



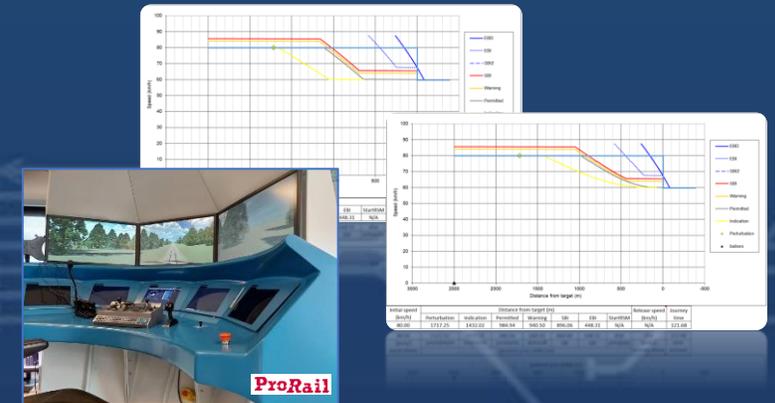
AŽD Praha s.r.o.

How can the braking curves be adapted to a more realistic behaviour of the rolling stock?

Jakub Marek

UNISIG Braking curves TF Leader, representing the AŽD Praha company

UNISIG Super Group Leader, representing the AŽD Praha company

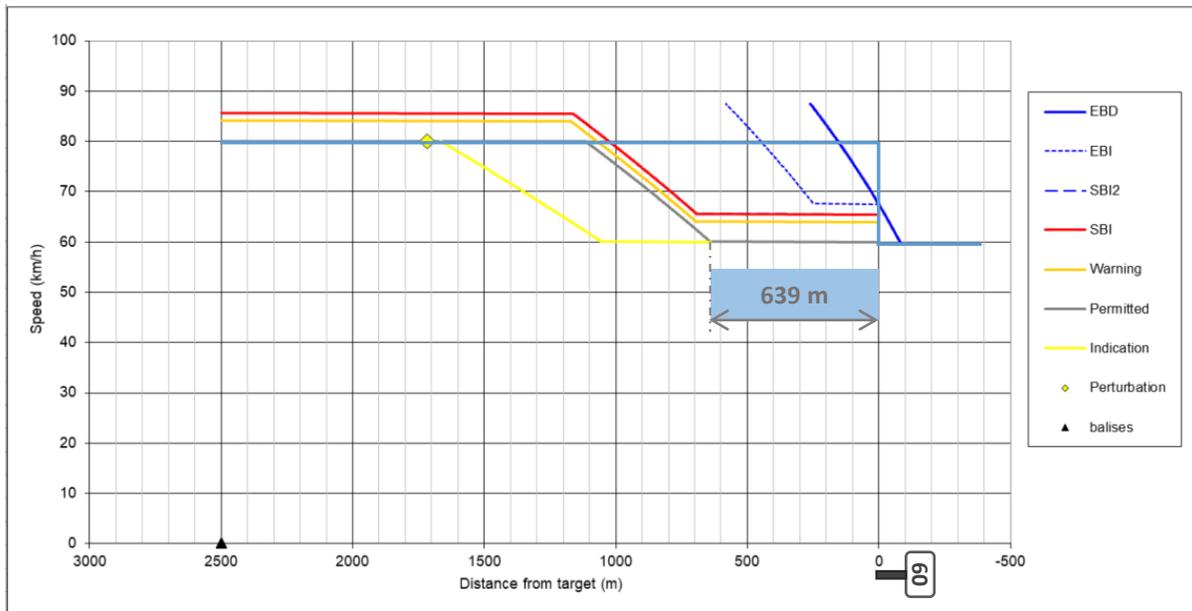


CR1344 (optimisation of the brake build-up time)

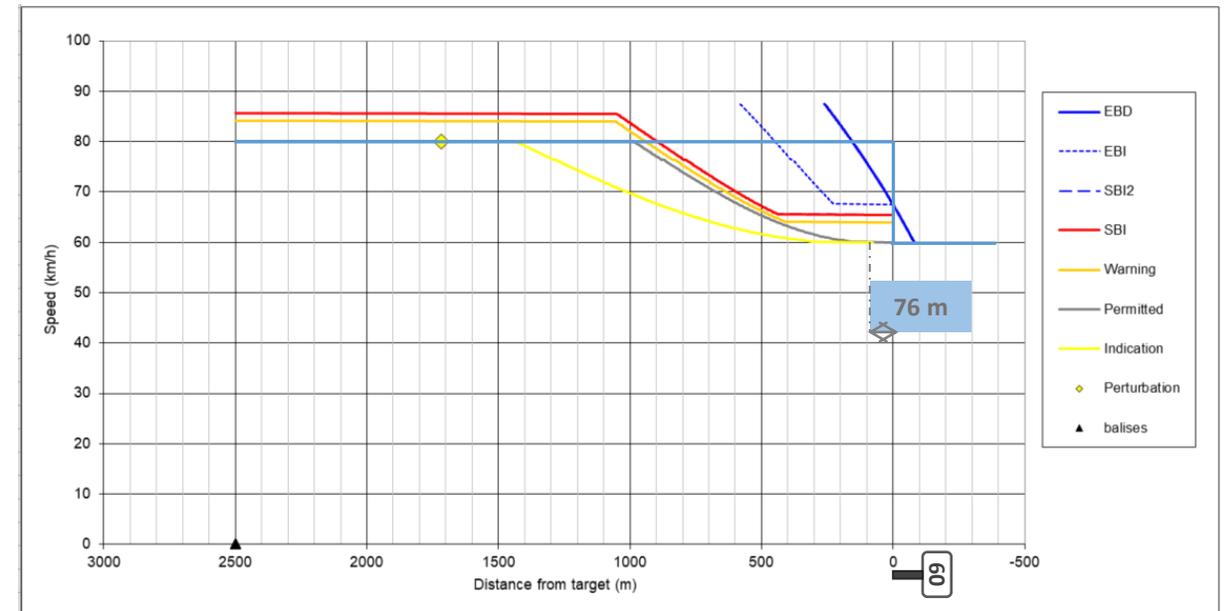
- Principle: consider actual ΔV (V_{est} vs. V_{target}), or even A_{est}

– previous braking curves (B3R2)

vs. – optimised braking curves (B4R1)



Initial speed (km/h)	Distance from target (m)							Release speed (km/h)	Journey time
	Perturbation	Indication	Permitted	Warning	SBI	EBI	StartRSM		
80.00	1717.25	1664.91	1114.33	1069.88	1025.44	448.31	N/A	N/A	125.23



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80.00	1717.25	1432.02	984.94	940.50	896.06	448.31	N/A	N/A	121.68

*) Freight train, 673 m, braked in P mode, 87 br.%, **SB** in TSM allowed

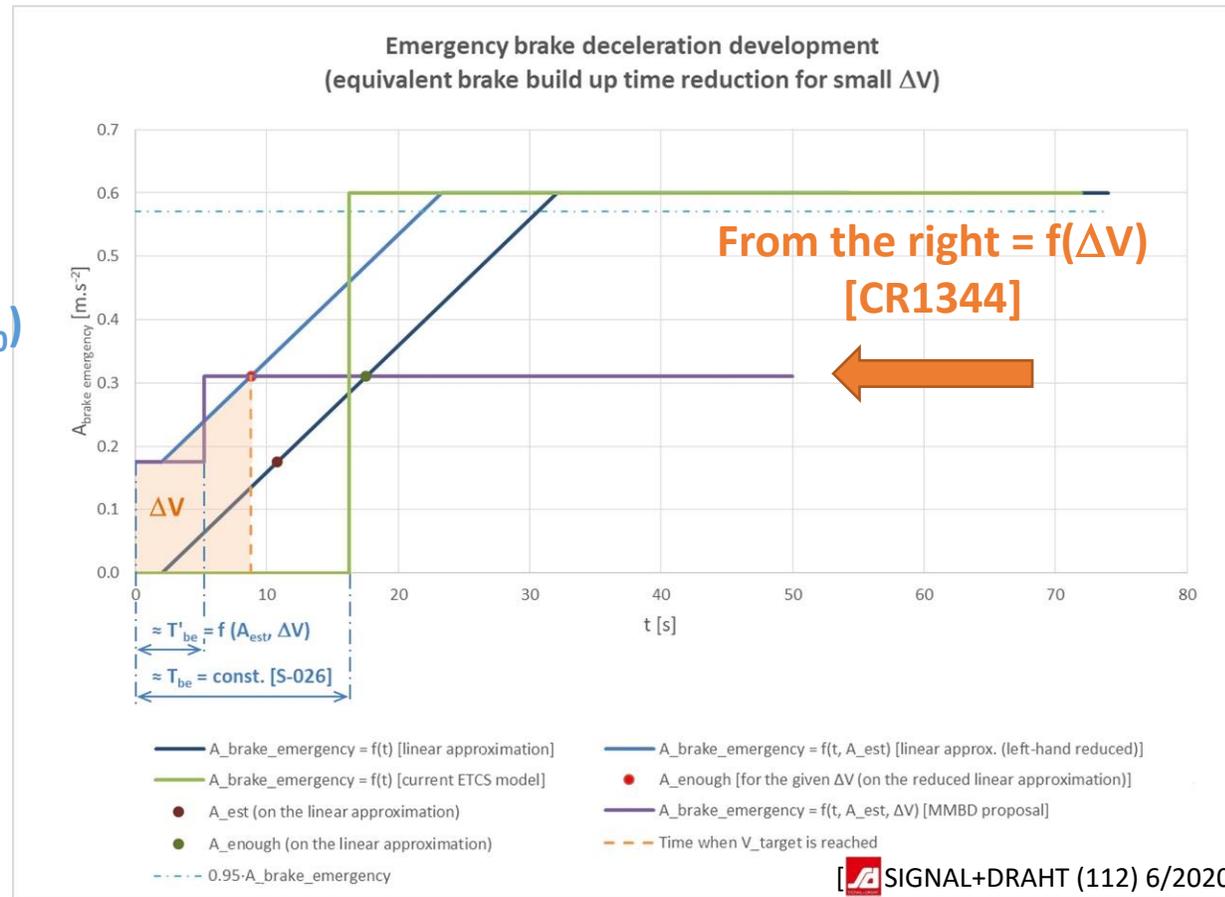


How can the braking curves be adapted to a more realistic behaviour of the RST?
 » Only needed part of the brake build-up time is to be considered (CR1344) «

CR1344 (optimalisation of the brake build-up time)

- Principle: consider actual ΔV (V_{est} vs. V_{target}), or even A_{est}

From the left = $f(a_0)$
[CR1385]

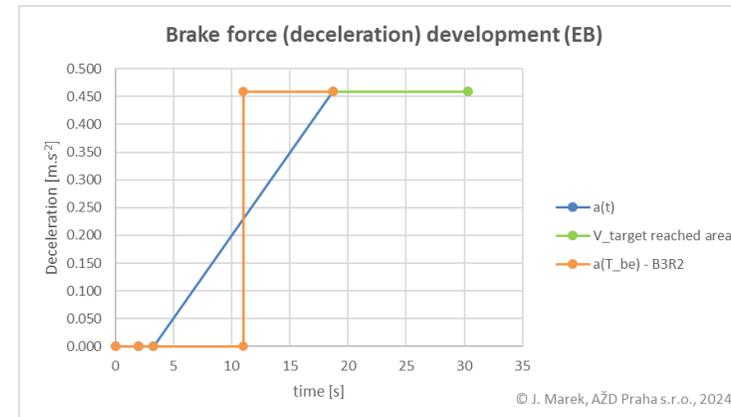



$$\Delta V = \int_0^{t_{\Delta V}} a \cdot dt$$

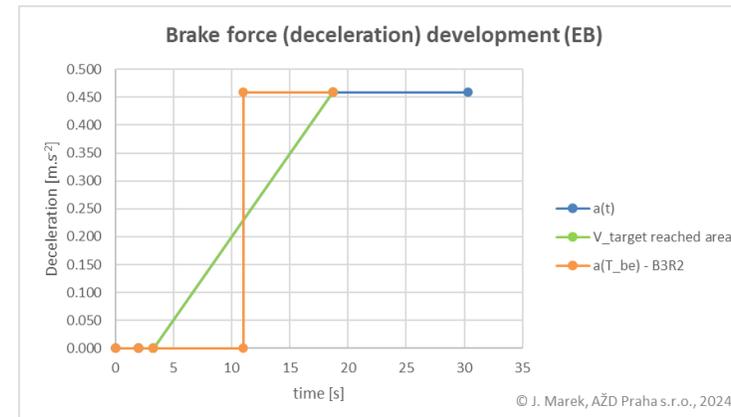
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– When the optimisation is not needed?

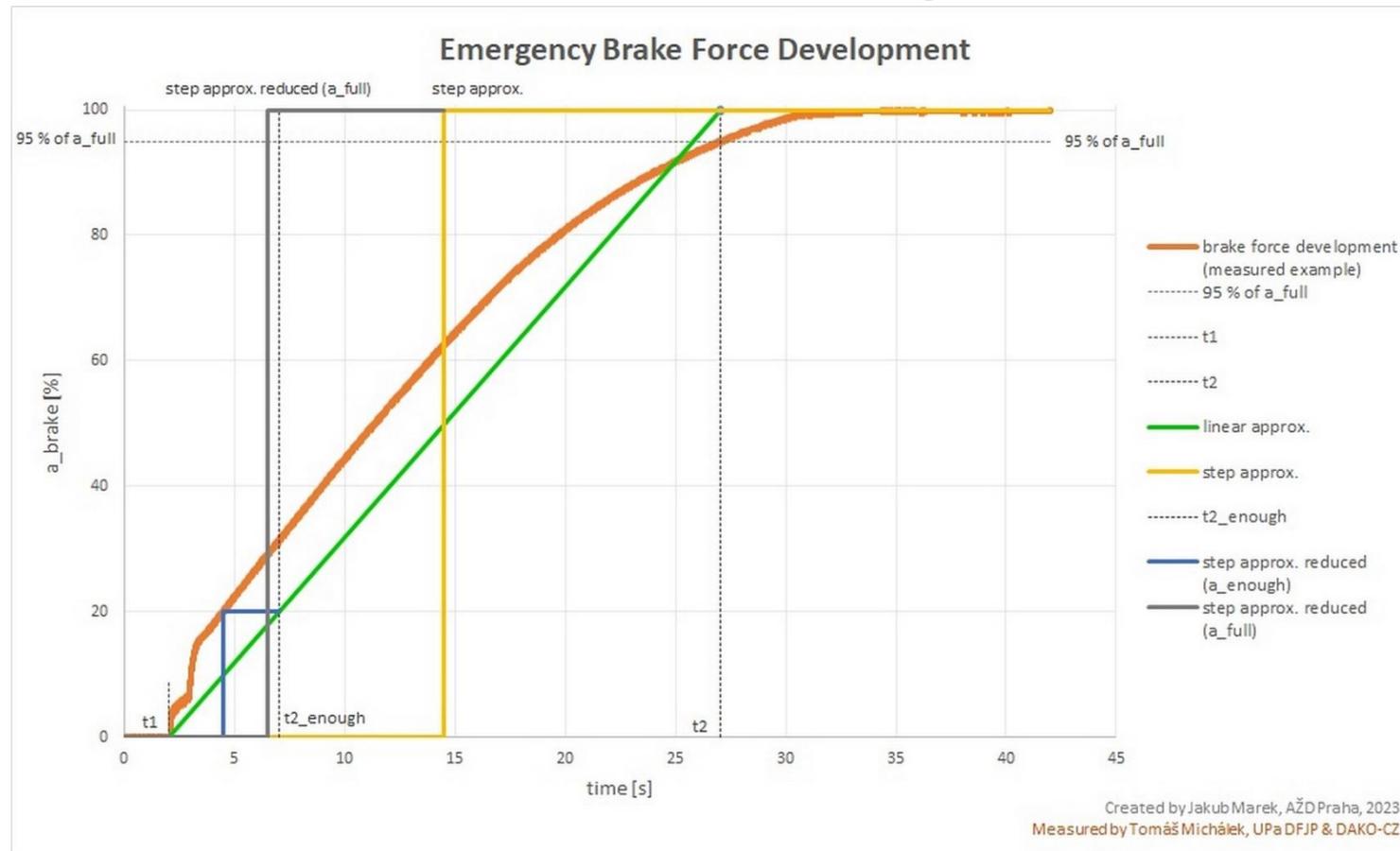


– When the optimisation should be done?



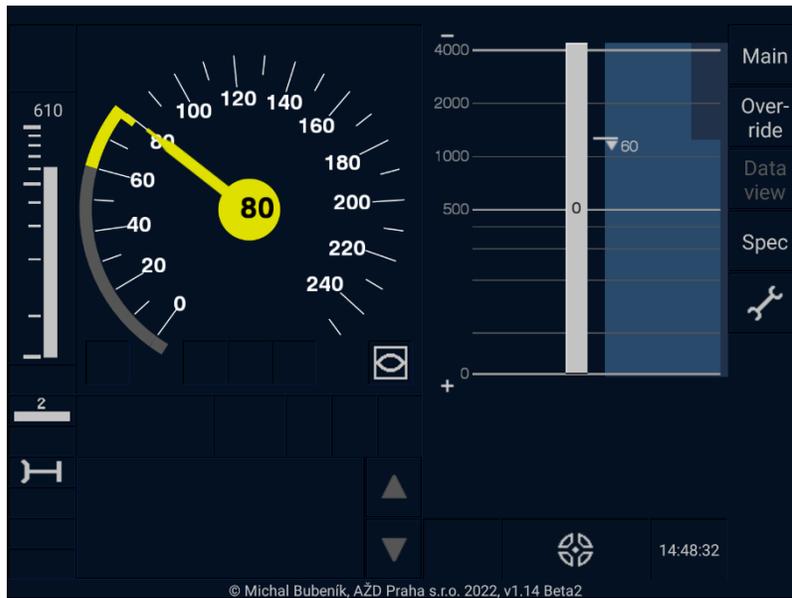
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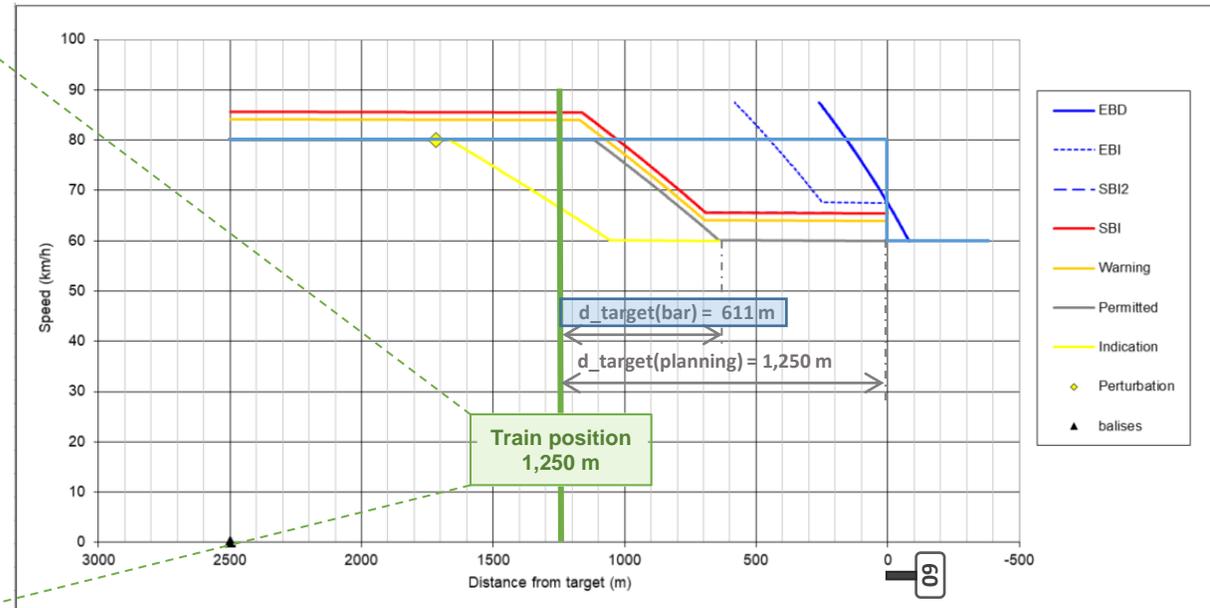


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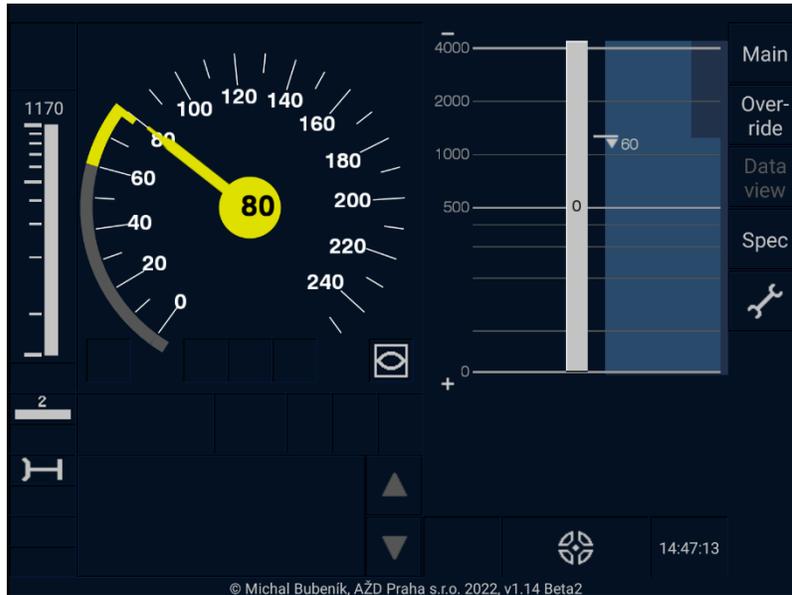
Freight train, 673 m, braked in P mode, 87 BWP; SB in TSM allowed



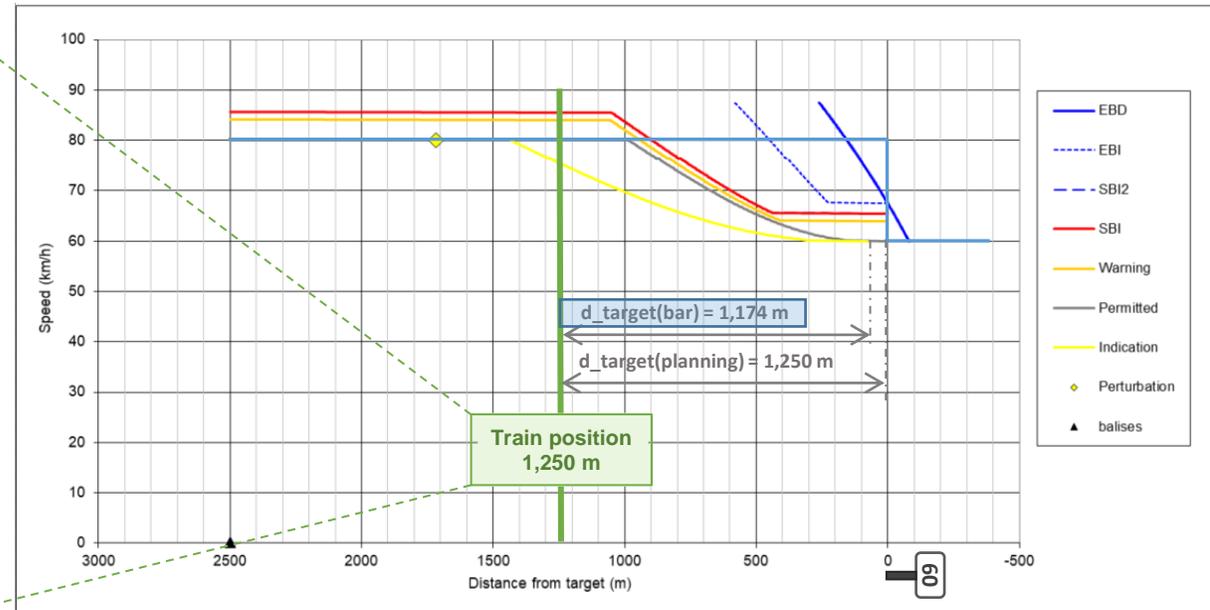
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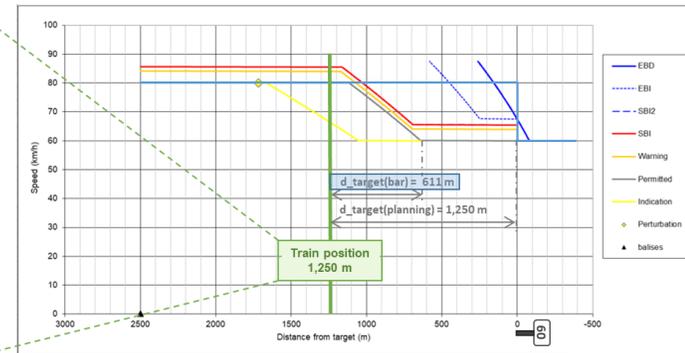


- Optimisation (reduction) of the brake build-up time (t_e) – comparison B3R2 vs. B4R1:

• B3R2-spec:

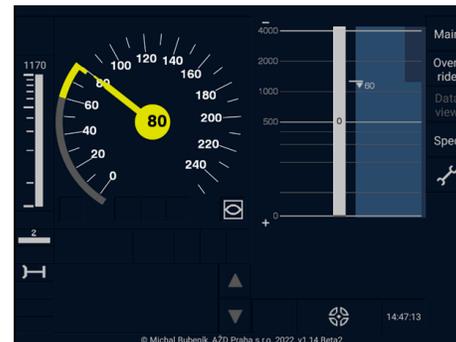


Freight train, 673 m, braked in P mode, 87 BWP; SB in TSM allowed

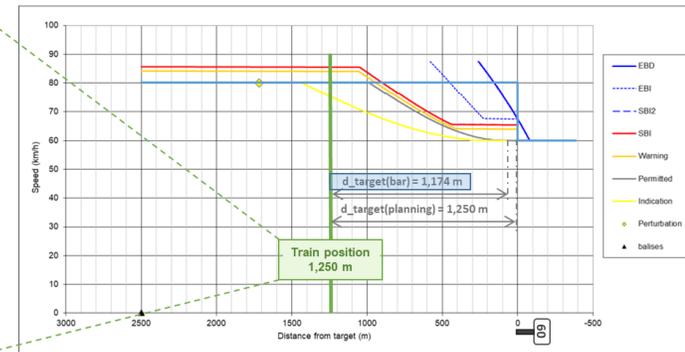


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• B4R1-spec:

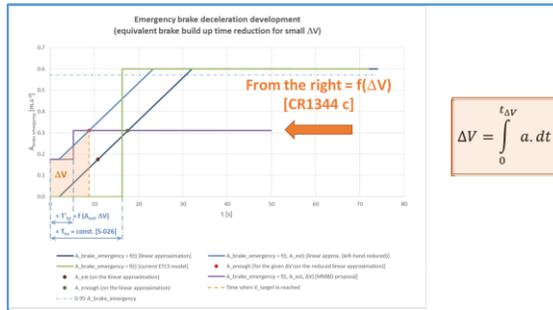


Freight train, 673 m, braked in P mode, 87 BWP; SB in TSM allowed



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- t_e computed for every target individually and is $f(V_{target} - V_{est})$
- uses integration of $a(t)$:



- validated against UIC measurements (> 4 000)
- tested by train drivers in NL (ProRail, NS)

NEO Simulator



– ! enabler for the future consideration of deceleration (CR1385)



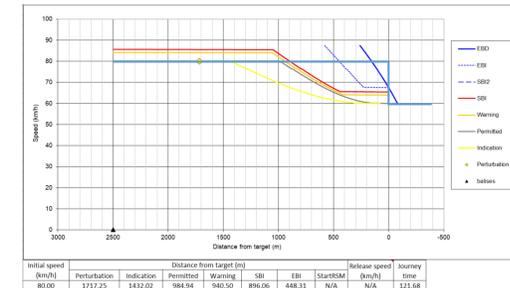
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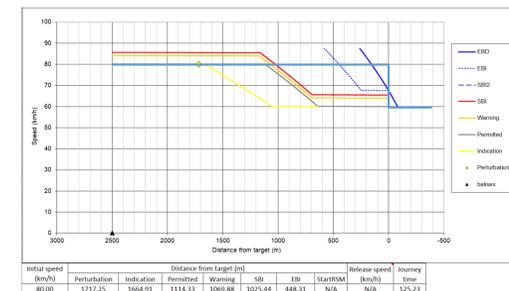


■ Optimised braking curves in B4R1 and **backwards compatibility**

– **new braking curves** using the brake build-up time reduction will be used in all **ETCS on-boards with** the highest supported **SV ≥ 3.0** :



– **ETCS on-boards with** the highest supported **SV < 3.0** using the **current** braking curves:



– *Note: thus, ETCS BCs are not dependant on SV of ETCS trackside*



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– NEO simulator (ProRail)

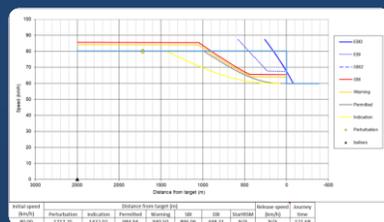
- real dynamics of the ride
- real train drivers
- to validate the tested solutions (advantages/ /disadvantages)



Thank you for your attention!

J. Marek

marek.jakub@azd.cz



Žirovnická 3146/2, Záběhlice, 106 00 Praha 10

www.azd.cz