φ-Index and W-Index from a Storm Hyetograph

φ-index (constant loss rate giving the observed runoff) and W-index of a storm from six interval rainfall depths and the measured direct runoff depth.

Method: Classical engineering hydrology relations

Input parameters

Unit system: SI

Parameter	Value	Unit
Interval length	1.0000	h
Rainfall, interval 1	4.0000	mm
Rainfall, interval 2	9.0000	mm
Rainfall, interval 3	15.000	mm
Rainfall, interval 4	12.000	mm
Rainfall, interval 5	7.0000	mm
Rainfall, interval 6	3.0000	mm
Direct runoff depth	25.000	mm

Calculated results

Parameter	Value	Unit
Total rainfall	50.000	mm
φ-index	4.5000	mm/h
W-index (average loss rate)	4.1667	mm/h
Losses	25.000	mm

Notes for this case

• The φ-index is the constant loss rate above which all rainfall becomes runoff: the rainfall in each interval in excess of φ·Δt, summed, equals the observed direct runoff. Intervals with less rain than φ·Δt contribute nothing. The W-index spreads the total loss over the whole storm duration and is lower. Both lump infiltration, interception and depression storage; they vary from storm to storm and with antecedent moisture.

Formula and method

$$\sum_i \max(0,\ P_i - \phi\,\Delta t) = R, \quad W = \frac{P - R}{t}$$

Variables

Δt	Interval length	s
P_1	Rainfall, interval 1	m
P_2	Rainfall, interval 2	m
P_3	Rainfall, interval 3	m
P_4	Rainfall, interval 4	m
P_5	Rainfall, interval 5	m
P_6	Rainfall, interval 6	m
R	Direct runoff depth	m
P	Total rainfall	m
ϕ	φ-index	m/s
W	W-index (average loss rate)	m/s

$P - R$	Losses	m

Method and standards

φ-index.

Assumptions and limits

- Constant loss rate through the storm.

References

Classical engineering hydrology relations

Report details

Report reference	FCC-111V-C8KP (the same inputs always give the same reference)
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Release checks	3 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/phi-index-infiltration

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.