“AOSI” Improving road safety on rural roads in Germany

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Dr.-Ing. Roland Weber (Corresponding Author)
Federal Highway Research Institute
Brüderstraße 53
51427 Bergisch Gladbach
GERMANY
Phone: +49 2204 43 560
Fax: +49 2204 43 683
E-mail: rweber@bast.de

Dipl.-Ing. Thomas Jährig (Co-Author)
formerly Technische Universität Dresden
now Federal Highway Research Institute
Brüderstraße 53
51427 Bergisch Gladbach
GERMANY
Phone: +49 2204 43 566
Fax: +49 2204 43 683
E-mail: jaehrig @bast.de

ABSTRACT

Although the majority of road accidents happen in urban areas, 60% of all fatalities occur on rural roads. For this reason the Federal Highway Research Institute (BASt) established a task force to improve road safety on existing rural roads in Germany by short-term up to medium-term measures. The analysis of severe accidents on rural roads found two main contributing factors: inappropriate speed and unsafe overtaking manoeuvres.

For this reason the project focussed on the enforcement of speed limits (short-term measure) and the safeguarding of overtaking manoeuvres by constructing additional passing lanes (medium-term measure).

The project group chose ten roads with a high number of severe accidents. Where inappropriate speeds were a main contributing factor for accidents, speed cameras were installed. On the other roads, where unsafe overtaking manoeuvres were a main contributing factor to accident occurrence, short passing lanes were built to make overtaking safer.

The research project was based on a before/after comparison of traffic and accident data. After the measures were implemented road users were questioned about their acceptance of the measures.

Speed enforcement had a very positive impact on accident frequency and severity. Within 3 years accidents with serious injuries were reduced by 7 to 50 %.

To this day the installation of passing lanes has been very successful, too. In a 2 years period head on crashes were reduced to zero. Passing lanes combined with adjacent sections where overtaking is prohibited contribute to higher road safety, advantages in travel time and to a relaxed driving behaviour.

BACKGROUND

The road network is one of the most important prerequisites of a successful and efficient economy of a country. During the last 40 years the traffic volume in the countries of the European Union increased year after year. The downside of this development is that each year there are more than 1.3 million accidents causing more than 40,000 deaths on roads. In other words, road traffic accidents are the second highest reason for mortality among people under the age of 45 in Europe.

Around 4500 people were killed in accidents on German roads in 2008. Although the majority of road accidents happen on roads in urban areas, 60% of all fatalities occur on rural roads. This background shows the need for action to reduce the number of accidents and the accident severity especially on rural roads. Due to the fact that there are already more than 167 Tkm of rural roads in Germany it is obvious that a significant improvement of traffic safety on rural roads can only be achieved by measures which are suitable for existing roads.

Against this background the Federal Highway Research Institute (BASt) established a task force in order to improve road safety on existing rural roads in Germany by short-term up to medium-term measures. The Task Force was composed of experts from local road authorities of different federal states, universities and members of the German Insurance Association (GDV) to cover a broad field of competence.

APPROACH

In the early stage of the project the main task was to analyse the location of accidents on the rural road network, the distribution of the different types of accidents, e.g. driving accident (i.e. driver loses control of the vehicle without influence of other road users) overtaking accident, and their severity.

Based on the selection criteria of road sections with an accident rate of more than two severe accidents in one kilometre within 3 years two main contributing factors to high accident severity were detected. There was one type of road where inappropriate velocities lead to accidents due to a loss of control of the vehicle (single vehicle accident). The probability of these accidents increases with a decreasing steadiness of the alignment, combined with bad weather and/or surface conditions. Their severity is influenced by the type and distance of obstacles on the side of the carriageway. There was a second type of road, where unsafe overtaking manoeuvres related to a misjudgement of sight distance, speed of oncoming vehicles or possible acceleration lead to accidents (accident in longitudinal direction).

In order to reduce the likelihood of these types of accidents the project focussed on the enforcement of speed limits (short-term measure – see FIGURE 1) and the safeguarding of overtaking manoeuvres by constructing additional passing lanes combined with the prohibition of overtaking in sections with one lane per direction (medium-term measure – see FIGURE 2)

FIGURE 1 Speed camera enforcement.

FIGURE 2 Additional passing lane

Both types of measures were expected to have an extremely positive overall impact on road safety.

Ten rural road sections showing a high number of severe accidents were chosen for this trial by the task force. The selection criterion was defined by having at least two severe accidents on a road section of one kilometre within three years.

On five of the chosen test sections, where inappropriate speeds were a main contributing factor for accidents, speed cameras were installed with spacing from 500 m to up to 2500 m. On the other five roads, where unsafe overtaking manoeuvres were a main contributing factor to accident occurrence, short passing lanes with lengths from 600 m to up to 1200 m depending on the local circumstances at the relevant road sections were built to safeguard overtaking movements. These lengths were chosen in deviation from current German road design guidelines, which specify lengths of 1000 m to 2000 m for passing lanes.

Each test section was equipped with induction loops to record the number of vehicles distinguished according to vehicle type, location specific time- and date-stamp and velocity of each vehicle (see FIGURES 3 and 4). With this procedure information about the traffic flow, the traffic composition and the vehicles' velocities can be gathered irrespective of weather conditions and time of day or night. In addition pursuit runs were carried out on sections controlled with speed cameras. Velocity information recorded every 2 meters enables displaying the speeding behaviour of car drivers along a continuous section.

Measurements were taken before and after the implementation of each measure to perform a before/after comparison and to investigate the effectiveness of each measure. Pursuit runs, carried out on speed camera equipped sections, were conducted twice after the implementation with a gap of about one year in between. On the other five test sections with passing lanes only induction loops were used. They were located at the beginning, in the middle and at the end of a passing lane as well as in the section where overtaking was prohibited.

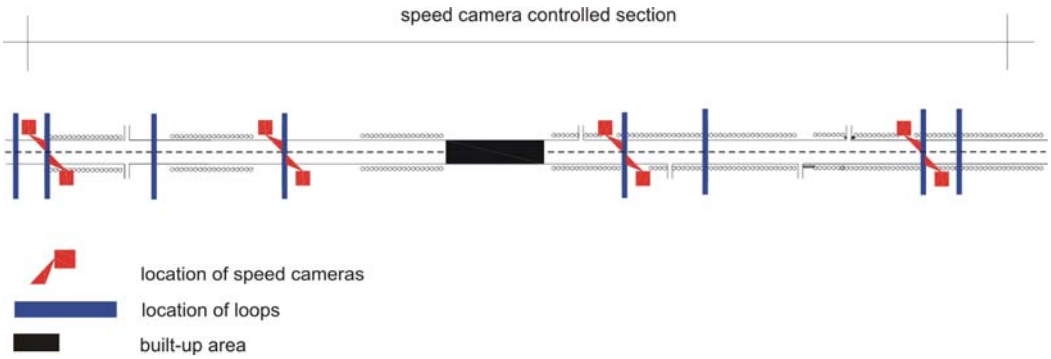

FIGURE 3 Location of speed cameras and loops.

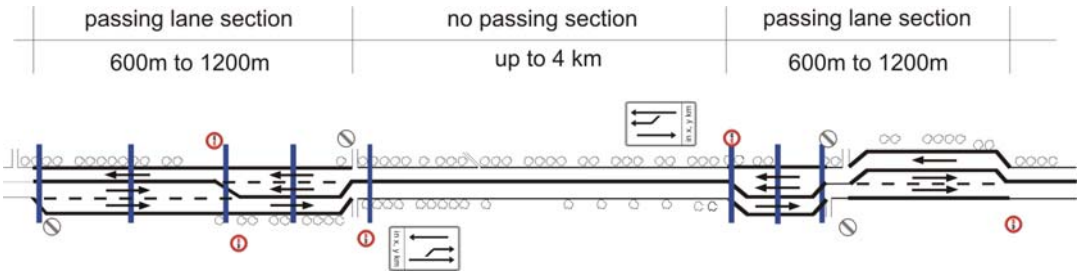

FIGURE 4 Location of passing lane sections, signs and loops.

To inform the driver about the special situation on the approaching road section, special traffic signs were used. Speed cameras were announced by a sign showing “speed camera control” with a supplement of the distance. On routes with passing lanes special traffic signs were installed in sections with only one lane in each direction showing the distance to the section where overtaking is allowed. In sections with two lanes in one direction there were signs indicating the remaining length of the passing lane (see FIGURE 5).

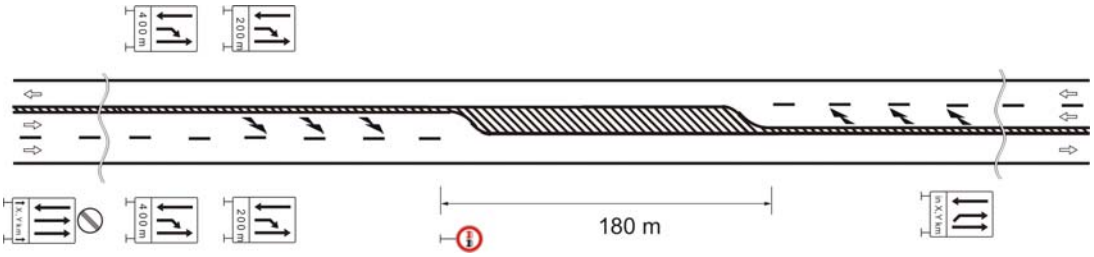

FIGURE 5 Signage for passing lanes

For a time period of three years before and after the implementation of the road safety improving measures, road accidents on the test sections were monitored. The accident data were provided by the local police authorities and contained information of date and time, the number of people involved, the accident severity, the manner of

impact, weather conditions etc. With these data the effectiveness in terms of changes in accident rates could be investigated.

In addition, road users were interviewed on routes with speed camera systems along the road and on routes with passing lanes. They were asked their opinion towards the measures and their effectiveness. Moreover there were questions about how the measures influenced their own driving behaviour and about the acceptance level of the system. This survey should serve to represent the opinion of regular road users who are directly affected by the measures.

RESULTS

Traffic safety increased significantly on those roads where stationary speed cameras were installed with a spacing of up to 1500 m.

The before condition on these roadways consisted of high velocities. After the implementation of speed cameras high velocities were reduced, at cross sections with speed cameras to the level of the legal speed limit. One year after the implementation speed went down by as much as 20 kph (V_{85}). This reduction in speed could be observed over the whole road section. Speeding at camera controlled cross sections decreased to 1 %. At cross sections without speed cameras the reduction in speed was less obvious. Two years after the speed camera implementation, however, the second measurement showed a development toward more homogeneous velocities over the whole investigated section (see FIGURE 6). Top speeds were reduced too. It seems that people got used to the new situation and noticed that it was safer and more relaxing to drive at the level of permitted speed on this specific road. The development towards a homogeneous driving behaviour also contributes to reducing the environmental pollution. Road users who got used to the situation appear to have adjusted their driving habits by going slower at all times which saves energy and prevents noise and thus has a positive environmental impact.

The decreasing level of speed on camera enforced test sections had a considerable influence on the number of accidents and their severity. On some test sections reductions in the number of accidents with serious injury up to 51 % were achieved (see FIGURE 7). In addition the total number of accidents was decreasing, too. There was a noticeable shift from accidents with a very high severity to a low accident severity after the implementation of the measures. Especially driving accidents and overtaking accidents were reduced. This is an obvious example for the direct dependency of speed and accident severity.

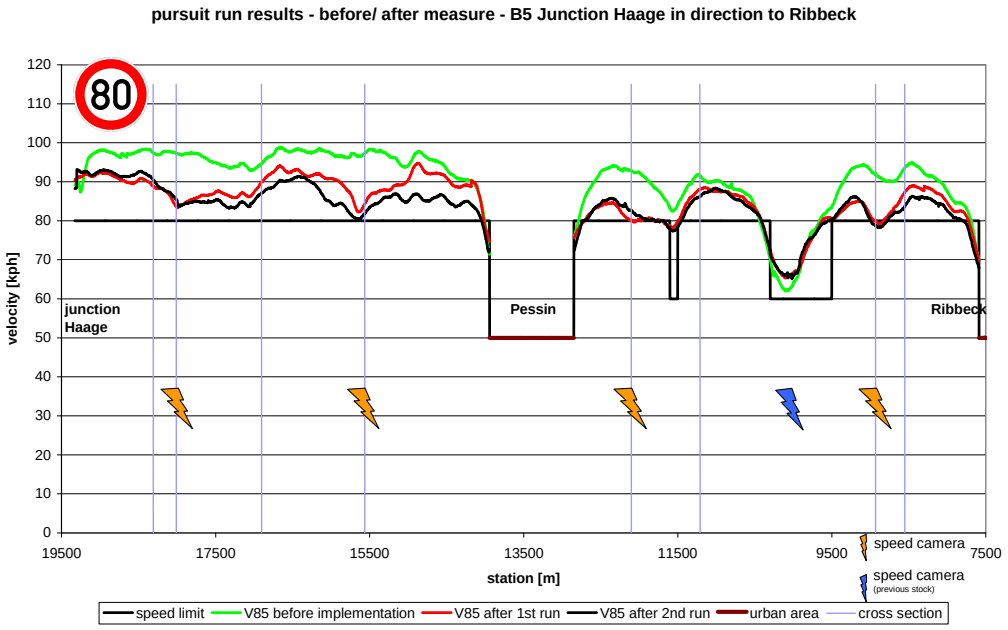

FIGURE 6 Pursuit run results (speed limit at 80 kph).

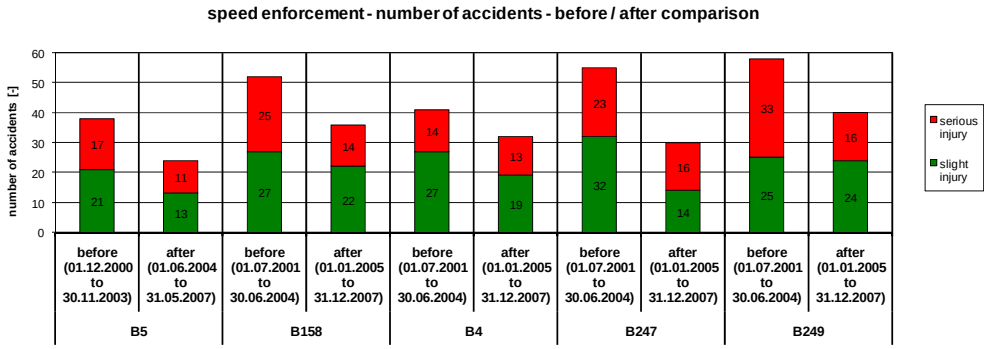

FIGURE 7 Number of accidents on sections with speed enforcement.

The attitude towards the acceptance of speed enforcement differed depending on the geographical region. For sections with many hidden speed cameras in the region the acceptance was not as good as for other test sections where hidden speed cameras were not as frequently used. But the overall acceptance of deploying speed cameras on high risk rural roads reached from 75 % to 95 %. On the other side around 65 % supported speed enforcement as a good tool to improve road safety in general.

One problem which still exists are ignorant motorcyclists. Because in Germany speeding drivers caught by automated speed control must be identified from the pictures taken (which is positively impossible due to compulsory helmet wearing), there are motorcyclists who keep ignoring the legal speed limit which sometimes ends in accidents with high severity.

On all five test sections with additional passing lanes the evaluation of velocities showed different results. In sections with just one lane in each direction and in the continuous right lane in the three lane sections the velocities changed subtly. For passing lanes, however, very high speeds of up to V_{85} of 125 kph were measured. Such high speeds were independent of the total length of the passing lanes, i.e. it did not matter whether the passing lane had a length of about 600 m or 1200 m.

Even though the problem of speeding could not be resolved, the accident situation on sections with additional passing lanes changed for the better. Although the investigation for all test sections has not been finalised, yet, the preliminary results are showing a considerable development towards less severe accidents. Formerly the majority of crashes were accidents in longitudinal direction. These accidents accounted for serious head-on crashes with many fatalities. By creating additional passing lanes the risk of having such an accident could be significantly reduced.

Another result of the trial is that the passing lanes with lengths of 600 m to up to 1200 m are long enough to dissolve queues formed in sections where overtaking was prohibited. Although the average travel time on the test sections did not decrease, people were driving more relaxed and safely. Traffic signs providing information about the next possible safe overtaking possibilities are contributing to the more relaxed style of driving.

CONCLUSION

Speeding and dangerous overtaking manoeuvres are main reasons for the high number of accidents with fatalities and seriously injured on rural roads. The deployment of lined speed camera supervision on road sections with a very high accident severity could remarkably improve road safety. The number of accidents with serious injury could be reduced by up to 51 %. This success was mainly based on the enforcement of the legal speed limit. Average speed reductions of around 10 kph could be achieved. The implementation of additional passing lanes was very effective in the avoidance of head-on crashes. Although passing lanes with lane lengths from 600 m to 1200 m are shorter than recommended in current German design guidelines, there is no negative influence on traffic flow. Both, short-term and medium-term measures are very effective at improving road safety on rural roads where accidents are caused by speeding or unsafe overtaking manoeuvres.

Future research should focus on the design and furniture of junctions along roads equipped with additional passing lanes and their influence on traffic flow and road safety. Moreover, the influence of slow moving vehicles (tractors, etc.) on traffic flow needs to be investigated in view of no-passing sections extending for as much as 4 km.