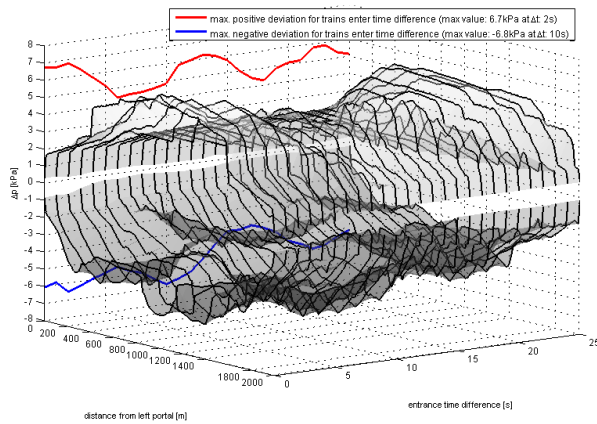
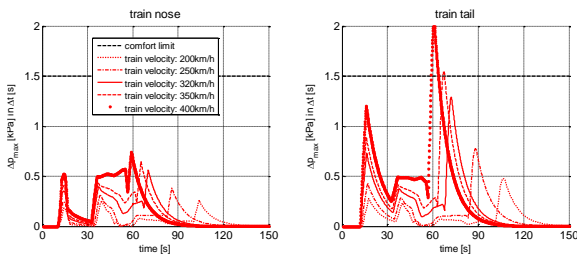


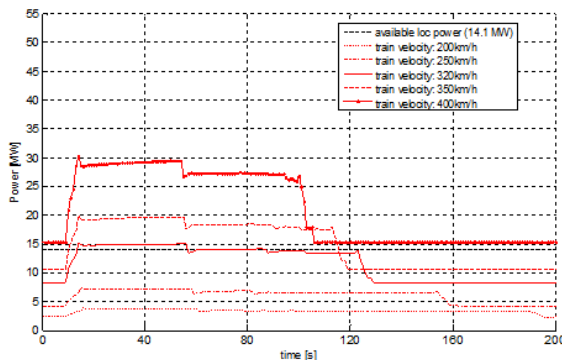
Free cross-sectional area of rail tunnels in Europe



Positive and negative pressure variations from normal pressure due to train crossings in tunnels



Maximum pressure change at train nose and train tail within 4 s time interval for different train velocities



Traction power requirements during the tunnel passage of a train with different train velocities

Description

The Swedish transport authority Trafikverket is responsible for the development, maintenance and support of the railway infrastructure as well as the traffic management of the national railway system. Amongst others, Trafikverket defines the future high-speed rail network in Sweden. This includes the specification of the tunnel features of the future high-speed lines.

In case of high-speed rail traffic, the aerodynamic conditions in tunnels and on trains must be considered for the tunnel design. These aerodynamic conditions were determined by HBI between 2008 and 2016 in comprehensive aerodynamic studies, in order to provide a basis for decision-making regarding the properties of tunnels to be implemented.

Services

HBI examined the following aspects in order to clarify several basic questions regarding tunnel aerodynamics:

- compilation of essential tunnel data of high-speed rail lines of the European rail network
- overview of the rolling stock of the European high-speed rail network
- survey of the transportation services and operating conditions of high-speed rail tunnels
- analysis of risk of non-acceptable micro-pressure waves (sonic boom) and corresponding countermeasures
- description of pressure comfort criteria in Europe

As a basis for the conception of the future high-speed rail lines, HBI also conducted a parametric study (1D simulations) to determine the impact of various train and tunnel parameters on the tunnel aerodynamics (pressure variations in the tunnel, pressure comfort on the train, required traction power, etc.). Within the framework of this study, the following parameters were varied:

- *train parameters:* speed, length, mass, etc.
- *tunnel parameters:* free cross-sectional area, length, wall friction coefficient, inclination, etc.

In total, more than 2'500 simulation cases were carried out and evaluated by HBI.