**NCTCOG volume delay function**

**General form:**

where:

: loaded travel time;

: free flow travel time;

: Conical congestion delay;

: Signal delay;

: Un-signalized delay.

**Conical delay:**

where:

: volume capacity ratio

VDF shift

**Signal delay:**

Signal delay is developed based on Webster’s delay function, but only consider the first term – uniform delay.

where:

red time;

: cycle length;

: volume;

adjusted saturation flow rate,

SPar, signalized parameter, it equals .

To calculate the signal delay, it needs to know the red time and cycle length of the signal intersection. This information is generally unknown, so they are estimated by formula.

The basic form of signal delay is not differentiable due to the “max” term. To make the delay function satisfy the mathematical property (continuously increasing function, and continuously differentiable), it is modified as follows.

|  |  |
| --- | --- |
|  | if |
|  | if |
| Interpolated by a polynomial function such that it is continuously increasing and continuously differentiable. The interpolation is as follows: | if |

**Un-signalized delay (the unit is minute):**

for yield sign and four-way stop sign;

for two-way stop sign.

where:

number of inbound links;

number of outbound links;

number of two-way links;

capacity,

Min\_delay: it equals 10/60.