BRAKING PERFORMANCE OF LIGHT TRUCK

1. Brake regulations for Commercial Vehicle and Passenger Car

◆UN-R13 is considered the use of commercial vehicles.

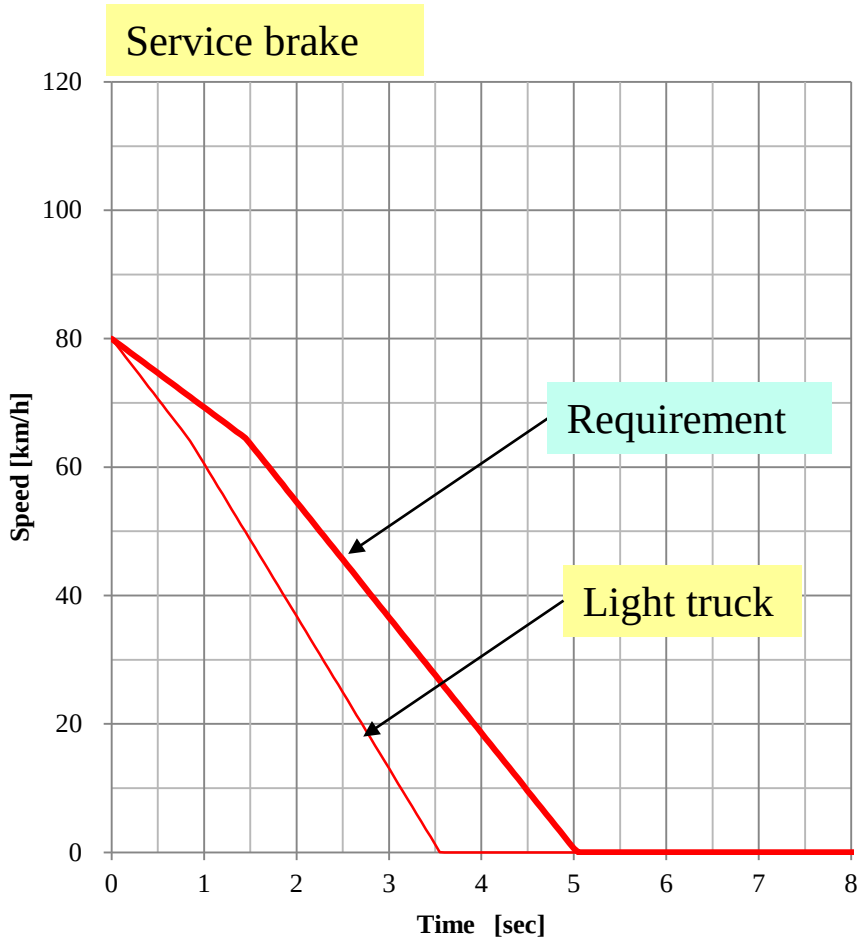
< Service brake >

	R13H		R13
Loading Conditions	Unladen / Laden		Unladen / Laden
Braking effort [N]	500 Max	<	700 Max
Initial velocity V0 [km/h]	100	>	80
MFDD [m/s^2] (Mean fully developed deceleration) 0.8V0～0.1V0	6.43	>	5.00
Braking distance [m]	70.0		61.2

BRAKING PERFORMANCE OF LIGHT TRUCK

2. Brake regulation conformity of the light truck

*The maximum deceleration of the light truck is 7m/s^2.
*The initial velocity of R13 is 80km/h.
*The braking effort of R13 is 700N.
Based on the above conditions and as follow Fig., **<u>the light truck is complied with R13</u>**.



BRAKING PERFORMANCE OF LIGHT TRUCK

3. The reason of the difference of the brake performance

< The feature of CV >

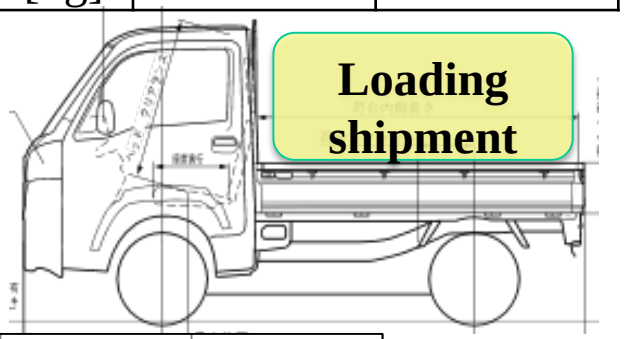
(1) Loading shipment

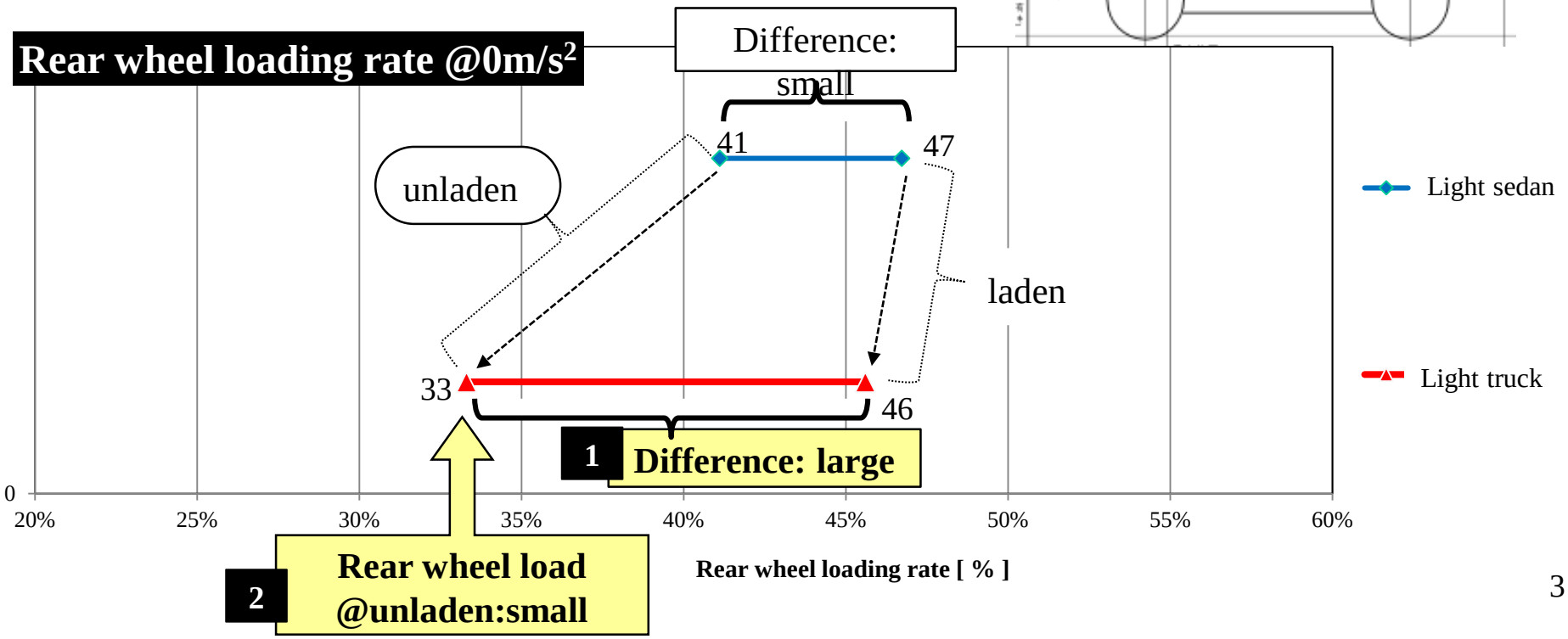
(2) Loading difference of rear wheels at unladen and laden → Large **1**

< The feature of Light Truck >

(3) Rear wheel load of unladen is **small** **2**

	Light Truck	Light Vehicle
unladen[kg]	**1012**	1051
laden[kg]	**1362**	1201

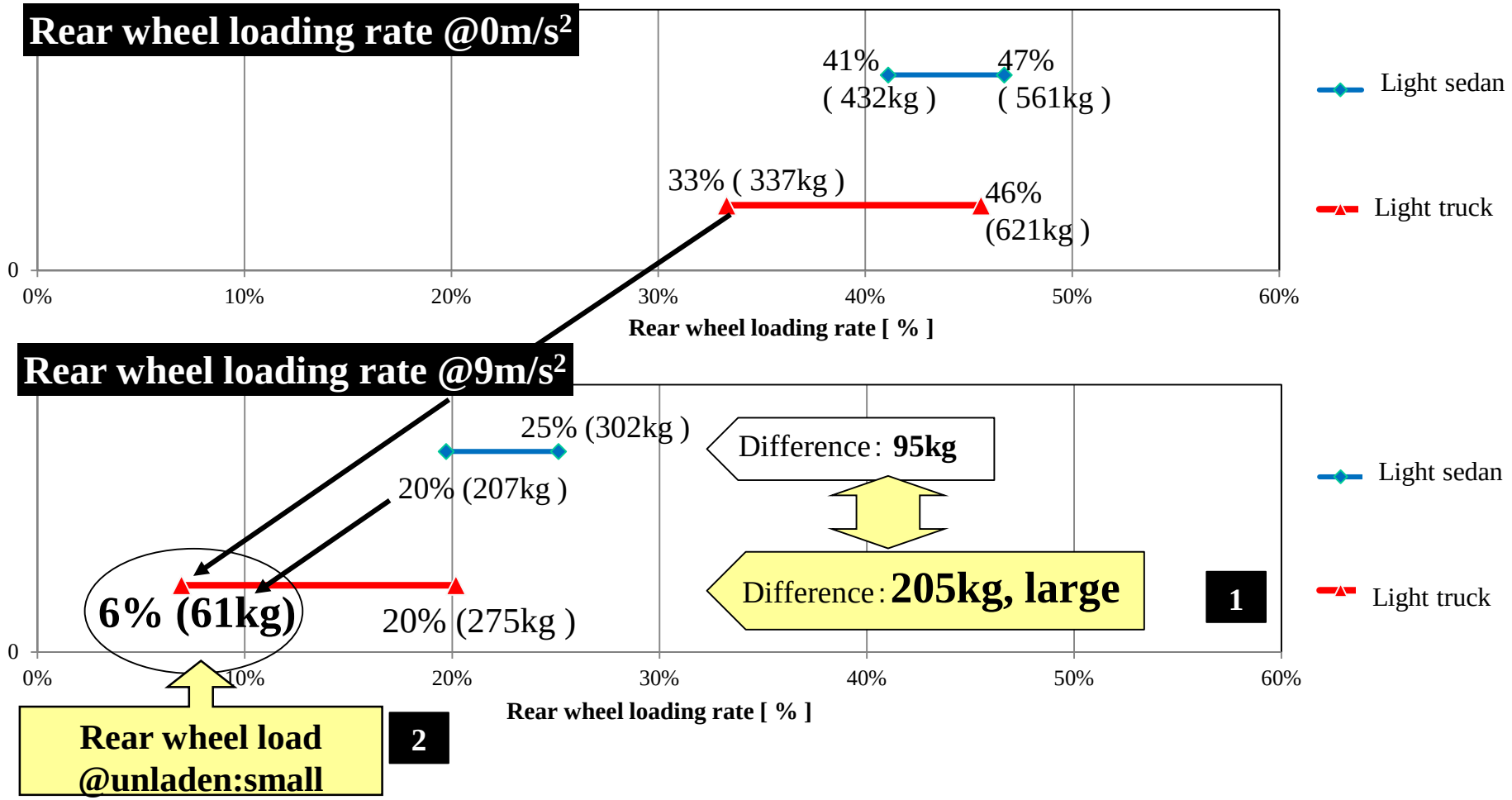




BRAKING PERFORMANCE OF LIGHT TRUCK

3. The reason of the difference of the brake performance

Difference of Light truck and Light vehicle

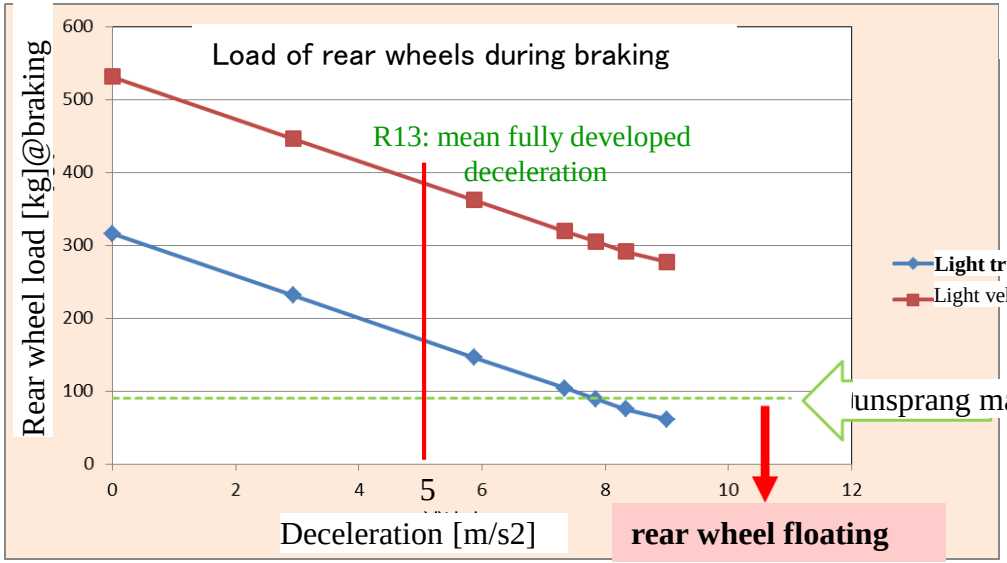


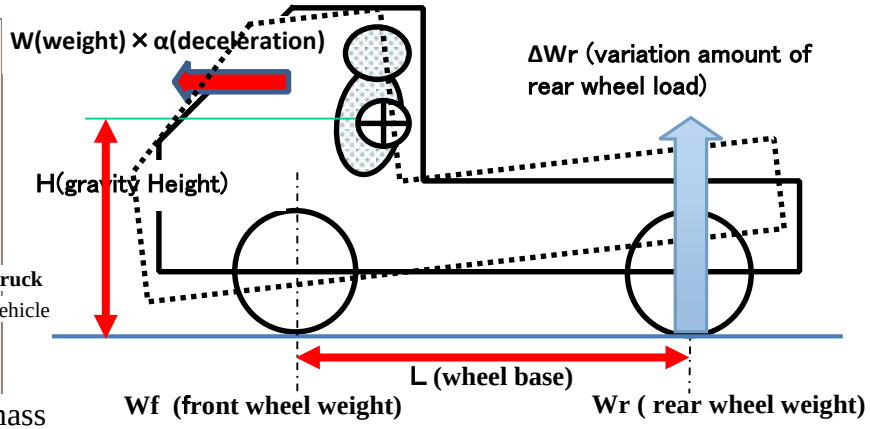
In case of 9m/s² deceleration, the rear wheel loading rate of the light truck is **only 6%**. Then, the rear wheel **side force decreases**, the vehicle's behavior becomes **unstable.**

BRAKING PERFORMANCE OF LIGHT TRUCK

4. Brake performance limitation of Light trucks

(1)The deceleration of the light truck is determined by the rear wheel load during braking, as bellows,





$$\triangle Wr \times L = W \times \alpha \times H$$

$$\triangle Wr = \alpha \times W \times \frac{H}{L}$$

		UNLADEN (2P)											
	Wheel base L	Gravity height H	Front wheel load Wf	Rear wheel load Wr	Vehicle weight W	Rear unsprang weight wr	制動時後輪荷重WrB[kgf]						
Deceleration ; α[m/s2]⇒								0	3	6	7	8	8.5	9
Light Truck	1905	560	644	316	960	90	WrB	316	231	146	104	89	75	61
							WrB-wr	226	141	56	14	**-1**	**-15**	**-29**
Light Vehicle	2450	595	629	531	1160	90	WrB	531	446	362	319	305	291	277
												215	201	187

Rear wheel load ; **small** →Rear side force : **decrease**

Need to limit deceleration at 7m/s^2 Maximum

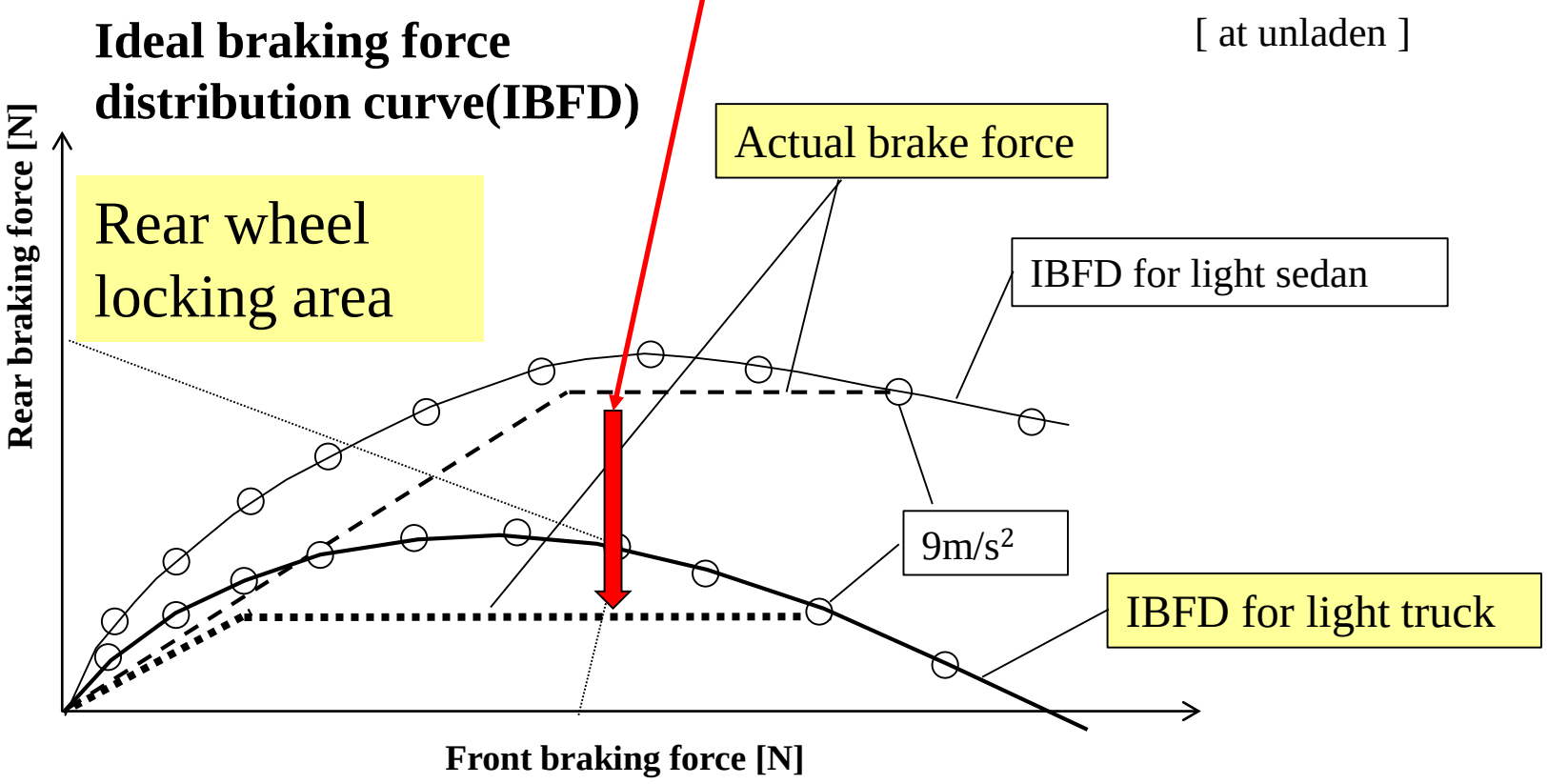
BRAKE SYSTEM DESIGN

4. Brake performance limitation of Light trucks

(2) The braking force distribution of the light truck

The braking force distribution curve of the light truck at unladen, as bellows,

The light truck must be limit the rear wheel braking force in order to avoid rear wheel locking for the light vehicle.



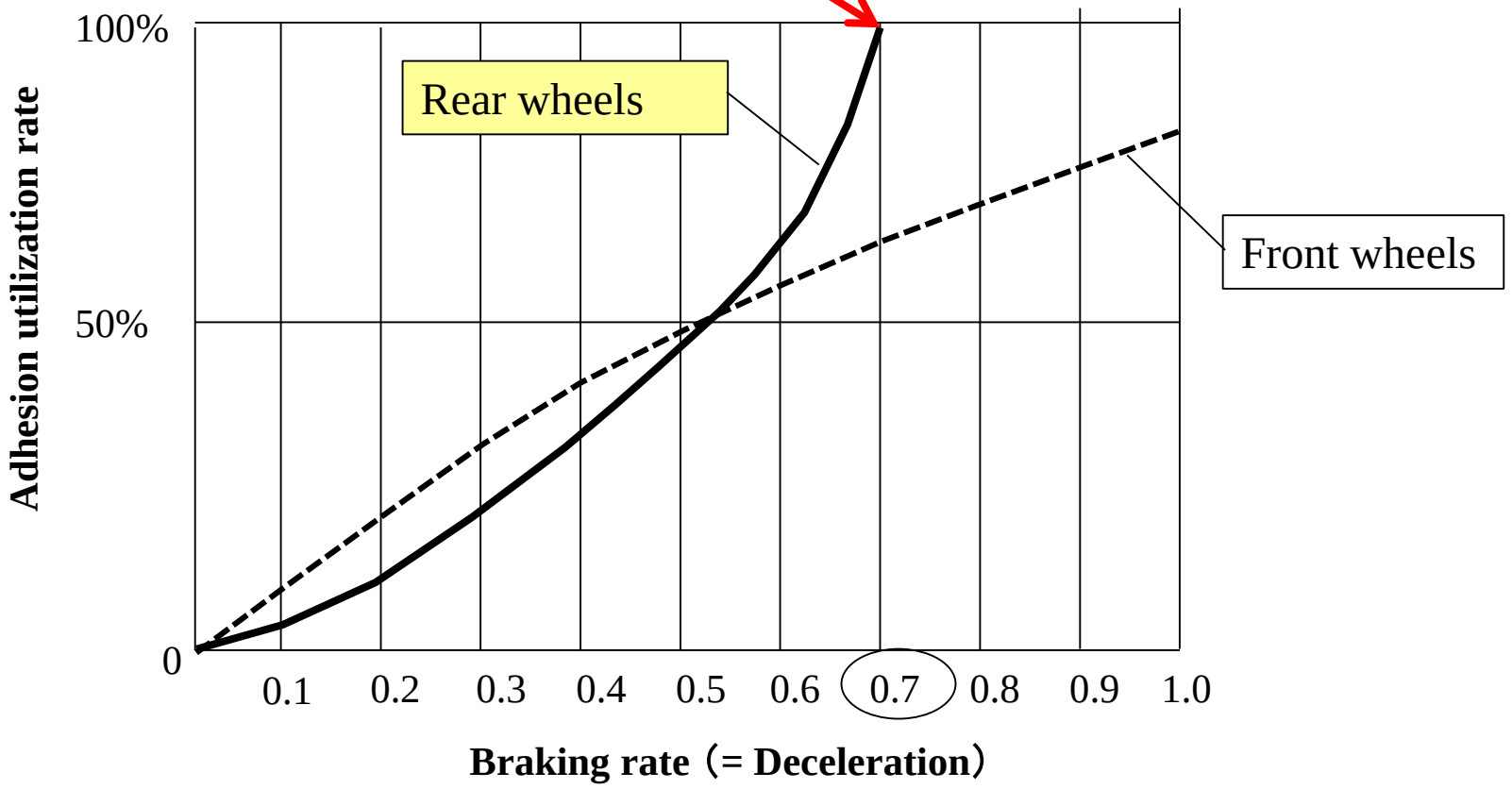
BRAKE SYSTEM DESIGN

4. Brake performance limitation of Light trucks

(3) The adhesion utilization curve of the light truck

Show the adhesion utilization curve of the light truck at unladen as bellows,

At unladen, the rear wheel adhesion utilization rate is 100% at 7m/s^2, so the rear wheels are locked.

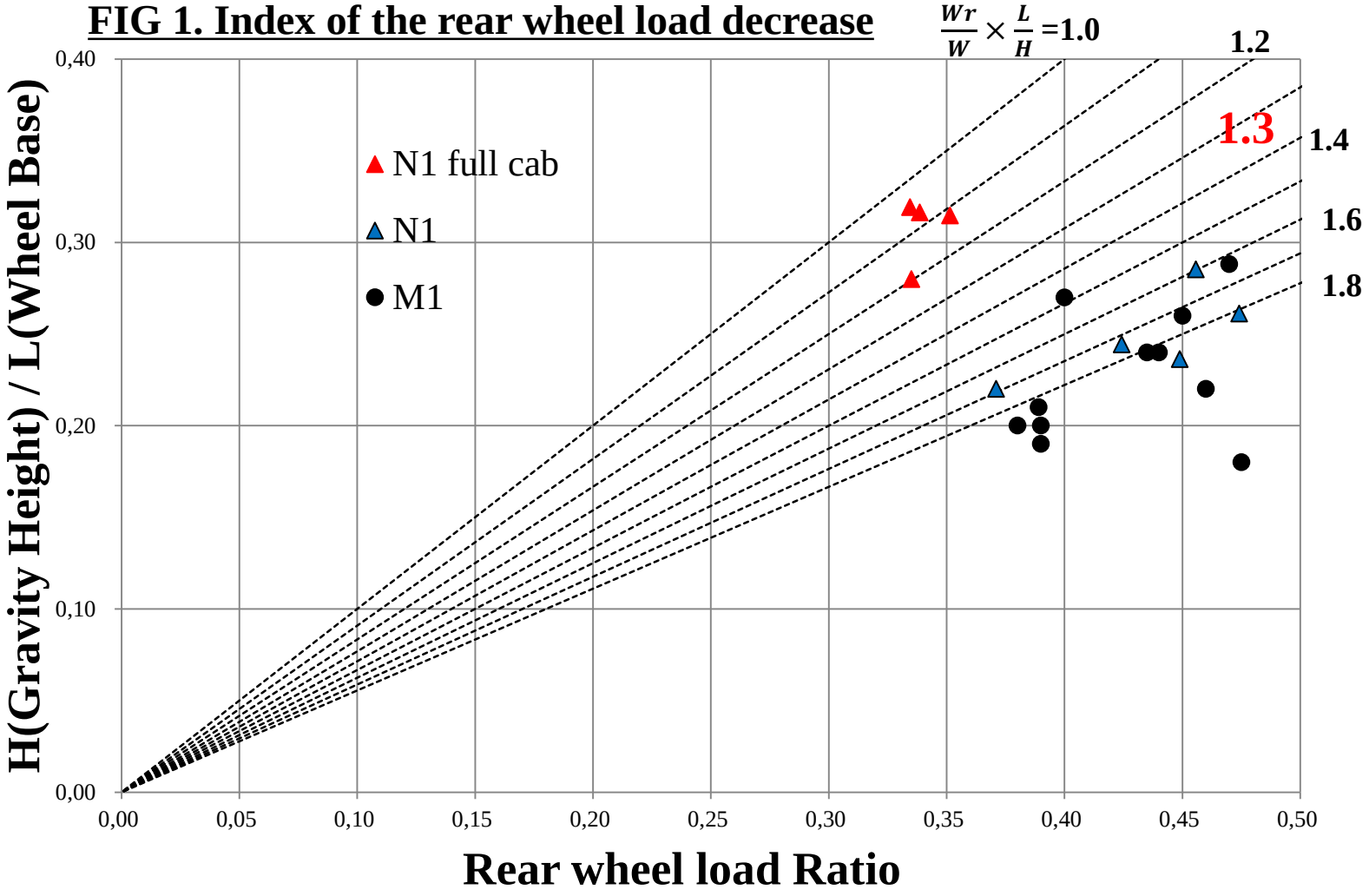


BRAKING PERFORMANCE OF LIGHT TRUCK

5. Comparison of the rear wheel load decrease

Full cab trucks of N1 are the different position compare to other vehicles of N1 and M1

FIG 1. Index of the rear wheel load decrease



BRAKING PERFORMANCE OF LIGHT TRUCK

6. Proposal for (N1 full cab vehicle)

In case of " $\alpha = \frac{Wr}{W} \times \frac{L}{H} \leqq 1.3$ "

C2C Maximum relative impact speed is 35km/h @unladen

■Maximum speed reduction for N1 full cab trucks

（Calculated by AEBS-05-06(D) AEBS Calculation Tool）

	Avoidance speed	35K	40K	45K	60K	Max. Decele-ration	Time_to_1g	TTC
	[km/h]	[km/h]	[km/h]	[km/h]	[km/h]	[m/s2]	[sec]	[sec]
M1/N1	42	0	0	15	35	9	0.6	0.9
N1 Full cab	**35**	0	15	25	40	**7**	0.6	0.9