



Safety Distance to the front

ACSF IWG 19th meeting
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Korea Automobile Testing & Research Institute

Safety Distance to the front

5.6.3.2.x Safety distance to the front

The distance to a vehicle in front is deemed to be critical when the distance the ACSF vehicle travels in [x.x] seconds is greater than the distance to the vehicle in front.

The critical distance shall be calculated using the following formula:

$$S_{Critical-Front} = v_{ACSF} \times t_{front}$$

Where: v_{ACSF} : the actual speed of the ACSF vehicle [m/s]

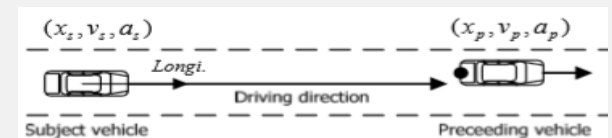
t_{front} : time gap of [x.x] seconds between the ACSF vehicle and the lead vehicle

● Road traffic Act, paragraph 1 of Article 19, of Republic of Korea

“Driver shall control vehicle speed to prevent collision with other road user in front when another road user suddenly stopped”

● Considerations to determine Safety distance

- Human driving data in following situation for acceptance of driver to clearance
- Braking distance to avoid collision in view of physics

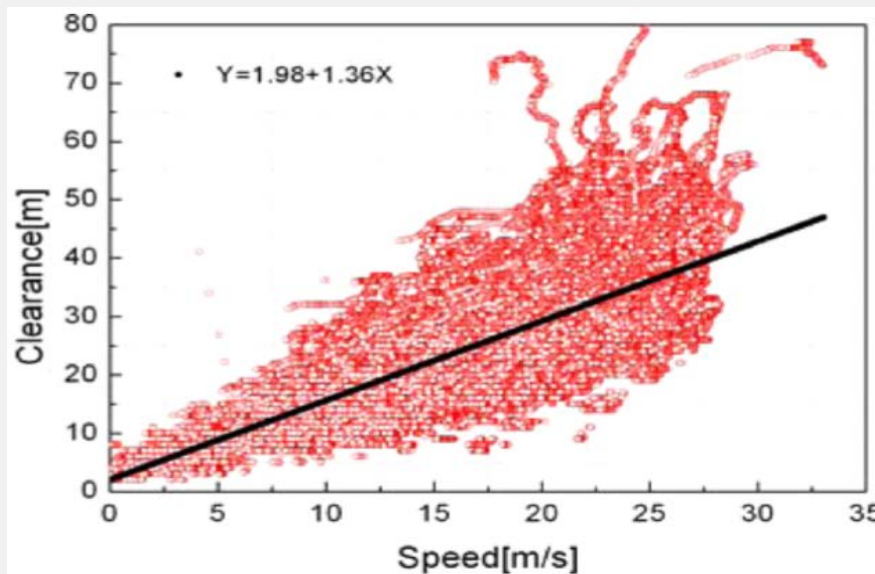




Human Driving Data (125 drivers) - Motorway

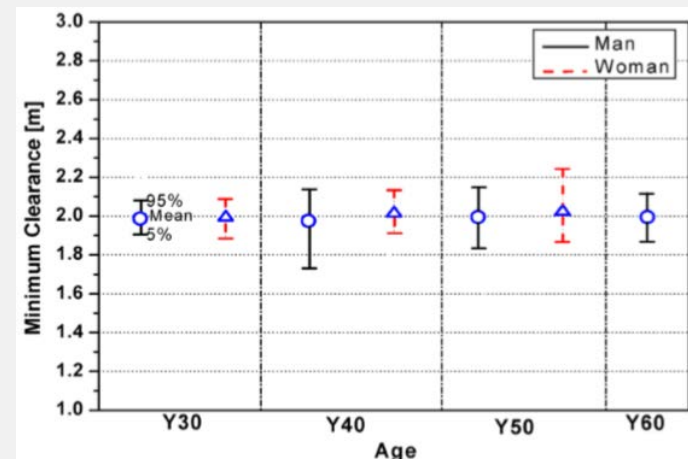
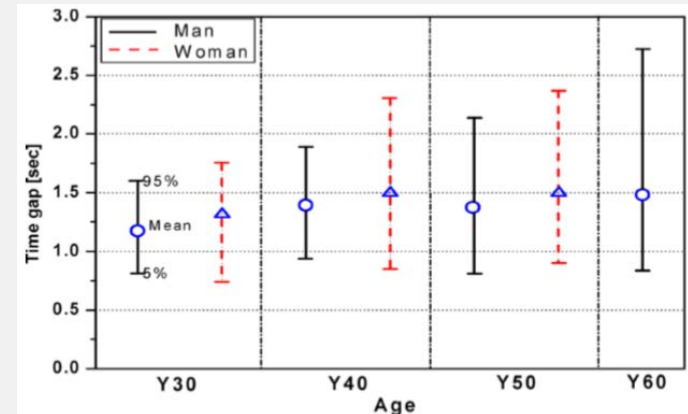
- Steady-state following data collected from 125 driver test data and the linear regression

➤ Age : 25 ~ 69 years old / Male : Female = 70 : 55(persons)



➤ Human driver's steady following clearance could be well represented by a first-order regression as follows :

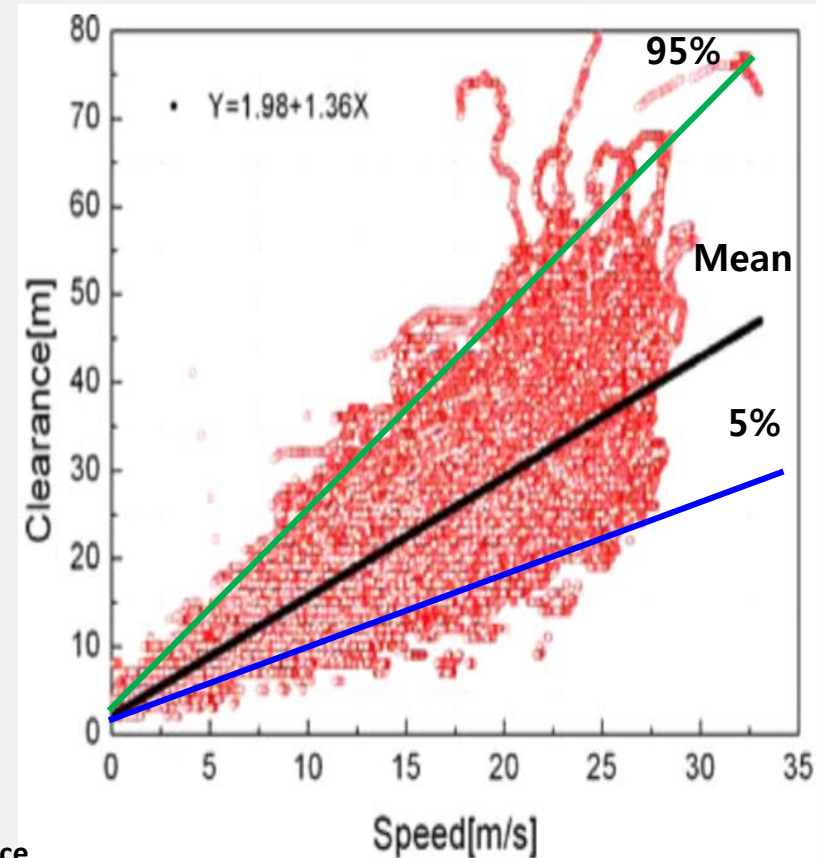
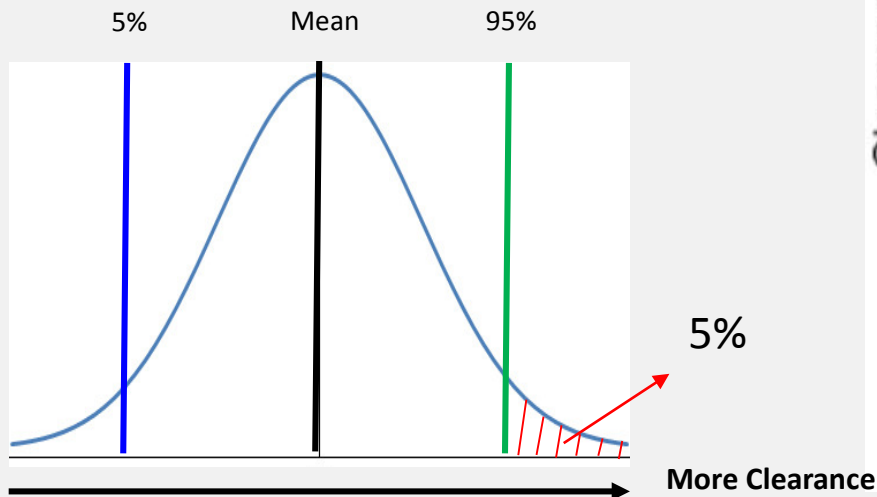
$$C_{following} = v_x \times \underset{\substack{\downarrow \\ \text{Time Gap}}}{\tau} + \underset{\substack{\downarrow \\ \text{Minimum Clearance}}}{c_0}$$



Human Driving Data (125 drivers) - Motorway

➤ Linear coefficient of the Time Gap

Index-Percentile	5%	Mean	95%
Linear coefficient [s]	0.7	1.4	2.3





Braking Distance

- Analysis of physical behavior for collision avoidance

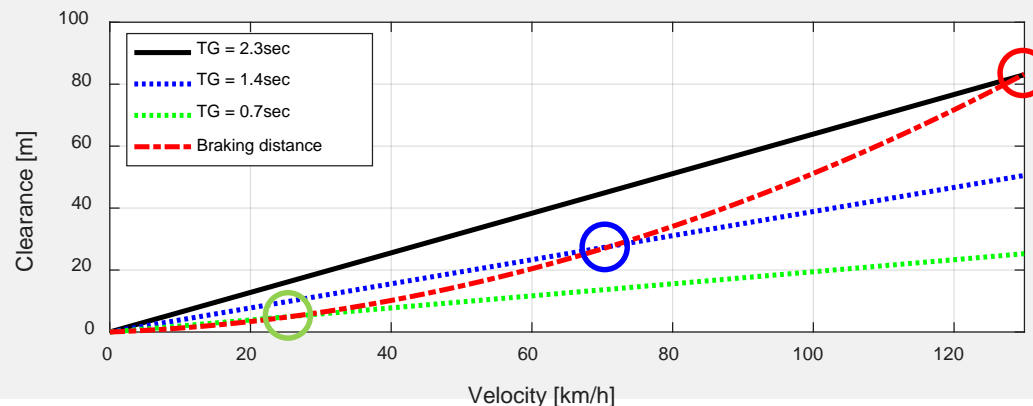
- The way for collision avoidance : Braking

- Braking distance (d_{brake})

- A situation where velocity of front vehicle suddenly reaches zero, that is, successive collision, is considered
- System delay (t_{sys}) = 0.3sec
- Maximum deceleration ($a_{x,max}$) = $-9m/s^2$

$$d_{brake} = (t_{sys} - v_x / 2a_{x,max}) \times v_x$$

- Clearance by TG 2.3 sec is higher than braking distance in operating velocity (0~130km/h)





Conclusion

- Safety distance in front

$$S_{Critical-Front} = v_{ACSF} \times t_{front}$$

Where: v_{ACSF} : the actual speed of the ACSF vehicle [m/s]

t_{front} : time gap of [x.x] seconds between the ACSF vehicle and the lead vehicle

- Time gap of [x.x] seconds between the ACSF vehicle and the lead vehicle

- Human driving data in following situation for acceptance of driver to clearance
- Braking distance to avoid collision in view of physics

➔ $t_{front} = 2.3 \text{ sec}$ (proposed time gap)