RECLASSIFICATION AND RECONSTRUCTION OF URBAN AREAS IN EINDHOVEN AND RIJSWIJK

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Introduction

The increased ownership of cars extended on the one hand the locomotion range for a great part of the population, while on the other hand creating new problems.
The crux of the problems is that motorised traffic occupies an unproportionally great part of public space, increasing the unsafety of the slow-moving traffic by causing more accidents, unfavourably influencing the feelings of traffic participants and impairing to an ever growing extent the environment. These problems are the most acute in towns, on account of the high concentration both of driving and parking vehicles. The traffic function of the town cramps more and more other functions of urban areas.
The multifunctional character, long since dominating the residential streets, is slowly but irresistibly eroding.

In the demonstration project "Reclassification and reconstruction of urban areas", the policy aimed at improving the quality of life, is realised by dividing the urban spaces into areas with a dominant traffic function and areas with a dominant "habitat" function, thereby giving them a new design.
The residential areas are so reconstructed that motorised traffic is curbed in order to improve other functions of the area. The goal of the reconstruction of traffic areas is to realise a safe and smooth throughflow of the traffic. In this respect special attention is given to bicycle traffic and to pedestrians crossing the street.

The scope of the demonstration project

One of the most important goals of this demonstration project is: "to investigate the possibilities of reclassification of urban areas into residential and traffic areas, and to reconstruct the residential areas accordingly by means of packets of appropriate countermeasures, some of which are quite simple, while other are more radical".

The various packets of countermeasures have been formulated by creating within the residential areas three types of reconstruction patterns. In

order to facilitate the investigation, clear distinctions between these types of reconstruction patterns have been made by proposing the following options:
- Option 1: to ban through-traffic from the streets
- Option 2: to ban through-traffic from the streets and to limit the speed of the rest of the traffic
- Option 3: to ban through-traffic, to limit the speed of the rest of the traffic and to create an attractive layout in the streets.

The reclassification of the urban area involving the division of public spaces into traffic or residential areas, presented no great problems. In the two municipalities some roads and streets were appointed as traffic area. On the arterial roads, various categories of traffic have been segregated from one another as far as possible, thereby ensuring a safe and smooth traffic flow. In addition, due attention has been given to crossing places for pedestrians and cyclists.

Beside arterial roads there are other types of streets with a certain traffic function but of a lower order: the main access roads. In such streets however the fast through flow of traffic is not a primary condition.

The selection of municipalities

In May 1976 all municipalities with more than 50.000 inhabitants were invited to inform the Steering Group Traffic and Transport (Stuurgroep Verkeer en Vervoer), whether they are interested in the project or not. The conditions the selected project areas had in any case to comply with were the following:
- the area size had to be about 100 ha;
- the intensities of motorised traffic and "sneaking" traffic involved so many problems that there was sufficient room for improving the quality of life of the residents;
- in addition to the residential function, other types of functions, activities had to be present in the area as well (schools, shops and various low-level industrial enterprises).

After a thorough assessment of the plans submitted by 22 municipalities, Eindhoven and Rijswijk were selected.

The Eindhoven project area (Stratum) (See Figure 1) consists of six districts, delimited by radial and tangential traffic roads. On the one hand the area is traversed by a circular road ("Rondweg"), with a rush hour intensity of about 2200 vehicles/hr (in 1978) and on the other hand by the Leenderweg (also with a rush hour intensity of 2200 vehicles/hr in 1978). The districts Kruidenbuurt and Kerstroosplein, situated within the limits of the project area were already reconstructed in the framework of earlier renovation plans, thus these districts were not included in the demonstration project. The population density in Stratum is about 80 residents/ha. The majority of houses are of the low-rise type (as a rule family houses with no front garden). Due to the scarce space available in the district, the habitat function of the streets was rather blurred, mainly on account of the cars parked along the streets. Schools, shops, small industrial enterprises are scattered over the entire project area, although some concentration of shops can be observed along the district and main roads.

The Rijswijk project area (see Figure 2) consists of five districts, criss-crossed by some busy arterial roads for the through-traffic to and from The Hague.
The traffic load this area has to put up with is clearly indicated by the high rush hour intensities: about 5000 vehicles/hr on the Haagweg and 1500 vehicles/hr on the Geestbrugweg (in 1978).
Since the urban area, through which these roads pass, was not dimensioned for such high traffic intensities, serious problems have arisen with regard to "traffic livability". There is much sneaking traffic in the narrow residential streets, while on the main roads cars and mainly public transport means are seriously hindered by traffic jams.
Cars, parked along residential streets, also hinder other activities, which should take place there. The population density in the Rijswijk project area is about 130 residents/ha, the houses are mostly of the low-rise type (family houses, frequently with a front garden). Schools and parks are scattered to some extent, whereas most shops and small-scale enterprises are concentrated in and around the old town centre.

The countermeasures

The countermeasures implemented in Eindhoven en Rijswijk or, more particularly, the main classification measure, consists of splitting-off roads from the existing net of arterial roads serving the through-traffic, in such a manner that the original arterial roads will function as main access roads to the residential districts or even as residential streets. The reconstruction was carried out according to the project by realising three various types of planned countermeasures (options) within the residential areas.

The following countermeasures were taken.

In the traffic areas of Rijswijk:
- provision of protected bicycle lanes and suggested bicycle lanes;
- reconstruction of service roads (banning of through-traffic);
- improving the crossing places for pedestrians e.g. (building a subway for pedestrians);
- displacement of tramway rails or creation of free tramway tracks;
- new traffic-light regulation for promoting the fast through-flow of traffic, while giving priority to bus and tram.

In the traffic areas of Eindhoven:
- provision of protected bicycle lanes and suggested bicycle lanes;
- construction of parallel (by-pass) roads;
- improving the crossing places for pedestrians;
- clear marking of driving lanes;
- provision of parking facilities along the streets;
- installation and improvement of traffic lights.

In the residential areas of Rijswijk

Option 1 - area
- modification of the traffic circulation by establishing one-way traffic systems and by partly reversing the driving direction in case of an already existing one-way traffic system;
- provision of parking facilities along the streets;

Option 2 - area

- construction of road humps and intersection plateaus;
- shifting of the street axes;
- modification of the traffic circulation by establishing partial one-way traffic systems and by partly reversing the driving direction in case of an already existing one-way traffic system; setting up stops for cars in some streets;
- countermeasures regulating the parking of cars.

Option 3 - area

- Construction of a woonerf; special countermeasures were taken in the Leeuwendaal-area, creating walking lanes (suggested lanes) and in Bomenbuurt-area, creating one-way traffic systems on account of the great number of cars parking there.

In the residential areas of Eindhoven:

Option 1 - area

- modification of the traffic circulation by establishing a partial one-way traffic system;
- provision of humps and exit constructions in some streets;
- provision of parking regulation in one street.

Option 2 - area

- construction of humps and intersection plateaus;
- shifting of the street axis (in one street);
- provision of parking facilities.

(N.B. in Kortonjo some streets were not reconstructed).

Option 3 - area

- some streets were reconstructed as woonerfs;
- in the rest of the streets option-2-measures were effected, a.o. with humps, parking facilities, while one street was not reconstructed.

In the countermeasures (see Table 1) distinction has been made between reclassification and reconstruction countermeasures. Thus, in Eindhoven

21% (2 km) of the streets were converted into main access roads. In Rijswijk 65% (6 km) of the streets were reclassified, partly as main access roads and for a minor part as residential streets (1.3 km).
There are differences between Eindhoven and Rijswijk also with regard to reconstruction (see Table 2). It is remarkable that only 51% of the residential streets in Eindhoven are of the woonerf type, while 33% were of that type already before the project. The bicycle lanes and bicycle paths are created along the arterial roads; in Eindhoven: more lanes, in Rijswijk: more paths. In Eindhoven preference was given to humps (mainly in options 3 and 2).
In Rijswijk there are relatively many axis-shifts and street constrictions in the option 3-areas, and raised intersection in the option 2-areas. The last series of countermeasures has also been carried out on main access roads in Rijswijk, while in Eindhoven on main access roads mainly narrowed stretches were created.
Furthermore, traffic lights have been installed on intersections between arterial roads and main access roads: three in Einhoven and four in Rijswijk.
Finally, we mention the construction of a pedestrian subway and a free track for tram and bus of 1.5 km length, both on the most busy arterial roads in Rijswijk.

Since governmental authorities find the "teaching" aspect one of the most important issues of this experimental project, right from the start much attention was given to investigations.

Prior to the investigation, the following policy-related question have been formulated in the investigation programme:
Question 1: Will the demonstration project provide knowledge and experience for promoting traffic safety in urban areas?
Question 2: Will the countermeasures taken (drastically) promote traffic safety in the demonstration areas, also taking into consideration the cost/benefit aspects of the countermeasures?
Question 3: Is it possible to generalise the conclusions drawn from the demonstration project with regard to traffic safety?
Question 4: Is it possible to determine on the basis of traffic safety considerations priority areas for countermeasures?

Question 5: Which effect has the demonstration project on traffic safety in the so-called "influence" areas?
Question 6: In which manner is the traffic safety affected by banning through-traffic from residential areas?
Question 7: Which are the effects of changes in mobility and modes of transport, caused by the reconstruction countermeasures, on traffic safety?
Question 8: Which influence have various realised countermeasures on traffic safety, also from the cost/benefit viewpoint?

After consultations with the project organisation, it has been decided to disregard the cost of the countermeasures by the Investigation Group for Traffic Safety.

Investigation groups

The most important goal of the investigation is "to establish by means of measuring and opinion polls, prior to and after reclassification and reconstruction of the streets, the effectiveness of variously composed packets of countermeasures".
The investigation programme supporting the demonstration project had so many aspects that five investigation groups had to be set up for: traffic circulation, traffic safety, environmental hygiene, social-economic aspects, furthermore for the use of and experience with public spaces.

The Investigation Group for Traffic Safety

This group formulated its investigation scope as follows: "Since reclassification and reconstruction will influence traffic safety, it is the task of this group to establish the effects on traffic safety of countermeasures in traffic areas and in the various option areas.
On the basis of investigation results conclusions will have to be drawn which can be applied to other, comparable urban areas as well. The investigation comprises studies of the causes and effects of traffic accidents. For this purpose accident, behaviour studies and enquiries were planned".

The investigation programme

The total investigation programme of the various groups covered the following issues:
Investigation Group Traffic Circulation: door-to-door inquiries, traffic counts, parking place counts, speed measurements, number plate studies;
Investigation Group Traffic Safety: door-to-door inquiries (traffic safety feeling), accident investigation, behaviour observation;
Investigation Group Environmental Hygiene: door-to-door inquiries, investigation into noise, vibrations and air pollution;
Investigation Group Social-Economic Aspects: door-to-door inquiries, polls in factories, institutions, offices, etc.
Investigation Group Use and Experience with Public Spaces: door-to-door inquiries, behaviour observation, results of action groups' activities, public participation, observation of the removal pattern of the residents.

The before-investigation was carried out in the autumn of 1977 and various periods of 1978, while the after-investigation took place in the autumn of 1982 and the spring of 1983.

Scope and execution of the traffic safety research

Traffic unsafety can be described as the danger the traffic implies for the individual road user, who may incidentally be involved in a traffic accident with all its unpleasant consequences.
Other unfavourable effects like smell, noise, vibrations, the awareness of being threatened by the traffic, etc, are not included in the concept of traffic unsafety.
The traffic safety research is aimed at disclosing the causes of accidents and their consequences.
The starting points of the traffic safety policy have to be formulated in a way permitting the evaluation of various categories of accidents and accident effects, furthermore the road user's feelings about the threat emanating from traffic.
Up till now the most practical manner for establishing changes in traffic safety consisted of determining the changes by the absolute or relative number of traffic accidents.

However, sometimes in a small-scale investigation it is not possible to collect, within a fairly short time, sufficient accident data, which would enable the investigators to make a statistically justified assessment. This applies to some extent to this demonstration project and more particularly to conclusions as regards the option areas and their parts as well.
Knowing the limitations of investigations exclusively based on collecting accident data, it has been decided to collect for the present project also data relating to the causes of accidents (process description). In addition to data on the volume and composition of the traffic, behavioural aspects (like speed behaviour, conflicting behaviour), which are supposed to be related in some way to accidents, had to be studies as well. Behaviour investigations and experience investigations also permit more refined distinctions according to options and locations than accident investigations alone.

Accident investigation

The accident investigation aims at establishing the effects of reclassification and reconstruction of streets on traffic safety, based on the changes in the number of traffic victims and injuries involving accidents, while also taking into account the changes in the volume and composition of traffic (Janssen, 1984).
According to one of the goals of the project, the accident data have to be compared for each option area. In the before-period in these areas there occurred annually 1 to 5 injury accidents. Thus, roughly an after-period of about six years would be necessary for such comparisons. An after-period of about one year permits evaluations of the traffic safety in the experimental areas only according to a distinction in arterial roads and residential streets. Consequently, in this period no evaluations referring to option areas can be expected.
In a next phase (after about three years) more detailed evaluations will be possible. Comparison between option areas (as regards changes in accidents) can in this period be affected by external factors, which may modify the traffic situations in and around the experimental areas.
Within the framework of the accident investigation a before-period of six years (1972/1977) was contemplated. Furthermore, the investigation re-

quired time for elaborating and implementing the countermeasures. For this transition period four years (1978/1981) were assigned. Finally, data concerning accidents and traffic were collected for some time after the realisation of the countermeasures. This first phase of the after-period lasted from 1982 till February 1983, thus a period of 14 months. In addition to this investigation, some special accident studies have been carried out in the before-period, concerning safety-provisions for cyclists and moped riders, furthermore a study of the effects of conclict-free phases in the traffic light systems at intersections for cyclists and moped riders. Finally, we made a practical investigation into a method for black-spot studies.

Behaviour investigation

In addition to accident data, data concerning the traffic participants' behaviour were collected as well. In the first place, data on near-misses were collected, because it is assumed that these are in some way related to accidents.
In the before-period a Dutch conflict observation technique has been evaluated with a validation study. This evaluation did not yet prove that the conflict observation technique can be used as a substitute for accident analysis. Nevertheless it was important to carry out conflict observations in order to get impressions as regards the changes in the traffic process, caused by the countermeasures taken and to get ideas how these changes affect traffic safety.
Since in the before-investigation no conflict behaviour observations have been carried out in each option area, a compromise was found by carrying out in the after-period a comparative behaviour investigation in control areas which can be compared to situations of the before-period. This conflict observation study also covered the speed behaviour of traffic participants.
Due to the calm traffic situation as a rule prevailing in residential areas and under the effect of implemented countermeasures, traffic will only be intensive on the access roads to the residential area in the rush hours. By access roads we mean residential streets, which adjoin the traffic area around the residential area.

On intersections of the access roads, at the border line of option areas, conflict observations have been carried out by means of the Swedish technique of Lund Institute of Technology (1983).
Furthermore, at the access roads to option areas "following" observations took place by a Dutch conflict observation technique, according to which pedestrians are followed by observers in a given area for a given period of time.
At the same access roads speeds were also measured and the passing cars were counted on the same intersections, where the conflict observations were effected. These traffic counts are necessary for the interpretation of the conflict technique, carried out at the same locations.
In this way a fairly reliable picture could be obtained from the traffic behaviour in relation to the driving speeds and traffic volumes in an option area.

As a compromise between methodological and financial considerations, only three of the demonstration areas have been investigated completely according to the plans. In the rest of the demonstration areas observations with a Swedish technique and speed behaviour measurements were carried out.

The problem we had in this connection was that no speed measurements and conflict counts were effected in the before-period. This, of course, meant that
- differences (if any) between the option areas in the before-period were not known;
- differences (if any) between the before- and after-period as the result of countermeasures, were not known either.
The problem was partly solved by investigating control areas. In this way it was possible to describe the various aspects of the traffic process in terms of speed behaviour, cross-over behaviour, conflict behaviour, etc. and the differences in traffic behaviour, as observed in the various option areas as the result of the countermeasures taken.

The municipalities of Eindhoven en Rijswijk included in their master plan some locations with special provisions for cyclists and moped riders. By means of a video-observation technique developed in the Institute for

Perception IZF-TNO (Van der Horst, 1983) films have been made in the before- and after-period. On the basis of these video films, some behaviour aspects, like speed, changes in speed, queue behaviour, interactions with other road users, were analysed in detail.

In the before-period of the investigation the Traffic Research Centre VSC of the Groningen State University studied the relations between subjective experience with traffic and actual traffic behaviour. With the aid of data obtained by the door-to-door inquiries in residential areas it was possible to pinpoint locations, which some parents found unsafe for their children. In the analysis of behaviour observations some aspects of children's behaviour (like individual and group behaviour, how they take part in the traffic, how they cross in the street) were taken into account as well.

Experience investigation

As mentioned earlier, it is important to take into consideration the feelings and assessments of the traffic participants since one can assume, that in case people realise the usefulness of countermeasures, they will comply with them more readily. For this purpose discussions with the groups concerned and public participation are of great importance.
In process evaluation it is evident that on locations of behaviour observations, the traffic participants should be asked questions about their behaviour just observed and their opinion about the countermeasures taken in view of such behaviour. For this purpose opinion polls had to be organised along the streets in order to get the required data.
However, the demonstration project did not envisage street opinion polls, but door-to-door inquiries. In this way, of course, no direct relation could be established between a behaviour, just displayed, and the opinion, thoughts of people over their behaviour. On the other hand, data obtained by door-to-door inquiries and their mutual relationships can be provide a deeper insight into and a better understanding of a process. In other words, it is possible to find out (to some extent) the effects of countermeasures on the awareness and behaviour of the residents.
Central authorities are also interested in the feelings of people as regards traffic safety, as a result of the implemented countermeasures.

General feelings, opinions, ideas can be revealed by door-to-door inquiries, although the validity of conclusions obtained in this way is still a matter of discussions.

In the before-period in six option areas polls were organised to reveal the feelings of the residents about the traffic safety in their own district.
The poll results permitted no exact conclusions: the volume of the poll was insufficient for this purpose. This volume was determined by the primary aim of the inquiries, which was to point out a limited number of locations, the residents found unsafe for their children. On these locations the Traffic Research Centre of the Groningen State University carried out an investigation in order to establish the relationship between the awareness of traffic safety and the actually displayed traffic behaviour.

It will be evident that the subject of the opinion poll in the after-period differed from that in the before-period. The opion poll in the after-period was focused on the effect the implemented countermeasures had in relation to their original aims. A part of this opinion poll involved a before- and an after-study (Kraay, 1984).

The effectiveness of the countermeasures

In the first place we studied the direct effects of the countermeasures on the through-going traffic, the driving speeds and the mode of transport.
The traffic counts seem to prove that there certainly was sneaking traffic in the demonstration areas in Eindhoven en Rijswijk before the reconstruction.
Based on the average vehicle intensity and the size of the residential areas it could be assumed, that sneaking traffic was the most intensive in the opinion-2 areas. Sneaking traffic could also be assumed to drive in option-3 areas and to a much lesser extent in option-1 areas. However, according to the residents' opinions, sneaking traffic is the most intensive in the option-3 areas, followed by the option-1 areas. Both traffic counts and opinion polls prove that the sneaking traffic volume is greater in Rijswijk than in Eindhoven.

After the implementation of the countermeasures, the most striking decrease of traffic intensities was found in option-3 areas; a certain decrease was also observed in option-2 areas. In case main access roads were included in the evaluation, a decrease of traffic volumes could be noted in option-1 areas as well (see Table 3).
The effectiveness of the countermeasures on through-traffic in Rijswijk is clearly manifested also on main access roads.

According to the residents, the countermeasures are the most effective in option-3 areas. The residents of option-1 and option-2 areas find the countermeasures also effective in this respect (see Table 4).

The reconstruction countermeasures caused no differences in the driving speeds in residential streets of the demonstration areas. As an exception we can mention the woonerf streets, where passenger cars drive at a considerably lower speed than in other residential streets. Moped riders (also in woonerfs) are hardly affected by the countermeasures (if at all) (see Table 5). It is remarkable that an arterial road which became a residential street displays in the after-investigation an unfavourable speed picture in comparison with other residential streets.

In view of options the passenger car and moped speeds are the highest in the option-1 and 2 areas and the lowest in the option-3 areas. It was found that some residential streets have a marked influence on the speed picture of the option areas. In each option area, the residents react quite differently to the speed behaviour of the drivers. According to some answers obtained in the polls, cars drive considerably slower in the option-2 and -3 areas since the implementation of the countermeasures, whereas according to other opinions in option-1 areas drivers drive faster now, than before, (see Table 6).

In one option-2 area in the residential districts of Cromvliet and Oud-Rijswijk, speed controls have been effected on five locations in the before- and after-period (Papendrecht, 1983).
As regards locations with relatively high speeds in the before-period, the average speed was reduced by 2 to 10 km/hr. The average speed was 36 km/hr in the after-period. As regards locations with low speeds, a re-

duction of 6 km/hr was found in one of the streets: the average speed fell from 37 km/hr to 31 km/hr (see Table 7).
It is not surprising that the countermeasures had a greater effect on main access roads with relatively fast driving cars than in residential streets, where driving speeds were anyhow lower, even before the countermeasures.
There were some residential streets in Rijswijk which demanded special attention, because cars driven at 65 km/hr even between the humps were signaled there.

The comparison of changes in the choice of the mode of traffic in the various options, gives no unambiguous picture.
On a national level the use of the bicycle undoubtedly increased. The questioned persons make more use of their bicycle (moped) since the implementation of the countermeasures, it was found. Traffic counts, however, prove that this does not apply to Eindhoven.
In control areas (the rest of municipalities), a reduction of bicycle/moped intensities and a rise of passenger car intensities can be observed. This indicates an increasing number of car drivers!
In the demonstration areas of Rijswijk a change in favour of the bicycle can be noted, while nothing of the kind is observed in Eindhoven (see Table 8).

According to the questioned persons there is no shift from the car towards the public transport system. Only 6% (on an average) of the persons interviewd make use of a bus or tram. There was hardly any change in this percentage between 1978 and 1983.

Some results of the accident investigation

From the comparisons between investigation areas and investigation periods (before, transit and after period) the following conclusions could be drawn:
- Within the residential zones the number of accidents involving injury dropped, even taking account of the drop in the amount of traffic, especially motorized. The actual number of accidents involving injury in these zones was 50-60% lower than expected on the basis of developments in the control areas.

The favourable effect of the experimental measures in the residential zones is attributable probably to the reduction in the amount of throug-traffic and to the adaptive behaviour of the traffic participants.

- In the demonstration areas on the arterial roads the countermeasures did not bring forth any changes in the number of injury accidents (see Table 9). The result was the same, in case the changes in traffic volumes have been taken into account. There are some indications, however, that the number of traffic victims per passenger kilometer slightly decreased.
- The number of injury accidents per vehicle kilometer increased on main access roads as compared to the control areas.
- On including the main access roads into the category of residential streets, there will be a decrease of accidents with regard to the residential streets in the control areas. The number of injury accidents per road kilometer decreased in both cases. In other words: the number of accidents is reduced, but the risk of being involved in an accident increases for the traffic still on the road.

(These conclusions are based on a small number of accidents in the after-period and consequently, the differences are only of an indicative character. We hope to make definitive statements in a second phase of the after-period).

- The total number of injury accidents decreased in the residential streets of the demonstration areas. If we take into account the decrease of the traffic volume as well, only the number of accidents between motorised and non-motorised traffic will be lower. Accidents with exclusively non-motorised traffic show a rising tendency, while there is no change in view of motorised traffic. More exact results will be available also in this connection over a longer after-period.
- There are no negative effects on traffic safety on roads in the influence areas. A decrease in the number of accidents in residential streets could be observed, independently of the changes in traffic volumes.

During the transit period, when the countermeasures were being realised, there were no changes in the number of injury accidents on arterial roads in and around the demonstration areas, while the number of injury accidents in the residential streets decreased even to a farther extent than after the implementation of the countermeasures. The same can be observed for the influence areas as well.

A detailed analysis of the results according to municipalities and option areas is at least in this phase of the accident investigation (after-period: 14 months) of a rather speculative character. The effect of the countermeasures on the main access roads is mainly for Rijswijk unfavourable, because 9 of the 13 injury accidents in total occurring on the main access roads were recorded in the after-period.
As regards options, a relatively greater decrease in the number of injury accidents (per vehicle kilometer) was observed for option-2 areas, followed by option-1 areas. In option-3 areas there was no reduction in the number of injury accidents. Per road kilometer the decrease of accidents becomes more pronounced and in this case in option-3 areas a decrease could be noted as well.
There are reasons to investigate the option-3 areas more thoroughly. A part of the option-3 area in Eindhoven, was already converted into a woonerf before the start of the demonstration project. In the other part countermeasures are applied, which are a mixture of various options (patchwork). If the previously converted part is disregarded, the option-1 areas will be moved by the option-3 areas to the second place.

There remain differences between the residential districts as regards the number of injury accidents, even after division by the amount of traffic or by the road length. Explanations may be found in the presence or absence of some criteria, which characterise the road net and the residential districts. Results of a preliminary analysis of the relationships between road criteria and accidents indicate that the number of injury accidents increases in residential districts, in proportion to the number of 4-way intersections and in proportion to the number of bends per road kilometer.

The traffic safety according to road type can also be expressed by the number of injury accidents per million vehicle kilometers.:
on arterial roads : 1.65
on access roads : 1.37
in residential streets : 0.64

In 1982 there were recorded four times more injury accidents in the traffic areas than in the residential districts, while the amount of traffic

(expressed in the number of kilometers performed by all vehicles) increased by a factor lower than two. These figures vary quite considerably in the concerned municipalities. Thus, traffic safety in residential areas cannot be limited to the accidents in residential streets. Both the residents living in such streets and persons who are responsible for the traffic control in those areas, have to take into account accidents, conflicts, behaviour, safety feelings, etc. on arterial roads and main access roads as well. A combination of the results of accident investigation, behaviour studies and opinion polls will permit a deeper insight into the entire unsafety of the traffic process in urban areas.

Some results of behaviour studies

Due to the limited scope of accident investigations it was found necessary to collect data concerning traffic behaviour and the feelings of road users about traffic and traffic safety. There were two reasons for collecting such complementing data:
- to get a deeper insight into the effect the countermeasures have on the residents; to find out the opinion of the residents about the countermeasures and to assess their behaviour with regard to the countermeasures;
- to disclose (if possible) the causes of traffic accidents.

Based on these reasons, on the one hand an evaluation of the actual traffic safety effects had to be carried out by means of behaviour studies and on the other hand an evaluation was needed, to compare the conformities and differences between the actual traffic safety effects and the related feelings, opinions, judgements of the residents in the option areas.

In analysing traffic safety according to intersection types, like residential street/main access road, residential street/arterial road and main access road/arterial road, the study of Hydén established in 1983, that the intersections between main access roads and arterial roads are relatively the most unsafe. The most favourable results as regards relative traffic safety were found for intersections between residential streets and main access roads (see Table 10).

More detailed results can be obtained by comparing the option areas. In this conflict observation study it comes to the conclusion that there are no differences in traffic safety between the option areas proper, neither are there differences in this respect between the option areas and control areas (see Table 11).
On comparing, however, the issues according to the categories of traffic participants and special manoeuvres, the cyclists emerge as the most endangered category.
Some results will be given:
- Cyclists leaving the option area conflicting with passenger cars coming from the left.
- Cyclists riding on the arterial road may come into conflict with passenger cars both entering or leaving the option area. This risk is the worst at the border of option-2 areas. The highest accident and injury figures were noted for cyclists involved in such situations. The main reason for this is that cars driving out of option areas assert rather aggressively their "priority from the right".
- Passenger cars, leaving the option area conflicting with passenger cars coming from the right. This risk is significantly greater at the exit zones of woonerfs, because during manoeuvring the car enters the other half of the road.
- Passenger cars, leaving the option area conflicting with passenger cars on the arterial road, making left hand or right hand turns in order to drive into the option area. Also this risk is greater at the entrances of woonerfs mainly because these are much too narrow, so that two cars, at the same time present at the exit, will inevitably come into conflict with one another. This situation is worsened by the usually busy traffic on the adjoining arterial road.

The Swedish investigators make the following comments on the results of this study. They found that the driving task of the driver has a greater influence on his traffic behaviour while he drives on an arterial road than the configuration of the intersections at the border of option areas. As exceptions the entries to and exits from woonerfs are mentioned. Thus, a frequently occurring conflict situation is where a car drives out from the woonerf and stops only after having passed or nearly passed the humps or pavement, extended to the exit, in this way quite

unexpectedly encountering a car, coming from the right and making a turn to the left in order to drive in the woonerf.
Similarly to the study made by the Institute for Perception IZF-TNO, this study also suggests to construct the hump farther from the intersection and more inwards the woonerf.
The investigators are also convinced that a speed reduction of passenger cars, driving out from the residential area, would positively affect the drivers behaviour in encounters with cyclists.

The behaviour of pedestrians (children and grown-up persons) was investigated on selected main access roads of three option areas (Advisie, 1983).
This study could find no differences in the districts as regards serious conflicts between children and motorised traffic. After a certain correction for the "following" time, it seems that the risk of a serious conflict (per unit of time) is the lowest in woonerfs. In the rest of option areas the average figure for serious conflicts (per unit of time) is higher than the double, However, it is not justified to rely exclusively on relative and corrected figures, mainly in such kind of study. The fact that children in the option-3 area of Rijswijk often spend more time for a route (thereby increasing their risk to be also involved in a serious conflict) can be motivated by the attractiveness of some streets, where for example they can play.
As regards grown-up pedestrians, they are only in the woonerf area of Rijswijk involved in serious conflicts with motorised traffic. With due reservation, we could draw from this study the conclusion that pedestrians are exposed to higher risks in the woonerf of Rijswijk. The reservation seems justified by the fact that the prediction effect of the applied conflict observation technique was only tested on children walking in the street, excluding grown-up pedestrians. The configuration of the district in question, with the facilities provided therein, may also play some role in serious conflicts involving pedestrians. There are certain obstacles installed in the streets, which, so to speak, compel the pedestrian to cross the street in front of driving cars at places, which are not sufficiently visible (see Figure 3).

The serious conflicts observed by Hydén at the exits of residential

districts have been calculated as annual, injury accidents. The figures obtained in this way have been differentiated according to the type of roads at the district exit: residential street/main access road, residential street/arterial road and main access road/arterial road. In Table 12 are included the actual figures for injury accidents, recorded in the after-period (from January 1982 till the end of February 1983). Since Hydén only observed conflicts between motor cars and bicycles and mopeds, the actually occurred injury accidents were differentiated according to these conflicts and all injury accidents. On comparing the assessed and recorded accidents, it becomes evident that the orders of magnitude are identical and the order of precedence is the same for the assessed and total number of accidents. These figures can only be checked in a longer after-period.
However, already in the present phase, the results seem to prove that serious conflicts are in some kind of correlation with injury accidents.

Some results of inquiries (opinion polls)

It is often assumed that there are causal relationships between opinions, ideas, etc. entertained by traffic participants, their experiences with traffic, their alleged behaviour, their traffic behaviour resulting from all these issues and the occurrence of traffic accidents.

These mutual relationships had hardly been studied up till now.
In the before-investigation, some relations have been analysed, resulting in the following comments:
- it does not seem possible to establish a relationship between mentioned dangerous locations and the involvement of children in accidents in the district where they live;
- the relationship between the subjective unsafety and accidents has been studied, using as indicators for subjective unsafety the following: are the children escorted to school?; are they allowed to play in the street?; are they allowed to cross the street alone?; what is the parents' opinion about the safety for some parts of the street?
The analysis results proved that the residents do not know much about accidents occurring even in their own street or neighbourhood. These findings also prove that complementary data concerning subjective experience cannot be directly related to traffic safety.

To be sure, these data with their interwoven connections can provide more insight in what we call: process evaluation. In simpler words: it is possible to establish (at least to some extent) the effect of countermeasures on the personal experiences and behaviour of the residents. Govermental authorities are also interested in the feelings of residents in view of traffic safety as a consequence of the countermeasures taken. Opinions, general feelings, ideas can be revealed by door-to-door inquiries. However, the validity of the results obtained by these inquiries is still under discussion.
It was found that the countermeasures implemented made traffic relatively safer in the traffic areas and the option-2 areas (excepting pedestrians in Eindhoven), for pedestrians, cyclists and car drivers. Furthermore, it also emerged that traffic areas and to a lesser extent option-3 areas, are found by residents less safe than option-1 and option-2 areas.
More than 50% of the people questioned in residential areas and 80% in traffic areas found their district rather unsafe for children.

There are still quite a lot of people who think that even after the reconstruction there are dangerous locations in their district. More particularly that was the opinion of 55% as against 61% in the before-period.

The opinion polls also revealed that the mostly imagined problems of the residents about traffic safety mainly refer to traffic areas, the arterial roads. Only a very limited number of locations in residential areas required greater attention. According to the opinion polls, the reclassification and reconstruction countermeasures did not change the distribution of traffic over the demonstration area, neither did they considerably affect the volumes and speeds of motorised traffic nor did they lessen the fear from traffic of the residents.

The extent to which the implemented countermeasures succeeded in realising the direct goals of the project will have to be assessed by the option measures.

The goal of option-1 measure was to ban through-traffic from the residential area. In Eindhoven 41% of the interviewed people maintained that there was sneaking traffic in their district in the before-period, 59%

found that sneaking traffic (at least partly) disappeared, while 38% deny this.
In Rijswijk 60% of the interviewees observed sneaking traffic in the before-period, 76% is of the opinion that sneaking traffic is (at least partly) banned, while 22% contest this.
In other words, it can be stated that this countermeasure was more successful in Rijswijk than in Eindhoven, Anyhow, the problem of sneaking traffic is still far from being completely solved.

The option-2 measure was aimed at banning through-traffic from the district and at reducing the speed of the rest of the traffic. In Eindhoven 30% found sneaking traffic in their streets, according to 47% there still is sneaking traffic, while 51% claim that sneaking traffic could (at least partly) be eliminated.
In Eindhoven, 17% of the residents find that many drivers drive at speeds above 30 km/hr.
In Rijswijk according to 59% there was sneaking traffic; according to 13% there still is, while according to 82% it could (at least partly) be banned. As regards the speed behaviour of drivers, 50% of the people in Rijswijk are of the opinion that many drivers transgress 30 km/hr. In general, the residents here also think that the problems signaled by them are only partly solved. However, the countermeasures were found more effective in Rijswijk than in Eindhoven.

The goal of the option-3 measure was to ban through-traffic from the district, to limit the speed of the rest of the traffic and to create an agreeable sphere in the reconstructed areas. In Eindhoven 37% observed sneaking traffic in their district prior to the countermeasures, 84% finds that sneaking traffic (at least partly) disappeared.
According to 43% many cars are driven at speeds higher than 30 km/hr in their district.
67% found it agreeable to walk, saunter, "smell the fresh air" in the streets in the before-period, whereas in the after-period only 50% were of the same opinion.
In Rijswijk 30% observed sneaking traffic in the before-period, while 92% think that now it disappeared (at least partly). Only 37% find that many drivers drive faster than 30 km/hr.

In the before-period 87% enjoyed walking, sauntering in the streets, while the number of people who maintained this opinion dropped to 54% in the after-period.
Thus, according to the residents, the option-3 measures cannot be regarded as successful either (see a survey in Table 13).

Finally, we shall have to find out to what extent the countermeasures promoted traffic safety in the eye of the residents. For this purpose we listed the most relevant questions about traffic safety and indicated the effect with minus and plus signs according to the various options. We decided upon a subjective mode of evaluation because no systematic presentation of the answers was possible. According to an analysis of answers to exclusively specific traffic safety questions, the residents found the option-2 areas and the results there achieved the most successful (see Table 14).
The negative picture obtained for option-3 (woonerf) area in Rijswijk is quite remarkable. The education level of residents in this area (a fairly large woonerf) is rather high and during the polls the inquirers were often confronted with critical attitudes.

The traffic areas

In the traffic areas of the control areas a 6% rise in motor car volumes, whereas in the traffic areas of the demonstration areas a relative decrease of motor car volumes could be established. The question is, whether this decrease can be ascribed to the effect of the demonstration project measures.
The decrease in bicylce and moped volumes in the traffic areas of the demonstration area is less remarkable than in the control areas.
In the traffic areas of the demonstration areas there was no considerable change in the number of injury accidents, established in proportion to road length and traffic volumes.
Any change there was, was in the positive direction and can become important in a longer after-period.

Within the traffic areas of the demonstration area the arterial roads were converted into access roads and a small part of them into residential streets (only in Rijswijk: 1.28 km).

On the converted main access roads in Eindhoven similar changes were observed in the amount of motorised traffic as in the rest of arterial roads, whereas in Rijswijk the traffic volumes decreased significantly (25%), with no changes on the arterial roads.

As regards main access roads, there seemed to be an increase of injury accidents as compared to the arterial roads in the control areas, in case the reduction of traffic performance was taken into account; per road kilometer there was a slight decrease.

Some points of view

It is evident that the demonstration project carried out in the municipalities of Eindhoven and Rijswijk not only provided information about the effects of countermeasures, but also gave a picture of traffic safety in urban areas.
As a conclusion, I will present some viewpoints, which according to my opinion deserve more attention in future.

Observation 1

The demonstration project "Reclassification and reconstruction of urban areas" is a part of the experimental policy of Dutch authorities.
The goal of such policy experiments is to execute a project as a test and on a limited scale, permitting to establish the effects of the policy tested. Thus, the main goal of the demonstration project is to gather information about the effect of the policy practised. This means that for an experimental policy in principle the same requirements have to be determined as for scientific experiments, bacause these requirements are the best guarantee that the effects will be truly established.

In addition to a great amount of useful information obtained from this demonstration project, some methodological aspects emerged as well, which are relevant for the organisation of such projects, permitting a more accurate measuring of the effects.

It is recommended to spend more time and attention on the exact formulation of the policy questions. The same applies to the translation of policy questions into research questions.

It is also advisable to include investigators in the investigation in an early phase of the project, in order to ensure that the policy questions will be translated effectively and correctly into so many research questions as are necessary for the project.

Observation 2

In selecting the experimental areas it is of importance to take at first a stock of the criteria of the areas in question, depending on the problems and to study the effects these criteria may have. Thus, it is well known from literature that certain traits of the infrastructure, population, traffic and road play some part in traffic safety.
On selecting the experimental areas it is also advisable to define the volume of the sample on the basis of which generalising statements can be made.

The aforementioned factors had the following implications for the demonstration project.
At the start, we assumed demonstration areas, consisting of 2 traffic areas and 2x3 residential areas, where the packets of reconstruction countermeasures had to be realised. Later it was found that the demonstration areas actually consist of more, quite different areas. Thus, there is in Rijswijk an option-1 area (where reconstruction was already realised in the before-period); an option-2 area with exclusively dwellings and an option-2 area with a mixture of dwellings and factories and an option-3 area. Eindhoven comprises an option-1 area, an option-2 area with asphalt-surfaced roads and raised intersections; option-2 areas with clinker roads and traffic humps half-way in residential streets; a counter "patchwork" type option, as a mixture of option 1, 2 and 3 countermeasures. In addition, both in Eindhoven and Rijswijk there are traffic areas, which clearly differ from one another and where, along the roads, houses, blocks of flats are built. Altogether, there were at least 10 experimental areas of different type according to the areas and to the countermeasures taken.

Another feature of residential areas, which distinguishes them from one another, is their population.
In Eindhoven the education level of the questioned persons is lower than in Rijswijk. This is mainly characteristic for options 1 and 3.

In Rijswijk an extremely high education level characterises option 3. As regards the ownership of cars, in the before-period in Rijswijk option 2 surpassed option 3.

In case in future projects the aforementioned observations will be duly taken into consideration, it will be feasible to make more refined measurings and to extend the possibility of drawing generalised conclusions.

Observation 3

The analysis of the results of the inquiry investigation reveals that the answers to identically formulated questions concerning traffic safety were unsystematic and different within option areas.
Quite inevitably the question arises whether we have sufficiently advanced measuring instruments at disposal to penetrate to the core of the matters. On the other hand it is quite possible that the residents proper have only vague and misty ideas about subjective traffic unsafety. Even if one tries to bridge over the uncertainties and ignorance by more practically formulated questions, like "are there dangerous locations in your neighbourhood?" one cannot be sure whether a location which is dangerous for one person, will be as dangerous for some one else. According to this observation it is rather difficult to investigate, whether subjevtive factors gave an influence on the traffic participants' behaviour and the power of this influence.
In investigation into this problem is urgently required because otherwise the value of answers to questions of the indicated type cannot be defined in process evaluation.

Observation 4

The investigation proved that by means of the conflict method several relevant behaviour aspects of the traffic process can be disclosed, which cannot be found out by inquiries or accident analysis. The main purpose of the conflict method is not only the prediction of the number of accidents, but the revelation of factors which may cause accidents. Thus, the method describes the aspects of the traffic process, which by their mutual interrelationships, inevitably lead to accidents. In other words: the conflict observation technique is a form of systematic behaviour observation, focused on interactive traffic behaviour, which under certain circumstances may become critical.

In view of the several and undeniable advantages of the conflict method (it needs a short time, it applies an adaptable measuring programme, it collects general data for the same periods of time), it is highly recommended to pay more attention to this mode of measurements, mainly in case of the discussed evaluation investigations.

Observation 5

In traffic areas four times more injury-related accidents were recorded than in residential areas, while the amount of traffic was greater by a factor under two. This implies that traffic safety cannot be limited to residential streets. The attention of both the residents of residential areas and of traffic controlling bodies has to be directed to traffic problems arising on arterial roads and on the transitions from residential areas to traffic areas. This is the conclusion we could draw from the accident study and behaviour observations.

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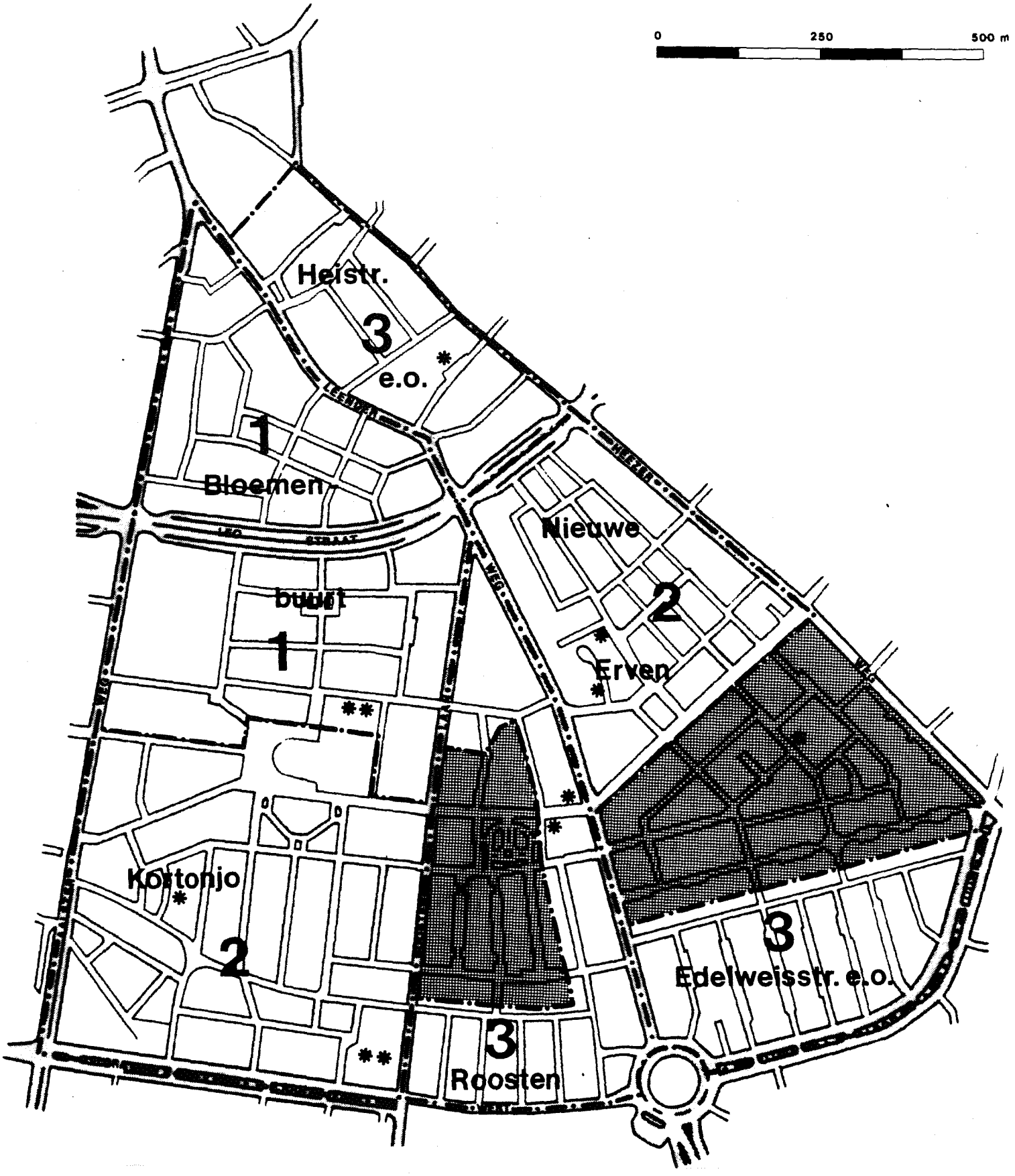
FIGURES 1-3

Figure 1. Demonstration area Eindhoven

Figure 2. Demonstration area Rijswijk

Figure 3. Pedestrian and car movements in the residential area (Advisie, 1983)



Areas, redesigned before the demonstration project

3 Number of option area

Boundaries

Kindergarten, primary schools etc.

Figure 1. Demonstration area Eindhoven

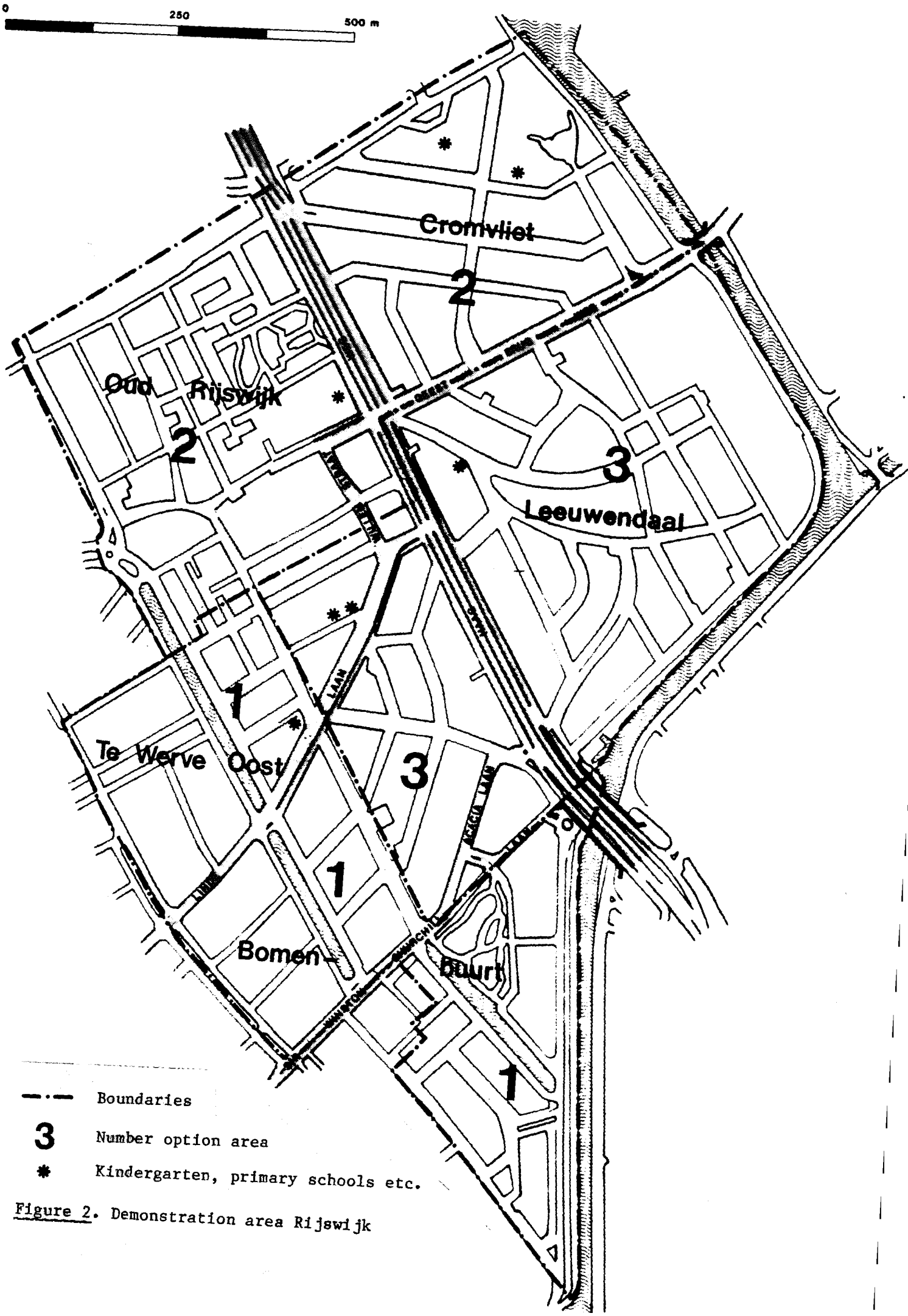


Figure 2. Demonstration area Rijswijk

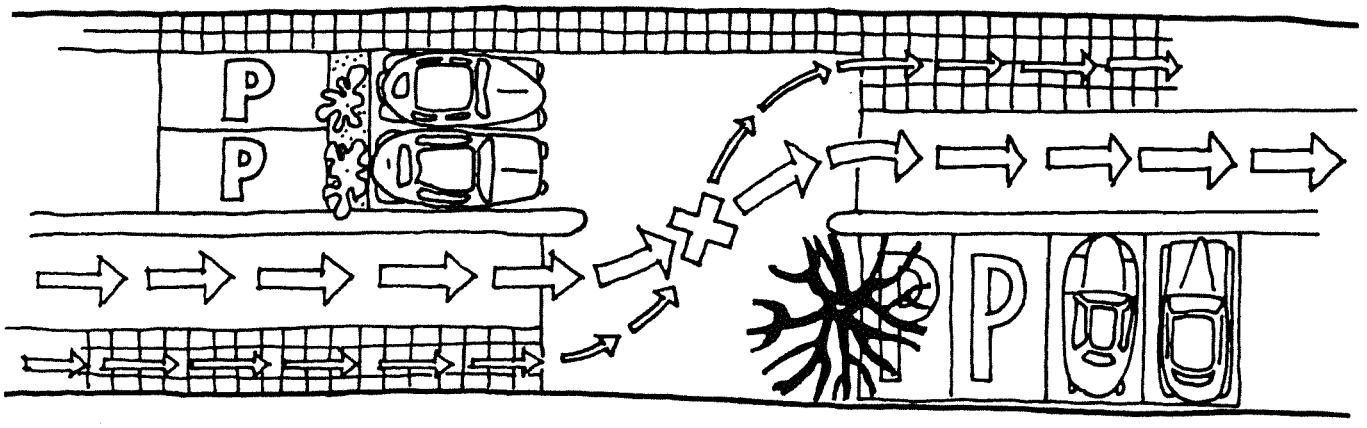


Figure 3. Pedestrian and car movements in the residential area (Advisie, 1983)

TABLES 1-14

Table 1. Survey of replanning measures in the experimental areas of Eindhoven and Rijswijk.

Table 2. Survey of countermeasures in the experimental areas of Eindhoven and Rijswijk.

Table 3. Survey of traffic counts of the experimental areas of Eindhoven and Rijswijk in before and after period.

Table 4. The extent of sneaking traffic according to the residents, (opinion poll) according to cities and options.

Table 5. The highest and lowest average speeds in km/hr for passenger cars and mopeds according to cities and options.

Table 6. Behaviour of car drivers after the implementation of counter-measures according to cities and options.

Table 7. Speeds on some access roads in before and after period.

Table 8. Changes in the mode of traffic in the cities and options of Eindhoven and Rijswijk.

Table 9. Number of injury accidents in absolute figures, per km road lenght, and per million vehicles km for experimental areas of Eindhoven and Rijswijk.

Table 10. Number of serious conflicts according to the category of traffic participant and intersection type (Source: University of Lund, 1983).

Table 11. Serious conflicts according to the category of traffic participants and options (Source: University of Lund, 1983).

Table 12. Assessed number of injury accidents per year on working days between 7.30 and 17.30 hrs according to the conflict observation technique of Hydén, the recorded number of corresponding injury accidents and the total number of injury accidents per year, over the after-period for three types of intersections.

Table 13. The option measures and their direct effects.

Table 14. Changes in the opinions concerning traffic safety as the consequence of the countermeasures.

	Eindhoven			Rijswijk		
	Access roads	Residential streets	Unchanged arterial roads	Access roads	Residential streets	Unchanged arterial roads
km road length	1.98	0	7.30	4.72	1.28	3.17
in %	21	0	79	51	14	35

Table 1. Survey of replanning measures in the experimental areas of Eindhoven and Rijswijk.

Counter measures in residential areas	Eindhoven Option 1	2	3	Rijswijk Option 1	2	3
Road length, km:						
- One-way traffic for all vehicles	1.3	0.4	0.8 [1)]	1.3	1.1	0.1
- Woonerf	0	0	4.1 [1)]	0	0	4.9
- Number of closed streets for motorised traffic	0	2	1	0	3	1
Number of humps	17	70	85	1	18	43
Number of axis shifts	0	2	26	0	6	90
Number of intersection plateaus	0	3	10	11	20	6
Number of intersections and road constrictions	3	4	0	4	4	20

Counter measures in traffic areas	Eindhoven arterial roads	access roads	Rijswijk arterial roads	access road
Road length, km:				
- Protected bicycle lane	2.0	0	1.1	0
- Suggested bicycle path	1.4	0	3.7	0
- Segregated tram and bus routes	0	0	1.5	0
Number of humps	0	1	0	14
Number of axis shifts	0	4	0	19
Number of intersection plateaus	0	0	0	21
Number of intersections and road constrictions	0	25	0	17
Number of pedestrian crossings	16	0	4	0

1) 2.2 km were already restructured in woonerfs.

Table 2. Survey of countermeasures in the experimental areas of Eindhoven and Rijswijk.

Traffic counts of residential areas	Eindhoven Option 1	2	3	Rijswijk Option 1	2	3	Control areas
Average volumes between 07.00 - 19.00 hours							
Bicycles							
counts 1977/78	267	386	316	100	158	136	907
counts 1982	224	255	229	157	228	156	908
difference in %	-16	-34	-28	+57	+44	-15	+0
Mopeds							
counts 1977/78	42	50	49	19	35	26	184
counts 1982	24	24	31	11	35	17	96
difference in %	-43	-52	-37	-42	0	-35	-48
Motor vehicles							
counts 1977/78	360	373	260	255	492	528	1149
counts 1982	341	360	221	327	364	371	1167
difference in %	-5	-3	-15	+28	-26	-30	+2
All vehicles							
counts 1977/78	669	809	625	374	685	690	2240
counts 1982	589	639	481	495	627	544	2171
difference in %	-12	-21	-23	+32	-8	-21	-3

Traffic counts of traffic areas	Eindhoven Arterial roads	Access roads	Total traffic area	Rijswijk Arterial roads	Access roads	Total traffic area	Control areas
Average volumes between 07.00 - 19.00 hours							
Bicycles							
counts 1977/78	2126	1633	2005	1657	659	994	1957
counts 1982	1763	1390	1686	2215	731	1244	1729
difference in %	-17	-15	-16	+34	+11	+25	-12
Mopeds							
counts 1977/78	532	324	502	523	193	317	553
counts 1982	264	194	251	361	110	210	254
difference in %	-50	-40	-50	-31	-43	-34	-54
Motor vehicles							
counts 1977/78	9554	2289	8008	17034	2564	7569	7314
counts 1982	9794	2329	8198	17120	1922	7196	7638
difference in %	+3	+2	+2	+1	-25	-5	+4
All vehicles							
counts 1977/78	12212	4246	10515	19214	3416	8880	9824
counts 1982	11821	3913	10135	19696	2763	8650	9621
difference in %	-3	-9	-4	+3	-19	-3	-2

Table 3. Survey of traffic counts of the experimental areas of Eindhoven and Rijswijk in before and after period.

Sneaking traffic	Eindhoven Option			Rijswijk Option		
	1	2	3	1	2	3
Presence						
None	36	53	46	33	32	5
Some	26	23	21	35	37	25
Much	15	7	16	25	22	65
Eliminated by counter measures?						
Not quite	38	47	16	22	13	6
Partly banned	45	24	38	35	39	60
Completely banned	14	27	46	41	43	32
Is the area safer now?						
No	12	9	12	14	15	18
partly	47	27	24	37	28	29
Yes, distinctly safer	38	59	58	47	55	46

Table 4. The extent of sneaking traffic according to the residents, (opinion poll) according to cities and options.

		Option 1		Option 2		Option 3		Control situation	
		Eindhoven Bloemen-buurt	Rijswijk Bomen-buurt	Eindhoven Nieuwe Erven	Eindhoven Kortonjo	Eindhoven Kruiden-buurt	Rijswijk Leeuwen-daal	Eindhoven De Burght	Oost en West
Passenger Cars									
highest	$\bar{v}$	27.3	38.6	32.2	36.1	19.2	21.8	24.7	27.8
lowest	$\bar{v}$	13.1	16.7	14.3	14.6	11.7	12.9	16.8	13.4
Moped									
highest	$\bar{v}$	31.5	32.1	34.3	32.1	27.5	24.5	29.5	28.0
lowest	$\bar{v}$	14.8	16.2	11.3	17.1	12.0	15.0	11.7	10.0

Table 5. The highest and lowest average speeds in km/hr for passenger cars and mopeds according to cities and options.

Behaviour after reconstruction	Eindhoven Option 1	2	3	TA	Rijswijk Option 1	2	3	TA
Do car drivers pay attention to pedestrians?								
more than before	14	23	31	14	15	20	51	14
less than before	7	5	5	8	7	5	13	10
Do car drivers pay attention to cyclists?								
more than before	12	22	28	13	17	21	43	21
less than before	5	4	6	8	9	8	13	16
Car speeds								
lower than before	26	64	62	47	45	59	78	40
not lower than before	72	33	32	49	54	40	22	56

TA = Traffic area

Table 6. Behaviour of car drivers after the implementation of counter-measures according to cities and options.

	Before-situation		After-situation	
	$\bar{v}$	v85	$\bar{v}$	v85
Access roads				
Laan van Hofrust	37.5	46.0	35.3	42.4
Caen van Necklaan 1	45.5	52.5	35.8	42.9
Caen van Necklaan 2	42.4	48.5	35.8	42.9
Residential streets				
Tulpstraat	37		31	
Beetslaan	28		32	

Source: Papendrecht, 1983

Table 7. Speeds on some access roads in before and after period.

Changes in the modes of traffic	Option 1 Eindhoven	Rijswijk	Option 2 Eindhoven	Rijswijk	Option 3 Eindhoven	Rijswijk
Traffic counts						
Car	- 6%	+27%	- 3%	-25%	-14%	-29%
Bicycle	-16%	+57%	-34%	+44%	-28%	+25%
Moped	-44%	-41%	-53%	0	-28%	-33%
Opinion poll						
Car	-13%	- 5%	-21%	-24%	-19%	-10%
Moped/bicycle	+15%	+ 6%	+ 9%	+11%	+25%	+13%
Walking	- 9%	- 2%	+ 3%	- 2%	- 2%	- 2%
Public Transport	0	0	+ 3%	+ 9%	+ 5%	- 2%

Table 8. Changes in the mode of traffic in the cities and options of Eindhoven and Rijswijk.

Accidents in residential areas	Eindhoven Option 1	2	3	Rijswijk Option 1	2	3	Control areas
Injury accidents							
- before-period	9	14	31	7	32	16	879
- transition period	7	8	10	1	8	1	540
- after-period	0	1	7	0	0	0	152
Injury accidents per km road length per year							
- before-period	0.4	0.4	0.6	0.3	1.1	0.5	0.5
- transition period	0.4	0.3	0.3	0.1	0.4	0.1	0.5
- after-period	0	0.1	0.8	0	0	0	0.5
Injury accidents per million vehicle km							
- before-period	1.5	1.3	2.7	2.2	4.3	2.1	0.6
- transition period	1.9	1.2	1.5	0.4	1.7	0.2	0.6
- after-period	0	0.6	4.1	0	0	0	0.6

Accidents in traffic areas	Eindhoven Arterial roads	Access roads	Total traffic space	Rijswijk Arterial roads	Access roads	Total traffic space	Control areas
Injury accidents							
- before-period	478	50	528	242	44	286	3574
- transition period	250	28	278	114	25	139	1912
- after-period	59	4	63	29	9	38	533
Injury accidents per km road length per year							
- before-period	10.9	4.2	9.5	12.7	1.2	5.2	6.7
- transition period	8.6	3.5	7.5	9.0	1.0	3.8	5.4
- after-period	6.9	1.7	5.8	7.8	1.3	3.6	5.1
Injury accidents per million vehicle km							
- before-period	2.4	2.6	2.4	1.7	0.9	1.5	1.8
- transition period	1.8	2.3	1.9	1.2	0.9	1.1	1.4
- after-period	1.5	1.2	1.5	1.0	1.2	1.1	1.4

Before-period: 1972/1977; transition period: 1978/1981; after-period: 1982 and Jan./Feb. 1983.

Table 9. Number of injury accidents in absolute figures, per km road lenght, and per million vehicles km for experimental areas of Eindhoven and Rijswijk.

Type of intersection	Number of serious conflicts car/car	car/slow traffic	total	Serious conflicts	Accidents 1)	Relative risk 2)
Residential street/access road	17	15	32	4.25	0.05	0.04
Residential street/arterial road	29	53	82	6.31	0.33	0.09
Access road/ arterial road	1	7	8	8.00	0.71	0.18

1) Assessed number of injury accidents per year per intersection type on working days between 7.30 and 17.30 hrs.
2) Average risk, based on the number of serious conflicts, multiplied by a conversion factor and divided by the sum of vehicle and pedestrian intensities.

Table 10. Number of serious conflicts according to the category of traffic participant and intersection type (Source: University of Lund, 1983).

Option	Number of serious conflicts			Serious conflicts	Accidents 1)	Relative risk 2)
	car/car	car/slow traffic	total			
Control areas	11	11	22	2.75	0.35	0.06
Option 1	4	28	32	5.42	0.44	0.13
Option 2	20	26	46	5.75	0.16	0.07
Option 3	23	21	44	5.50	0.18	0.07

1) Assessed number of injury accidents per year on working days between 7.30 and 17.30 hrs.
2) Average risk, based on the number of serious conflicts, multiplied by a conversion factor and divided by the sum of vehicle and pedestrian flow.

Table 11. Serious conflicts according to the category of traffic participants and options (Source: University of Lund, 1983).

Type of intersection	Assessed number of injury accidents according to Hydén	Number of corresponding reported injury accidents	Total number of reported accidents
Residential street/ access road	0.05	0.11	0.18
Residential street/ arterial road	0.33	0.35	0.48
Arterial road/ traffic road	0.71	0	0.86

Table 12. Assessed number of injury accidents per year on working days between 7.30 and 17.30 hrs according to the conflict observation technique of Hydén, the recorded number of corresponding injury accidents and the total number of injury accidents per year, over the after-period for three types of intersections.

Opinion poll			
Option 1 Eindhoven	before-period	sneaking traffic	41%
	after-period	sneaking traffic	38%
Option 1 Rijswijk	before-period	sneaking traffic	69%
	after-period	sneaking traffic	22%
Option 2 Eindhoven	before-period	sneaking traffic	30%
	after-period	sneaking traffic	47%
	after-period	speed >30 km/hr	47%
Option 2 Rijswijk	before-period	sneaking traffic	59%
	after-period	sneaking traffic	13%
	after-period	speed >30 km/hr	50%
Option 3 Eindhoven	before-period	sneaking traffic	37%
	after-period	sneaking traffic	16%
	after-period	speed >30 km/hr	43%
	before-period	leisure walk	67%
	after-period	leisure walk	50%
Option 3 Rijswijk	before-period	sneaking traffic	90%
	after-period	sneaking traffic	6%
	after-period	speed >30 km/hr	37%
	before-period	leisure walk	87%
	after-period	leisure walk	54%

Table 13. The option measures and their direct effects.

	Eindhoven Option			Rijswijk Option		
	1	2	3	1	2	3
Children	-	+	0	0	0	-
Children playing	-	0	-	0	0	-
Children biking	+	+	+	+	+	+
Dangerous locations for children	--	-	--	--	0	-
Dangerous intersection grown-up persons	+	-	0	--	0	0
Old people	0	+	0	+	+	-
Pedestrians	+	0	0	0	+	-
Cyclists	+	+	0	0	+	+
Moped riders	+	+	0	0	0	0
Car drivers	+	+	+	0	+	0
Total	+2	+4	-1	-2	+5	-3

Table 14. Changes in the opinions concerning traffic safety as the consequence of the countermeasures.