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Discussion paper on Calculation of necessary safety distance for safe lane change manoeuvre, ACSF-C.

To ensure that the lane-change manoeuvre can be carried out in a safe manner two terms need to be fulfilled, a safe TimeHeadway (TH) and a minimum Time-to-Collision (TTC).

Time Headway is the time from when Vehicle 1 exists a certain point and until Vehicle 2 arrives at that point.

Time-to-collision is the time until, if nothing happens, a collision will occur.

These two safety measures are dynamic, meaning that they are applicable at any speed.

To determine the values of the TH and TTC a worst case scenario is used. The scenario is that the Subject Vehicle (SV) is doing 80km/h and is about to make a lane change. Behind the Subject Vehicle a Primary Other Vehicle (POV) is driving in the other lane (to which the SV is about to change into), doing 120km/h.

Maximum deceleration rate for the POV is set to 4m/s². Comfort brake level is often regarded to be approx 3-3.5m/s², somewhat harder braking (4m/s²) could be accepted if necessary to avoid accidents (used in this calculation).

Determine Time-to-Collision (TTC):

$$V_{SV} = 80 \text{ km/h} = 22.2 \text{ m/s}$$

$$V_{POV} = 120 \text{ km/h} = 33.3 \text{ m/s}$$

$$\Delta V = V_{POV} - V_{SV} = 33.3 - 22.2 = 11.1 \text{ m/s.}$$

$$TTC = \frac{\Delta V}{decel_{max}} = \frac{11.1}{4} = 2.75 \text{ s}$$

Determine Time Headway (TH):

$$TH = \frac{Distance_{headway}}{V_{POV}} = \frac{TTC * \Delta V}{V_{POV}} = \frac{2.75 * 11.1}{22.2} = 1.375 \text{ s.}$$

Approximation of TTC and TH

Determine safety distance using TTC and TH on different Delta V cases:

Safety distance is calculated by multiplying the Time Headway (TH) with the speed of the oncoming vehicle from behind, Vpov .

$$Example : 1,375 \times 33.3 = 45,8 \text{ m}$$

Safety distance

