the critical storm duration.

Method: Modified rational method V = Q_i t_d − ½Q_o(t_d + t_c) (FHWA HEC-22 practice); intensity curve i = a/(t + b)^n

Input parameters

Unit system: SI

Parameter	Value	Unit
Runoff coefficient	80.000	%
Catchment area	5.0000	ha
Time of concentration	10.000	min
Allowed outflow	0.25000	m³/s
Rainfall curve i = a/(t + b)^n: a (mm/h with t in min)	3,000.0	
b (minutes)	20.000	
n	0.80000	

Calculated results

Parameter	Value	Unit
Critical storm duration	194.28	min
Intensity at the critical duration	40.958	mm/h
Peak inflow C i A	0.45509	m³/s
Storage volume needed	3,772.7	m³

Notes for this case

- The rainfall constants a, b and n come from your local intensity–duration–frequency curve for the chosen return period.

Formula and method

$$V(t_d) = C\,i(t_d)\,A\,t_d - \frac{Q_o(t_d + t_c)}{2}, \quad i = \frac{a}{(t+b)^n}, \quad V = \max_{t_d} V(t_d)$$

Variables

C	Runoff coefficient	-
A	Catchment area	m²
t_c	Time of concentration	s
Q_o	Allowed outflow	m³/s
a	Rainfall curve i = a/(t + b)^n: a (mm/h with t in min)	-
b	b (minutes)	-
n	n	-
t_d	Critical storm duration	s
i	Intensity at the critical duration	m/s
Q_i	Peak inflow C i A	m³/s
V	Storage volume needed	m³

Method and standards

Modified rational method.

Assumptions and limits

- Small catchments, linear outflow rise.
- Durations from t_c to 24 h are searched; a maximum at the 24-hour limit is flagged as a lower bound.

References

- Modified rational method V = Q_i t_d − ½Q_o(t_d + t_c) (FHWA HEC-22 practice); intensity curve i = a/(t + b)^n

Report details

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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/civil/hydraulics/detention-storage-modified-rational

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.