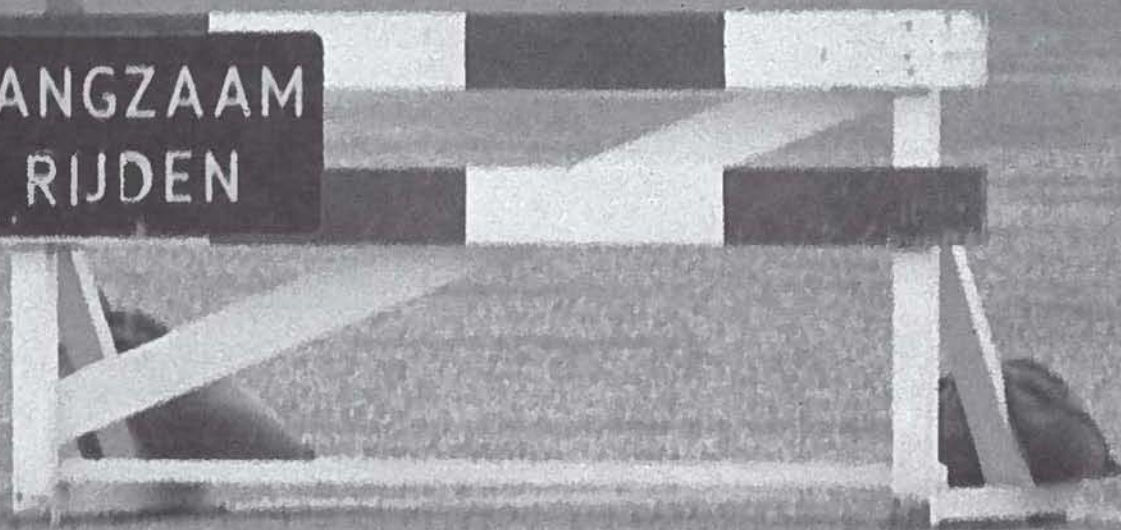


RESEARCH ACTIVITIES 1984





LANGZAAM
RIJDEN



C O N T E N T S

<u>SWOV's objects</u>	4
<u>How SWOV is organised</u>	5
<u>Introduction</u>	6
<u>Basic research</u>	7
Theoretical work	7
Data collection	8
Analysis of accident figures	9
Development of research instruments	9
<u>Policy-supporting research</u>	15
Identification of problem areas	15
Research into the factors influencing road safety	16
Research into the impact of safety measures	19
Development research	23
<u>Reports published in 1984</u>	25

SWOV'S OBJECTS

The Institute for Road Safety Research SWOV was founded in 1962 on the initiative of the Minister of Transport, the Royal Dutch Touring Club ANWB and the Netherlands Association for Automobile Insurance NVVA. The reason was the constant increase in the number of road casualties and the realisation that scientific research was indispensable for an effective approach to road safety problems. SWOV's object is to contribute to road safety by means of scientific research and dissemination of the results. Its activities cover all aspects and areas of road safety. SWOV also contracts research to third parties. In this way it has a co-ordinating function in planning road safety research in the Netherlands.

The research results and know-how are spread:

- among policy-making bodies which can put the research results into practice,
- among scientists, in order to exchange research results and methods, and
- among institutions and persons concerned with road safety.

Much of SWOV's research is focused on obtaining information for policy measures. Most assignments for this come from the Ministry of Transport. In recent years, however, more and more assignments have been received from provincial and municipal authorities.

HOW SWOV IS ORGANISED

The Institute for Road Safety Research SWOV is governed by a board of governors and a director. In 1984 the board of governors consisted of the following persons:

<u>Chairman:</u>	Th.J. Westerhout
<u>Deputy Chairman:</u>	J. Barkhof, representing the Royal Dutch Touring Club ANWB
<u>Secretary:</u>	J.C. Slagter, representing the Director-general of the Public Works Department
<u>Treasurer:</u>	J.D.J. Idenburg, representing the Netherlands Association for Automobile Insurance NVVA
<u>Members:</u>	P.B. van Gorp, representing the Minister of Transport W.F. Haak, representing the Minister of Welfare, Health and Cultural Affairs W. Hustinx, representing the Netherlands Association of Bicycle and Automobile Industry RAI A. van 't Laar, representing the SWOV employees

Director of the institute is Prof. E. Asmussen. The institute is organised in the following departments:

- Pre-Crash Research
- Crash and Post-Crash Research
- Methods and Techniques
- Policy Support and Consulting
- Research Services
- Information
- Personnel
- General Affairs

I N T R O D U C T I O N

1984 has been an important year for SWOV, in that the first moves have been taken towards better integration of research and policy. To this end plans have been drawn up for a new-style SWOV, which should be fully implemented no later than 1 January 1989. Broadly the plans entail placing much greater emphasis on two of SWOV's functions:

- (a) acting as architect of the road safety research carried out in the Netherlands; and
- (b) integrating the results of Dutch and foreign research and adapting them for use in road safety policy.

SWOV's most important function to date - to carry out all sorts of road safety research itself - will be considerably reduced.

The improved integration of research and policy to some extent already began to take shape in 1984. For example, SWOV started work, in close collaboration with government agencies and the workers in the field, on a number of projects included in the National Road Safety Plan published at the end of 1983 by the Ministry of Transport. These projects are being implemented using the SWOV "dynamic system approach" which the Organisation for Economic Co-operation and Development is encouraging its member states to use when tackling their road safety problems. The approach is designed to improve the traffic and transport system by means of more problem-oriented thinking and working and better comparison and coordination of measures. In addition, the Ministry's Road Safety Directorate (DVV) and SWOV have combined forces to produce a progressive Medium-Term Plan for Road Safety, a large part of which will be devoted to developing and promoting a view of how to improve road safety. This development is of considerable significance to SWOV, since it may be expected to result in more systematic acquisition of knowledge and, consequently, a more coherent programme of SWOV research projects. It also means that SWOV will be in a better position to anticipate the government's longer-term policies and start developing the necessary theories in good time. In this way SWOV will be able to be more effective and responsive in its policy-supporting function.

This report still reflects primarily the research work of the "old-style" SWOV, and is very similar in form and execution to last year's report. It aims to give the reader an idea of the various projects SWOV has carried out in the field of basic research and support for the work of the government. At the end is a list of the reports published in 1984.

Prof. E. Asmussen
Director

BASIC RESEARCH

The basic research carried out by SWOV involves theoretical work, permanent data collection and analysis, and the development of research instruments. These activities are not directly related to applications, but they are indispensable to the research needed to support the work of the government. If all the knowledge first had to be assembled whenever the government or another client requested information, this would take so long that SWOV's eventual reply would often amount to shutting the stable door after the horse has bolted. Effective underpinning of policy is impossible, then, without basic research. The main forms of basic research are reviewed below.

THEORETICAL WORK

Integration of research, policy and management

In 1984 the Organisation for Economic Cooperation and Development published a report entitled "Concepts and methodologies for integrated safety programmes", which urges an integrated approach to road safety problems in the member states. It was compiled by a group of prominent scientists and officials from eighteen countries, supplemented by representatives of the World Health Organisation and the Committee of European Ministers of Transport. The report centres on the "dynamic system approach" developed by SWOV, a model for research into road safety problems and the improvement of road safety. In this approach the accident process is regarded as a succession of increasingly critical events culminating in an accident and all that this entails. The model divides the process into a number of phases where measures can be taken to prevent accidents, to prevent or reduce injuries and damage if one occurs, and to repair injuries and damage. The dynamic system approach offers new ways of identifying and analysing problems and systematically predicting and evaluating the effects of road safety measures.

Traffic behaviour

SWOV carries out theoretical research into the behaviour of road users in collaboration with some other research organisations. Very little is as yet known about the way in which traffic behaviour arises and how it is related to the occurrence of accidents. It is not realistic, therefore, to expect that research into this very extensive and complicated matter can be completed in the near future. To enable policy-supporting research nevertheless to make use in the short term of the information provided by research into traffic behaviour, the latter has been split up into a number of projects and reports are being issued in phases. In 1984 four reports were published: one of a literature study into driver behaviour on bends; one of an exploratory study into the detection of potential collisions on the approach to an intersection from a bend; one of an experiment concerning drivers' perception of their speed; and one of an experimental study into the relationship between stress, workload and road environment.

Since 1983 research has not been confined exclusively to the opportunities available to road users to satisfy the demands of the traffic system but has concentrated particularly on their decision-making behaviour. This research is designed in particular to indicate how and to what extent the behaviour of road users is influenced by the risk they believe to be associated with it. The results

may be useful in road safety education, publicity campaigns and driving lessons. The first results became available in draft form in 1984.

Electronics in traffic

In 1984, at the request of the Road Safety Council, SWOV carried out a literature survey to uncover gaps in our knowledge of the possible applications of electronics in traffic risk control. The report, which is now complete, contrasts the current practical applications of electronics in traffic with the applications which are theoretically possible. It deals with topics including the importance of the controlled introduction of electronic aids, a functional classification of the applications and the main points which need to be taken into account when using electronic aids.

Survey of the post-crash area of policy

Little systematic research has been carried out as yet into the factors which can improve the treatment of injuries and repair of material damage after an accident. At the request of the Road Safety Directorate (DVV) of the Ministry of Transport, SWOV produced a report on this area of policy in 1984, containing a systematic account of all the factors which play a part in limiting and repairing the consequences of road accidents: injuries, mental and social problems, material damage, traffic problems. The various types of emergency service assistance required are shown in a structural diagram, which enables interactions, overlaps and gaps between problem situations and the work of the emergency services to be established. Better emergency service assistance is likely to result in less injury and material damage after a road accident and more rapid repair.

DATA COLLECTION

The most important basic data on traffic and road safety in the Netherlands are collected by the Road Accident Records Office (VOR) of the Ministry of Transport and the Central Bureau of Statistics (CBS). The VOR collects data on road accidents, the CBS on the travel behaviour of the various categories of road users. Collating the two sets of data provides information on the risks of the various types of traffic participation.

The data do not however yield sufficient information on the way road accidents occur, the factors that contribute to their occurrence, and the resulting injuries. SWOV has consequently developed a coding system which yields much more information on the way accidents occur. It also wishes to create an integrated road accident registration system, by linking the VOR data to those from other data banks: in 1983 a successful experimental link was established with the data bank of the Road Transport Department (RDW), which holds the data on vehicles. The report of this experiment was published in 1984. SWOV also acted as advisor on a similar link between VOR data and data held by the Medical Record Association (SMR). The latter's data bank contains information on the injuries of road accident victims admitted to hospital. The experiment, which was designed by SWOV, started in 1984 and is being carried out by the SMR itself to safeguard completely the privacy of the accident victims concerned.

ANALYSIS OF ACCIDENT FIGURES

As a rule SWOV analyses the provisional figures for road accidents in the Netherlands every quarter. The analyses are designed to show the general trend so that the authorities can be informed rapidly if shifts take place. In 1984 SWOV was able to carry out only one quarterly analysis, however, owing to a serious delay in the processing of the registration forms which the police fill in for each accident. The problems were due to the changeover to a new information system. In the meantime SWOV has had the opportunity to improve both the quarterly analyses themselves and the resulting reports. In future not only fatal accidents but also those where injured victims are admitted to hospital will be analysed. In addition to the quarterly analyses based on provisional figures, SWOV will carry out an annual analysis based on the definitive figures published by the CBS: this will attempt to interpret interesting trends noted in the quarterly analyses. Lastly, SWOV will carry out a medium-term analysis for the government at the beginning of each new term of government.

Since 1980 SWOV has had a unique system, using the SWOV minicomputer, for producing cross-reference tables based on the CBS data on fatal road accidents (these are tables which the CBS does not publish). This system works very rapidly (often taking only a few minutes), and contains a large number of accident, victim, road and vehicle data, as well as data on when the accident occurred (time, day of the week, date, month and year), visibility and weather conditions. The system is frequently used to provide central and local government with accident data. It also plays a major role in research into the nature and extent of road safety problems. The system contains accident data from 1971 onwards; the data on 1983 were added in 1984. Starting in 1984 accidents with injured victims admitted to hospital have also been included. Data on the collision partners and the manoeuvres preceding the accident have been added.

DEVELOPMENT OF RESEARCH INSTRUMENTS

The rapid progress of science and technology in general has not been without its effects on road safety research. SWOV and the organisations with which it collaborates are making a contribution in this respect, also internationally. Dutch road safety research plays a prominent role, especially in the development of new techniques and methods of designing and testing safety devices and collecting and analysing data on road safety.

Mathematical simulation models

Mathematical simulation models are an important aid in the design of safety devices for vehicles and roads and the prediction of their effects. SWOV is particularly active in developing computer models of the collision process and adapting them, working in close collaboration with other Dutch and foreign research organisations. The computer models are capable of simulating collisions which cannot be simulated in practical trials, either for financial or ethical reasons or because the objects involved exist only on the drawing board. The models enable accelerations, moments of force and deformations of humans, vehicles and obstacles to be computed and reproduced graphically.

To begin with a model was developed to simulate collisions between vehicles and street furniture and between vehicles and other vehicles; humans were not included in this model. The second step was to develop a model which simulates accidents where humans come into contact with the interior or exterior of vehicles; this model centres on the forces exerted on human tissue in a collision. The experience gained from developing these two models is now being used to develop a model of the collision process which includes both vehicle, human and surroundings. There is great interest in these models, both in and outside the Netherlands.

Netherlands Railways, for instance, in 1984 put forward the SWOV models for simulations of collisions involving trains to be carried out by a consortium of European railway companies. The models have been adapted and enlarged for this purpose, and the initial results obtained are encouraging. The last in this series of deterministic models based on the laws of mechanics which SWOV is working on is a mathematical/statistical model designed to predict the distribution of risks of injury and gravity of injuries among a particular population given a certain type of accident.

In addition to the models of the collision process SWOV is attempting to develop a mathematical model for the improvement of road safety. This relates to the prevention of both injuries and accidents and the work of the emergency services. Ultimately it should be possible to predict trends in road accidents and the effects of measures with this model. The actual development of the model is currently at a low ebb because of the lack of reliable data on a number of important factors. In 1984 SWOV published a report of an exploratory study of the potential and limitations of a model of this kind; a partial model was then designed to provide experience and test the feasibility of the approach.

Safety criteria for traffic facilities

At the end of the seventies SWOV began a study into criteria for a safe design for the entire Dutch road network both in built-up areas and outside. Analysis of road, traffic and accident characteristics should provide explanations of the differences in accident rates; these in turn should enable recommendations to be made on the best coordination of design to the use made of the various types of road. Because of its size and complexity, this study has been divided up into a number of projects. Following the collection of the data needed on the "primary road network" - main roads outside built-up areas - analyses have been carried out, starting in 1983, to ascertain the key accident rates. The accident rates for a number of types of road in the primary road network were established in 1984; these have now been used to indicate priorities in the Passenger Transport Medium-Term Plan. The complete results of analyses on the primary road network will be published in 1985. To prepare the ground for the establishment of key accident rates for secondary and minor roads, a trial survey of road characteristics was carried out in 1984. The results of the trial offer good prospects for the definitive survey of the road, traffic and accident characteristics required.

Barometer of road safety

To enable the government to take a more rational approach to road safety, for some years now SWOV has been carrying out preparatory work on the development of a "barometer" of road safety. This should enable trends in accident rates to be described, analysed and interpreted. It should also enable national problem areas to be identified and the effects of general measures to be predicted and evaluated. This requires an information network which provides data not only on accident rates but also on road, traffic, vehicle and personal characteristics, traffic density, weather and other conditions, etc. The preparatory phase involves examining what variables the barometer should include, what the representativeness, quantity and quality of the data must be, and within what time scale the data must be available.

Conflict observation techniques

The road safety authorities are now taking a much greater interest in local problems, particularly slow traffic, than they did in the past. Far fewer accident data are however available at local level, of course, than at national level. It is more difficult, in many cases impossible even, to identify the problems and evaluate measures on the basis of accident data. This has made it necessary to look for additional data, and it was decided to look at conflicts (near misses) between road users. Because there are far more conflicts than accidents, it takes less time to obtain sufficient data on them for statistical analysis. Furthermore, conflict observations provide a good deal of information on dangerous traffic situations and the way in which accidents occur.

In 1983 the International Committee on Traffic Conflict Techniques (ICTCT) in Malmö organised an international comparative study of these techniques, and SWOV was closely involved in its design and execution. The study showed that the results of six techniques developed in Europe are comparable. It is now also known on the basis of which objective characteristics the seriousness of conflict situations is assessed; this is an important step towards the widespread applications of conflict observation techniques. The report of the Malmö study was published by SWOV in 1984, thus making the results available to the officials and researchers of the countries involved.

As a follow-up to the Malmö study SWOV began developing a general Dutch technique in 1984, in collaboration with the Road Safety Directorate (DVV) and the Traffic and Transportation Engineering Department (DVK). This technique is based on a Swedish one already used in the Netherlands in the pilot scheme for the reclassification and reconstruction of urban areas. The new technique will be used, among other things, in some of the National Road Safety Plan projects. The cooperative committee mentioned above will indicate the possible applications of the technique, monitor its quality and encourage its use, for example by instituting training programmes for observers. The committee will maintain contact with the users of the technique, e.g. scientific institutions, local government and civil engineering firms. SWOV has now begun compiling a users' manual.

Statistical analysis techniques

Identifying critical traffic situations - i.e. combinations of characteristics which can cause accidents - requires highly advanced statistical analysis techniques and suitable computer programs. Two such programs, Homals and Canals, are used on a large scale in SWOV research. Homals enables the researcher to discover the relationships between characteristics in the same category (e.g. roads or accidents), whereas Canals enables him to find links between characteristics of two different categories (e.g. roads and accidents). These two programs were developed by the University of Leyden and adapted for road safety research by SWOV.

In 1983 SWOV began developing Overals, an analysis program designed to find links between more than two categories of characteristics (e.g. roads, vehicles and accidents); here again SWOV is working in close collaboration with the University of Leyden. There is now a workable version, which was used to carry out the first analysis in 1984. It merely needs the finishing touches before it is complete, as planned, in 1985.

The analysis techniques described here enable links between characteristics to be discovered, but not causal relationships. Consequently SWOV began consultations with the University of Leyden in 1984 on the development of an analysis technique which does reveal cause and effect (path analysis).

The University of Utrecht has developed exact methods in collaboration with SWOV for testing results of statistical analyses of small samples for their reliability, since the standard methods of approaching large samples are not satisfactory in this case. The new methods will be particularly useful for evaluating local measures, where researchers are often faced with the problems of small samples. In 1984 the University of Utrecht supplied the associated program pack, which is suitable not only for small samples but also for large ones. This Contingency Tables pack also enables Goodman interactions to be described, which enables comparisons to be made with the Leiden techniques.

The incorporation of SWOV research in current research at the universities of Leyden and Utrecht has proved very fruitful for all parties concerned. It has increased the possible applications of the programs and SWOV has found solutions to statistical problems in road safety research at a relatively low cost.

Traffic censuses

Traffic censuses are needed to establish traffic performance in a given area. Automatic equipment cannot be used if the different types of traffic participation need to be separated: counts have to be made visually. In large areas especially, exact visual counts are impossible, thus sample counts are the only solution. Even the standard statistical sample counts, however, are often far too expensive. As an alternative SWOV has devised a "mobile" census method with a much higher output, which permits a dramatic reduction in the number of census hours. The missing data can be estimated with the aid of two general trends. The first and

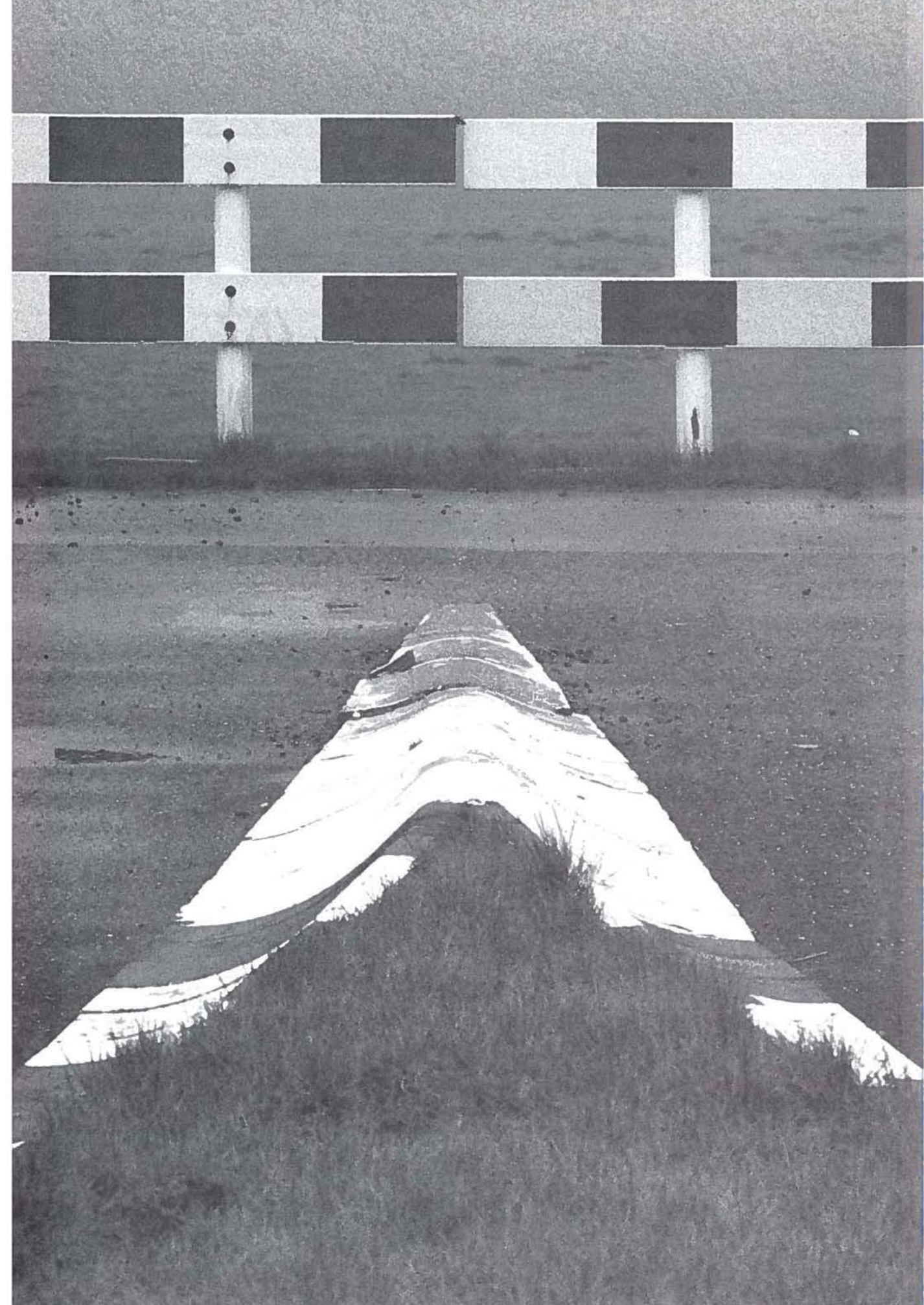
most important is the general daily trend, which shows the familiar pattern with peak hours in the morning and evening. The second indicates the difference between carriageways with a traffic function mainly during the morning rush hour and carriageways with a traffic function mainly during the evening rush hour. It would be worthwhile to investigate how applicable this method is to residential streets.

SWOV published a report on the estimation of intensities on the basis of composite trends in 1984, but the final report on the mobile census method, also planned for 1984, has had to be postponed owing to a change in priorities.

Quantitative decision-making

To enable the traffic authorities to predict the effectiveness of certain measures in specific situations, SWOV is developing quantitative decision-making procedures. The quantitative information needed to apply such procedures was collected in 1983. An outline report of the standard procedures and practical applications in relation to road safety measures was planned for late 1984; this has been delayed, however, owing to the allocation of higher priority to a study of the economic damage due to road accidents. The two projects are in fact closely related.

The results of the economic damage study were published in 1984. It showed that the economic damage resulting from road accidents amounts to 4-5% of the gross national product: 10,000-15,000 million guilders in 1982. It can be concluded from these figures that many road safety measures are self-financing because of the savings in damage.



POLICY-SUPPORTING RESEARCH

SWOV's policy-supporting work can be classified into research into problem areas, research into the factors which influence road safety, research into the effects of measures, and development research.

IDENTIFICATION OF PROBLEM AREAS

Road accidents involving cyclists

As a result of questions in Parliament about the higher fatality figures among cyclists in 1982 than in 1981 (cyclists were the only category of road users in which the rise occurred), the Ministry of Transport commissioned a study of trends in accidents involving cyclists in relation to trends in the ownership and use of cycles from SWOV in mid-1983. The report of the study was published in 1984. The most important findings were:

- (a) the use of cycles has increased sharply in recent years;
- (b) the total number of cyclists injured or killed has remained constant in recent years, but the risk of being involved in an accident in relation to distance covered has dropped 20%;
- (c) the seriousness of accidents expressed as a fatality rate (number of deaths per 100 victims) for cyclists has fallen 20-25% in recent years.

The report gives a number of possible explanations for these developments and a forecast of accident rates among cyclists in 1990. It also suggests how an integrated traffic and road safety model for cyclists could be drawn up.

Road accidents among the elderly

A few years ago SWOV carried out an analysis of the problem of road accidents among the elderly during the 1974-77 period. Another such analysis was carried out in 1984, this time of the 1978-82 period. No substantial differences were found between the two periods. The main conclusions were as follows:

- (a) there are far fewer deaths among the elderly in road accidents than in accidents at work and at home;
- (b) the road accident rate among the elderly is significantly higher than that of virtually all other age groups, their susceptibility to accidents is greater, they run a greater risk of injury in an accident and they are more likely to die from their injuries;
- (c) most of the elderly who die in road accidents are on foot or on a bicycle at the time of the accident.

Alcohol consumption among motorists

SWOV has been conducting regular research into alcohol consumption among motorists in the Netherlands since 1970. These roadside surveys are carried out at various locations. In 1981 the SWOV research was combined with police investigations for the first time, the main aim being to bring about a sharp reduction in the number of refusals and reduce the workload on the research workers and police.

Another study of alcohol consumption among motorists was carried out in 1983, this time by the University of Leyden at SWOV's request. Following this study SWOV published a report in 1984 on alcohol consumption among motorists from

1970 to 1983, the effectiveness of police surveillance and current and future research. The conclusions included the following:

- (a) the 1974 Alcohol Act continues to have a good effect on alcohol consumption among motorists, but the effect is by no means strong enough;
- (b) since the Act was introduced the proportion of women road users under the influence of alcohol has been steadily rising;
- (c) the chances of catching drunken drivers could be increased considerably if breath test tubes were to be replaced with handy, reliable and accurate screening testers.

Accidents on railway level crossings

Every year on average 55 people are killed as a result of collisions between trains and road vehicles on public level crossings. It is not surprising, then, that accidents on level crossings were given special consideration in the preparation of the National Road Safety Plan published in 1983. One of the things the working group which was subsequently set up did was to produce recommendations for research, as a result of which SWOV carried out a literature study as a possible basis for research proposals. The results of the literature study will be available in 1985.

Regional and local accident rates

SWOV has devised a plan for regional accident rate analysis for the Regional Road Safety Policy in the Province of North Brabant project (part of the National Road Safety Plan).

This is a trial project designed to encourage provincial and municipal authorities to formulate and implement regional or local road safety policies. The plan includes an accident rate analysis as the basis for selecting problem areas and developing policy considerations and measures. The Royal Dutch Touring Club ANWB has commissioned SWOV to look into ways of establishing which Dutch municipalities have the best road safety on the basis of objective data; SWOV is to report to the ANWB in 1985.

RESEARCH INTO THE FACTORS INFLUENCING ROAD SAFETY

Research into the factors influencing road safety essentially covers the three phases which can broadly be identified in the accident process, i.e. the events before, during and after a collision. The objectives are accident prevention, injury prevention and repair of injuries respectively. Research into the factors which influence repair of injuries is still however to a large extent at the theoretical stage.

Accident prevention

In the province of North Brabant SWOV has investigated what *combinations of road and traffic characteristics* entail an increased risk of accidents. In 1984 SWOV presented the last project reports and the final report of the study to the local highways authority. The final report indicates how the results of the various parts can be integrated so that the highways authority can use them as a basis for its policy. Two of the important conclusions were:

- (a) for safety reasons traffic should be concentrated as far as possible on a few major roads and kept off secondary and minor roads;
- (b) continuity of road characteristics is highly important on busy roads, whereas the local road and environmental characteristics are particularly important on quiet roads.

At the request of the Traffic and Transportation Engineering Department (DVK) SWOV looked at the problem of *spray from heavy goods vehicles on wet roads* obstructing the view of other road users. The results of the study were presented to the DVK in 1984 in the form of a report, which describes the nature and extent of the problem in terms of both loss of visibility and accidents. The report also puts forward various measures to reduce the problem considerably by modifying roads and heavy goods vehicles themselves. A very effective way of preventing spray and splashing mentioned is the use of very open asphalt concrete in roads being built or resurfaced.

Measures which can be taken on the vehicles themselves include a combination of airflow (created by roof spoilers) and wheelguards; these measures not only reduce the amount of spray and splashing, they also prevent accidents on wet roads, reduce the fuel consumption of heavy goods vehicles and make them safer in collisions.

Little is yet known about the risks to road users under the influence of *alcohol or medication*. SWOV began a project to obtain more information on the subject in 1982, in collaboration with the University of Utrecht. The survey is concerned primarily with road accident victims admitted to hospital for treatment: volunteers among them give blood and urine samples so that their consumption of alcohol and medicaments can be assessed. It should have been completed in 1984; however, since it was not possible to collect sufficient data during the period allotted, reporting will not be able to take place until 1985. The second part of the survey involves taking blood and urine samples from a control group of road users resembling the sample of victims as far as possible but who have not been involved in an accident. This part of the survey has not yet begun; the aim is to complete it in 1986.

In 1984 SWOV published the definitive report of a study of the relationship between *frictional resistance of road surfaces* and the risk of accidents. This relationship has long been known in the case of national trunk roads but not in that of other roads. The study investigated above all whether friction should be high everywhere or only at locations where large numbers of braking and steering manoeuvres are carried out, e.g. at intersections and on bends. The study shows that on roads with mixed traffic in particular the risk of wet-road accidents is lower the higher the friction. Increasing friction is likely to have the greatest effect as a rule in the lower friction categories, especially on bends.

Since 1984 SWOV has also been conducting research into the relationship between *road maintenance* and road safety. The effect on accident rates of unexpected changes in the frictional resistance, levelness and gradient of roads is being examined. SWOV is to formulate research proposals on the basis of a qualitative problem analysis and a literature study. A draft problem analysis was completed in 1984. The results of the study will be used as a basis for maintenance standards for national trunk roads in the framework of rational highways administration.

Injury prevention

As well as conducting research into the factors which influence the risk of an accident, SWOV is investigating those which influence the risk of injury in an accident. This research is concerned with injury-preventing measures on vehicles and shoulders of roads.

In the past, research into measures on *vehicles* was concerned only with reducing the risk of injury to occupants and riders. One of the results was the introduction of compulsory wearing of seat belts in cars and crash helmets on mopeds. Current research is also looking into ways of constructing vehicles so that they constitute less of a danger to collision partners. The research into injury prevention by means of measures on vehicles centres around two accident studies, one concerned with car occupants and the other with pedestrians, cyclists, moped riders and motorcyclists. The latter is still relatively new and is to a large extent still at the literature study and hypothesis stage. An exploratory survey of the ways in which moped crash helmets are fastened was carried out in 1983; there had been indications in foreign research that moped riders involved in accidents lost their helmets relatively often. The results of the exploratory survey were such that a larger-scale survey was carried out in 1984. SWOV also contributed to a report by the European Experimental Vehicles Committee (EEVC) on accidents among cyclists and moped riders in the participating countries, published in 1984. It describes the factors which affect the occurrence of accidents of this kind and the resulting injuries, and contains recommendations for reducing their number and gravity. It was presented at the International IRCOBI Conference on the Biomechanics of Impacts.

As part of research into ways of reducing the risk of injury to occupants and riders of vehicles, since 1975 SWOV has been carrying out an accident survey which examines what factors (characteristics of vehicle, person, road and environment) influence the outcome of accidents for car occupants, i.e. the nature and seriousness of the injuries they suffer. The report on permanent effects published as part of the survey in 1984 suggests that every year some 13,000 road users are injured in such a way that a year later they still have minor or serious physical complaints. It was also found that many road users still have to cope with problems of various kinds (psychological, legal, insurance and medical) a year after the accident. The final report of the study as a whole is planned for late 1985/early 1986.

Research into the safety of *road shoulders* previously resulted in the installation of guide rails alongside motorways. Nowadays research is concerned particularly with shoulders of other roads, since this is where most accidents occur. The aim is to devise universal basic criteria for the safe construction of these shoulders. The study is looking at both road, traffic and accident characteristics. Three draft reports on the subject were completed in 1984.

RESEARCH INTO THE IMPACT OF SAFETY MEASURES

The research conducted by SWOV into the impact of safety measures can be divided into three main categories: it may be designed to evaluate the effects of experimental or definitive measures or to predict the effect of a measure still in the planning phase.

Evaluation of experimental measures

A large part of the SWOV research programme involves evaluating measures taken at local and regional level, which is where the most road safety measures have been taken in recent years.

As part of the pilot scheme for the *Reclassification and reconstruction of urban areas*, numerous measures were taken in Eindhoven and Rijswijk to make areas safer and more pleasant to live in without impeding the circulation of traffic. The two experimental areas were divided into traffic zones and residential zones. In the traffic zones various measures were taken to encourage the safe and smooth movement of both slow and fast traffic and to reduce noise and air pollution to a minimum. Various packages of measures were introduced in the residential zones, ranging from relatively simple and cheap to radical and expensive, depending on the objective. There were three potential objectives:

1. to keep out through-traffic;
2. to keep out through-traffic and restrict the speed of other traffic;
3. to keep out through-traffic, restrict the speed of other traffic and give the area an attractive appearance.

The research into the effects on road safety involves looking at behaviour, subjective reactions and accident rates. The 'before' survey, carried out in 1977 and 1978, yielded, among other things, a mine of information on conflict observations (a novelty at the time) and black-spot studies. The 'after' survey was virtually completed in 1984. The results of the accident survey indicate that a structural approach to the urban road network can have a good effect on road safety:

- in the residential streets the number of accidents involving injury per vehicle kilometre was halved;
- on the main traffic arteries and access roads there was a drop of about 15%;
- the overall drop in the traffic and residential zones of the experimental area was about 20%.

Because of the relatively short 'after' period and the consequently small numbers of accidents, it is not yet possible, on the basis of the accident survey, to say

which package of measures has the greatest effect on safety in residential streets. Not until accident data are available for a longer 'after' period will it be possible to make a pronouncement. Even aside from this, we find that some 80% of accidents involving injury in towns take place on main traffic arteries: purely from the road safety point of view this is where the greatest return can be expected from measures. For the reconstruction of residential streets relatively simple measures to keep out unwanted traffic and restrict the speed of other traffic are therefore probably more appropriate than complex and expensive measures such as semi-pedestrianisation (woonerf). The results of the survey of behaviour and subjective reactions show that the measures have resulted in less unwanted traffic in the residential streets and lower speeds among the remaining traffic.

In 1977 the Minister of Transport introduced a state grant scheme for *experiments in built-up areas* to increase road safety for pedestrians and cyclists in the form of small-scale infrastructural measures. SWOV assessed the effects on safety by carrying out accident surveys before and after the introduction of the measures. This covered a total of ten experiments, including semi-pedestrianisation (woonerf and similar schemes) and measures to restrict speeds. The report of the survey, completed in 1984, shows that the semi-pedestrianisation schemes in particular have resulted in a large reduction in the number of road accidents, but the other infrastructural measures also have a good effect on road safety. Above all the number of accidents among pedestrians and moped riders has been reduced considerably by the experimental measures.

Evaluation of definitive measures

Since 1 January 1984 municipal authorities have had the power to introduce *30 kmph zones* in built-up areas. The Ministry of Transport has set up a research advisory committee to evaluate the effects of this measure, for whom SWOV drew up research proposals in 1984.

The government's desire to encourage cycling has led it to ask SWOV to examine the safety of various kinds of *cycle provisions*. Following the completion of a literature study and research design in 1982, the survey proper began in 1983. This examines, on the basis of accident data, how safe it is for cyclists and moped riders on sections of road without provisions for cycles, with cycle lanes and with self-contained cycle tracks. Reporting is to take place in 1985.

Since the introduction in 1973 of a universal *speed limit* of 100 kmph for all motor roads, this has been under continual discussion, especially in the case of motorways. In 1983 the State Secretary commissioned an evaluation of the present situation regarding speed limits. SWOV has consequently compared the effects of current policy with those of a number of alternatives in relation to road safety. The report of this study was completed in 1984, but it has not yet been published in case additions have to be made.

Since 1969 SWOV has been carrying out annual polls on the presence and wearing of *seat belts* in cars. The results of the 1979-83 polls were published in 1984. The main findings are:

(a) wearing of seat belts is highest on motorways (over 70%) and lowest on roads with local traffic (over 40%);

(b) the proportion of lap and diagonal belts has fallen very low.

SWOV is also involved in a project in the province of Friesland to investigate the effect of brief concentrated police and publicity campaigns on motorists' wearing of seat belts.

On 1 Januari 1985 a compulsory *regular testing scheme* is to be introduced for motor vehicles under 3,500 kg. After six years an evaluation will be carried out to establish whether the scheme should be retained or withdrawn. If it is retained, the results of the evaluation will be used to optimise the scheme. The evaluation will be carried out and the report drawn up by the Road Transport Department (RDW), who will be advised by SWOV. As a run-up to the evaluation SWOV carried out a preliminary survey in 1984 of the relationship between the age of cars and their defects, mainly on the basis of foreign literature. In addition, again in 1984, it supplied the RDW with a design for a survey of the state of repair of Dutch cars before and after the introduction of the scheme.

In response to a commission from the Public Works Department SWOV has evaluated the *wind-related* warning system on the Moerdijk bridge, having already been involved in the development of the system at an earlier stage. SWOV reported on the evaluation in 1984.

At the request of the Road Safety Directorate (DVV), SWOV is investigating the possibilities of a survey of the effects of radio *traffic information* on road safety; in 1984 SWOV carried out a preliminary study. The survey proper, which is part of the National Road Safety Plan, is to be carried out externally; its completion is planned for 1985.

Predicting effects of measures

In 1980 the government submitted a proposal to Parliament for the inclusion of the *environmental aspects* of traffic measures in Section 2 of the Road Traffic Act. The Public Works Department has asked SWOV to examine what effects this amendment might have on road safety. The report of the study was presented to the Department in 1984. As a follow-up SWOV has developed a decision-making procedure for measures under Section 2. Essentially what this entails is that the highways authority can examine in advance what changes in behaviour a measure is likely to have and what the effect would be on road safety. To quantify the effect on road safety the authorities could use key figures when drawing up guidelines: SWOV has drafted a proposal based on findings from the current study of safety criteria for traffic facilities (see Basic research, section on Development of research instruments).

At the request of the Road Transport Department (RDW) SWOV produced a report in 1984 on the likely effect on the safety of car occupants of extending *compulsory wearing of seat belts to back seats*. The main findings were:

- wearing seat belts would certainly improve the safety of rear-seat passengers;
- if from now on all rear-seat passengers were to wear seat belts this would not result in a spectacular drop in the total number of accident victims because only a relatively small group of people are involved;
- considerable technical improvements could be made to rear seat belts;
- there would have to be a large number of exceptions to the rule, which makes it difficult to legislate.

It was concluded from these and other findings that it would be better to require the presence of rear seat belts than to make wearing them compulsory.

In response to a commission from the Royal Dutch Touring Club ANWB, in 1984 SWOV looked at the effects of organisational *changes in primary education* on the road safety of the pupils involved. The greatest improvement in road safety is likely to result from postponing the start of the morning session in combination with the introduction of a 'continuous' timetable (without a long lunch-hour): maximum saving 130 serious injuries a year, resulting mainly from reduced exposure to traffic (the morning peak is avoided and pupils no longer go home during the lunch break).

In the Netherlands there are no *emergency call-boxes* alongside most non-motorway roads outside built-up areas. SWOV was commissioned by the ANWB to investigate whether an emergency communication system is actually necessary and if so what functional requirements it should meet. It is in any event clear from the literature that there is a positive relationship between the chances of survival of accident victims and the speed and quality of medical assistance. This project is to be completed in 1985.

Again at the request of the ANWB, SWOV carried out a limited study in 1984 to examine the correctness of the claim that traffic in the *United States* is safer than in the Netherlands, because the driving style there is less aggressive. The results of the study indicate that there are scarcely any research data on the driving style of the Americans, nor are there any indications that American traffic is safer than Dutch; the contrary would seem to be more likely.

Starting in 1986 cars in the United States are required to be fitted with *additional high-level brake lights*. This decision was taken after an experimental study which found that they have a good effect. This led the Netherlands Association of Bicycle and Automobile Industry RAI to ask SWOV what the effect of high-level brake lights would be on road safety in the Netherlands. To answer this question SWOV carried out a literature study in 1984 and produced a report of the results. On the

basis of the literature and accident data SWOV concludes that the effect would be marginal and possibly even harmful. Any further research into high-level brake lights should form an integral part of research into the whole problem of vehicle lighting and signalling.

In response to a commission from the Road Safety Directorate (D.V.V.), SWOV produced a note on possible improvements in *bicycle lighting* as part of its work to support the National Road Safety Plan. The note, which is to be presented to the Directorate in 1985, concludes among other things that new ideas and products do not seem to make a great contribution to improving bicycle lighting; more could be achieved by improving what is currently available.

DEVELOPMENT RESEARCH

Safe road shoulders

In 1983 SWOV began developing guide rails for non-motorway roads, since it is there that most accidents on shoulders take place. There are a number of objections to using motorway guide rails on other roads; from the road safety angle these include visual narrowing of the road, restricted visibility at intersections and on bends, and the danger of rebound into oncoming traffic. The mathematical simulation models mentioned above (see Basic research, section on Development of research instruments) are able to play an important role in this research. Several types have been developed and tested, and in 1984 a type was found which as a rule works well in minor collisions: the vehicle is guided safely and does not rebound. Further research is needed to establish whether this type (or a variant) also works well in more serious collisions and whether the vehicle being guided is brought to a halt within a short distance.

Breath testing devices

In view of the plan to replace blood samples with breath analysis SWOV was asked to formulate provisional functional requirements in a report and has carried out various activities in collaboration with the Forensic Science Laboratory. Once the available equipment had been surveyed and a provisional list of requirements drawn up, the emphasis was on designing and carrying out a laboratory study. A practical study is also being designed. The results are to be presented to the Alcohol and Traffic Working Group, which is responsible for formulating requirements and on which SWOV sits.

Wind nuisance

Strong gusts of wind can cause vehicles to change direction without warning, thus endangering road safety. The problem is worst on dams, dikes and bridges. To reduce wind nuisance on the planned road over the Eastern Scheldt dam (which forms part of the Delta Plan), SWOV is developing a semi-open windshield at the request of the Public Works Department. SWOV designed this development study in 1982 to link the results of wind tunnel measurements and computer simulations of man-machine systems. The actual study began in 1984 and is to be completed in 1986-87.

Road safety education

A long-term project on road safety education for children was completed in 1984 with the presentation of a road safety practice programme for toddlers. The project was carried out by the University of Groningen and supervised by SWOV. As a follow-up a new project began in 1984, this time on road safety education for cyclists and moped riders. It is taking place as part of a scheme under the National Road Safety Plan. The ultimate aim of the project is to produce a set of educational objectives which are relevant, practicable and acceptable. Four reports of literature study have now been completed; these outline the problems concerning the traffic behaviour of cyclists and moped riders and their education.

Concentrated traffic surveillance

In 1983 SWOV carried out a literature study of the scope for improving the enforcement of traffic laws by means of police surveillance. The results of the study led SWOV to start three new projects in 1984 in collaboration with the University of Leiden; these are to provide background information enabling better techniques for police surveillance of drunken drivers to be developed.

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