German Aerospace Center

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Safely in tunnels – DLR commences operations on a ‘world first’ – a unique train tunnel simulation facility

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A train model in the simulation facility

To make railway trains faster and more economical, their shape is decisively important. Two new research facilities at the German Aerospace Center (Deutches Zentrum für Luft- und Raumfahrt; DLR) in Göttingen are involved in developing the aerodynamically optimum shape for future rail vehicles. They will be unveiling their work to the public on Friday, 8 October 2010. The tunnel simulation facility is the only one of its kind in the world, and scientists can use it to investigate the ride characteristics of scale-model trains at speeds of up to 400 kilometres per hour. The other facility, for side wind investigations, is also unique. The investment in these two train research facilities amounted to more than three million Euro.

60-metre long facility

"We want to conduct research into high-speed trains with enhanced environmental credentials, with more lightweight construction and higher standards of passenger comfort," explained DLR Director Prof. Ulrich Wagner at the opening ceremony in Göttingen. "We are developing the technologies for the trains of the future, and are demonstrating what lies within the bounds of technical feasibility."

Europe's leading location for research into rail vehicle aerodynamics

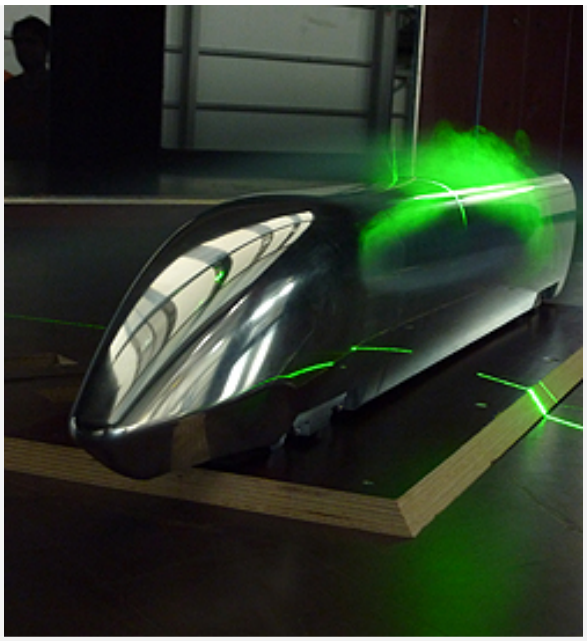
"When these two new facilities enter service, Göttingen will become Europe's leading research location for rail vehicle aerodynamics," stated Josef Lange, the Secretary of State at the Ministry of Science and Culture of Lower Saxony. "This means that the German Aerospace Center is continuing to live up to Göttingen traditions, harnessing its superlative expertise and its new experimental facilities to set new standards for research into the future of high-speed trains at the highest international levels."

Antiquity sets a good example

A leaf out of the books of the Romans

In the quest for an efficient method for accelerating model trains as rapidly as possible, the DLR researchers took a leaf out of the books of the Romans. In ancient times, they used catapults to fire arrows at their opponents. In a similar way, this modern test facility, measuring more than 60 metres in length, catapults scale-model trains up to a speed of 400 kilometres per hour. These trains are built to scales of between 1:20 to 1:100. Using cutting edge measurement techniques, tests are conducted into the aerodynamic behaviour of high-speed trains in a tunnel. A particularly critical moment is the point where a train enters a tunnel. The effect is akin to the piston moving inside an air pump. A pressure wave is created which can give rise to the same kind of explosive noise emissions as supersonic aircraft. The researchers in Göttingen aim to prevent this from happening.

Making side winds into a predictable threat



Flow visualisation using laser

High-speed trains encounter another kind of problem: "At speeds of 300 kilometres per hour, the front section of a double-decker train can start to lift, making it prone to tilting in strong side winds, despite the fact that the train may weigh several hundred tons," explained Prof. Dillmann. This is why a side wind test facility has been constructed in Göttingen. It can be used to simulate the forces and pressures which side winds can exert on a train. In turn, this guides research into ways of reducing a train's susceptibility to the effects of side winds.

DLR's Next Generation Train Project

At DLR, the threads are now being drawn together in the 'Next Generation Train' project to create the train of the future. The DLR Institute of Vehicle Concepts in Stuttgart is heading an interdisciplinary team comprising eight DLR institutes. The central objective is to drive forward research and development efforts into the next generation of high-speed trains. In this endeavour, DLR scientists are examining a host of issues: how train speeds can be increased while at the same time halving specific

energy consumption levels, how to make trains quieter, more comfortable and safer, how to optimise wear characteristics and lifecycle costs, how to leverage modularisation and system integration concepts to build trains more cost-effectively and how to design development and approval processes more efficiently.

DLR’s Next Generation Train project

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