

Research-Advice- Tests-Standards

**Federal Highway
Research
Institute**



bast



Contents

- 4 **BASt – Tasks, Development, Aims**
- 6 **Roads of the Future**
 - Department Highway Construction Technology
- 10 **Construction and Maintenance**
 - Department Bridges and Structural Technology
- 14 **Promoting Mobility, Enhancing Safety and
Protecting the Environment**
 - Department Traffic Engineering
- 18 **Optimising Vehicle Technology**
 - Department Automotive Engineering
- 22 **Focusing on People**
 - Department Behaviour and Safety
- 26 **Providing Services and Resources**
 - Department Administrative Services and Staff Units

BAST - Tasks, Development, Aims



4

Germany has a network of modern, safe roads and an increasing number of haulage companies from all over Europe is using this infrastructure for cross-border transportation. Studies predict that road traffic and in particular freight traffic will increase considerably over the coming few years.

This development is a challenge to politicians and to society in general. In order to ensure mobility it is essential to develop new ideas and new concepts – also on an international level. The traffic system must be efficient in order to secure its substance and reserves. On doing so, environmental pollution needs to be reduced by means of

technologies and building materials that preserve the environment. More progress needs to be made in respect of road safety.

The Federal Highway Research Institute (BAST) creates the basis to achieve all of this. BAST is a

technical and scientific institute of the Federal Ministry of Transport, Building and Urban Development (BMVBS). BAST provides the ministry with scientifically-backed decision aids for technical and road-traffic related issues and plays a significant role in drawing up regulations and standards.

Assignment and History

In 1951 BAST began its work with research in the field of highway construction. In 1965 BAST was commissioned, beyond the scope of highway construction tasks, to work towards enhancing highway capacity and safety. In 1969 the Federal Parliament voted to establish a central agency for road traffic accident research which was set up at

BASt. Since 1983 the institute has had its headquarters in Bergisch Gladbach near Cologne. An office building and ten halls with testing facilities, some of them equipped with unique large-scale testing plants, are located on the premises covering around 20 hectares.

Tasks

The tasks of BASt are distributed among the administrative services department, two staff units and five specialised departments:

- Highway construction technology
- Bridges and structural technology Traffic engineering
- Automotive engineering
- Behaviour and safety

BASt conducts its own research work on issues of special significance on its testing plants. Its tasks include consulting services and drawing up experts reports. BASt also assesses the quality of services and products, for which it carries out assessment, testing, certification and seminars.

Most of the BASt areas of work involve cooperation with other research agencies, particularly institutes associated with universities and colleges. Its work is oriented towards defined aims.



Research Aims

- Improvement in the efficiency of road construction and maintenance
- Improvement in the efficiency of the construction and maintenance of bridges and civil engineering structures
- Road safety improvement
- Improvement in road use efficiency
- Environmentally-friendly building methods, reduction in pollution
- Reduction in vehicle-related energy consumption and environmental pollution and the use of new sources of energy and alternative drive concepts
- The role of the road network within the overall transport system

Roads of the Future



6

Roads are to be constructed in such a manner that they fulfil current requirements and those of the future too. The current network is to be maintained. The highway construction technology department has the task of developing measures and methods of construction which are sustainable, cost-efficient and environmentally-compatible.

Road Maintenance

Roads are vital for our infrastructure. They must be fit for traffic. An unfavourable age structure, constant increase in the

volume of road traffic – in particular of heavy vehicles – and a shortage of financial resources require systematic road maintenance as well as an optimised maintenance schedule and coordination for the entire network. This involves the regular recording and evaluation of data on federal main roads. BAST was commissioned with



ensuring the quality of these data. The data gained flow into the Pavement Management System (PMS), which enables forecasts on the development of pavement conditions to be made. Thus vital bases are ascertained for future planning, taking into consideration available funding.

Sustainable Construction Methods

Besides optimising surface properties, long-term use is also significant when developing construction methods and procedures. BAST is responsible for several test stretches of road and is involved in a constant procedure for improving conventional construction methods. Worth mentioning here are concrete roads with fibres or compact asphalt pavements and concepts for innovative compound construction methods, such as a robust concrete construction to ensure general bearing capacity. A layer of asphalt is applied

onto this concrete construction. This layer can be renewed in a short time, hence keeping an obstruction of the traffic flow to a minimum.

Model Roads

In order to find out how innovative pavement designs behave under traffic loads, these loads are simulated at two test laboratories. The behaviour of the entire pavement structure can thus be studied at lower cost by means of accelerated load tests.



Noise Reduction

Nowadays, 80 million European citizens are directly affected by noise – and traffic is one of the primary sources. Wherever it is essential, noise-reducing road surfaces need to be built,

pavements are improved and new ones are also developed.

Open-pore layers have the greatest effect in terms of noise reduction as they absorb some of



the tire on pavement noise. BAST is intensifying efforts to improve single-layer and dual-layer open-pore asphalt pavements, particularly in respect of improved noise reduction and durability.

Skid Resistance

Skid-resistant road surfaces are decisive for safe driving. For this reason requirements in respect of the skid resistance of new road surfaces right through to expiry of warranty obligations were included in a set of regulations.

BAST is coordinating research activities to constantly optimise monitoring systems for determining and assessing skid re-

sistance of road surfaces. It is also conducting activities to estimate the development of skid resistance under the influence of road traffic with the help of laboratory procedures.

Construction process

As road traffic and the associated restrictions increase, the subject of construction while the road is open to traffic is becoming increasingly important. Rapid construction without hindering traffic flow is required, while at the same time safeguarding the construction site and ensuring the durability and use of new materials and technologies.

BAST develops economical evaluation procedures both for new developments and for existing road constructions. Such considerations on economic viability also involve economic



costs, for example as a result of the formation of traffic jams, accident risks and environmental pollution.

Applications are required for both new constructions and maintenance management. This is to reduce the number of construction sites and environmental pollution – despite an increasing volume of road traffic.

Environmental Protection

Road construction also needs to take environmental issues



should not be impaired when these construction materials are used. Using recycling materials and by-products is also economical.



into consideration. Using recycling materials and industrial by-products reduces the environmental impact – natural resources are preserved and disposal site space is saved. Ground water and soil quality

The development of low-temperature asphalt, which BAST supports, is primarily aimed at improving working conditions during construction. At the same time, it is possible to reduce the CO² emissions during production. Experts from the highway construction department are operating in all significant national and international road construction bodies. The results of their work are incorporated in guidelines, sets of regulations and test specifications.

Construction and Maintenance



road sign bridges, noise protection walls and supporting structures. Construction equipment includes bedding, road transitions, railing, safety barriers and drainage devices.

Building materials, methods of building and the structures, including the respective test procedures, must be tested

and improved. Equipment and fixtures for bridges and tunnels must be improved in order to ensure and enhance road safety. Since the observation of European regulations is becoming more and more significant in this

10

Bridges and tunnels need to be stable, safe for road traffic and durable. Improving construction methods and drawing up measures to maintain constructions are central tasks of the bridges and structural technology department.

Quality and Safety Standard

Bridges and road engineering structures include concrete, steel and composite steel bridges as well as tunnels and their fittings and



connection, maintaining high national quality and safety standards, both those already achieved and those targeted, is particularly vital when drawing up and harmonizing European standards and guidelines.

Increasing Requirements

An increase in traffic, particularly in heavy-vehicle traffic, means that building materials

driven on, i.e. road surfaces and road transitions. In the case of older constructions, an increase in traffic load may also lead to a reduction of the planned residual utilization period.

In order to ensure stability and road safety as well as durability, test and calculation procedures need to be adapted to current states of technology. New test procedures need to be developed

and experience needs to be gained in order to be able to evaluate these procedures.

The most important aim in all of these activities is to use laboratory tests to design construction components and building materials so that they are best suited to practical purposes, and also to

develop test procedures suitable for construction sites. These must serve to give proof of quality achieved in a quick, reproducible manner, so that the quality of products and execution can be effectively regulated.

and procedures need to be consistently adapted in order to fulfil safety, economic viability and environmental-compatibility requirements. This applies mainly to the maintenance of existing engineering constructions, but also to new constructions. Increasing loads affect those areas directly





Equipment Components

New restraint systems have been developed to safely maintain crashing vehicles on bridges if objects below bridges require particular safety protection.

It is particularly problematic that current bridges can only absorb crash forces up to a certain extent.

Construction Maintenance Management

Financial requirements for maintaining bridges and engineering constructions are rising steadily due to an increasingly unfavourable age structure. It is therefore extremely important that construction maintenance management be further developed to ensure that the funds made available for maintenance are put

to use both effectively and target-related.

Procedures are being developed to systematically plan, implement and check on maintenance measures. These procedures enable authorities responsible for maintenance management to increasingly influence decisions on where, when and how repairs are to be carried out and how much is to be spent on such repairs. This also involves improving procedures for testing constructions – in particular non-destructive tests – and procedures to determine the bearing capacity of current constructions.



Putting a comprehensive management system in place can result in an optimal combination of the type of measure, the location and the point in time of implementing a measure for the current condition of constructions and for certain targets.



Tunnels

Fittings are of great significance for tunnel constructions, in addition to construction and maintenance. Fittings and operational procedures in tunnels need to ensure a high degree of safety for tunnel users, both in

accidents. BAST researchers are developing suitable concepts.

The effectiveness, the interaction and the usability of safety and operational devices are permanently undergoing further development in order to enhance safety for tunnel users.

Work carried out by the bridges and structural technology department is contributing towards ensuring that even in future limited funds available for the construction and maintenance of bridges and structures on federal highways will be put to effective use and that road safety will be enhanced.



standard use and in the event of accidents. Top priority must be given to people being able to save themselves in the event of

Promoting Mobility, Enhancing Safety, Protecting the Environment



14

Traffic engineering is called upon to bridge the conflict between traffic demands and ecology. The search for cost-effective possibilities to use the existing highway network efficiently, maintain the level of service, to enhance safety and minimise the environmental impacts caused by traffic are therefore focal areas of the department traffic engineering.

Traffic Data

In order to obtain data on the capacity of the highway network and a controlling instrument for future planning and development purposes there-

with, comprehensive traffic flow and operation analyses are indispensable. BAST carries out passenger car and freight traffic counts all over Germany. Monitoring systems are tested to conduct in-motion surveys of the number of vehicles and their loads.

BISStra

In BISStra (German Federal Highway Information System) all main German roads are recorded, as well as engineering structures, their construction details, their condition and their bearing capacity. In future, information on accident and road condition

analyses will also be included. This system assists the Federal Ministry of Transport, Building and Urban Affairs and BAST in solving various administrative and research tasks.

Planning and Design

The extension of the road network depends on numerous aspects, such as traffic usability and safety, environmental effects and financial aspects. BAST compares various systems with regard to traffic safety and flow, incorporating the results into technical guidelines. In addition, BAST takes part in the further development of procedures used for the economic evaluation of road-building projects.

Road Signs

Road signs serve to regulate traffic and contribute towards improving traffic safety and flow. BAST supports the BMVBS in developing new traffic regulations and road signs and keeps a digital record of all signs.

Traffic Signs

Ensuring a unified, systematic, clear system for directing road traffic is essential for good

orientation. BAST coordinates the conversion of new scientific findings into guidelines.

Traffic Management

Variable message signs enhance safety and improve the traffic flow on highways. This promotes mobility and contributes towards environmental protection by means of harmonizing traffic. At



BAST, work on a set of guidelines for road infrastructure, the respective communications technology and traffic computer centres, among other things, has created a basis for expanding the traffic management system.

Environmental Protection

BAST also studies the effects of highway traffic on nature and compiles basic findings on road and traffic-related soil, water and ground water pollution. Measures for the reduction of pollutants are

included in regulations on the basis of these findings.

BASt is developing acoustic reference standards for pavement surfaces and conducts research



into the effects of noise reduction measures. Findings are converted into guidelines and standards under the control and with the involvement of this institution.

In addition, BASt investigates the road traffic-related effects on air quality as well as possible steps to be taken to reduce such effects, thus adhering to the limit or threshold values contained in European directives.

Road construction-related impacts on nature are to be reme-



died as quickly as possible. Soil areas are re-cultivated, lakes and ponds created. BASt also develops guideline principles for the maintenance of roadside areas to allow sustainable plant and animal life. Highway construction can cut and reduce animal habitats. An optimal design of bridges and passages enables animals to reach and change their habitats.

Technical Service

To ensure road safety and serviceability, the Technical Service carries out minor repairs and maintains road equipment. Other tasks are cleaning, the maintenance of roadside grassed areas and plants and winter services.

BASt is involved in the development of new technologies for use by the Technical Service, but also in compiling the associated regulations; suitability tests are carried out for the machines and materials to be used.

Tests

Road markings must be sufficiently visible by day and by night. The materials used must be durable and skid-resistant. On its turntable



road-marking test system, BAST checks whether these properties are fulfilled. On this testing facility all marking systems and other materials used can be tested under time acceleration.

Construction components with internal illumination, such as warning lights and variable message signs, and retro-reflecting surfaces are subject to constant technical development which is monitored by BAST. These tests are conducted in a special laboratory, 70 meters long and 12 meters high. This laboratory can be kept completely dark and is unique in the world.

Safeguards and Worksites

Steel safety barriers and concrete protective walls prevent vehicles from leaving the road or ensure that vehicles are rejected back onto the road. BAST conducts crash tests on this equipment

with trucks, cars and busses on test grounds.

Worksites are secured primarily with block-off devices and control equipment which needs to be safe and clearly recognizable from the greatest possible distance. BAST carries out design approval tests prior to using any such equipment.

Maintenance of Road Equipment

Modern roads with high traffic flows are equipped with numerous elements for traffic control and safety, as well as for the information of road users, for example with traffic management systems, protection and guidance features. BAST supports the BMVBS in estimating the financial requirements for the maintenance of such systems.



Optimising Automotive Engineering



18

Automotive engineering contributes greatly towards improving road safety. The automotive engineering department focuses on the mitigation of accident consequences and environmental pollution caused by traffic.

Crash Tests

Modern cars have numerous devices for improving active and passive safety. At the BAST vehicle engineering test facility accidents are simulated to study the causes of injuries and their consequences. The tests

are based on data gained in accident surveys on scene which the Association of the German Automobile Industry has been performing for BAST for a number of years.

In order to ensure that in statutory test procedures for head-on and side collisions, crash-related stress for passengers and for vehicles corresponds to the stress experienced in real accidents, BAST is currently working on test procedures in an international joint venture project to evaluate



how different vehicles react in accidents.

Pedestrian Safety

On the automotive engineering research sector, pedestrian safety is of special concern. By the year 2015, the front part of all newly registered vehicles must be constructed in such a manner that the risk of injury in the event of a collision is greatly reduced. Test procedures and test tools are being improved in large-scale test series conducted by BAST and as part of BAST's involvement in European and international committee work.

Test drives

BAST is conducting test drives on its premises in order to assess the active safety of vehicles or vehi-

cle parts in critical situations. For example, these test drives assess whether tires with run-flat properties still have sufficient safe driving qualities if a loss of pressure occurs.

Research on better brake systems and headlight systems

for motorcycles are contributing towards more safety in the area of motorcycle technology.



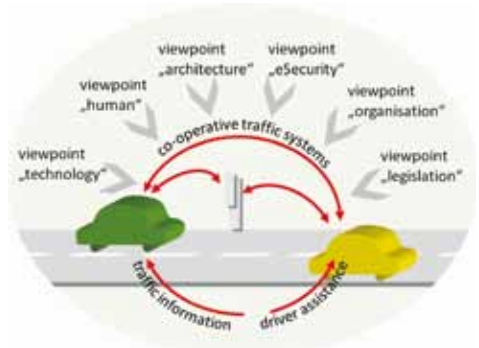
Driver Assistance Systems

Electronic driver assistance and information systems, such as navigation systems or track-retention systems to support

drivers in various manners are becoming increasingly popular in modern vehicles. Besides making driving more convenient, these systems also contribute towards enhancing road safety. They take some of the load off drivers or warn drivers of dangerous situations. It is, however, possible that these systems may have a negative influence on driving performance due to an excessive load of information for drivers.

BASt aims at showing the possible positive and negative effects of these systems on road safety, with tasks focusing on both the design

each other, either directly or via control centers. In the event of an accident or an emergency



braking maneuver, for example, a warning may be sent out to following vehicles. BASt supports the development of such systems to analyse their potential for traffic safety and to trigger further applications.

Large-Scale Testing Facilities

BASt is examining the interaction between vehicles and road surfaces in order to avoid or reduce environmental pollution and to enhance active vehicle safety. These examinations involve testing and improving requirements of roads and tires to reduce environmental pollution and increase road safety. To carry out this research, BASt has two large scale testing facilities on its premises.



and the evaluation of the human-machine-interface as well as the clarification of legal matters.

Cooperative Systems

The future belongs to cooperative systems: vehicles will be exchanging information with

The interior drum testing facility (IPS) is encased, it can be air-conditioned and watered and primarily serves the purpose of testing skid resistance. The vehicle/pavement interaction facility (PFF) serves to test the acoustic effects of truck and passenger vehicle tires on real pavements and to measure rolling resistance. Both testing facilities can be equipped with different patterns of road surfaces.

Exhaust Gas Emissions

Reducing exhaust gas emissions in road traffic is also an important item of research. For this purpose BAST applies the TREMOD

emission calculation model for forecasts. This mathematical model can be used to calculate the energy consumption and the emission of exhaust gas for traffic in Germany in annual steps up to 2020. A clear decrease in emission over the past few years is primarily due to more stringent threshold value laws.

BAST is involved in creating the essential pre-requisites for the approval of new motor technologies such as hybrid and hydrogen engines through its participation in drawing up regulations and laws.



Focusing on People



22

The most important aim of safety research is the reduction of the number of accidents and the mitigation of their consequences. Despite state-of-the-art highways and the latest technical achievements intended to make traffic safer, accidents are unfortunately still bound to happen. Key factors in this context are the attitudes and behaviour of road users.

The behaviour and safety department is responsible for detecting and determining accident black spots, for

analysing the causes of accidents and for developing suitable safety concepts.



Statistics

The BAST research program and official accident statistics form a vital basis for statistics.

These are supplemented by the Institute's own data and evalua-

tions to find answers to specific questions.

For international comparison BAST has access to the IRTAD database (International Road Traffic and Accident Database) which contains accident data from numerous countries on four continents.

Concepts and Measures

Based on its own research results and experience gained at home

campaigns. Both cost-benefit estimates and effectiveness studies become an essential basis for the continuous optimisation of measures.

Risk Groups

Traffic participation of any kind involves specific risks. These risks occur as soon as children travel as passengers in cars, and they include pedestrians, cyclists and motorised road users.

BAST research defines the individual risk groups and initiates further research for life-long learning in promoting road safety.

Children need to be prepared for participation in road traffic. Comprehensive programmes assist parents and traffic instructors in this

task, for example the “Child and Traffic” programme of DVR, and various other offers for traffic education, both at school and out of school. Many of these measures are results of the BAST research.

The accident risk is still higher for young drivers than it is for any other age group. Improved



and abroad, BAST develops safety concepts and proposals for measures. It advises BMVBS on organising informative campaigns and it also advises the federal and state governments on drawing up safety programs.

BAST is involved when the German Traffic Safety Council (DVR) and its members prepare safety

driving instruction can enhance their safety. BAST is testing new methods of teaching and examining driving skills. Particular



24

attention is given to a longer period of preparation for novice drivers and diverse possibilities provided by the use of new electronic media.

The effect of advanced training programs for novice drivers, programs for drivers transporting hazardous goods, for driving instructors, for the police and programs providing problematic drivers with extra training are examined.

Drivers who have come into contact with the law due to an excessive consumption of alcohol or because they have got too many points in the Central Register of Traffic Offenders must

have their driving skills tested in an assessment of driver aptitude. BAST has been dealing with constantly improving these measures for a long time and is requiring that they be optimised by means of an exchange of experience among those responsible for assessment.

Protection Systems

Every year BAST counts the number of belted car occupants, child seats and other child restraints, motorcycle riders wearing protective clothing and the number of cyclists choosing to wear a helmet. These safety measures are still considered to be important life-savers.



Assessment

Since 1998, BAST has been acting in the capacity of an „Assessment Agency for Bodies Providing

Driving License Services“ (the former Accreditation Agency), ensuring the appropriate quality standards in driving license system. BAST examines the skills required by the various driving license assessment authorities. It also examines institutions that offer courses aimed at restoring driving licenses and the driving license test centres. In addition, the assessment center regularly monitors quality standards to ensure that full use is made of options for improvement.

Test Vehicle

Participation in traffic frequently results in conflicts which develop to become aggressive disputes and increase the accident risk. The main issues are: How do these conflicts arise? How can they be avoided? Which measures can be implemented to promote cooperative, social behaviour on the road?

BAST uses a specially equipped test vehicle to study driver's behaviour. This vehicle is also used to determine the ability to drive a vehicle in the case of illness or when under the

influence of alcohol, drugs or medicine.

Emergency Rescue Services

Numerous improvements have been made during the past decade to enable the emergency rescue services to provide first aid at the scene of accidents more quickly and more efficiently, hence saving human lives. An important issue is how to improve the willingness of road users to provide first aid at the scene of an accident.



Accident researchers regularly exchange information and experience with European road safety institutes and with universities. BAST is a member of the Forum of European Road Safety Research Institutes (FERSI).

Providing Services and Resources



26

The development of research programs and the coordination of external research activities are some of the tasks carried out at the administrative services department, as is knowledge management, the development of IT processes, in-house technical administration and planning and promoting human resources.

The staff units „Research Programme Delivery, Quality Management“ and „Press and Public Relations“ are responsible for ensuring that BAST carries out its work in an efficient, quality-orientated manner that is also effective from the point of view of public relations.

Research

Research projects are designed to come up with answers to highway traffic issues. Every year

BAST supervises more than 300 projects with a financial volume of approximately 9 million Euro. These projects are carried out by universities, colleges, engineering companies and other institutes. BAST carries out around 350 projects of its own every year and is also realising more and more projects for the European Union.

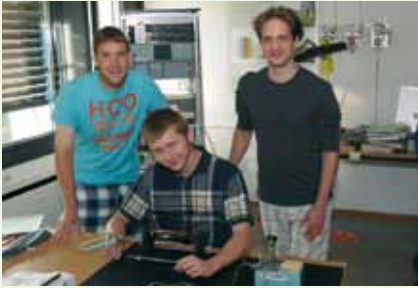
Information Technology

Information and communications structures need to be state-of-the-art. BAST is involved in the development and supervision of large databases.

A Competent Team

BAST has a staff of more than 400 who work in more than 40 different disciplines. Engineers, natural and human scientists, economists, technicians and

administration staff contribute with professional solutions to solving the diverse tasks BAST faces.



The institute also provides more than 20 young people with vocational training every year.

International Cooperation

Problems which arise in the traffic area require more and more international cooperation. An exchange of information and cooperation in international organizations and committees are hence becoming more significant, for example cooperation in the European Union, with associated institutes all over the world and with standardisation committees.



Controlling and Quality

Meaningful planning and quality-orientated processing succeeds, even in times of tight financing, in making use of the resources available in the most effective manner and to carry out numerous tasks to a consistently high quality standard.

Public Relations

BAST publishes the results of its work in various forms: as research reports in its own publication series, as summary reports providing research information, in brochures, leaflets and in the Internet under www.bast.de, but also in technical journals, in the public press and at special conferences and exhibitions.

Several hundred visitors from Germany and abroad visit BAST every year. The offer ranges from one-day information visits to technical discussions lasting several days or week-long specialised excursions and exchanges of information and experience for guest researchers and specialised student trainees from universities abroad.

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Bundesanstalt für Straßenwesen

Brüderstraße 53

D-51427 Bergisch Gladbach

Telephone +49 2204 43-0

Fax +49 2204 43-673

E-Mail info@bast.de

Internet www.bast.de

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