

# High Speed Technologies for Nordic Conditions

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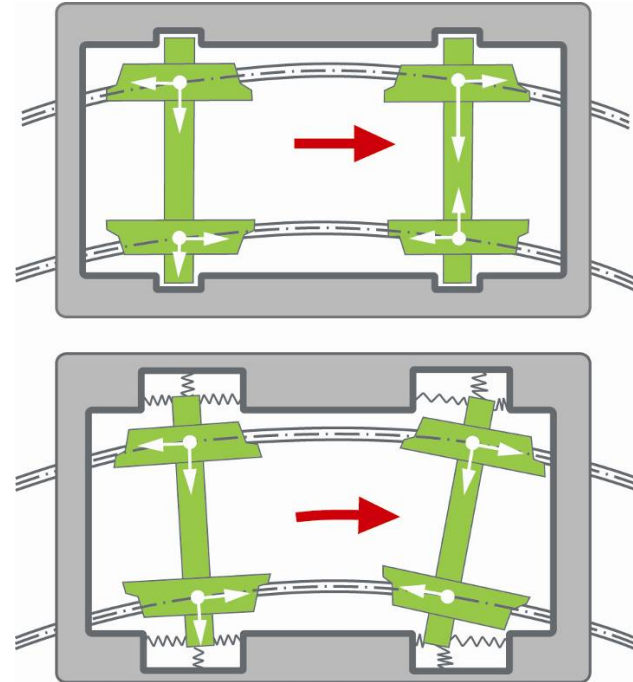
# What do we want?

Gröna Tåget will make it more attractive to travel by train through:

- Shorter travel times
- Lower costs, enabling cheaper fares
- An attractive, functional passenger environment with a high level of comfort for all
- Higher capacity
- High environmental performance
- Reliable in nordic winter conditions

# More value for infrastructure owner – Track-friendly self-steering bogie

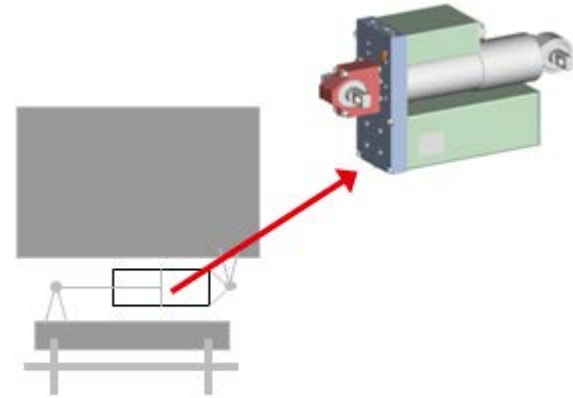
- Track forces typically 60 % of limits
- Certified for 250 km/h and 1.2 m/s<sup>2</sup> (180 mm cant deficiency)
- Has been favourably tested at 303 km/h on a track just meeting requirements for 200 km/h
- Based on 25 years of experience with track-friendly self-steering bogie



- ✓ Type tested
- ✓ Reliability tested
- ✓ Revenue service ongoing for now 500 000 km

# More value for travellers: Active Suspension

- 1) Keep carbody in centred position in curves
  - Wider carbody possible
  - Better cross wind stability
  - ⇒ Better ride comfort by avoiding bump stop contact
  - ⇒ Possible to run at high speeds in curves
- 2) Better ride comfort
  - ⇒ Same ride comfort at 250 km/h as without active lateral suspension at 200 km/h



- ✓ Type tested
- ✓ Reliability tested
- ✓ Revenue service ongoing for now 500 000 km

# More value for environment and performance: Permanent Magnet Motor Drive


- Higher efficiency and power-to-mass-ratio
- Reduced energy consumption
- Simplified cooling



- ✓ Type tested
- ✓ Reliability tested
- ✓ Revenue service done for 505 000 km

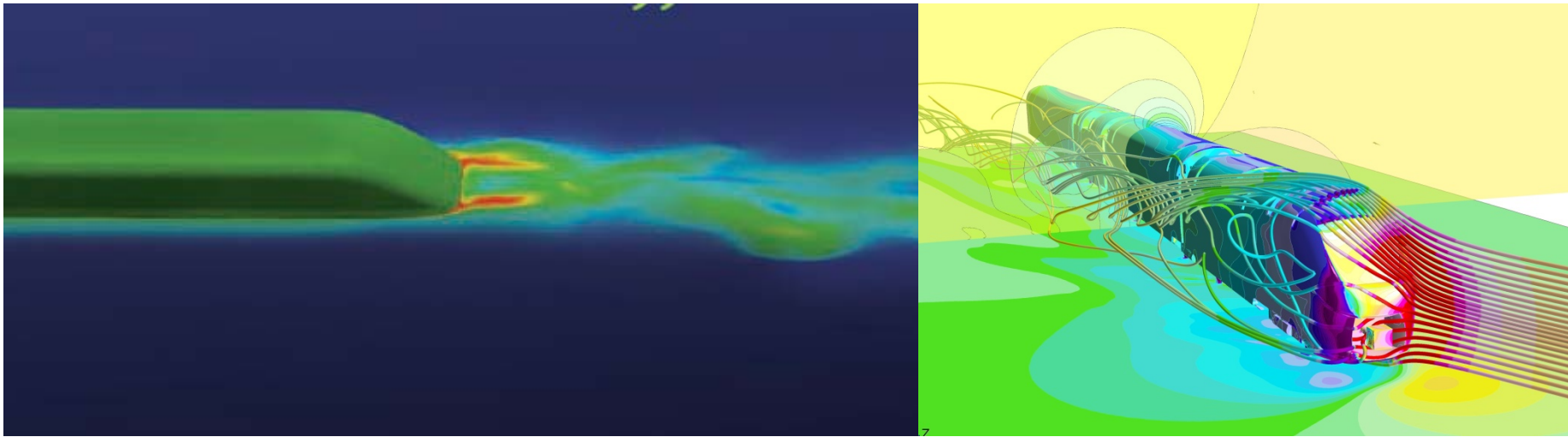
# More value for reliability: Design for winter conditions

- Systematic approach from start of design
- Low temperature
- Humidity and Condensation
- Snow, different conditions
- Melting and freezing
- Ballast projection (pick-up)
- De-icing needed regularly

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|---|--|---------------------------------------|------------------------|----------------|
| <b>Winter Design</b><br>Guidelines for Railway Vehicles   |  |                                       |                        |                |
|    |  |                                       |                        |                |
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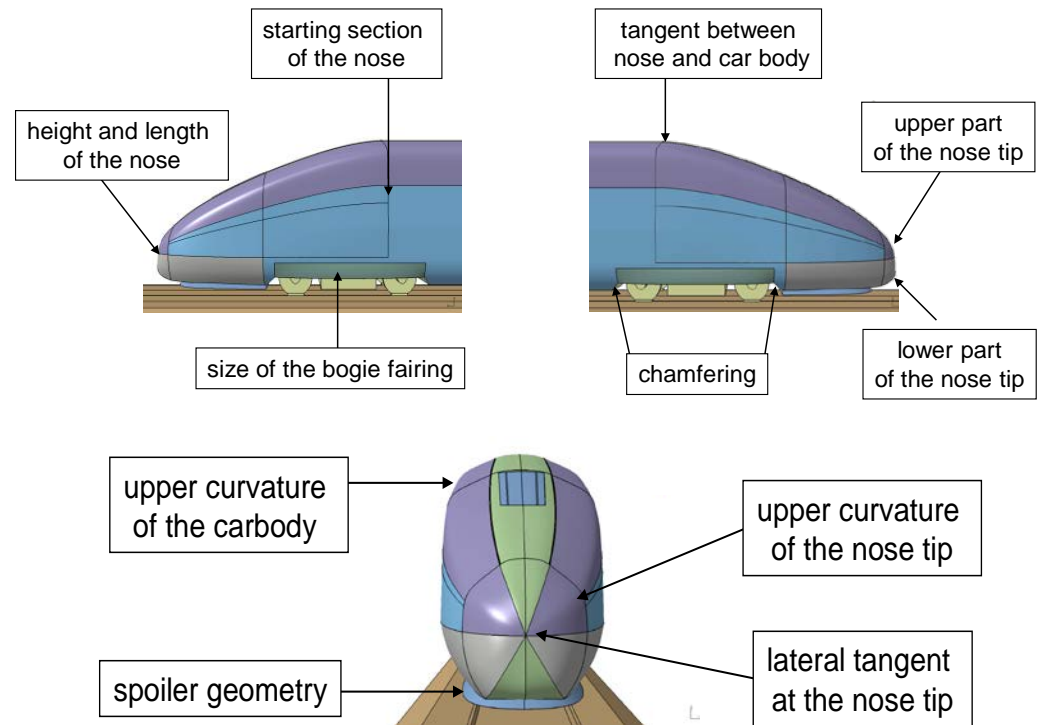
# More value for environment and performance: Aerodynamic optimisation

- Reduction of drag saves energy and traction power
- Drag and Cross-Wind Optimisation



# More value for environment and performance: Aerodynamic optimisation

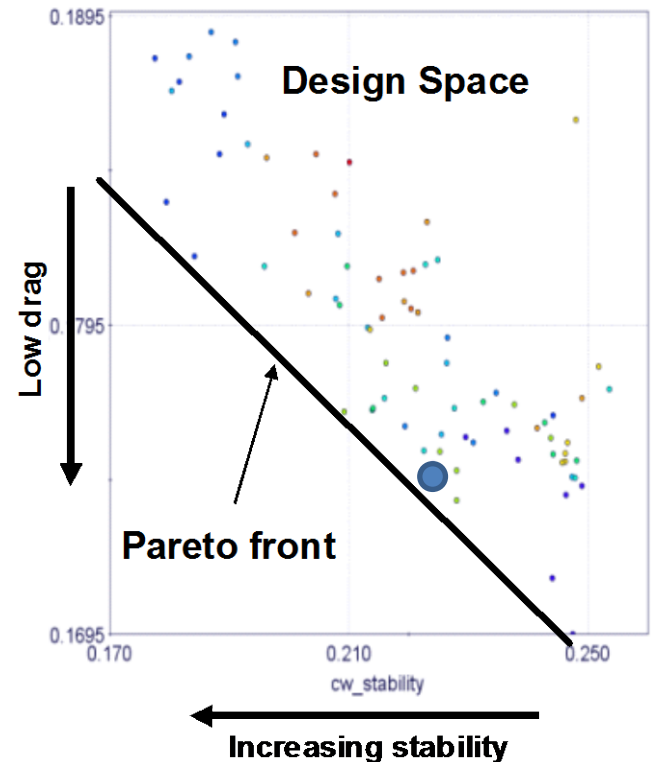
- Parameterized model defines the variables and boundary conditions
- Computer optimisation by using the parameterized model
- Goal function is reduce drag while keeping the cross wind safety





# More value for environment and performance: Aerodynamic optimization

- Thousands of “virtual wind tunnel tests” in the computer used to find the very best shape
- Main result shows 20 – 30 % lower drag and 10 – 15 % lower energy consumption
- Installed power can be reduced with lower cost
- Lower energy cost for operators



# Why did it work?

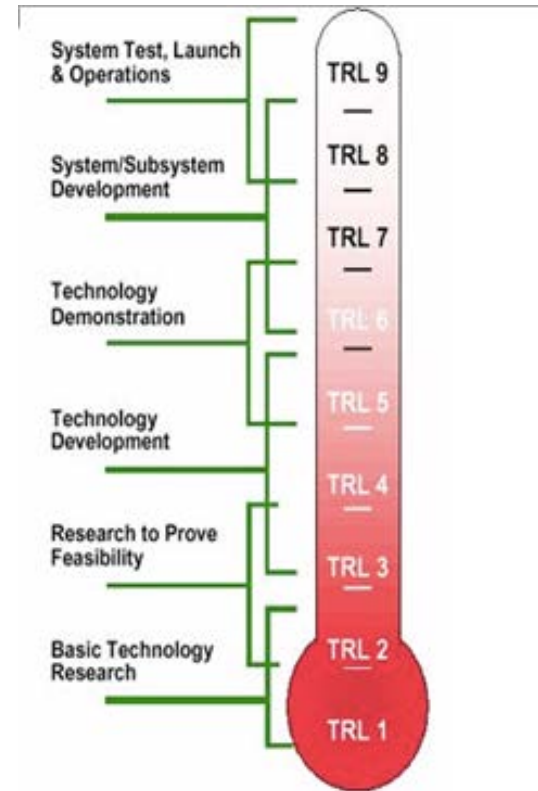
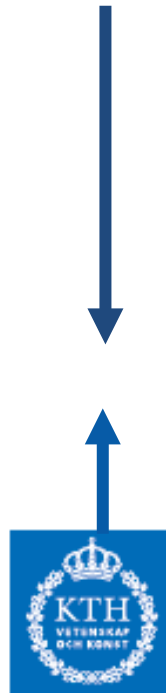
Multiple partners and multi interests in a R&D project !

- Create a common understanding and objectives
- Create a team relation
- Make win-win setup (understand all the agendas)
- Share information and experience
- Develop a communication plan and explore that
- Involve Management in right levels and in right times
- Create flexibility in leadership and navigate between structure and creativity
- and handle challenges ...

# Unique relation with industry - university

- Employ PhD educated in industry
- Strong involvement in R&D Programmes
- Personal relations
- Senior researchers, PhD and Master thesis students for R&D programmes

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# Unique project set-up creates new values



Thank you for your attention !