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Agenda item B.2., acceleration devices

PROPOSAL OF VELOCITY FOR THE ACCELERATION SLED IN ECE-R16

presented by the Expert from Germany

The introduction of the acceleration sled (AS) into a regulation containing already the deceleration sled (DS) affords equivalence of loading severity in both sled types. The DS produces at the end of the braking more or less rebound movement, the inverse action of the AS does not generate this rebound movement. It is necessary to control the influence of the DS-rebound on the loading severity to find out the total velocity influence on the loading severity at the DS. A medium value of total DS-velocity can then be proposed as velocity of the AS.

Diagram 1 shows typical curves of loading severity and sled velocity at a DS. The sled velocity below zero indicates the rebound movement starting at t_0 (time of zero sled velocity). The loading severity is indicated by the dummy displacement, s_0 is the dummy displacement at t_0. The maximal dummy displacement is s_1 and occurs at t_1. The sled velocity at t_1 is v_1. The maximal sled rebound velocity is v_2 and occurs at t_2 . Diagram 2 shows two typical rebound velocity curves in greater amplification; these rebound curves belong to a DS with steel sheet braking where t2 reaches quite great values because of a long rebound way, see t2 examples in table 1.

Diagram 1 shows clearly that the maximal dummy displacement (= maximal loading severity) s1 occurs not far from t0, table 1 lists t1 values mostly a bit greater than t0. Rebound velocities only a bit later than t1 have no longer influence on the loading severity. Diagram 3 shows all the different rebound sled velocity curves from which the s-, t- and v-values in table 1 are taken from. In table 1 and diagram 3 can be seen that v1 has a remarkably lower range of values than v2. So for this DS with steel sheet braking only values of v1 between 0.96 and 2.15 are relevant although v2 reaches values between 1.72 and 4.03.

Table 2 and diagram 4 present respective values and curves like those from table 1 and diagram 3 for a DS with polyurethane tube braking. These typical examples show t2-values which are far smaller than those at the DS with steel sheet braking and only a bit greater than t0 (the polyurethane tubes do not release the sled like the steel sheets). This means that for this DS with polyurethane tubes the max. values of v1 and v2 are in the same range up to 3.3.

The evaluations presented above have four results:
- At DS with steel sheets the maximal rebound velocity may not be relevant but a smaller value
- At DS with polyurethane tubes the maximal rebound velocity seems to be the relevant value
- The DS presented offers a relevant rebound velocity range up to 3.3 km/h
- Respectively for the AS a velocity of 52 km/h with a tolerance of plus/minus 1.5 km/h can be proposed.

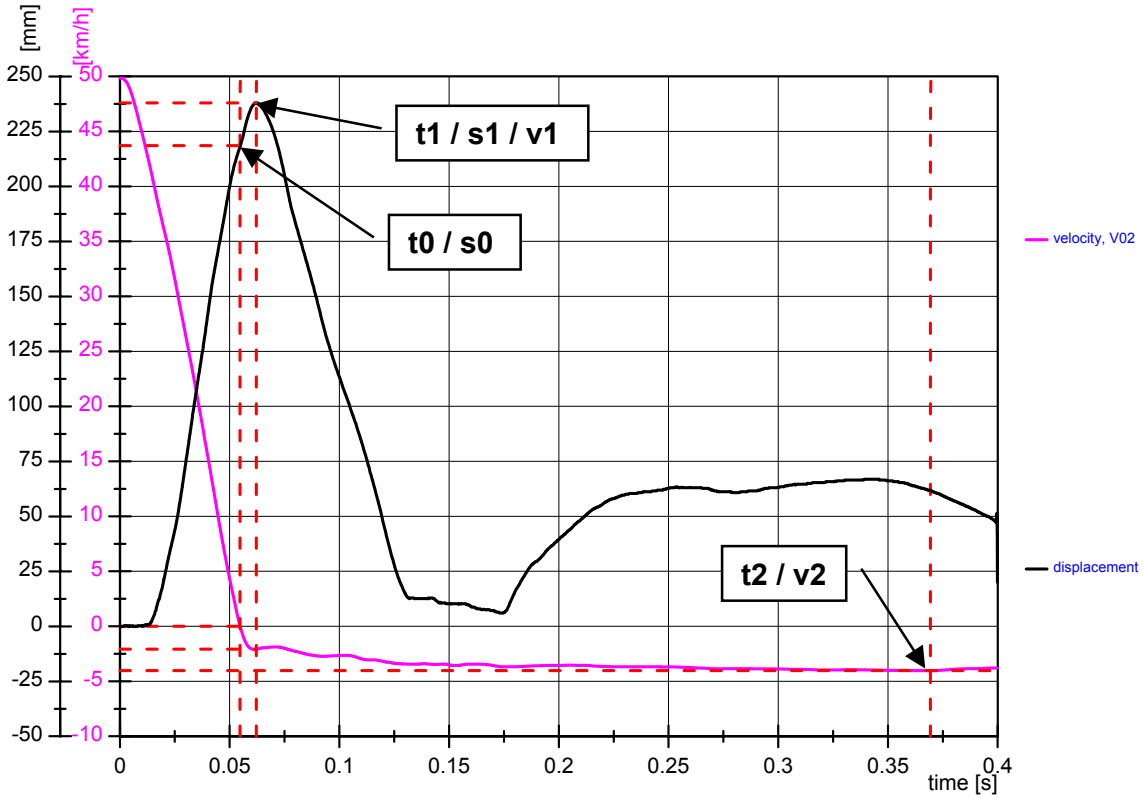

Diagram 1: loading severity and sled velocity

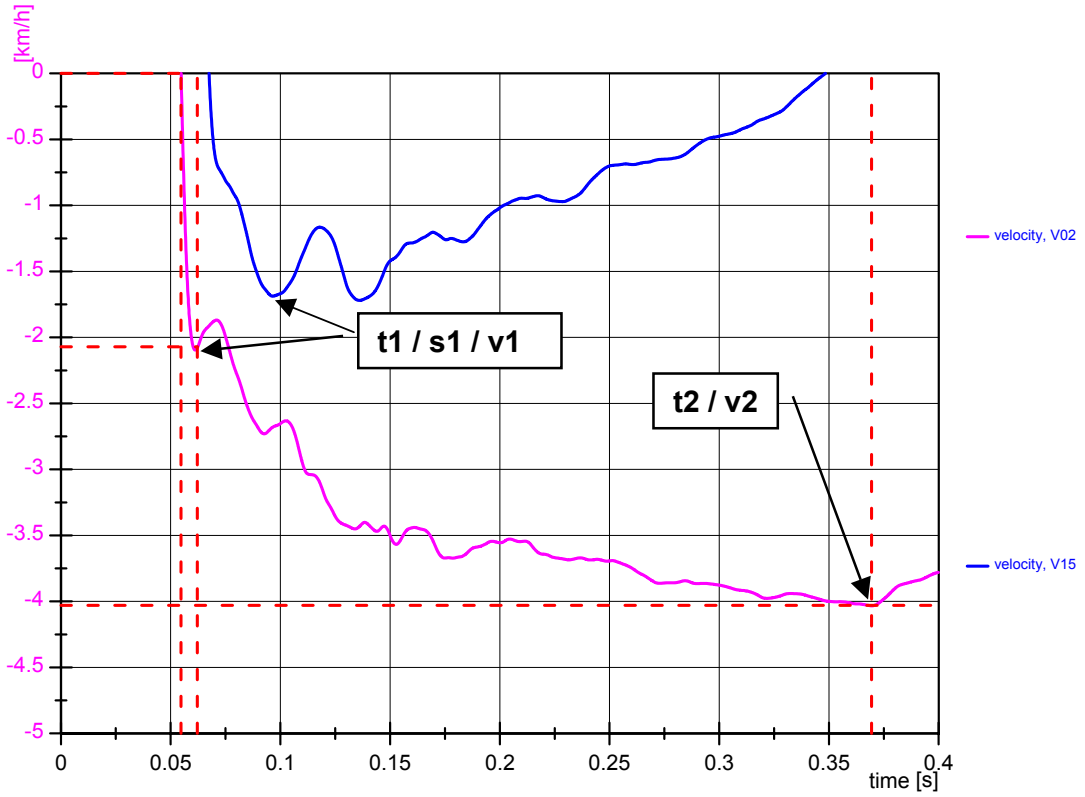

Diagram 2: sled rebound velocity

REBOUND STEELMETAL BRAKE

		t0 [ms]	s0 [mm]	s1 [mm]	t1 [ms]	v1 [km/h]	v2 [km/h]	t2 [ms]
without load limiting without pretensioning strong ECE-R 16 pulse	V01	55,4	221,5	239,4	62,4	1,22	2,80	151,4
	V02	54,8	218,5	238,0	62,2	2,07	4,03	369,5
	V03	53,8	232,3	254,1	61,1	1,84	3,70	362,9
without load limiting without pretensioning weak ECE-R 16 pulse	V04	69,7	194,8	195,2	63,6	-	3,16	191,4
	V05	74,9	200,5	200,5	67,1	-	2,88	200,2
	V06	71,0	192,1	193,7	64,0	-	3,82	197,3
retractor pretensioner 4 kN load limiting	V13	62,8	249,8	291,8	77,8	2,15	3,28	133,1
	V14	62,8	207,8	249,9	79,1	1,41	2,10	134,1
	V15	67,5	207,7	234,1	80,7	0,96	1,72	136,0
buckle pretensioner 6 kN load limiting	V19	61,7	210,9	234,9	74,7	1,47	2,60	131,4
	V20	62,1	203,0	222,1	71,1	1,98	3,61	239,2
	V21	63,3	189,1	209,0	72,0	2,03	3,76	235,9

Remarks:
t0 : time of 0 sled velocity
s0 : dummy displacement at t0
s1 : max. dummy displacement
t1 : time of s1
v1 : sled velocity
v2 : max. sled rebound velocity
t2 : time of v2

Table 1: loading severity and rebound velocity versus time

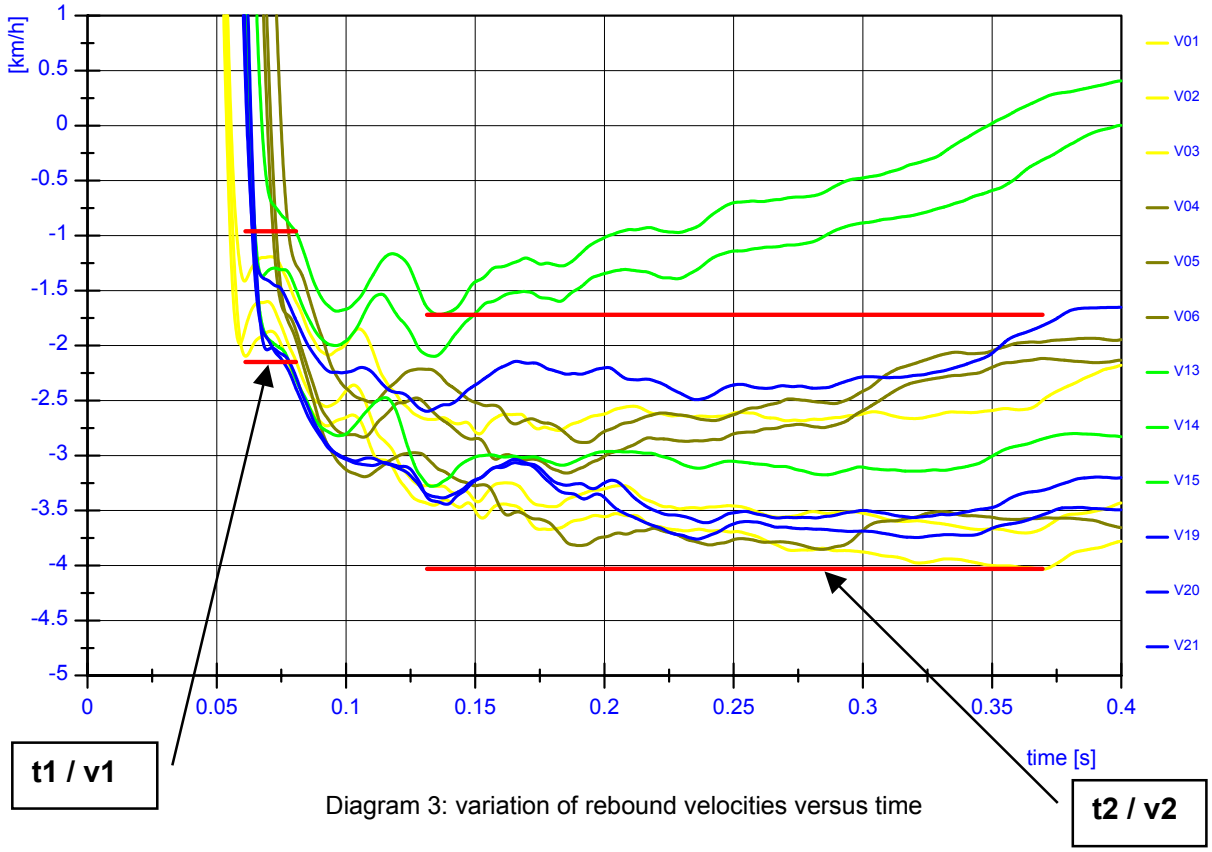

Diagram 3: variation of rebound velocities versus time

REBOUND PU TUBE BRAKE

		t0 [ms]	s0 [mm]	s1 [mm]	t1 [ms]	v1 [km/h]	v2 [km/h]	t2 [ms]
without pretensioning without load limiting	03/481	60,1	192,9	193,4	65,2	1,46	2,69	79,9
	03/482	57,7	193,4	193,7	58,7	0,39	3,05	78,5
without pretensioning load limiting	04/080	57,6	231,4	280,2	79,0	2,77	2,86	74,0
	04/081	58,6	234,5	282,4	80,1	2,49	2,65	74,2
retractor pretensioner load limiting	04/186	58,3	242,8	402,5	133,9	0,21	3,19	72,9
	04/187	58,2	254,8	403,1	153,8	-0,22	3,29	72,7
retractor pretensioner without load limiting	02/311	55,5	211,8	240,1	67,9	3,03	3,03	68,1
	02/312	55,6	204,9	224,1	66,9	2,88	2,88	68,1

Remarks:
t0 : time of 0 sled velocity
s0 : dummy displacement at t0
s1 : max. dummy displacement
t1 : time of s1
v1 : sled velocity
v2 : max. sled rebound velocity
t2 : time of v2

Table 2: loading severity and rebound velocity versus time

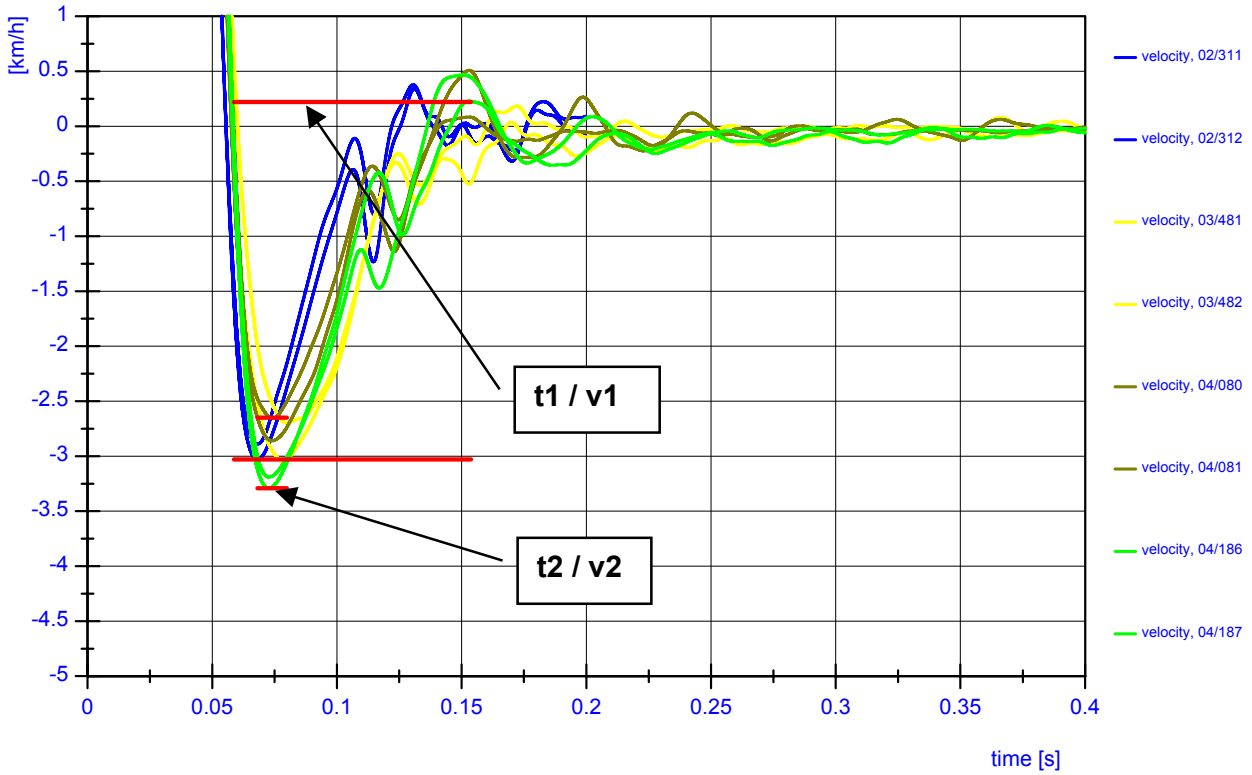

Diagram 4: variation of rebound velocities versus time