Queue Length and Delay at a Signal (Deterministic)

Maximum queue, queue clearance time, average delay and the share of vehicles stopped at a fixed-time signal approach by the deterministic D/D/1 queuing model.

Method: Deterministic (D/D/1) queuing at a fixed-time signal

Input parameters

Unit system: SI

Parameter	Value	Unit
Arrival flow (vehicles per hour)	600.00	
Saturation flow (vehicles per hour of green)	1,800.0	
Cycle length	80.000	s
Effective green	35.000	s
Average space per queued vehicle	7.0000	m

Calculated results

Parameter	Value	Unit
Effective red C − g	45.000	s
Maximum queue (vehicles)	7.5000	
Maximum queue length	52.500	m
Time to clear the queue after green starts	22.500	s
Average delay per vehicle	18.984	s
Degree of saturation qC/(sg)	0.76190	
Share of vehicles stopped	84.375	%

Notes for this case

• Deterministic queuing: uniform arrivals and departures at saturation flow. Random arrivals add overflow delay as X approaches 1 (Webster's second term), so real delays are higher.

Formula and method

$$Q_{max} = qr, \quad t_0 = \frac{qr}{s-q}, \quad \bar{d} = \frac{r^2}{2C(1-q/s)}, \quad X = \frac{qC}{sg}$$

Variables

q	Arrival flow (vehicles per hour)	-
s	Saturation flow (vehicles per hour of green)	-
C	Cycle length	s
g	Effective green	s
l_v	Average space per queued vehicle	m
r	Effective red C − g	s
Q_{max}	Maximum queue (vehicles)	-
L_q	Maximum queue length	m
t_0	Time to clear the queue after green starts	s
$\bar{d}$	Average delay per vehicle	s
X	Degree of saturation qC/(sg)	-
P_s	Share of vehicles stopped	-

Method and standards

Deterministic queuing at signals.

Assumptions and limits

- Uniform arrivals, undersaturated approach.

References

Deterministic (D/D/1) queuing at a fixed-time signal

Report details

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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/roads/signal-queue-length

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.