

Experiences from the first commercial use of IWT4 the new instrumented wheelset technology in an approval process for Germany

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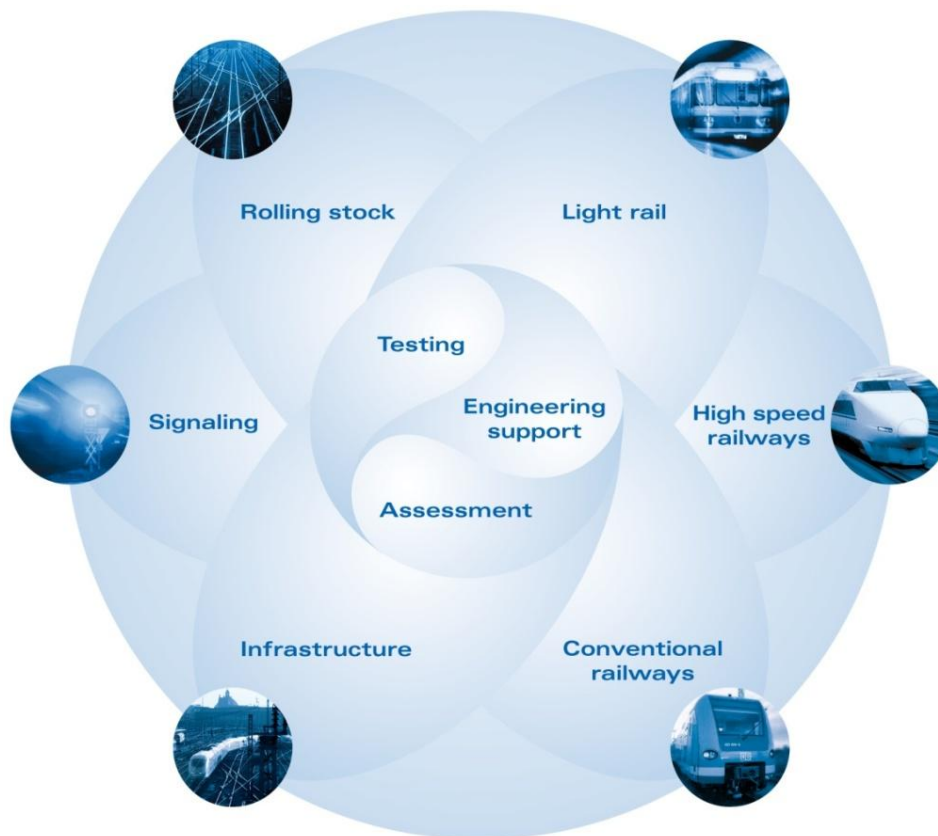
iWT4

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- Background on instrumented wheelsets
- IWT4 Technology
- Validation and approval
 - Laboratory tests
 - Field tests
 - Approval
- Summary

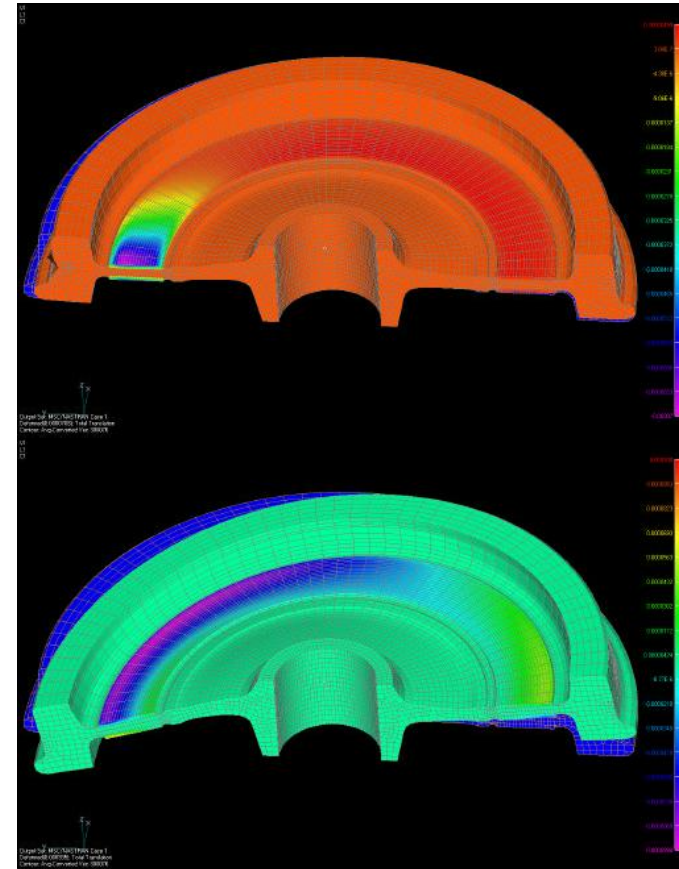
- TÜV SÜD Rail GmbH has taken over and integrated Brunel Railmotive with the two departments „Technical Documentation“ und „Testcenter Rolling Stock“ as of August 20, 2008



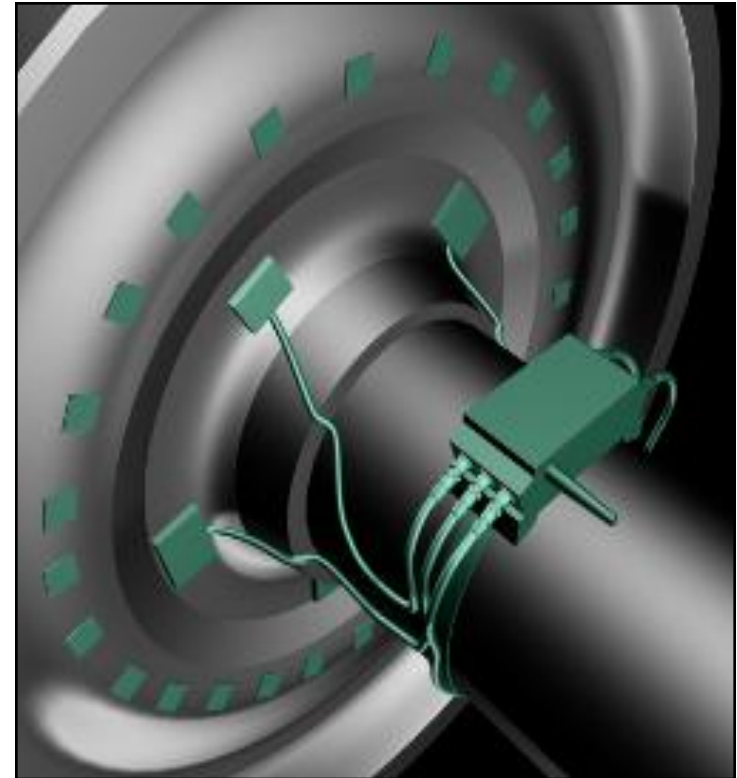
- Sweden has a long history of Instrumented wheelsets (IWVs), starting in the 1950's
- In 1960's Swedish wheelsets were able to measure both vertical and lateral forces
- In 1990's vertical track forces were able to be measured in the kHz range



- Strain signals from each gauge provide a “strain field snapshot” of the entire wheel at any instant.
- A system identification process is undertaken.
- IWT4’s algorithms learns about the characteristics of the wheel.
- IWT4 does not require a special wheel geometry.
- A vehicle’s standard wheelset can be used.



- During measurement a “strain field snapshot” of each wheel is sent to an onboard processor.
- Algorithms determine the wheel angle from the strain field
- The learned wheel characteristics are then applied to determine the wheel-rail forces





- As we use an over determined system, IWT4 can produce a “quality signal” which gives a real-time indication that the results produced are reliable.
- Biggest advantage is flexibility, currently we measure vertical, lateral, longitudinal forces, and lateral contact position.
- However in principle if a load is significant enough to cause a strain in the wheel, and it is possible to calibrate, then we can measure it!

IWT4 – The Development



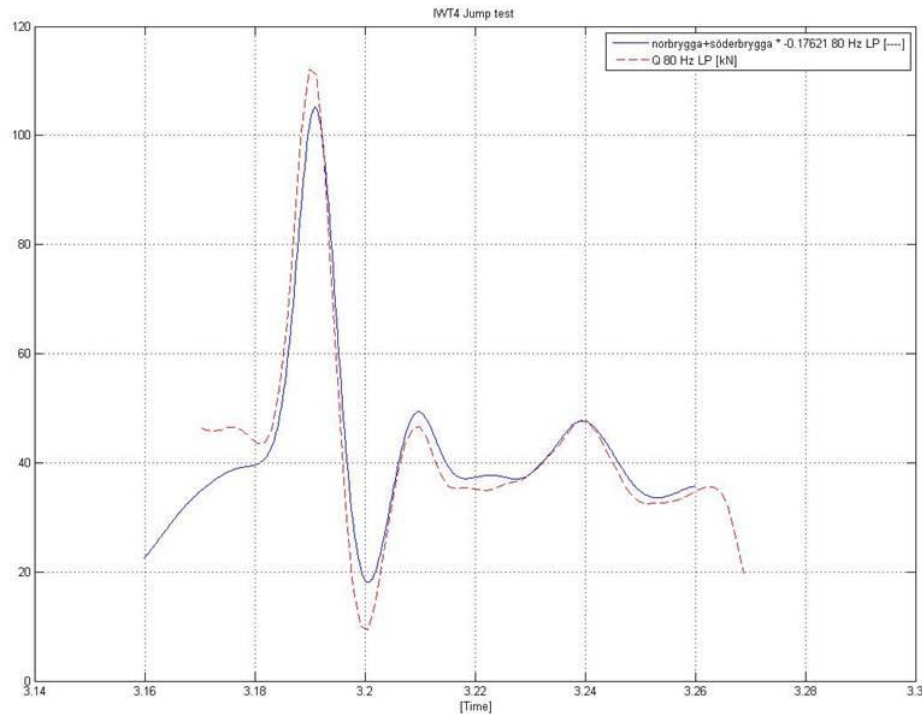
Rail

- Development wheels built for:
 - 1 x Conventional freight car wheelset
 - 1 x Talgo EMU wheelset (Straight web & stub axle)
 - 1 x EMU – Driven Wheelset
 - 2 x High speed container wagon wheelsets (Braked)



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- Static calibration rig tests
- Simplified roller rig tests
- On track testing, with plausibility checks via accelerometers
- Check of the dynamic response by a “jump test” onto a section of instrumented track



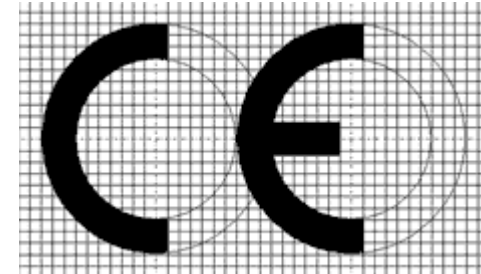
Interfleet Technology AB - test center

IWT4 – The Approvals



Rail

- EU Directives
 - Tested and compliant with the relevant EU directives and CE marked.
- Eisenbahn Bundesamt (EBA) approval
 - Began in 2006
 - An EBA approved independent assessor appointed (Gutachter)
 - Assessment of the wheelsets performance by both static rig tests (based on ORE B10) and from field tests
 - Completed April 2008



First EN14363 Field tests



Rail

- Vehicle running dynamics test in the approval of car transport unit in Germany, Eisenbahn-Bundesamt (EBA)
- EN 14363, normal method, complete procedure
- Test runs in Switzerland
- Short coupled 2x2 axle unit
- Side buffers between cars
- $v = 120 \text{ km/h}$, $uf = 130 \text{ mm}$

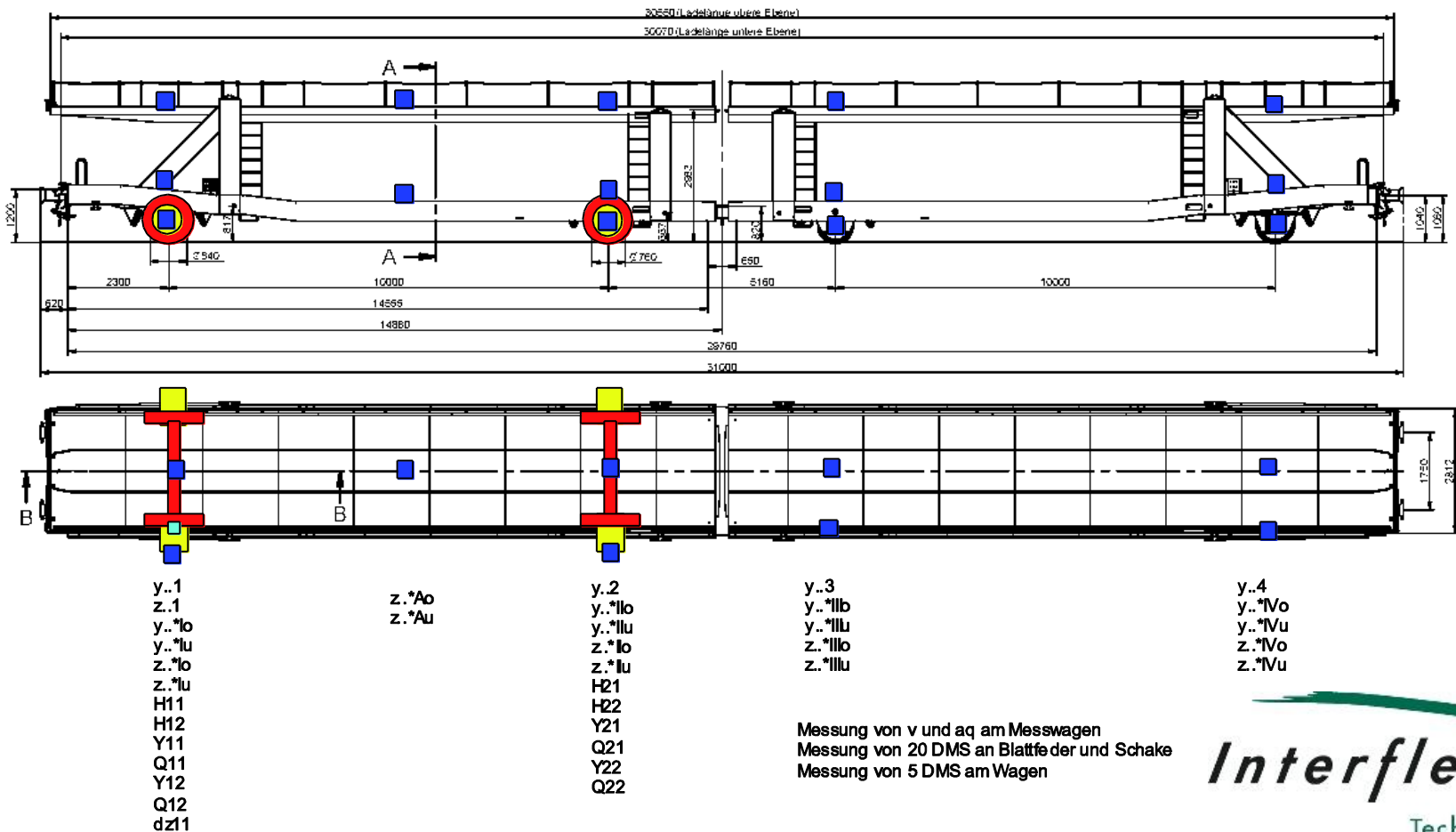


Instrumentation plan

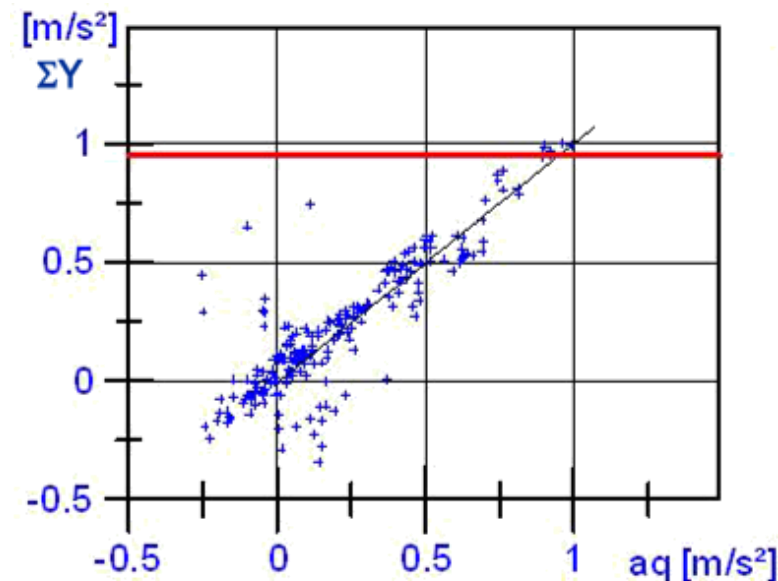


Rail

- 2 IWT4 of 840 mm and 730 mm (red), axle box forces (yellow), accelerometers (blue)



- Plausibility by comparing $\Sigma Y/\text{mass}$ versus a_q
sum lateral forces of one car against uncompensated lateral acceleration a_q
- Plausibility checks for three curve radii classes
- Performed for all evaluation sections
- Results should all lie on a regression line of inclination at 45°



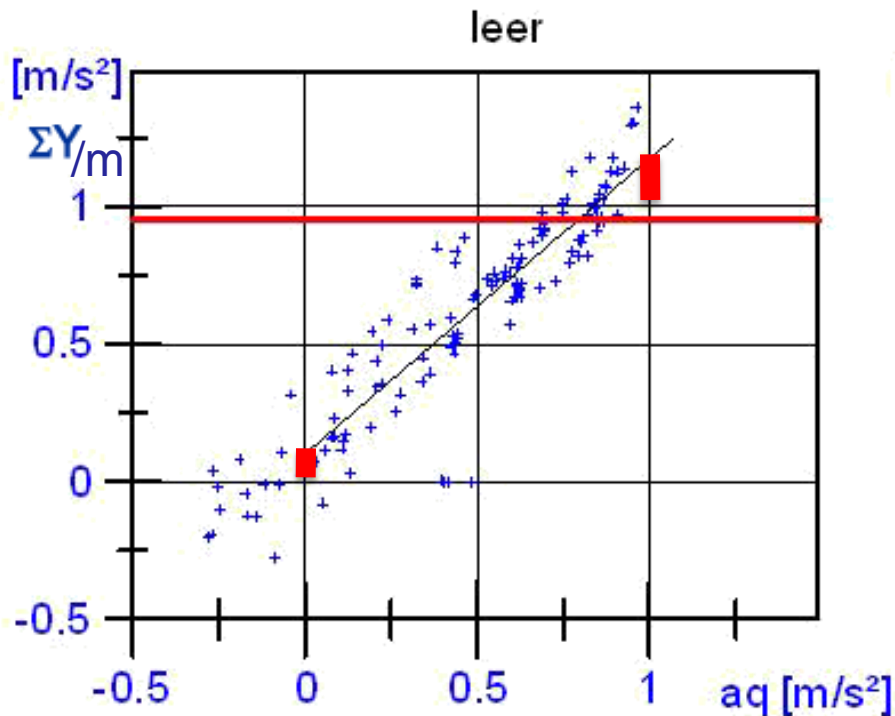
Plausibility for ΣY (250-400m radii)



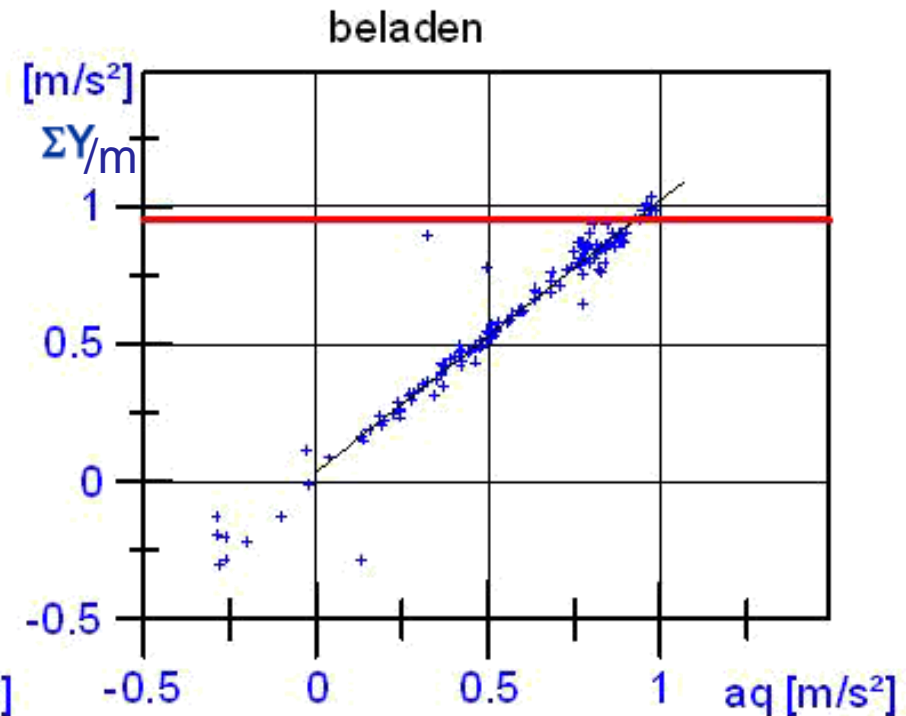
Rail

- Unloaded not (1,1), loaded closer to (1,1)
- Systematic error? Any influences not regarded?

VB 250-400m



VB 250-400m



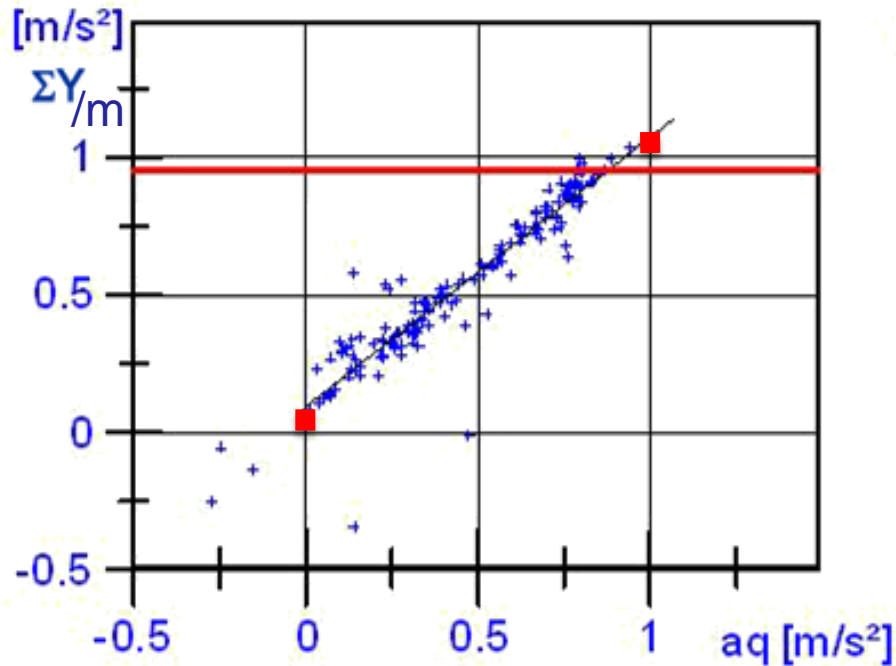
Plausibility for ΣY (400-600 m radii)



- Unloaded still not (1,1) but closer, loaded very close to (1,1) Rail

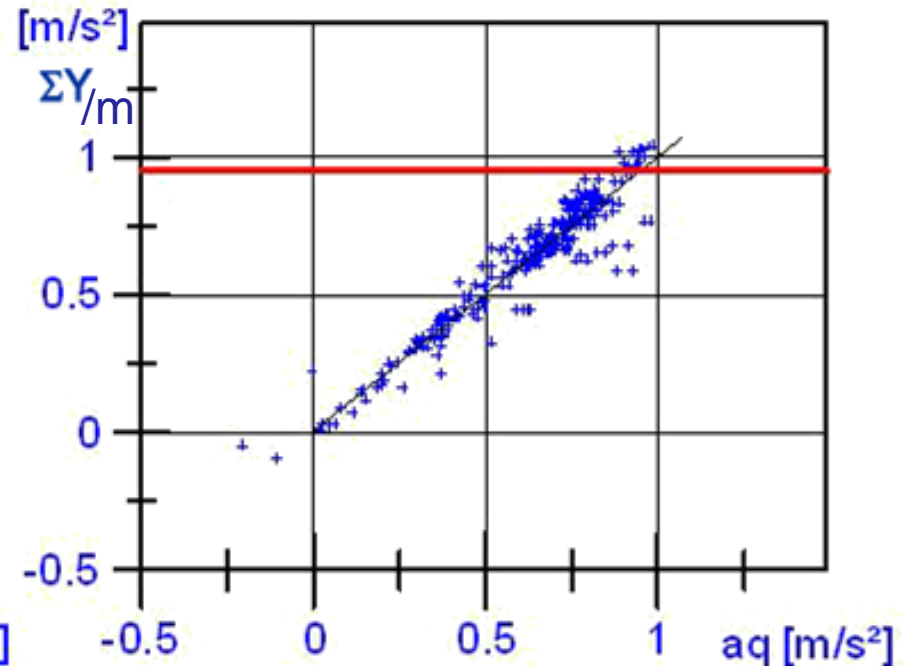
VB 400-600m

leer



VB 400-600m

beladen



Plausibility for ΣY (600-3000m radii)

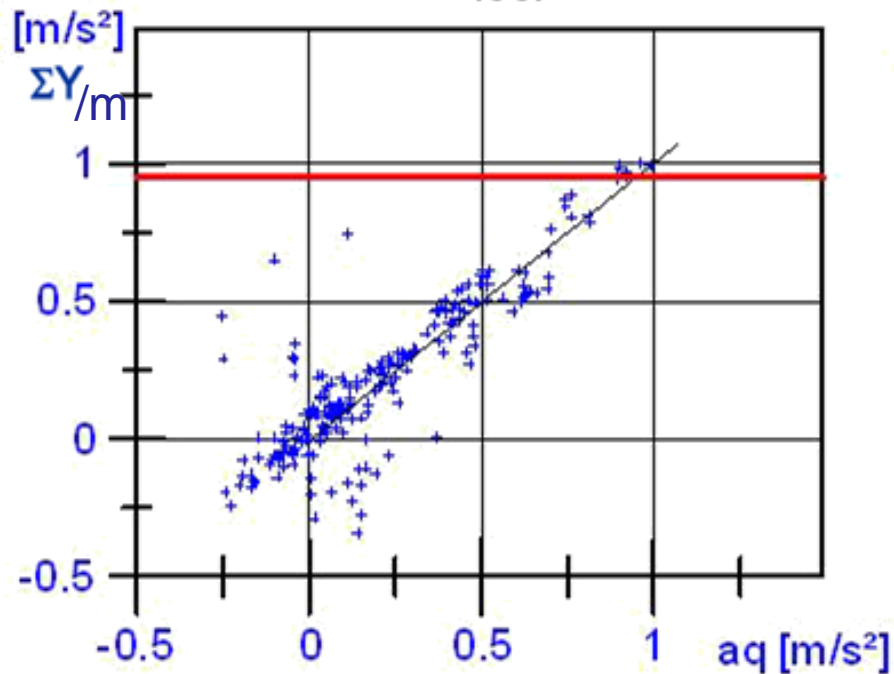


Rail

- ΣY was not calculated correctly
(Influence of short coupling was not taken into account.)

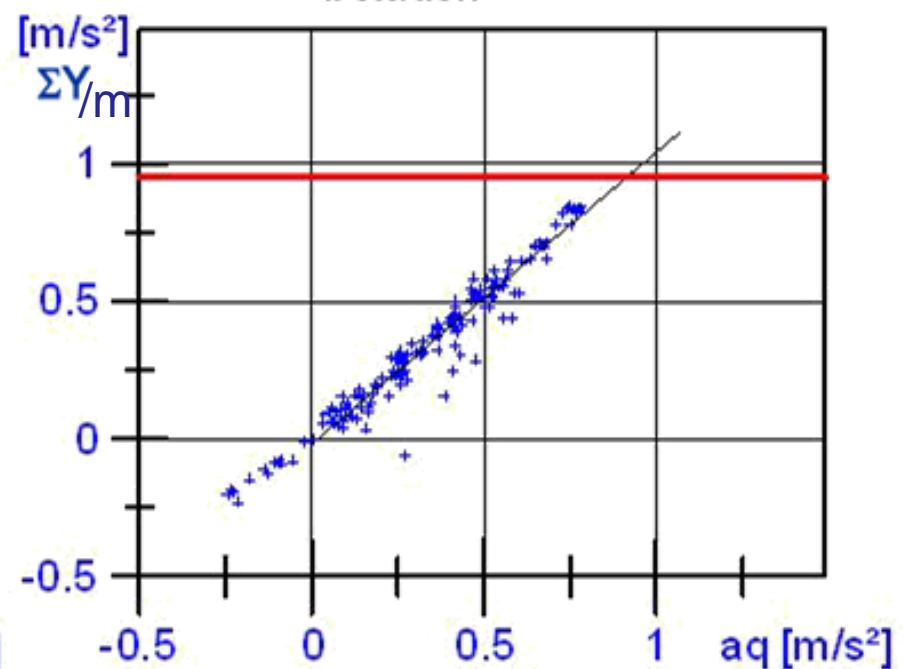
VB 600-3000m

leer



VB 600-3000m

beladen



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Approval by Eisenbahn-Bundesamt (EBA)



Rail

Traction and braking	<p>IWT4 can be used on <u>ALL</u> configurations with the following exceptions:</p> <p>If brake discs are mounted to the wheel disc they must be removed.</p> <p>Currently “Tube Drives” (Hohlwellenantrieb) cannot be instrumented</p>
Maximum cant deficiency	300mm (+10%)
Maximum speed	280 Km/h (+10%)
Maximum static axle load	250 KN



- Extensive laboratory tests exceeding the ORE B10 tests have been performed on IWT4
- Field tests showed the reliability and quality in a railway environment
- An independent assessor reviewed these test results
- EBA approval was granted basing on these tests and reviews
- First vehicle tested and approved in Germany using IWT4