

## Abstract

The federal motorway A2 is located in Lower Saxony between Helmstedt and Rinteln on a length of 155 kilometres. On this section of road both carriageways of the A2 were widened to three lanes in the nineties of the last century. The traffic volume of the A2 is approximately between 65.000 and 120.000 vehicles/24 hours, in the region of Hanover even up to 140.000 vehicles/24 hours. The A2 is equipped with modern traffic control systems in order to regulate the traffic volume on a length of 107 kilometres. Further traffic control systems are currently being planned.

In recent years the multitude of serious traffic accidents has lead to a discussion about the level of traffic safety on the A2 in public and in politics. The causes for traffic accidents and for the impact on accident severity can be attributed to different aspects. These can become apparent on the levels of environment, vehicle or driver. Hence, certain environmental factors such as higher traffic volumes or higher percentages of heavy freight traffic can facilitate driver errors or intensify their consequences. Examples for driver errors are maladjusted speed, insufficient safety distances or difficulties with merging onto the motorway.

The federal state of Lower Saxony has reacted adequately to the described set of problems. Using novel analytic methods, the present study systematically describes the traffic situation on the A2 in order to deduce traffic safety measurements. In this context an innovative holistic concept was developed as a basis for specific suggestions of measurements for improving the safety on the A2.

The traffic situation on the A2 and accordingly the events of traffic accidents are characterised by a high complexity and diversity regarding the affecting load factors. These circumstances require a comprehensive research of all elements which are associated with traffic accidents. Thus, a new integrative approach is required in which aspects of road construction, road design; traffic management, and traffic psychology are considered in order to describe the influencing factors concerning road, vehicle and driver. The integrated description of all affecting load factors was used as a basis for developing indicators for the implementation of traffic safety measurements.

The identification of traffic safety problems on the A2 and the deduction of safety measurements was the superior goal of the present interdisciplinary study. Thus the traffic safety measurements were supposed to have an additional benefit in contrast to conventional methods of traffic safety research.

The present research study is based on comprehensive information of 8949 accidents which happened between February 2005 and December 2008 on the Lower Saxon section of the A2. These analyses were supplemented with accident data from the German In-Depth Accident Database (GIDAS) by the Hanover Medical School (n=134) including data concerning human behaviour, such as aspects of perception and information processing. Furthermore 35 records regarding lethal accidents which were provided by the public prosecution could be analysed in detail in order to learn more about the genesis of fatal accidents.

The development of a load profile demanded comprehensive analyses of aspects connected to road construction, road design and traffic management. Furthermore an analysis of bottlenecks was conducted. Hence, the capacities of the Lower Saxon section of the A2 and the highway B65 were computed for the current state (year of 2005) and predicted for the future (year of 2025). Thus existing and predicted bottlenecks were identified in order to generate measurements to facilitate the traffic flow. Additionally data of measuring sections in the range of traffic

control systems were evaluated. Hence an analysis of the speed choice behaviour for certain traffic situations could be conducted.

From the viewpoint of road construction the current state of the infrastructure regarding the alignment and the constitution of single elements were explored. For this purpose the Lower Saxon section of the A2 was driven and aligned kinematically by a test vehicle. Beyond the analysis of the alignment parameters, the lateral distance of safety equipment could be identified. Further the analysis of the road surface was conducted separately for the different construction types in order to identify advantages and disadvantages of certain surface types.

Additional information about the driver workload was investigated by the means of driver monitoring in a field driving study. The goal of this study was to describe behavioural and performance aspects depending on external load factors (e. g. traffic volume). The real driving study was conducted using the "DLR ViewCar" which is an instrumented vehicle able to record driving parameters, such as velocity and safety distances. Thus, 10 participants were driving from Braunschweig-Nord to Rennau and back on two different days with different traffic volumes. In result the highest workload and the shortest safety distances could be found at medium traffic volumes. At the same time the variance of velocity was the highest.

The consolidation of the described A2 analyses allowed a profile of hazards to be developed. Thus, the results of the accident and load analyses were integrated in so called initial positions. These can be classified into four groups: Driver behaviour, Infrastructure, Traffic bottlenecks and General aspects. Finally, measurements were deduced and their effectiveness was evaluated.

The broadness of the measurements includes driver psychological aspects as well as proposals concerning the widening of motorways or junctions. Thus some examples of the proposed measurements for the whole A2 section in Lower Saxony are velocity and section controls, distance controls, quality management of the traffic control systems, building of contribution lanes between close junctions and many more.