

**XXIVth WORLD ROAD CONGRESS  
MEXICO 2011**

**GERMANY - NATIONAL REPORT**

**STRATEGIC DIRECTION SESSION STD**

**MANAGING ROAD ASSETS IN THE CONTEXT OF  
SUSTAINABLE DEVELOPMENT AND CLIMATE  
CHANGE ADAPTATION**

**Preservation Management of the Road Infrastructure in  
Germany**

## 1. Introduction

The road network in Germany consists of almost 13,000 km of federal motorways, 40,000 km of federal highways, 87,000 km of regional roads, 91,000 km of district roads and 395,000 km of local roads. On the whole, the German road network of about 626,000 km corresponds to a gross capital asset of more than 470 billion €. The federal trunk roads alone, i.e. the federal motorways and federal highways, with a total of 53,000 km account for more than 180 billion € thereof.

Owing to its central location in Europe, the German motorway network bears the brunt of transit traffic and will have to master steadily increasing traffic volumes as a consequence of the enlargement of the Single European Market. Even minor disruptions in the network due to traffic restrictions or the failure of individual installations lead to major traffic obstructions involving considerable consequential costs for road users and the national economy as well as adverse effects on the environment. Therefore, the preservation of the federal trunk roads is a priority task we have to tackle today and in the future if we want to safeguard the mobility of the economy and society in the long run.

In addition to the ever-increasing traffic loads, the more and more unfavourable age structure of the structural fabric of the roads and the use of the available budget funds in an economically efficient way, force all parties involved to systematize the preservation of federal trunk roads in order to ensure an adequate quality of the transport infrastructures for road users in the future. In this connection, greater attention has to be attached to an optimized preservation planning in terms of technology and economic efficiency and to the demand-oriented allocation of funds.

The objective of systematic road preservation is to:

- guarantee a uniform trafficability of roads of the same functional class
- ensure an adequate quality of the road infrastructure in the long run
- and to support the highway authorities in their timing and financial planning of the necessary preservation measures as well as in the realization of such measures.

Thus, in view of the given quantitative and qualitative benefits, it will be possible to minimize the preservation requirement. Differentiated standards for the quality level of the federal trunk road network which is intended or possible in the medium and long run were developed on the basis of the new forecast of maintenance requirements to update the Federal Transport Infrastructure Plan and decided on in a political framework.

## 2. Condition survey and assessment

### 2.1 Road pavements

The results of the **condition survey and assessment (ZEB)** which has been carried out since 1992 for the overall federal trunk road network are the most important basis for the systematic preservation of the federal trunk roads. Subproject 1a comprises a survey of the longitudinal evenness, subproject 1b investigates the transverse evenness, subproject 2 the skid resistance and subproject 3 the structural features (surface); all subprojects are carried out at national level. Subproject 4 covers the condition assessment, the evaluation and the graphic presentation of the results.

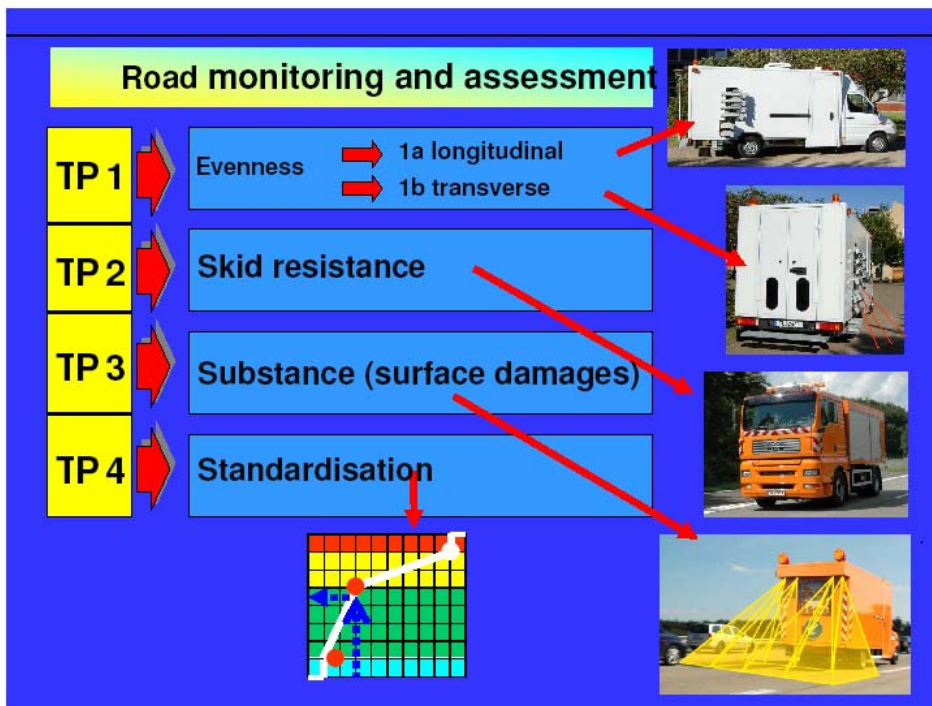


Fig. 1: Subprojects for the survey and assessment of the condition ZEB

The condition criteria are collected by fast-moving sensor vehicles which are equipped with the most advanced detection technology. For all condition criteria, dimensioned condition parameters are aggregated for the section to be surveyed and assessed. This section has a fixed standard length of 100 metres on roads outside built-up areas for the metrological condition survey. In the course of the subsequent evaluation, the condition parameters are

transferred into dimensionless condition indices with marks ranging from 1 (very good) to 5 (very bad, applying feature-specific standardization functions, and are assigned to the colour classes blue, green, yellow and red for the purpose of visualization. The results are processed for each federal state and presented in the form of section diagrams and general maps.

The results of the survey and assessment of the condition provide a good overview of the distribution and the status level of the condition of pavements for the whole network. They are presented separately for all features or in more user-oriented service values combined according to fixed linking rules and based on road safety and driving comfort and in asset values which are more targeted towards the authorities responsible for construction and maintenance, reflecting the structural condition. A whole range of standardized evaluations were developed for the diverse issues. The statistical evaluation of the results of the survey and assessment of the condition already allows for network-wide important conclusions and comparisons concerning the surface condition and for the localization of deficits in the network. Preservation programmes can be systematically optimized. At object level, the causes of an inadequate road condition can be analyzed from the status level of the features.

The Federal Highway Research Institute (BAST) in Bergisch-Gladbach performs the quality assurance of the survey and assessment of the condition. This includes primarily the related suitability tests and inspections. For each assessment campaign, a wealth of data is collected. The data base which has in the meantime been set up at the BAST ensures a reliable data management. The comparability of the measurement campaigns is assured in the long run by the accessibility of the raw data.

## **2.2 Structures**

The structural inspections are carried out in accordance with DIN 1076. The assessment and evaluation of the damage detected is subject to the “Guideline on the uniform registration, assessment, recording and evaluation of the structural inspection according to DIN 1076 (RI-EBW-PRÜF)”. Each structure is assigned a mark for the condition ranging from 1 to 4. This condition mark is composed of individual marks for stability, durability and traffic

safety. The nationwide data management is also incumbent on the Federal Highway Research Institute.

### 3. Coordinated preservation programmes

The desired **coordination of preservation measures** for structures and road pavements is supported by the reporting of medium-term preservation programmes of the federal states to the Federal Government. The visualization of the preservation measures in section diagrams facilitates the timing and coordination of the individual measures. The optimized selection of the type of measure (longest possible service life, elimination of the cause of damage) and the network-wide coordination of the timing of work sites minimizes the obstructions to traffic.

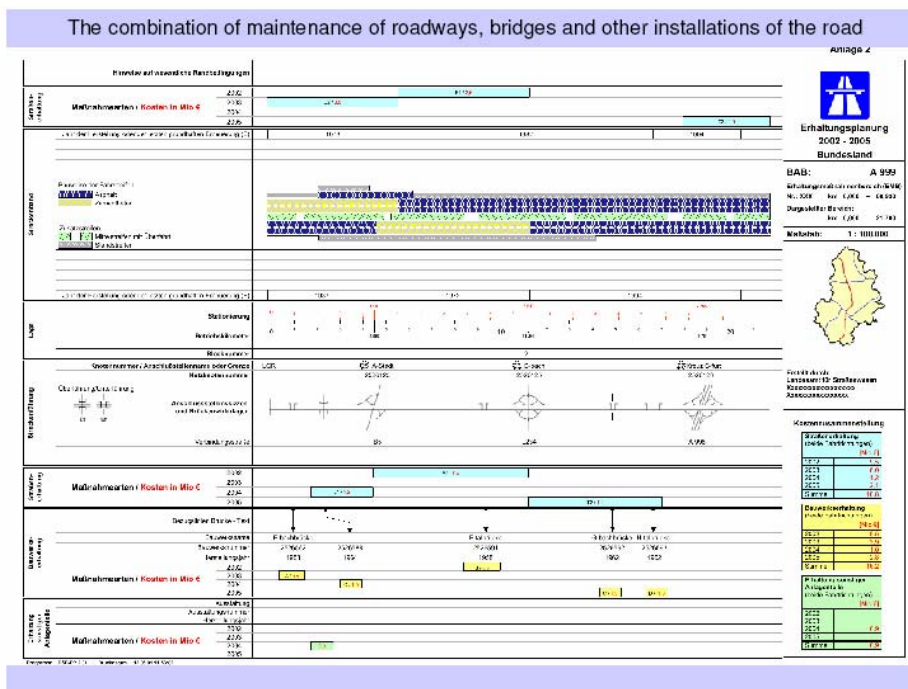


Fig. 2: Coordination of preservation measures

The "**Guidelines for the Planning of Preservation Measures at Road Pavements (RPE-Stra 01)**" were introduced for the federal trunk roads to obtain uniform rules for the

planning of preservation measures. The processes for an efficient management of road maintenance which were developed within the framework of research work are translated into practical administrative work and the preservation planning for the federal trunk roads which differs from one federal state to the other is standardized. The RPE-Stra 01 are framework guidelines and support the elaboration of coordinated medium-term preservation programmes.

Decisions on preservation measures are taken on the basis of systematic analyses of the relevant network under review on the basis of aspects which are as objective as possible. In this respect, the time and type of the preservation measure are optimized and coordinated for the overall network. The objective is to counteract the adverse development of the age structure of the structural fabric of roads and of the condition of pavements and in particular to minimize, to the extent possible, the traffic obstructions due to work sites on very busy sections. The application of the RPE-Stra 01 illustrates the necessity of providing the latest available data for the whole network.

Guidelines for the planning of preservation measures at structures are currently being prepared.

#### **4. Computer-aided management systems**

##### **4.1 Pavement Management System PMS**

In the future, however, comprehensive preservation planning will only be possible using computerized procedures. The link-up of all data which are relevant to preservation can only be carried out with the support of the appropriate software. In many years of research work, the algorithms for a **computer-aided Pavement Management System (PMS)**, adapted to the conditions of the German federal trunk road network, were developed. The aim of this development work was to elaborate a PMS with a modular structure which is ready for application.

The modular structure makes it possible to replace existing modules by more advanced and improved ones at some later date. New insights and findings can thus be integrated into updated modules and, after sufficient testing, be included in the PMS without restricting the procedural options of the PMS. The benefits of the PMS are mainly the possibilities of interlinking a variety of data and information network-wide which are

relevant to preservation and to optimize the proposals for action. It is a decisive evolution of the current possibilities to be able to estimate the efficiency of the selected strategies and measures over several years by means of the PMS. The application of the PMS leads to technologically and economically optimized strategies. When preparing preservation programmes, engineers are supported by the PMS and the long-term safeguarding of an adequate service and asset value is facilitated. The PMS makes it possible, depending on the budget earmarked for this purpose, to estimate the consequences of the network-wide condition development and to visualize them.

The possibilities of substantiating the funds required for preservation are decisively improved. The transparency of the whole decision-making process is enhanced and authentic and convincing data for financing are gained. In the medium run, the PMS will facilitate and improve preservation planning for the federal states. But the most important precondition for the application of the PMS is a well-functioning data management. The PMS links up as-built data (data of the road network), condition data (survey and assessment results), structural data, data concerning the preservation history, traffic data, road safety data (accident data) and other preservation-relevant data. The accessibility of objective measurement data makes it possible to elaborate preservation programmes according to uniform procedures and uniform assessment algorithms. The input data and the results projected on the network and/or the route section can be visualized and used for improved public relations activities. The appraisal of the condition development and the impact of selected preservation strategies or of given investment decisions is made possible by means of the PMS, and preservation planning will in the future become more rational and easier.

When the PMS was first applied in the period from 1998 to 2002, it was coordinated with all federal states for its use in preservation management. In the meantime, the PMS is being applied in almost all federal states. The prerequisite for its network-wide application is the completion and regular updating of the structural data.

#### **4.2 Structure Management System BMS**

The comprehensive BMS, for which the programming has almost been completed, comprises all functions for preservation management. The basis is the collection and provision of object-related information, e.g. about damage to and the condition of engineering structures. In connection with network-related data, outline conditions and

restrictions, the basis for analyzing processes, such as efficiency calculations, prioritizations and the identification of requirements, is thus created. This results in proposals for action, optimized programme planning and information about the funding requirements. An important aspect is the provision of uniform and compatible procedures for all parties involved.



### **4.3 Other Installations Management System SAMS**

At the moment, a comparable set of instruments is being developed for the preservation management of the Other installations.

We have very detailed data about traffic control systems at federal motorways. Apart from the 2,722 km of active traffic management systems, the use of the hard shoulder is temporarily permitted along 207 km of motorways and 80 access points are equipped with ramp metering systems. Moreover, 125 strategic traffic management systems and 8 junction control systems are in operation.

The production costs of the individual installations are estimated on the basis of a uniform price level, starting out from empirical values. The installations were not yet differentiated according to their individual parts, such as the signal generator, control device, masts etc., owing to the great number of such installations.

On the basis of the average values of the installations thus identified and of the production costs, the capital asset of these Other installations was calculated to amount to 12.3 billion Euro.

## **5. Final remarks**

Owing to the complexity of the interactions to be taken into consideration, the serviceable condition of the federal trunk roads can only be maintained in an effective and targeted manner by a comprehensive concept for preservation management including computer-based management systems. Systematic road preservation enhances the transparency of the whole decision-making process and provides authentic and convincing data for financing purposes in order to convince the political decision-makers of the necessity for timely action and adequate funding.

The preservation management of the federal trunk roads ensures an effective and economically efficient allocation of funds with the aim to keep the roads permanently in a safe condition.