



RAILWAY GROUP
Centre for Research
and Education
in Railway Engineering



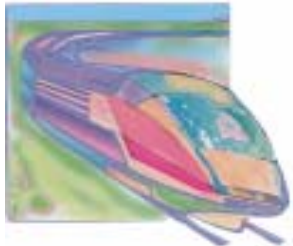
The “GreenTrain” Program

An overview by

Evert Andersson

Professor & Program coordinator

everta@kth.se





RAILWAY GROUP
Centre for Research
and Education
in Railway Engineering



“GreenTrain”

A joint program between

Banverket (Swedish National Rail Administration)

Bombardier Transportation (Sweden)

SJ AB (largest train operator)

Transitio AB (train leasing company)

KTH (Royal Institute of Technology)

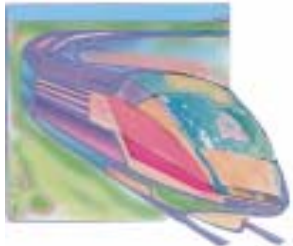
(program coordinator)

Also involved are at the current stage are

VTI (Swedish Road and Transport Research Institute)

Interfleet Technology AB

CTH (Chalmers Technical University)





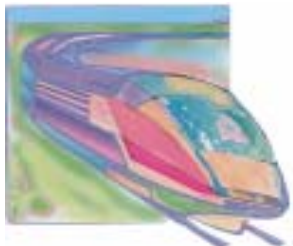
RAILWAY GROUP
Centre for Research
and Education
in Railway Engineering



is a research, development and demonstration program aiming at strengthening the ability of **developing** and **purchasing** the next generation of high-speed passenger trains for efficient and attractive passenger transportation at Swedish conditions.

It is also aimed at strengthening the ability to influence the **all-European standardization** (TSI, CEN).

In general terms the future high-speed trains must be **fast** and **attractive** to passengers, **economically viable** and still be friendly to track and **environment**.





Background

Current Swedish **12-year plan** (2004-2015)

- Heavy rail investment program (11 billion Euro)
- High-speed links & freight corridors
- Capacity enhancements
- Upgrading of existing lines.

Still high-speed trains will, to a large extent, **share tracks with heavy freight trains** (axle load to up to 25 metric tonnes!)

Currently the Swedish high-speed train **X 2000** is in successful operation with SJ AB since 1990.



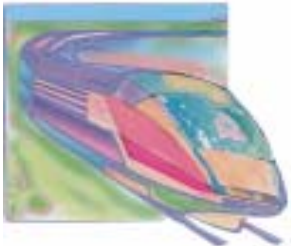
Top speed 200 km/h; average speed 130 – 165 km/h;
tilting carriages and radially steering bogies, cant def 245 mm.

Although upgraded in recent years, a new generation of trains is foreseen to be introduced within in the next 6 – 10 years.



Next generation High-speed trains (for Sweden)

- **Shorter journey time** (on upgraded and new infrastructure; top speed at least 250 km/h or higher)
- Improved **passenger comfort** (seating and working ability, noise & ride, pressure tightness, reduced motion sickness).
- **Space efficient, flexible** and attractive **interiors**.
- Improved **environmental performance** (energy, noise):
Energy consumption (per seat-km) should be reduced.
No higher **noise level** at 250 km/h (cf. 200 km/h).
Meet TSI demands.



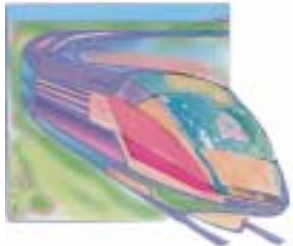


Next generation High-speed trains desired features for Swedish (Nordic) conditions

- **Track friendliness** (low track forces and wear, smooth ride on non-perfect track)
- **Flexible train consist** (3 – 12 cars), by multiple coupling (means at least 2 active pantographs).
- **Carbody tilt** (most likely)

Finally, very important is

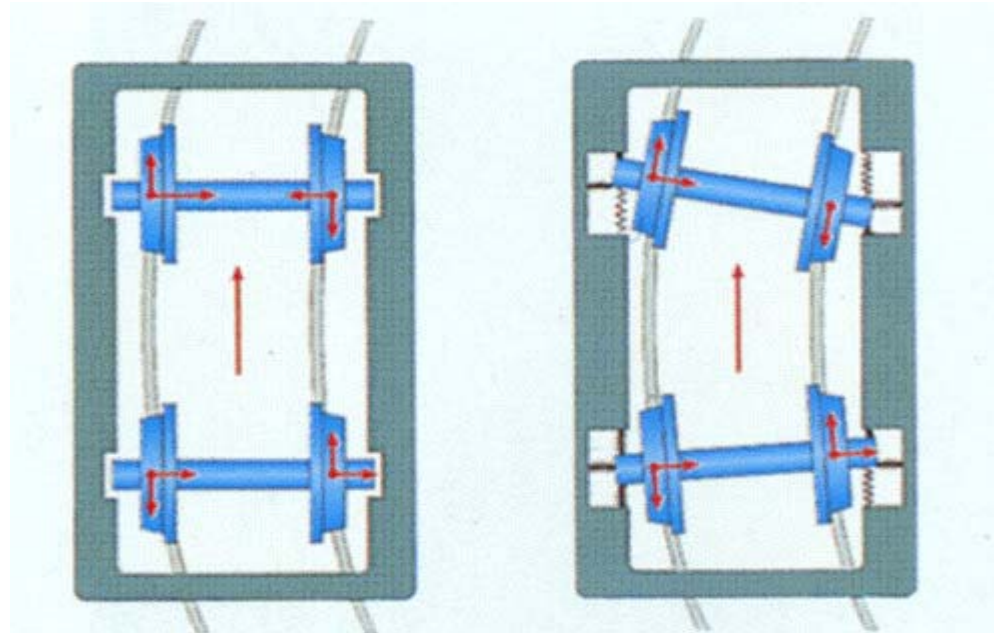
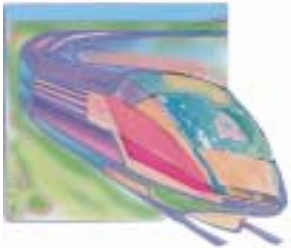
- **Reliability** (also under harsh winter conditions).
- **Reduced cost** (per seat-km) by 30 – 40 %, as to compete successfully with low-cost airlines.





Current program 2005 – 2008 particular focus on

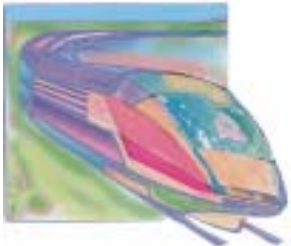
- **Track-friendly bogies** (passive self-steering + mechatronic)
Track forces + running stability
measured by instrumented wheels
- **Ride qualities** on non-perfect track (active lateral suspension)





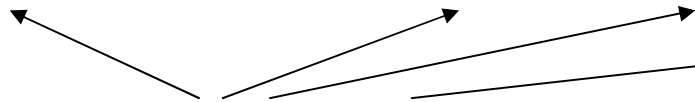
For 2005 – 2008 also testing of

- **Noise reduction** (external & internal).
 - Vehicle-borne and rail-borne shields and attenuation devices.
“(1 + 1 = 4)”
 - Structural-borne internal noise.
 - Resident’s annoyance for different noise characters.
- **Current collection**
(improved pantographs on existing overhead catenary)
- **Aerodynamics**
- **Winter climate protection** at high-speed operation.

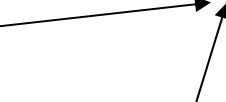




STEP 1
2006-07



Modified radial steered bogies

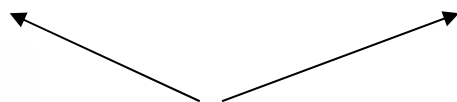


Bogie noise shield

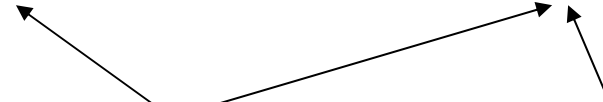
Testing 2006 – 2008: Modified "Regina" wide-body EMU train



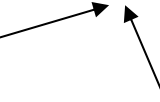
STEP 2
2007-08



**Modified existing radial
steered bogies with
active lateral suspension**



**Mechatronic bogies
based on existing bogies**



Bogie noise shield

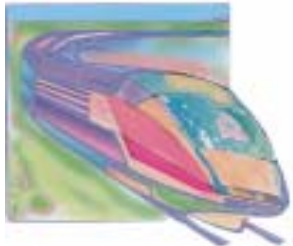


Source: Bombardier



Further for 2005 – 2008 also

- Studies on future **carbody tilt** systems performance & measures to reduce motion sickness
- Influence on **high-frequency wheel-rail forces** (100 – 1000 Hz) with respect to wheel & rail damage.
- Reductions of energy consumption
- Studies on **market demands**,
performance requirements speed, cant deficiency, power)
cost & revenue analysis,
suitable **track geometry**,
capacity in mixed rail traffic,
considerations of the general **European standard**,
etc ...
- Development of appropriate **specifications**.





RAILWAY GROUP
Centre for Research
and Education
in Railway Engineering



will be extended

from year 2007. In all, nine areas are defined:

- Basic requirements, concept studies.
- Market and traffic.
- Passenger requirements and preferences.
- Train crew requirements, including driver's cab.
- Train cost analysis – Design for manufacturing.
- Environmental performance – noise/vibrations, particle emissions and energy.
- Propulsion, brake and control systems. Condition monitoring and information management. Structural design of (light weight) carbodies.
- Aerodynamics.
- Running gear, wheels and suspension, carbody tilt. Track friendliness.

