Ministry of Land, Infrastructure and Transport

Korea Automobile Testing & Research Institute

Submitted by the Republic of Korea

Informal Document - ACSF-22-09

Minimum Safety Distance to the front

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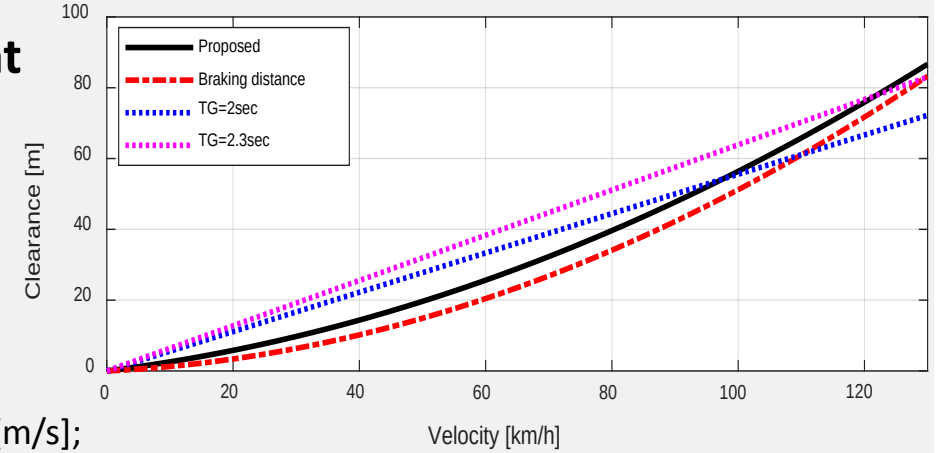
Time Gap proposed in last session

- **Minimum Safety Distance in front**

$$S = V_{ALKS} \times t_{front}$$



Where :

V_{LKLC} : the actual speed of the ALKS vehicle in [m/s];

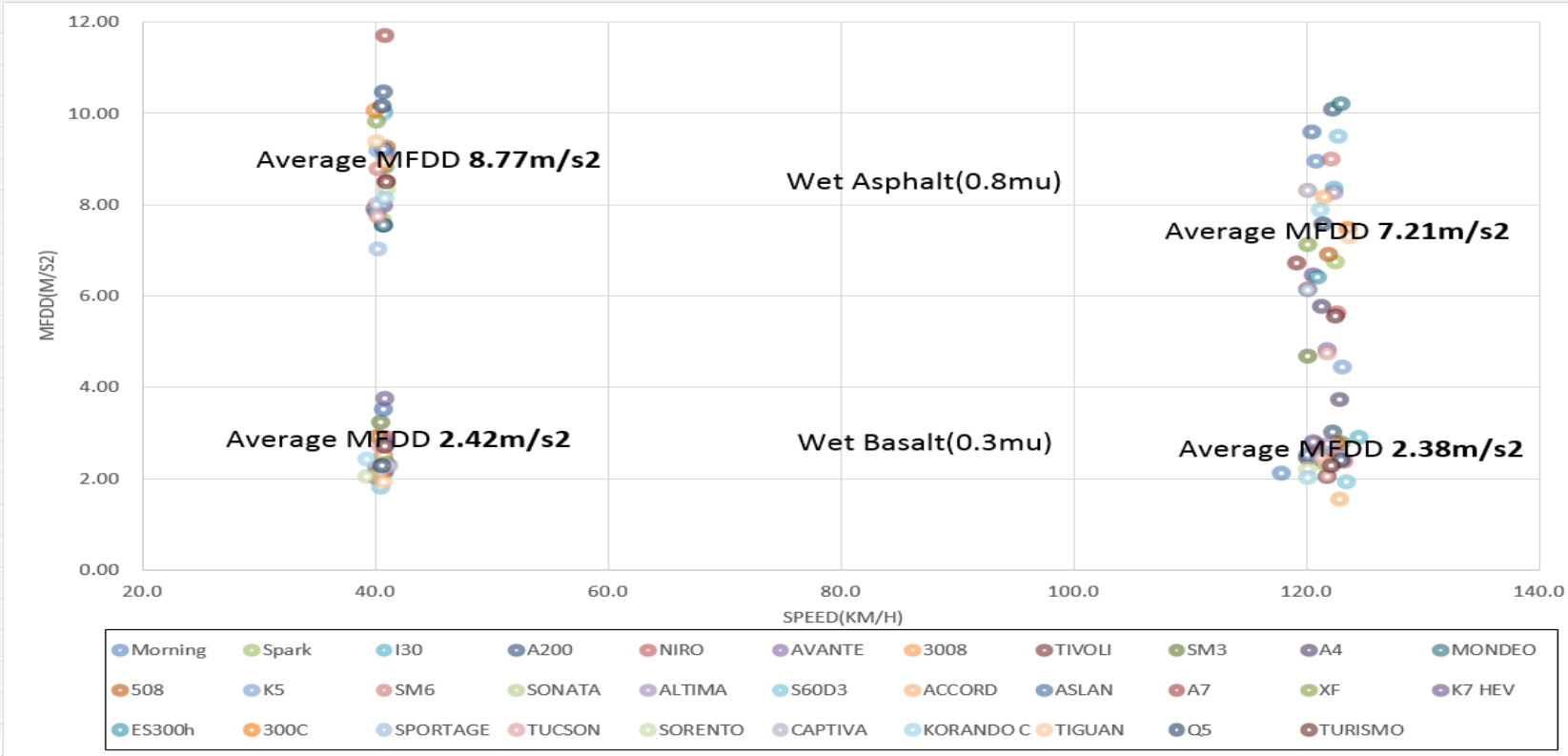
t_{front} : time gap between the LKLC vehicle and the leading vehicle in front in [second] = $0.8 + \frac{1.6 v_{LKLC}}{36.1}$

- **Comment from 20th session**

- Concern for too high deceleration($9m/s^2$)
- Taking Korean proposal(ACSF-20-08) with appropriate deceleration rate into account

New Approach for appropriate deceleration

- **Using deceleration data from the state of the art vehicle** (MY 2016 to 2018)
  - UN Reg. R13-H ABS Test(Additional Check)
  - 32 vehicle model, GVWR, 40km/h and 120km/h, 0.8μ / 0.3μ



Appropriate Deceleration

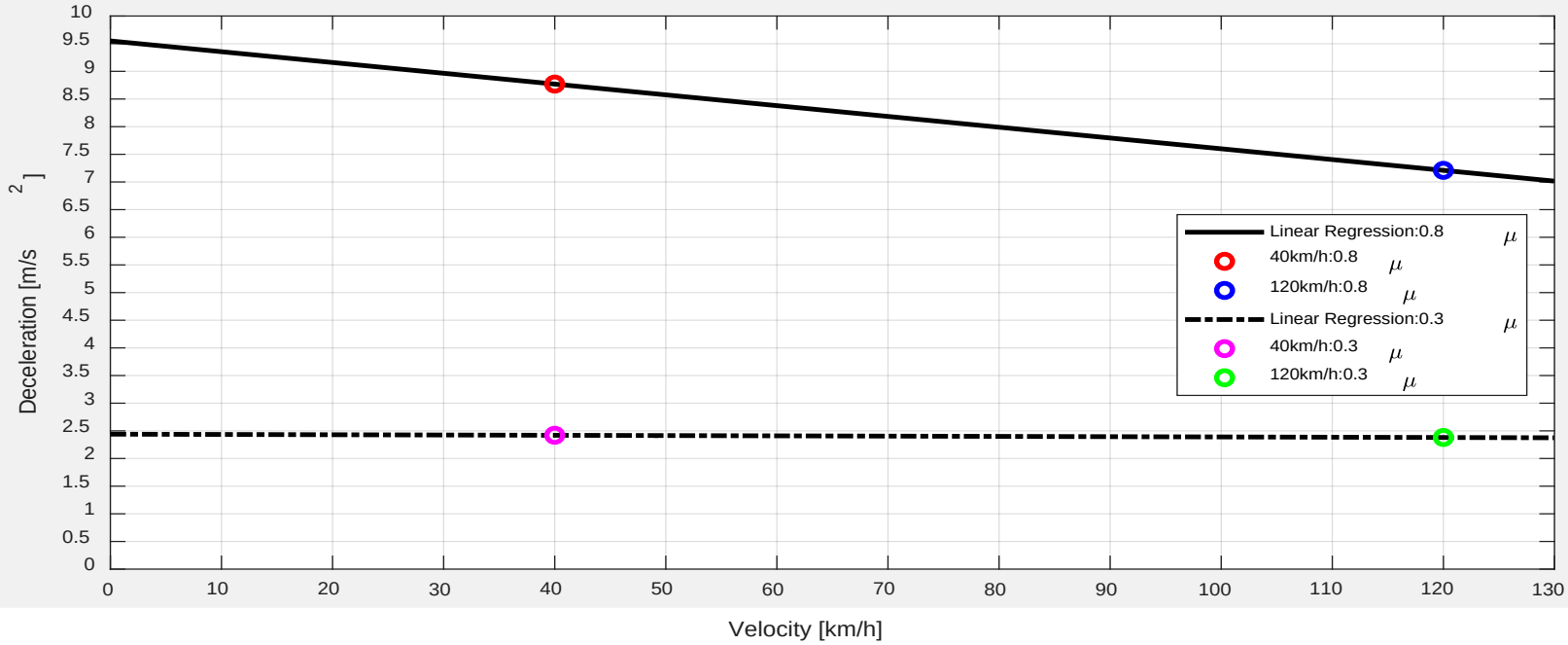
- **Deceleration ($a_{x,max}$) formulas by road condition(wet asphalt, wet basalt)**
  - Avg. MFDD deceleration ($a_{x,max}$) at 40km/h and 120km/h (0.8μ)= $8.77m/s^2$ and $7.21m/s^2$

$$a_{x0.8\mu}(v_x) = -0.0702 \times v_x + 9.55$$

  - Avg. MFDD deceleration ($a_{x,max}$) at 40km/h and 120km/h (0.3μ)= $2.42m/s^2$ and $2.38m/s^2$

$$a_{x0.3\mu}(v_x) = -0.0018 \times v_x + 2.44$$

  - Linear Decelerations by velocity

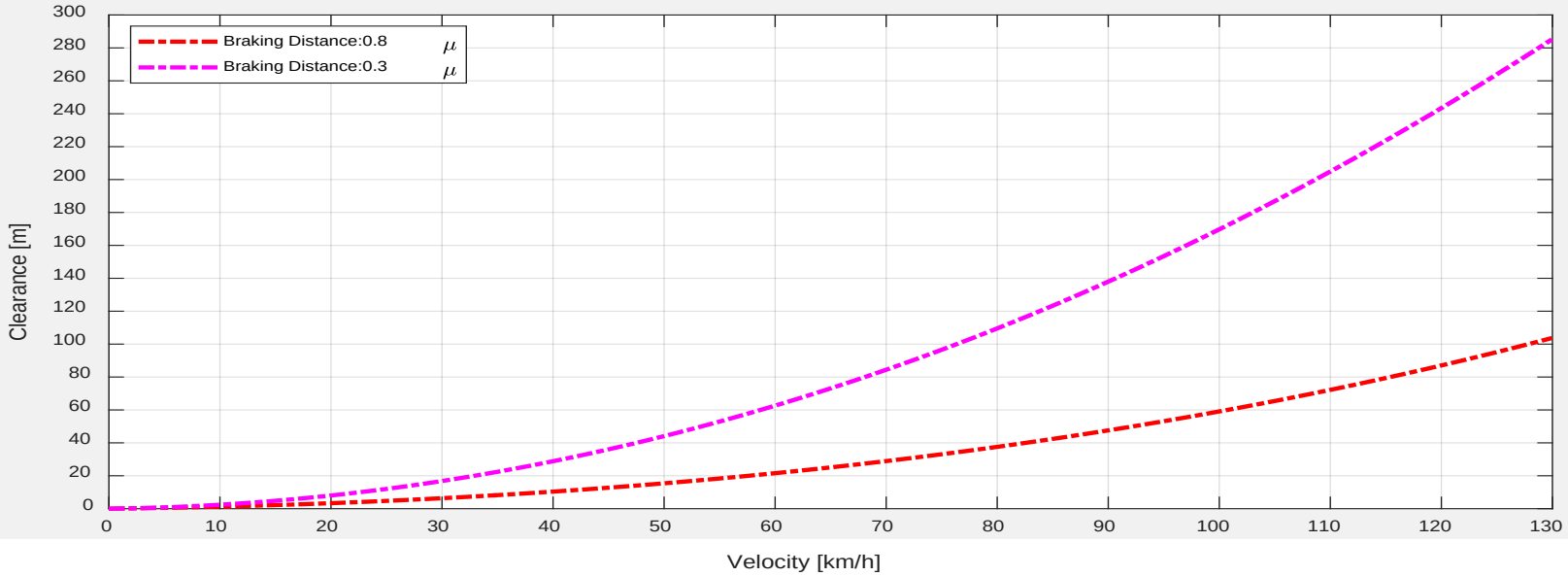


Braking Distance

- **Braking distance (d_{brake})**

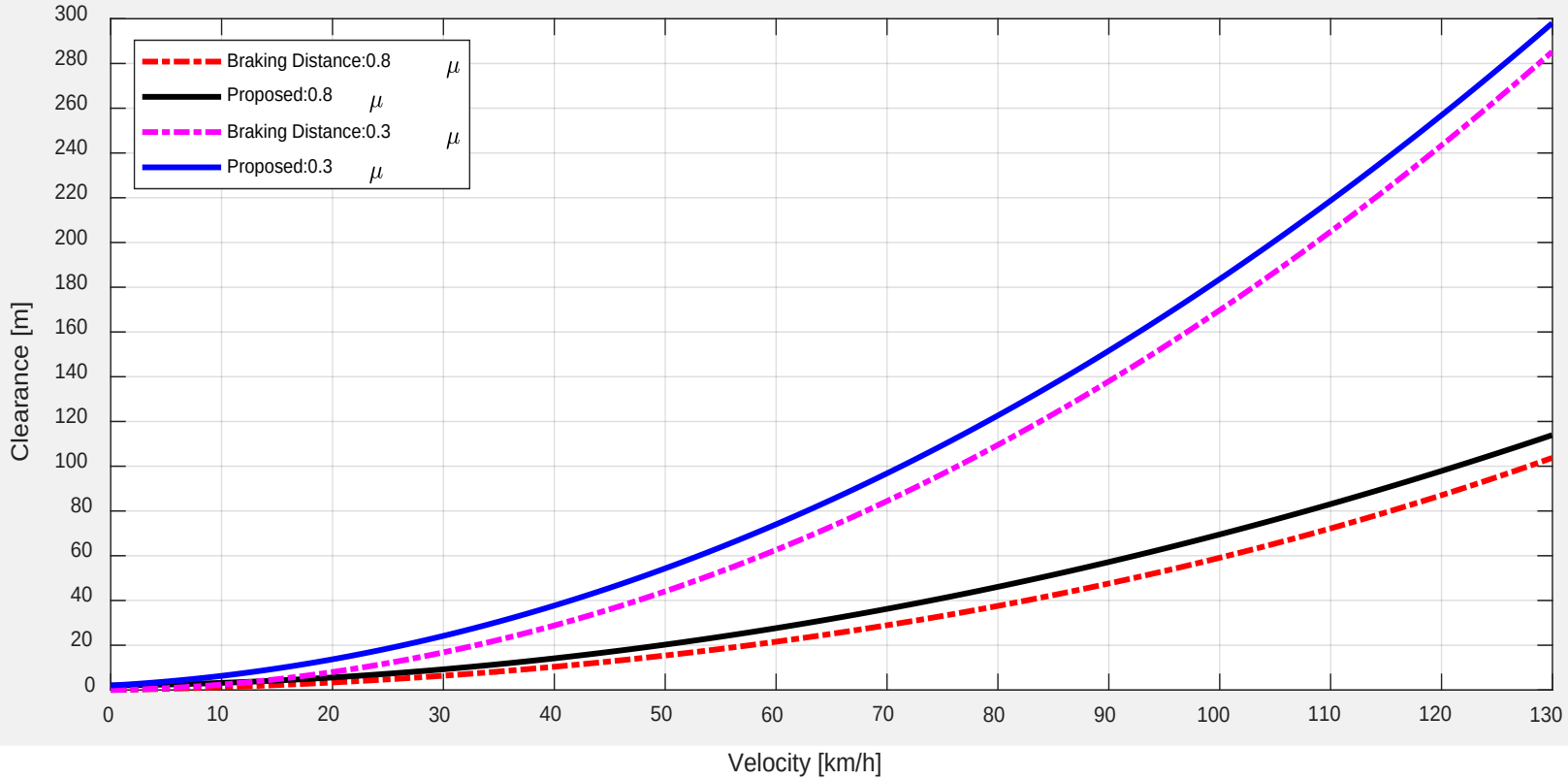
$$d_{brake} = (t_{sys} + {}^{v_x}/_{2a_x(v_x)}) \times v_x$$

  - System delay (t_{sys}) = 0.3sec
  - $d_{brake(0.8\mu)} = (t_{sys} + {}^{v_x}/_{2a_x(v_x)}) \times v_x \leftarrow a_{x0.8\mu}(v_x) = -0.0702 \times v_x + 9.55$
  - $d_{brake(0.3\mu)} = (t_{sys} + {}^{v_x}/_{2a_x(v_x)}) \times v_x \leftarrow a_{x0.3\mu}(v_x) = -0.0018 \times v_x + 2.44$
  - Braking distance by deceleration & velocity



Time gap's selection by road condition

- **Time gap increased by vehicle speed (0, 130km/h) and road condition (μ 0.8, 0.3)**
  - time gap 0.2 at 0 km/h and 3.1 at 130km/h for μ 0.8
  - time gap 1.0 at 0 km/h and 8.2 at 130km/h for μ 0.3



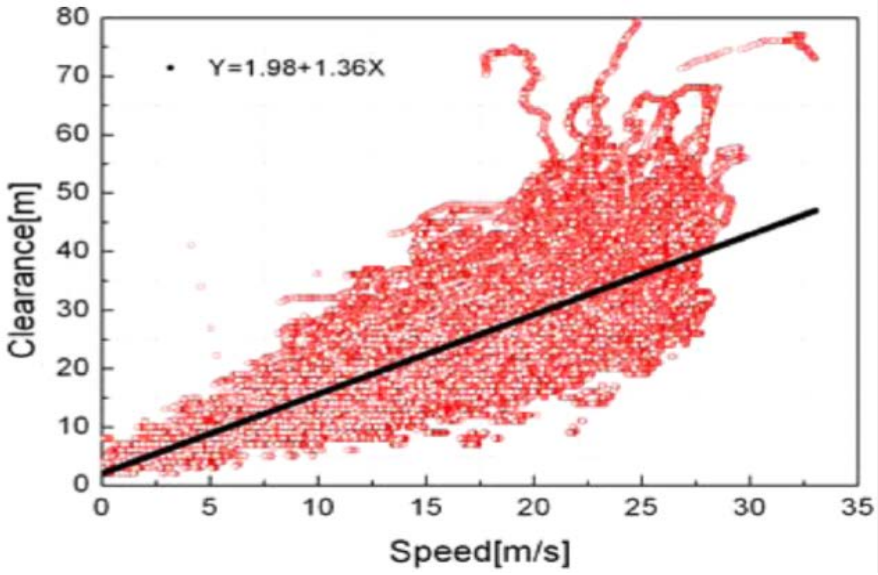
Minimum Clearance

- **Consideration of minimum clearance**

- Prevention of collision at 0km/h (repeated traffic jam situation, bumper to bumper)

- Minimum clearance extracted from ACSF-19-06 : 2m

  ➢ Steady-state following data collected from 125 driver test data and the linear regression(ACSF-19-06)



$$Y = 1.36x + 1.98$$

➢ Table of the braking distance and proposed Minimum Safety Distance in front

VALKS (km/h)	a (0.8mu)	a (0.3mu)	d brake (0.8mu)	Proposed MSD (0.8mu)	d brake (0.3mu)	Proposed MSD (0.3mu)
0	9.55	2.44	0	2.0	0	2.0
10	9.36	2.44	1.2	3.2	2.4	6.3
20	9.16	2.43	3.4	5.6	8.0	13.7
30	8.97	2.43	6.4	9.2	16.8	24.2
40	8.77	2.42	10.4	14.1	28.8	37.7
50	8.58	2.42	15.4	20.3	44.1	54.4
60	**8.38**	**2.41**	**21.6**	**27.6**	**62.6**	**74.1**
70	8.19	2.41	28.9	36.3	84.4	96.8
80	7.99	2.40	37.6	46.1	109.5	122.7
90	7.80	2.40	47.6	57.2	138.0	151.6
100	7.60	2.39	59.1	69.5	169.8	183.6
110	7.41	2.39	72.2	83.1	204.9	218.7
120	7.21	2.38	87.1	97.9	243.4	256.9
130	**7.02**	**2.38**	**103.8**	**113.9**	**285.4**	**298.1**

Renew Proposal

- proposal

$$S = V_{ALKS} \times t_{front} + d_s$$

Where :

V_{ALKS} : the actual speed of the ALKS vehicle in m/s;

t_{front} : time gap between the ALKS vehicle and the leading vehicle in front in second

$= 0.2 + \frac{2.9 * V_{ALKS}}{36.1}$ for dry and wet condition

[$= 1.0 + \frac{7.2 * V_{ALKS}}{36.1}$ for snowy condition]

ds : minimum clearance of 2 m