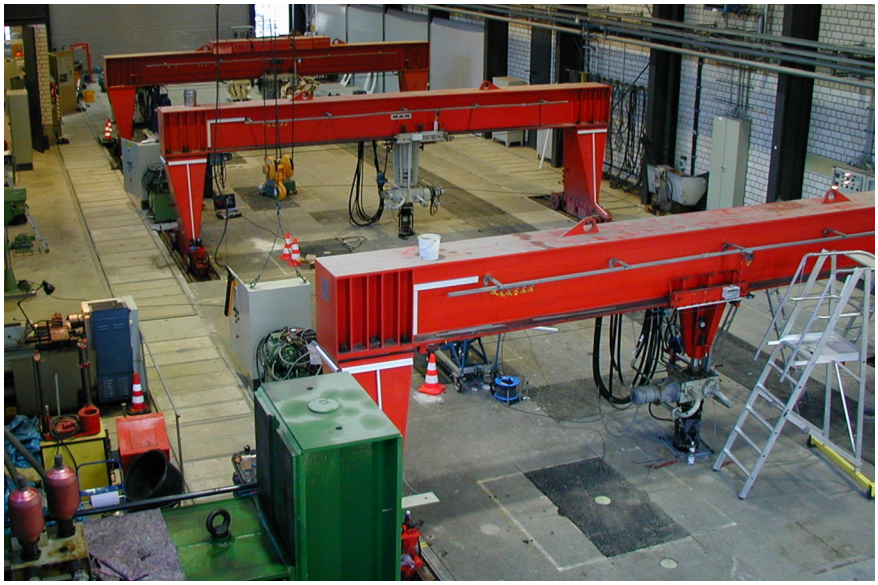
Dynamic Full Scale Pavement Test Facilities



The BASt indoor asphalt pavement test track

A pavement is a multi-layered structure composed of a variety of materials. Its capability to bear traffic loads depends decisively on the selected layer system, the thickness of each layer as well as on the quality of the chosen building materials and the workmanship. Two large indoor full scale pavement test facilities have been set up by the Federal Highway Research Institute (BASt) for dynamic testing of entire pavement structures as well as individual material characteristics under defined boundary conditions. These test facilities enable the execution of dynamic accelerated load tests to assess the bearing capacity and the mechanical performance of different pavement structures with different materials.

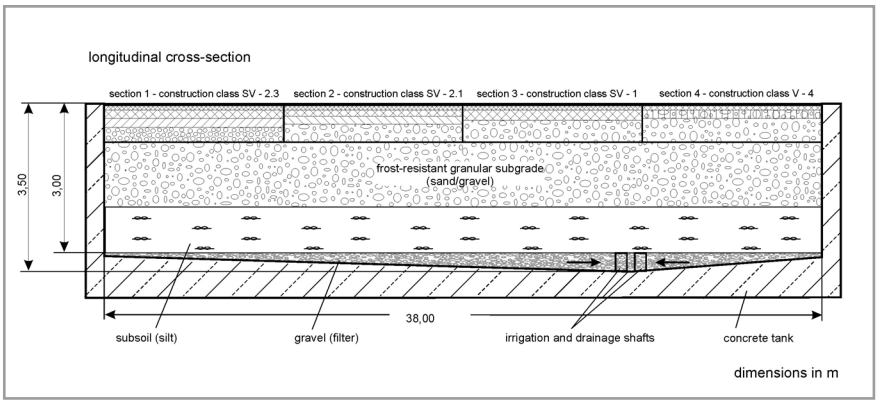
Inside the test halls, entire pavement structures can be built inside two up to 3.5 metres deep concrete tanks by using conventional road construction machinery according to actual practice. Once built, the pavement structures can be subjected to various climatic conditions. To simulate in-situ ground water table, the concrete tank can be flooded with water to any level required. The pavement surface can be irradiated with infrared heaters to simulate heat and solar radiation. A cooling system installed under an insulation cover above the pavement surface is used to simulate frost periods and freeze/thaw alternations by inducing top-down freezing.

The accelerated simulation of traffic loads is achieved by hydraulic impulse actuators. Each individual pulse applies a load impact of up to 5.75 tons to the pavement structure. This value represents the wheel load derived from the maximum permissible load of 11.5 tons for a driven truck axle. The loading by the pulse actuators is applied to the wheel tracks of the test track sections under a defined lateral distribution.

Measuring instruments are integrated into individual layers of the pavement structure in accordance with the research objectives. The most common sensors used are temperature sensors, strain-gauges in asphalt, concrete and cement bound layers and pressure sensors in unbound layers.

Rutting and unevenness of the pavement surface is measured with laser scanners. Layer thickness, mechanical properties like stiffness and surface deflections as well as possible defects inside the construction are measured by using non-destructive devices like Falling Weight Deflectometer (FWD) and Ground Penetrating Radar (GPR).

Differing in terms of size and test technique, the Federal Highway Research Institute's two full scale pavement test facilities are designed to examine both, asphalt and concrete pavement structures.



Cross-section of the asphalt pavement test track with four different pavement constructions according to the German guideline RStO

Asphalt pavement test track

The concrete tank with a depth of up to 3.5 metres permits a selective configuration of homogeneous subgrade layers to achieve specific in-situ properties bottom-up from the formation level. The pavement constructions can be varied according to current research objectives.

The accelerated simulation of wheel loads is generated by impulse actuators. Moving on parallel tracks which can be shifted in lateral direction, the range of the actuator covers an area of 1.80 metres length and 2.10 metres width, travelling at a speed of 2 millimetres per second in longitudinal direction.

Pulse actuator

The lateral distribution of the load impacts applied to the loading area corresponds to lateral in-situ wheel track distribution. A loading period of 690 hours is selected for each test run. During this period, the pavement is subjected to roughly 6 million pulses at a frequency of 145 pulses per minute. This corresponds to approximately one million wheel overruns.

Heavy vehicle overruns can be carried out via an access road leading towards the indoor test track. The mechanical pavement response like asphalt strain and soil pressure caused by heavy vehicle overruns can be measured simultaneously, triggered by light barriers installed at each pavement section.

Heavy vehicle passing

Technical data

Concrete tank

Length:	38.00 m
Width:	7.50 m
Depth:	3.00 – 3.50 m

Pulse actuator

Travelling rate:	2 mm/s
Pulse frequency:	145 pulses/min
Increment:	0.8 mm
Pulse duration:	0,025 s
Pause duration:	0.414 s

Concrete pavement test track

Full scale tests of concrete pavement constructions are also carried out at the Federal Highway Research Institute.

The weak points of concrete pavement constructions are the joints between adjacent concrete slabs. The main cause of damage of concrete pavements is the ingress of water through already damaged, open joints. Water penetrating the joints rinses the granular material of unbound base courses, undermining the concrete slabs. As a result voids weaken the slab-foundation, resulting in cracking and spalling under traffic loading.

To simulate the action of a wheel passing the joint between two adjacent concrete slabs a special dual pulse actuator was designed.

This dual pulse actuator applies time-shifted load impacts sequently to the adjacent edges of two concrete slabs.

Double pulse actuator

Strains inside concrete slabs are measured with strain-gauges, stresses in unbound base layers are measured with soil pressure cells. The measured mechanical response is used to compare the load-bearing capabilities of different pavement systems and building materials and continuously monitor any deterioration during the loading period.

Additionally, moisture and pressure sensors can be installed close to the joint to investigate damage sources and mechanisms associated with ingress of water into concrete pavement structures.

Technical data

Concrete tank

Length:	15.00 m
Width:	7.50 m
Depth:	2.30 m

Dual pulse actuator

Pulse duration:	0,025 s
Pulse frequency:	approximately 120 dual pulses/min
Interval between 2 dual pulses:	0.5 s

The pulse actuator operates in stationary mode on the joint.

Published by

Federal Highway Research Institute (BASt)
Press and Public Relations
Special consultants: Dr. Dirk Jansen
Bastian Wacker
Brüderstraße 53
D-51427 Bergisch Gladbach
Telephone +49 2204 43-0
E-Mail: infobast.de
www.bast.de
December 2017