Road safety in residential areas

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The Dutch experiences

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1. Introduction

The Netherlands is a small country, the Low Countries near the North Sea, port to the northern part of Europe, which is densely populated: 15 million inhabitants, 350 inhabitants/km2. Dutch citizens own more than 5.7 million passenger cars, 12 million bicycles, almost 500.000 mopeds and 180.000 motorcycles. The total network is 103.000 kilometer of road: 2000 km motorway, 53.000 kilometer roads outside built-up areas and 47.000 kilometer streets and roads inside built-up areas.

The Netherlands belongs to the safest high-motorized countries in the world, together with the United Kingdom and Scandinavian countries (Harris & Wegman, 1991). With 8.5 fatalities per 100.000 inhabitants in 1991 the Netherlands occupies a favourable position (Japan 11.6, the United States 16.4, Australia 13.6). Per kilometer driven the position of the Netherlands is a favourable one as well (the Netherlands 13 fatalities per billion kilometers driven, Japan 23, Great Britain 11, Denmark 17, Finland 16, the USA 12 and Australia 14).

Since an all-time peak in 1972 - almost 3300 road deaths - the yearly number of fatalities reduced till less than 1300, although mobility almost doubled. The Dutch road safety policy is written down in policy plans, the last one issued in 1991. Every few years these plans are updated. In 1988 the Dutch Government decided to use quantitative targets for road safety: by the year 2000 the number of fatalities and casualties should be reduced by 25% compared with the year 1985. By the year 2010 the reduction should be 50% for fatalities and 40% for other casualties. Given the growth in mobility, which was declared as politically acceptable and the possible reduction in fatality-rates, SWOV came to the conclusion that these targets still could be reached, but they are rather challenging and demanding.

2. Road safety problems inside residential areas

A majority of road accident casualties inside built-up areas take place on traffic arteries, those streets or roads where traffic or flow function dominates. About 20 - 40% of the accidents has occurred in streets with a residential function. It is an exception rather than a rule to find black-spots in residential areas. Accidents are scattered over the entire area. This leads to the conclusion that an area-wide approach to solve road safety problems in residential areas is most appropriate.

Mainly children and older people, pedestrians and cyclists are casualties of road accidents in residential areas. These road user groups belong to the most intensive users of these

areas. Older areas seem to be less safe than new ones. No simple explanation can be found for this, but a combination of various factors play a part (more mixed functions of streets in older areas, more (through) traffic and parking problems, less space to play for children etc.

A literature study of Kraay & Wegman (1980) gives a survey of criteria, which have a positive or negative effect on road safety:
- Residential areas with closely built houses, old residential areas and areas which are not very far from the town centre, display a relatively low road safety level. Areas with many shops and schools, with little playing space for the children are relatively unsafe;
- In densely populated residential areas, with many young pedestrians in the streets, the road safety is relatively low;
- Undifferentiated road systems, a poor segregation of traffic categories, many crossroads, long and narrow streets, involving complex traffic situations, have an unfavourable effect on road safety;
- On the other hand the segregation of traffic categories, culs-de-sac with sufficient place at their end to turn a car around, and loop streets have an undoubtedly positive effect on road safety;
- Busy streets with relatively heavy traffic and many parked cars affect road safety negatively.

3. Roads: function - design - road user behaviour

One of the problems of our road transport system today is that roads and streets are expected to fulfil incompatible functions at the same time, where the road user generally has to guess what to expect from the road traffic situation, and is presumed to guess what others expect from him: thousand times it goes smoothly, until one time, he makes an error.

The principle for a safe infrastructure is that every road is appointed a specific function and is designed such that the road or street in question meets the specific functional requirements as optimal as possible; most of all that it guarantees optimal safety. Three functions can be distinguished: the flow function, rapid processing of through traffic, secondly the access function, rapid accessibility of residential and other areas; and finally the residential function: accessibility of destinations along a street while making the street safe as a meeting place ('habitat function').

Roads and streets have to form a classified road system according to hierarchy.

The key to arrive at an 'intrinsic' safe road traffic system lies in the systematic and consistent application of three safety principles:
- prevent unintended use, i.e. use that is inappropriate to the function of that road;
- prevent large discrepancies in speed, direction and mass at moderate and high speeds;
- prevent uncertainty amongst road users, i.e. enhance the predictability of the road's course and people's behaviour on the road.

4. From segregation to the woonerf-concept

To improve road safety and based on the principle of segregation between different traffic categories, different urban planning has been developed and implemented in the past (OECD, 1979). It is easy to understand that this idea of segregation cannot be easily implemented in existing residential areas. During the seventies an entirely different concept was developed in the Netherlands: the 'woonerf-concept'. This concept received legal status in the Netherlands in 1976. In a woonerf the predominant role of the motorcar has been reduced. Motorcars are allowed to drive at a walking pace only, no sidewalks for pedestrians are necessary and are allowed, at junctions all traffic from the right has priority. The woonerf principle was implemented in many Dutch cities and villages and was, in one form or another, widely adopted abroad.

The woonerf was successful in improving amenity in residential areas and reducing accidents. Although some drawbacks could be notified as well: relatively high costs because most of the time streets have to be repaved completely and under high parking pressure conditions legal obligations could not be met fully.

Results of accident investigations indicate that woonerfs lead to a reduction of approximately 50% in the number of accidents (Kraay & Bakker, 1984).

5. From the woonerf-concept to 30 km/h-zones

It was generally acknowledged that with regard to road safety in residential areas two features were essential: reducing speed of traffic and reducing (through) traffic. From accident studies it turned out that the collision speed should remain below 30 km/h, because then the probability of serious injury will be minimal. From this finding it was deduced to set in residential areas the legal limit at 30 km/h. It was widely accepted that speed-restricting infrastructural measures should enforce the legal limit of 30 km/h. To guide Dutch municipalities to select effective speed-restricting measures a 'Handbook for 30 km/h measures' was developed (Ministry of Transport, 1984). Nowadays these measures can be found in the ASVV-Recommendations for urban traffic engineering (CROW, 1988).

So, three principles could be followed to improve road safety inside residential areas: to reduce the volumes of motorised traffic by simple one-way streets systems and street closings, secondly to reduce traffic and to restrict driving speeds of motorised traffic (cars, motorcycles and mopeds) by speed restricting measures and thirdly by creating woonerf areas.

In order to assess the effects of these three possibilities in the cities of Rijswijk and Eindhoven a large-scale demonstration project was carried out. The effects on road safety were reported in different studies (Janssen & Verhoef, 1989, Janssen, 1991 and OECD, 1990).

The results of this project indicated that a reduction of injury accidents was achieved of more than 80%. This was the case both in 30 km/h-zones as in woonerf areas. This was mainly due to reduction of motorised traffic (16% resp. 25%) and of reduction of the average speed by 22% resp. 40%. Because the safety effects were about the same it was

recommended to carry out 30 km/h-zones, because of the lower costs.

Over the years many municipalities have decided to implement 30 km/h-zones. Based on a recent survey we expect that in 300 out of almost 700 municipalities have realised one or more 30 km/h zone. Two accident studies have been carried out. In the first study (Vis, 1991) we draw the conclusion that 30 km/h-zones have reduced the number of accidents by 10 - 15%, based on an in-depth study of 15 areas. The numbers were too small to draw any conclusion on the reduction in casualties. The traffic intensity fell by 5 - 30% and a reduction in speed was measured in all areas. The opinion of residents was positive and the regulation enjoys a high level of acceptance. One negative point was mentioned by the residents: speeding behaviour of moped riders. The results of this study learn that the effects on accidents vary enormously: in some areas no accidents occur in the after period, in some areas no reduction was measured at all.

In a second study (Vis, 1993) data are used of 151 30 km/h-zones. From this study we concluded a reduction in injury-accidents of 22%. This reduction rate was according to our expectations, but lower than from the Rijswijk/Eindhoven-study. For this result we have found the following explanations: the areas in Rijswijk/Eindhoven were chosen because of the magnitude of the existing problems: high accident numbers (so regression-to-the-mean-effect is to be expected), high driving speeds, high amount of traffic. Moreover, the planning of the measures and the quality of those measures (density) in Rijswijk and Eindhoven is probably better than in general.

6. Conclusions and recommendations

Based on the results of the Dutch studies and experiments over the last decades the conclusion can be drawn that urban and traffic planning using engineering measures in residential areas, which reduce the amount of traffic and driving speed, improve road safety and reduce accidents effectively. Injury-accidents are reduced more than damage only accidents. Comparisons of the effects on accidents of 'woonerfs' and 30 km/h-zones learned that their effectiveness is about the same. Due to the higher costs of woonerfs, it is to be recommended to create 30 km/h-zones, when the aim is to improve road safety in residential areas.

Under circumstances reduction rates for injury-accidents of even 80% are measured, but a recent study under all Dutch municipalities turned out for 30 km/h-zones a reduction rate of 22% for injury-accidents. The effects on accidents vary enormously over different redesigned areas. Probably this has to do with the magnitude of the road safety problems in the before period and the quality of the measures taken.

It is to be recommended to select those areas where the positive safety effects are the most promising: high amount of (through) traffic, high speeds, high number of accidents, intensive use of the public space by vulnerable road users. Furthermore a careful design of countermeasures is most important.

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