

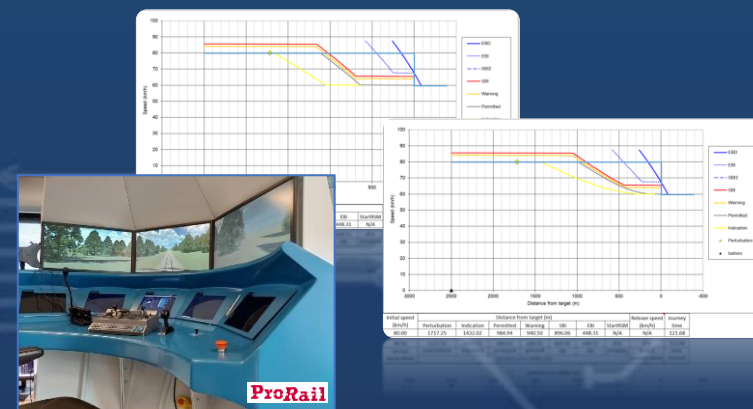
# AŽD Praha s.r.o.

## 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

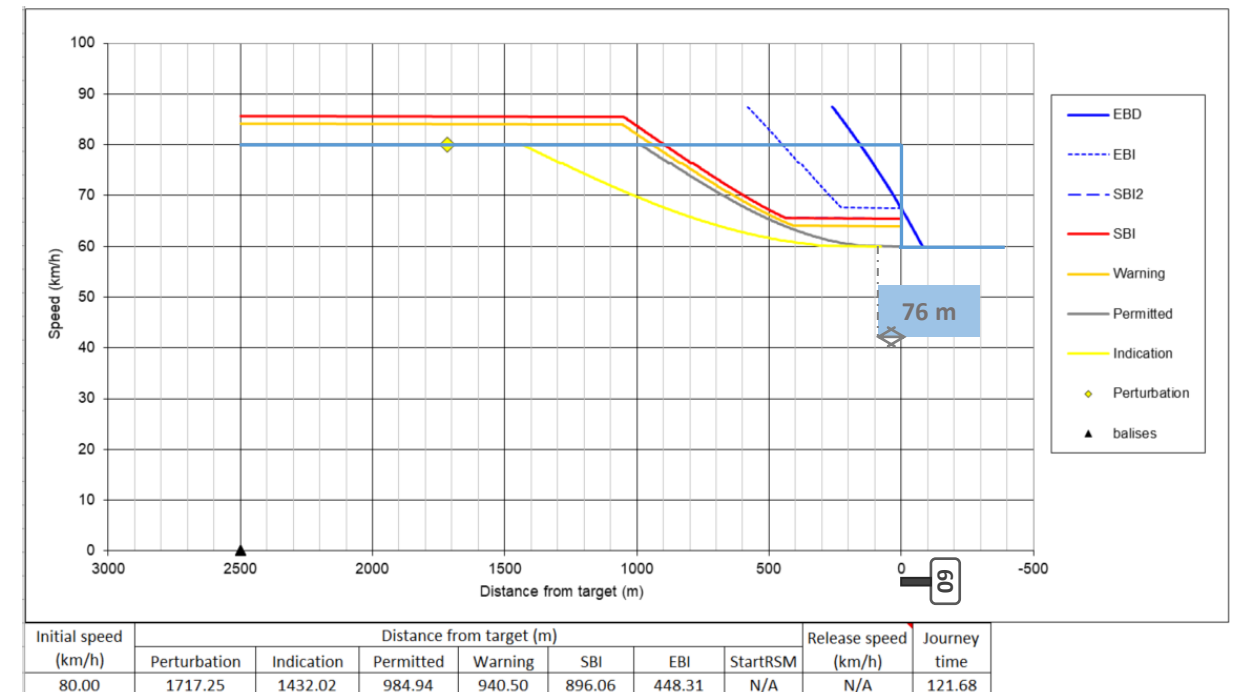
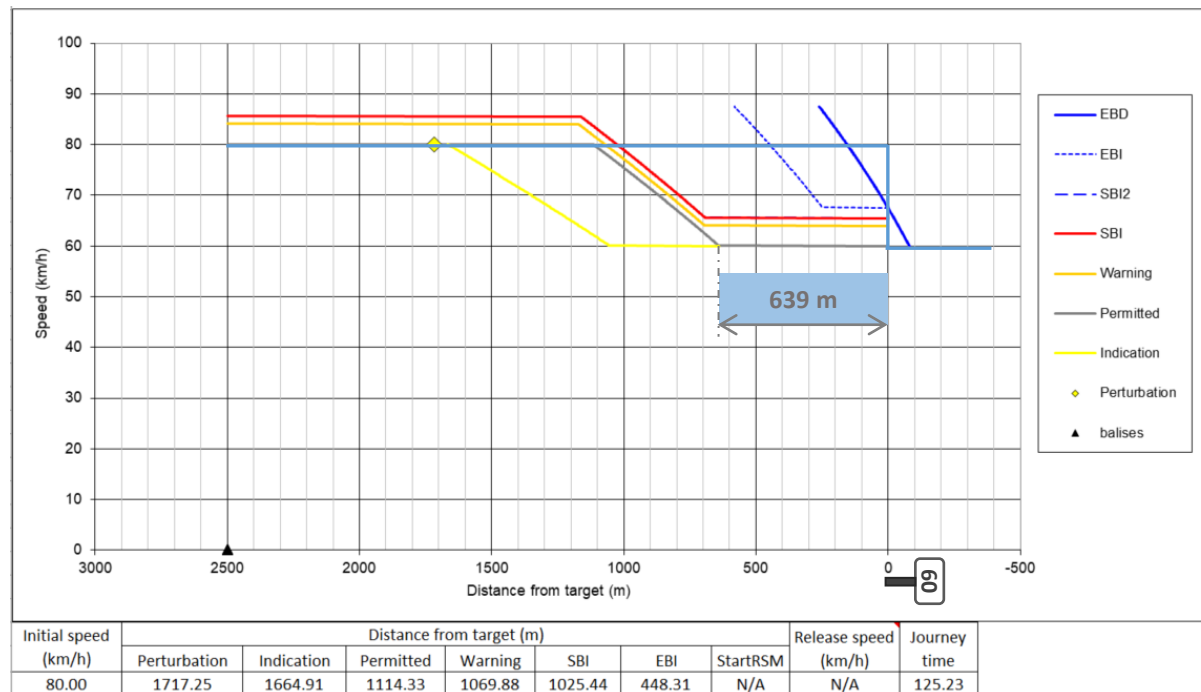


# CR1344 (optimisation of the brake build-up time)

- Principle: consider actual  $\Delta V$  ( $V_{est}$  vs.  $V_{target}$ ), or even  $A_{est}$

– previous braking curves (B3R2)

vs. – optimised braking curves (B4R1)



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

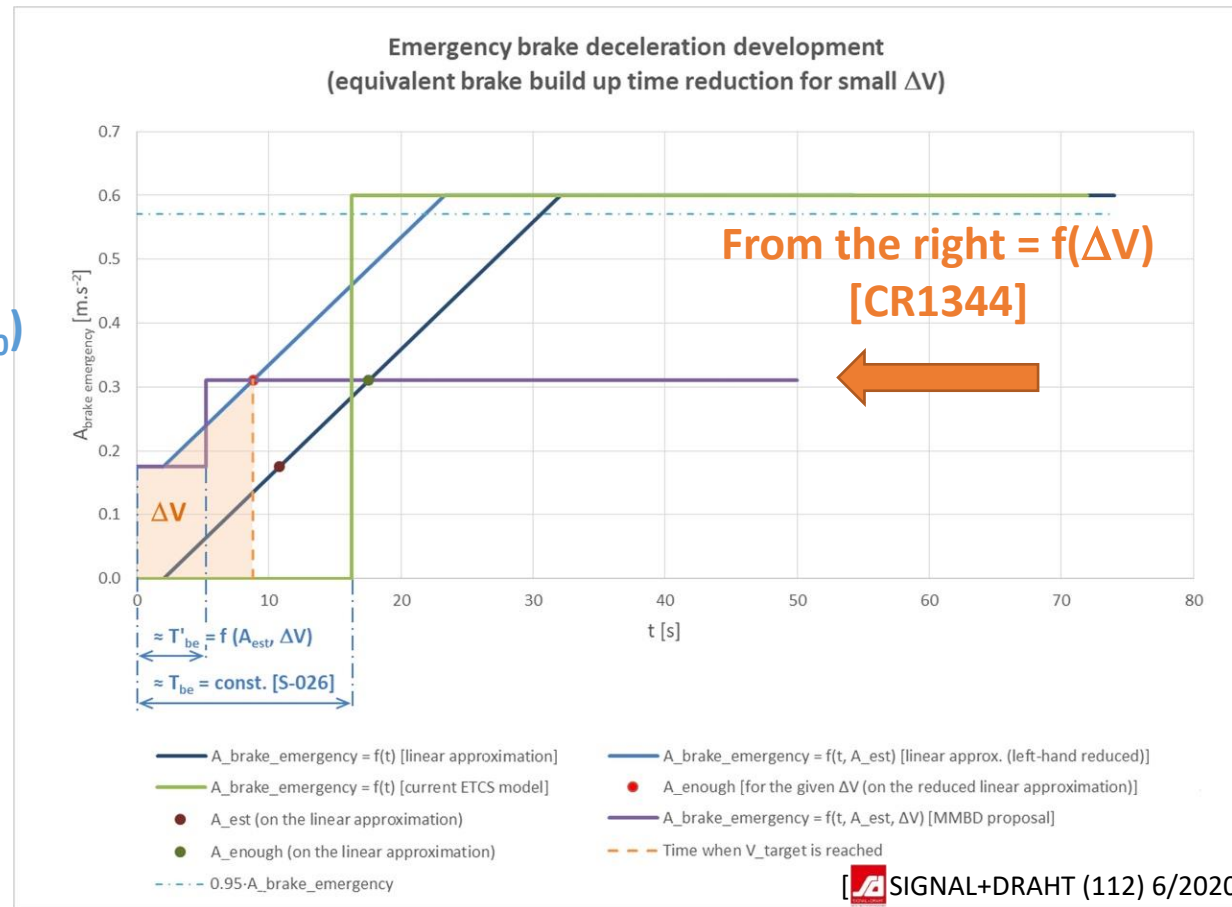


How can the braking curves be adapted to a more realistic behaviour of the RST?  
» Only needed part of the brake build-up time is to be considered (CR1344) «

# CR1344 (optimalisation of the brake build-up time)

- Principle: consider actual  $\Delta V$  ( $V_{\text{est}}$  vs.  $V_{\text{target}}$ ), or even  $A_{\text{est}}$

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

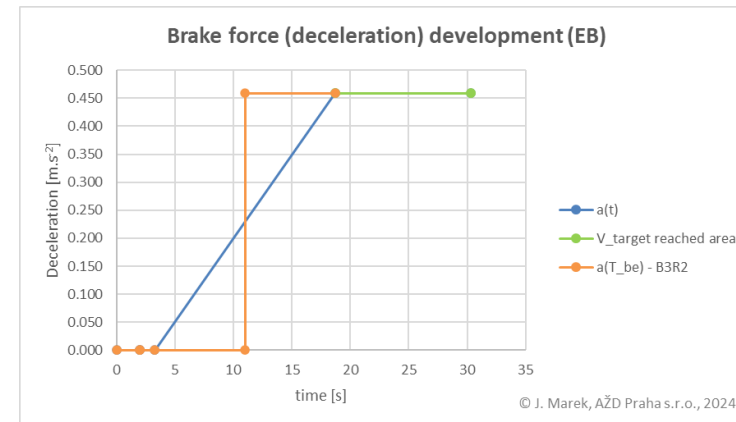


$$\Delta V = \int_0^{t_{\Delta V}} a \cdot dt$$

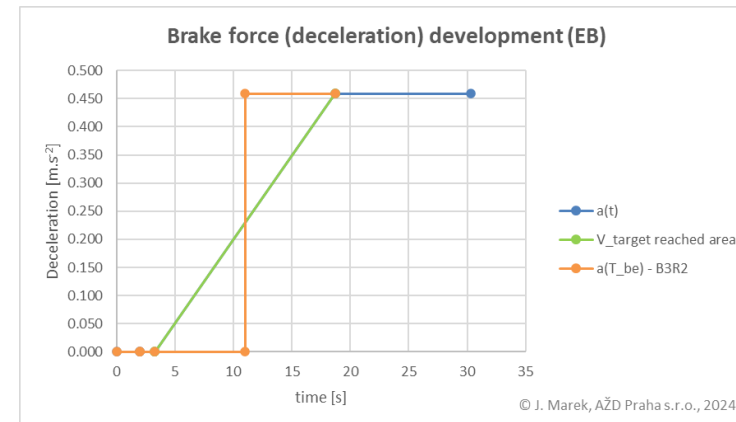
# CR1344 (optimisation of the brake build-up time)

- Principle: consider actual  $\Delta V$  ( $V_{\text{est}}$  vs.  $V_{\text{target}}$ ), or even  $A_{\text{est}}$

– When the optimisation is not needed?

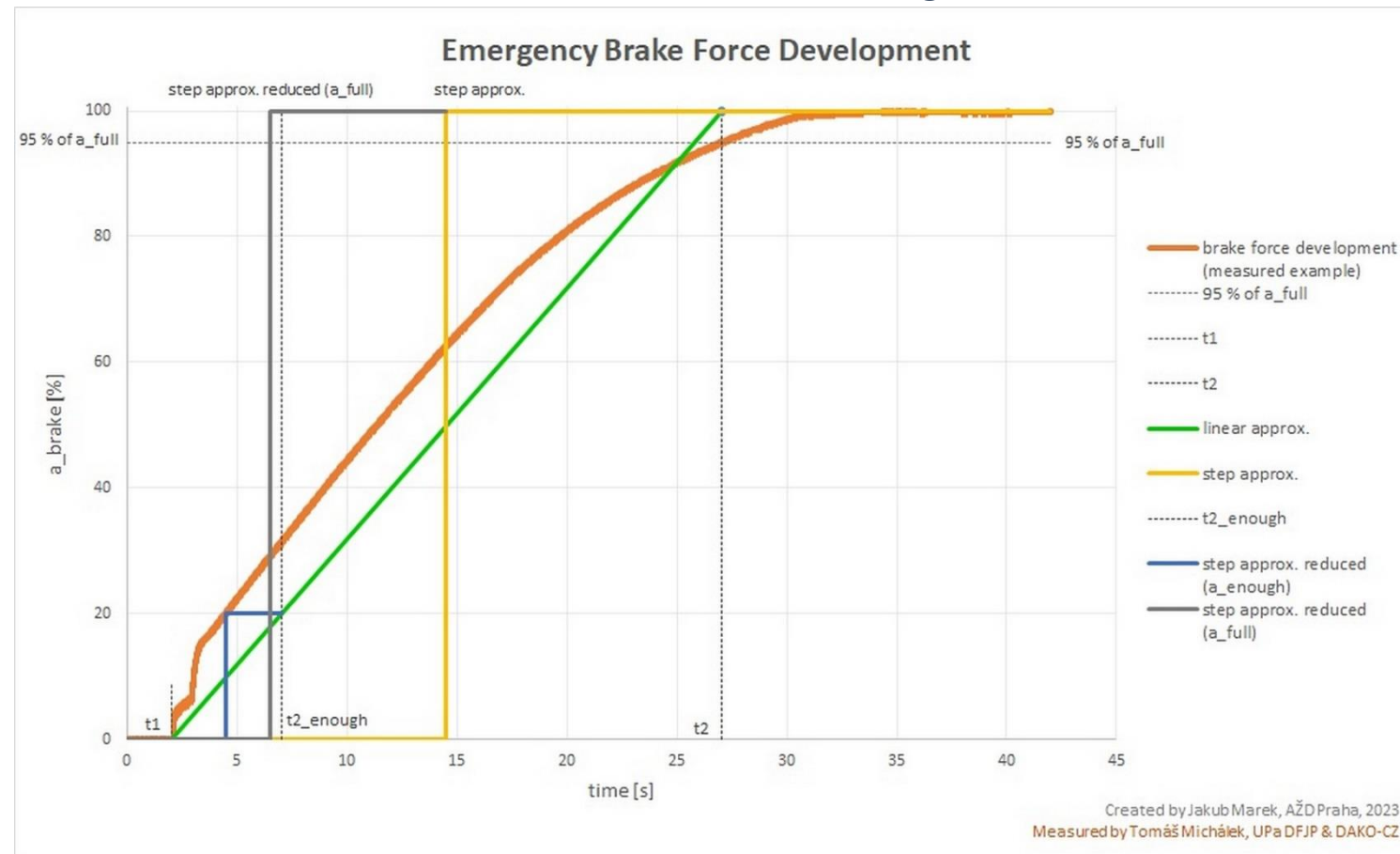


– When the optimisation should be done?



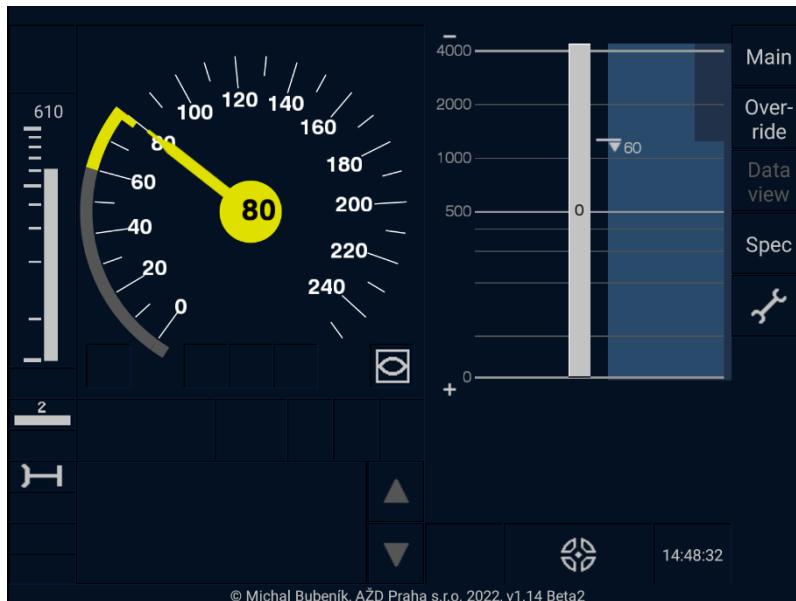
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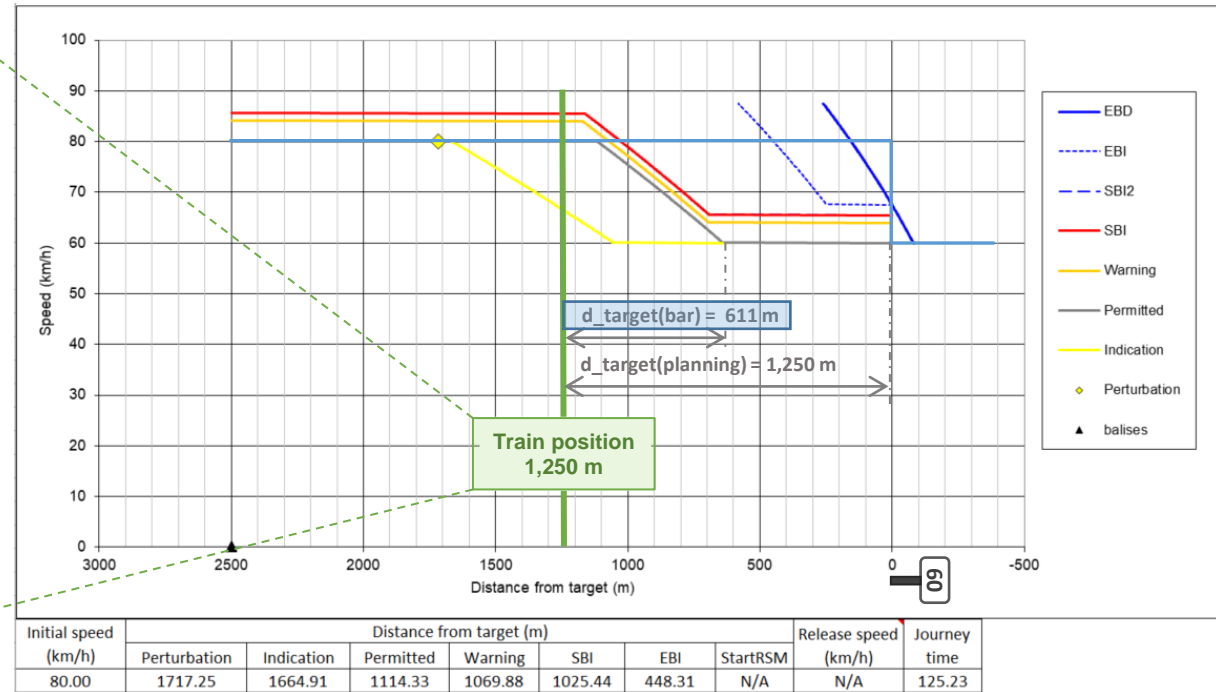


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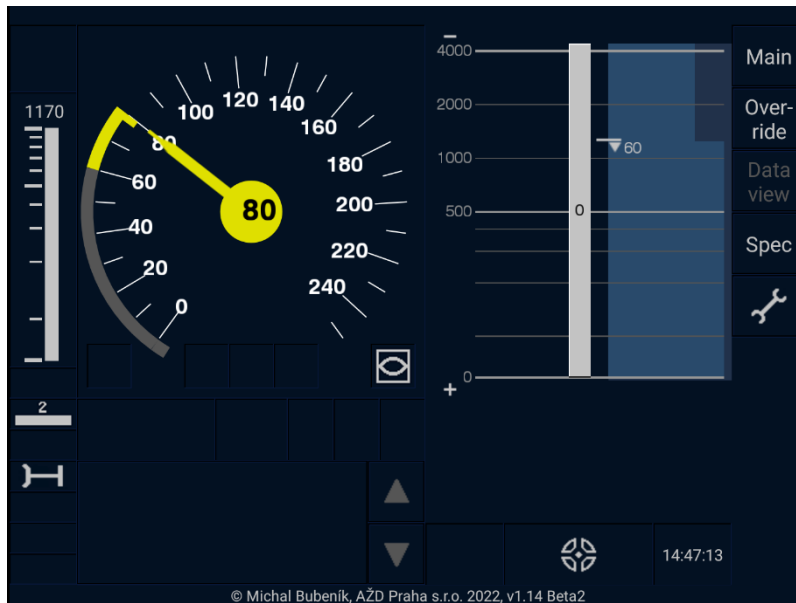


Freight train, 673 m, braked in P mode, 87 BWP; SB in TSM allowed

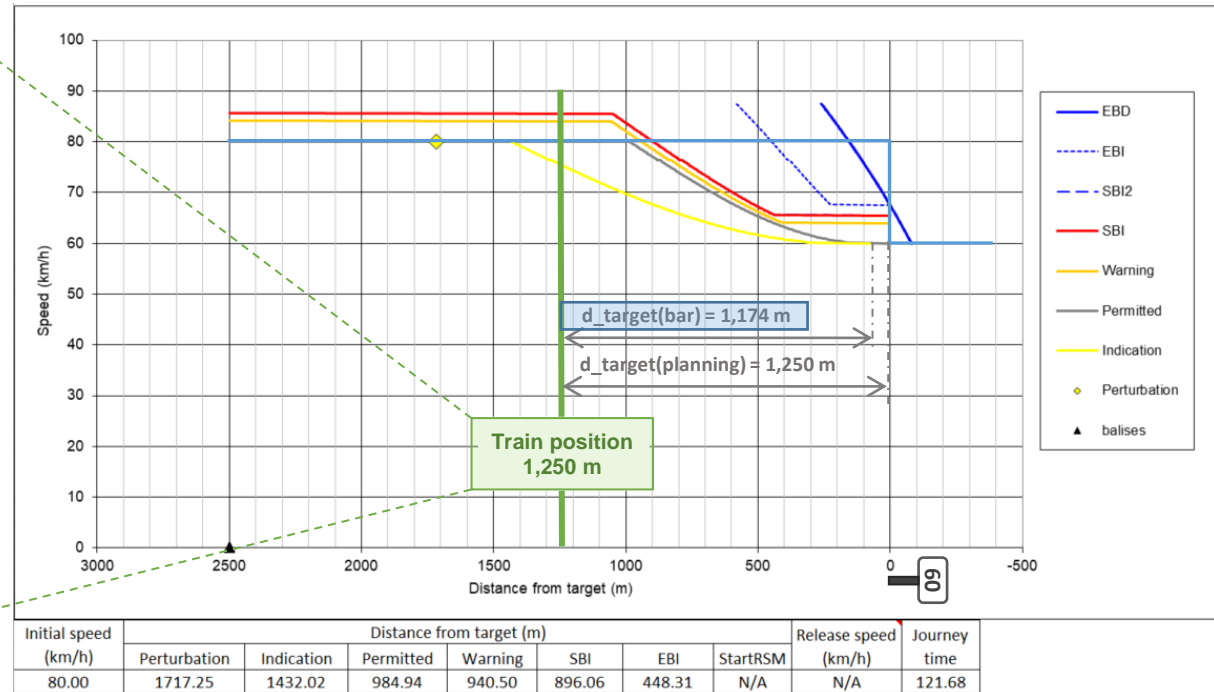


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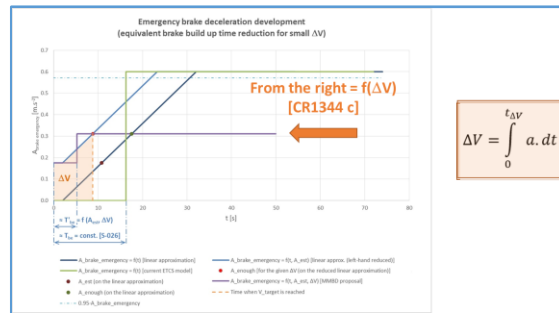




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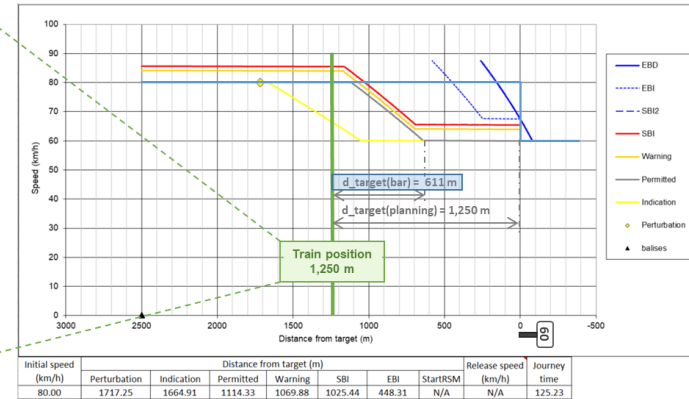
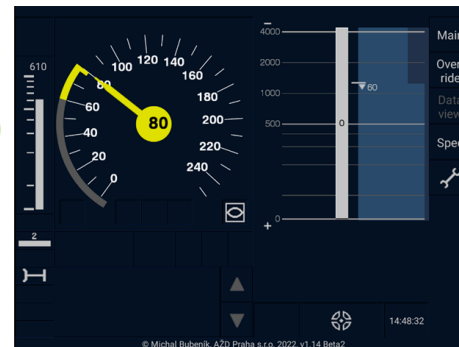
## Optimisation (reduction) of the brake build-up time ( $t_e$ ) – comparison B3R2 vs. B4R1:

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

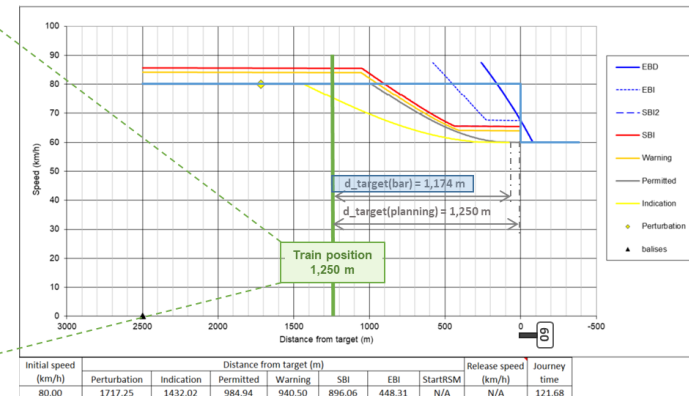
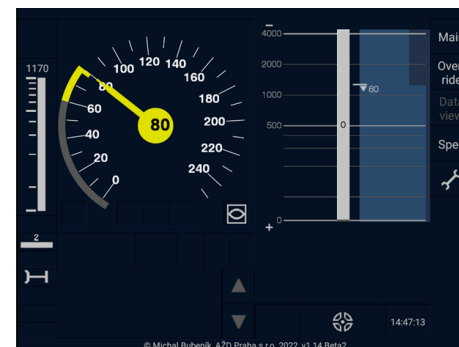


- validated against UIC measurements (> 4 000)
- tested by train drivers in NL (ProRail, NS)

### B3R2-spec:



### B4R1-spec:



### NEO Simulator



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

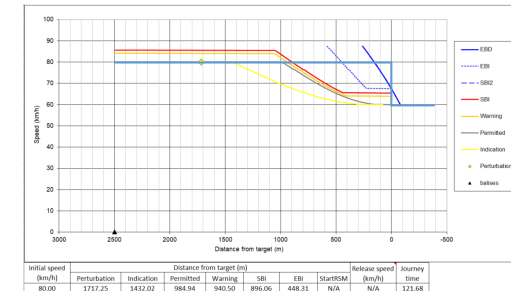


# CR1344 (optimisation of the brake build-up time)

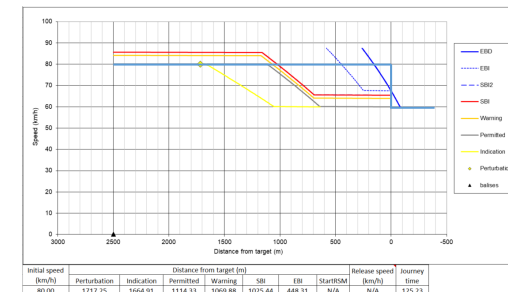


## ■ Optimised braking curves in B4R1 and **backwards compatibility**

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



- **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*



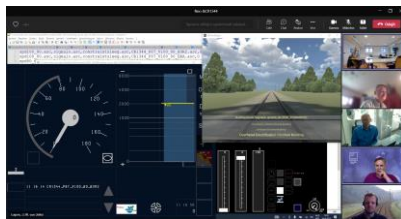
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- NEO simulator (ProRail)

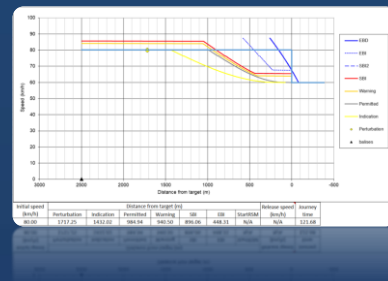
- real dynamics of the ride
- real train drivers
- to validate the tested solutions (advantages/ /disadvantages)



# Thank you for your attention!

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