SAFETY ASPECTS OF URBAN INFRASTRUCTURE

From traffic humps to integrated urban planning

Paper presented to the International Conference on Traffic and Environmental Management in Cities, Prague, Czechoslovakia, 23-24 May 1989

R-89-14

J.H. Kraay & A. Dijkstra

Leidschendam, 1989

SWOV Institute for Road Safety Research, The Netherlands

ABSTRACT

As is already known, many traffic and transport problems over the last 20 years have for a large part been caused by a strong increase in the ownership and use of motor cars.
The core of this problem lies with the large amount of space taken up by motorised traffic, the danger to traffic safety particularly for pedestrians, cyclists and moped riders, the experience of traffic safety and damage to the environment. These problems are most urgent in urban areas.

In this contribution an overview will be given of infrastructural measures in the Netherlands over the last 15 years. Their feasibility and their consequences for traffic safety have been stated.

In addition to the clearly positive results which can be achieved by using diverse measures in residential areas, reference is made to the fact that around 80 per cent of accidents take place on the main traffic arteries in cities and that this is an area in which more progress can be made.

Reducing the number of traffic accidents is one single aspect of improving traffic amenities. Environmental aspects are also influenced positively through effects such as less exhaust fumes and less noise and vibrations. Above all, the opinions about the traffic environment improve.

An area-geared approach to traffic safety has more chance of succeeding than taking incidental measures. It is also becoming increasingly apparent that an integrated municipal approach to traffic safety, by a concentration of forces at various municipal levels, for example, is more effective. Local civic organisations should also participate in this concentration.

INTRODUCTION

Over the last few years increasing interest has been shown by groups within both the Netherlands' social (such as government institutions, interest groups, among others) and scientific circles in the possibilities and limitations of behaviour-influencing techniques on the promotion of traffic safety and traffic amenities. These techniques include a wide range of possibilities such as the design of the traffic environment, legislation and law-enforcement as well as education, information and training.
This contribution focusses on measures relating to the infrastructure: town planning and design-measures of neighbourhoods and streets. The design makes clear what sort of traffic behaviour is expected of the road-user.

As is well known, many traffic and transport problems over the last twenty years have been caused by a strong increase in ownership and the use of motor cars.
At the core of this problem is the large amount of space taken up by motor-car traffic, the danger of traffic particulary to slow-moving vehicles, the experiences with traffic safety and the damage to the environment. These problems occur most strongly in the cities. Here the concentration of both moving and stationary traffic is greatest within the already scarce amount of available space. The traffic function increasingly encroaches upon the urban and social functions.

Solutions which had to be made mainly focussed on the following aspects:
- through traffic and obstructive short-cut traffic passing through streets not designed for this;
- large amounts of space taken up by parked vehicles;
- the large barrier effect of main traffic routes;
- threat to traffic safety, particularly to slow traffic;
- deterioration of the residential environment in urban areas through noise and vibrational nuisances and through air pollution.

TRAFFIC POLICY

The Dutch government recognised this issue and through a number of government memorandums in the 1970s experiments were set up with the aim of reclassification and reconstruction of urban roads with the intention of improving the quality of life (of which traffic safety is an important component).
The ideas around this involved and still involve on the one hand improving the safety and amenities of residential areas and on the other striving towards a clearer distinction of the urban area into residential districts and traffic areas. The form which this division would take would be made apparent from the results of experimental research.

Examples of this experimental policy in The Netherlands are experiments involving infrastructural measures in the field of:
- replanning of residential streets, possibly into woonerfs;
- 30 km/hour zones;
- crossing facilities on busy traffic streets within the inner city/built-up areas;
- routes for and school children and cyclists;
- through roads in smaller municipalities;
- reclassification and reconstruction of urban roads.

PROBLEM DESCRIPTION

From national accidents statistics the conclusion can be drawn that the danger posed by traffic within the inner city/built-up areas is especially a problem involving pedestrians, cyclists and moped riders coming into conflict with fast-moving traffic.

Local studies create the following impression:
- in residential areas accidents are not concentrated on specific sites (black spots), but are spread over the entire area;
- insofar as there are black spots, these occur on streets which can be termed as access roads;
- streets with a commercial (shopping) function and streets with a mixed commercial and residential function are usually relatively very unsafe;

- the victims of accidents in residential areas are mainly children and the elderly, pedestrians and cyclists;
- in older suburbs the danger posed by traffic is larger than in new suburbs; presumably this is due to a combination of factors: differences in site use, building density, living conditions, population composition and traffic policy.

INFRASTRUCTURAL MEASURES

Residential streets should not only ensure that destinations can be reached (by motor car). They also have many other functions, such as: inviting and offering space in which to play, cycle and walk; creating opportunities for social contact; offering space for recreation; offering parking facilities for residents and visitors.
These functions, which can collectively be called "tenement functions", are often given insufficient attention in existing residential streets. To bring about changes in this often requires physical measures which influence traffic behaviour and raise traffic safety.
This approach is characterised by two main objectives:
- keeping non-local traffic so far as possible out of the residential streets and local access roads;
- the promotion of "adjusted" behaviour by road-users on the residential streets and local access roads whose destination is within the residential area.

To achieve these objectives the following measures can be taken:

o Keeping out non-local traffic in residential areas:
a. Closing off streets which join on to access roads; only one or a few streets need to remain open. This creates a single system of cul-de-sacs. It is often necessary to provide an area at the end of such streets in which motor cars can turn around. Such a systematic approach can reduce the possibility of accidents, both within the residential area and on the adjoining roads.
b. Closing off streets within a residential area, so that cul-de-sacs and loop streets are formed. Research has shown that this does not influence the risk to traffic safety as strongly as measure a.

c. Combination of measures a. and b. As a result of this a complicated route is created which should make the neighbourhood unappealing to short-cut traffic. Only large residential neighbourhoods are suitable for such an approach.
d. A system of one-way streets, both with and without physical restrictions. A limited number of one-way streets within a residential area can reduce the total through traffic. In general, such a measure is difficult for police to enforce.

o The promotion of "adjusted" behaviour in residential streets.
This can be carried out with the help of traffic rules (for example, priority rules, speed restrictions). However, in most cases a change in the behaviour of road-users is more likely to come about as the result of changes in the appearance of the street rather than amendments to existing laws. The most satisfactory solutions offer physical measures which support speed-restriction laws but which at the same time also make road-users aware of the possibility of sudden and unexpected movements by other traffic participants.
If pedestrian areas or woonerfs (residential areas) are not possible in residential streets, then other forms of speed restrictions need to be imposed. It must also be clearly indicated at which point a residential street becomes an access road.
Attention should also be paid to parking in residential streets (to reduce the possibility of accidents involving playing children, among other reasons) and the application of special provisions for pedestrians and cyclists (in terms of position and design, among other aspects).

TRAFFIC HUMPS

One of the many physical measures which can be taken to promote the residential function of residential streets is the construction of traffic humps. These can be deployed incidentally or as a system (series). They can also be used in combination with other physical measures, such as artificial curves (axis realignment), road narrowings and obstacles (flower pots, poles). Traffic humps had their heyday in the Netherlands in the first half of the 1970s.

The specific objectives of the construction of traffic humps can be described as follows:
1. Influencing the speed behaviour of motorists. For example, in a case where the legal speed limit is exceeded or cars travel too fast in relation to children playing in the street. Sometimes it is also hoped that any short-cut traffic will disappear as a result.
2. Raising the level of traffic safety. Sometimes a link is made between a lower speed-behaviour and an improvement in traffic safety.
3. Improving (aspects of) traffic amenities. Here may be considered less nuisance from noise, better playing facilities for children, greater traffic safety experienced by elderly inhabitants.

On the basis of research, the following can be stated about traffic hump, developed by the TRRL (Britain) and in The Netherlands :
- the objectives stated above under points 1, 2 and 3 can indeed be achieved;
- they can have a positive influence on pedestrian behaviour (crossing-over behaviour, crossing-over facilities);
- from research in Britain it appears that traffic humps in certain circumstances clearly do have a positive influence. Streets included in the research show a 61 percent decline in the number of injuries. This drop was larger than the independent decline in vehicle flow (37 per cent) and the average driving speeds (43 per cent).

WOONERFS AND OTHER ERFS

Ideas other than traditional ones on the design which suburbs and entire cities should take are certainly not new. Le Corbusier had already launched his ideas about the new city in the 1920s (La Ville Radieuse, Plan Voisin). At the same time in the United States a differentiated road structure for a residential suburb was proposed by Strein & Wright and carried out in Radburn, New Jersey. After Howard, the pioneer of Britain's garden-city movement, gave substance to his ideas in Welwyn Garden City, a number of New Towns arose in Britain immediately after the Second World War. Reichov went so far in West Germany as to seek a motor car-free city in Sennestadt. Specific attention for pedestrians and cyclists can be found in the SCAFT guidelines in Scandinavia in the 1960s. Such new ideas have only been implemented on a very limited scale.

In most cases attention has been limited to speed-reducing measures, such as speed barriers, applied in a limited number of streets instead of entire neighbourhoods.

The "woonerf" (residential area) was first given legal status in The Netherlands in 1976. In the first instance the woonerf serves as a residential area, a meeting place, recreational place and walking area (site function). Of course, this public area also has a site-access function, also for moving traffic. It does not, however, serve any function for through traffic.

In addition to the woonerfs created by legislation, "winkelerven" (shopping-erfs), "dorpserfs" and "stadserfs" (village- and city-centre erfs) were also formed in the late 1970s. Streets and residential areas were also redesigned without the intention of creating a woonerf.

SWOV research into the effects of "erfs" has shown that:
- the number of traffic accidents can be halved in erfs;
- woonerven show a larger drop in accidents than shopping-erfs and village-erfs;
- reduction in the number of accidents is largest in categories involving pedestrians in all experiments;
- accidents involving motorised traffic according to collision category, whereby no difference was noted between woonerfs and other experimental measures;
- there are signs of a declining number of accidents according to a lower number of junctions of residential streets on to arterial roads and lower number of intersections within the residential area. The decrease in the number of accidents appears to be partly caused by barring through traffic and short-cut traffic and partly through the lower speed travelled by motorised traffic.

The woonerf scheme has since been expanded, as of 16 July 1988, to include shopping-erfs and village-erfs. It is hoped that these new erfs-regulations will be given an even wider application. From research results up to the present it can be concluded that the above-mentioned measures have had a noticeably positive influence on the public opinion about the traffic environment, the traffic behaviour and the incidence of traffic accidents.

RECLASSIFICATION AND RECONSTRUCTION OF URBAN ROADS

The largest experiment set up by the Dutch government is the demonstration project on reclassification and reconstruction of urban areas, carried out in the municipalities of Eindhoven and Rijswijk.
These experiments involved rigorous steps to keep short-cut traffic out of residential neighbourhoods and so increase safety and amenities. To begin with, the roads network has been divided into traffic arteries, access roads and residential streets. Each type of road was then planned according to its function.

For the residential streets three different objectives (options) were decided in advance. The packages of measures accompanying this vary from the relatively simple for option 1 (one-way traffic and a single traffic hump), via the slightly complex option 2 (one-way traffic in combination with various speed-reducing provisions) to the far-reaching option 3 (woonerf or similar construction). These measures aim to give the slow-moving traffic a more or less similar status with respect to fast-moving traffic.

The results of accidents research indicate that a structural approach such as this has a positive effect on traffic safety in city areas.
In residential streets the number of accidents with injury per vehicle-kilometre fell by 75 per cent. On traffic arteries and access roads this decline amounted to 17 per cent.
For the entire demonstration area the total reduction in the number of accidents per motor vehicle-kilometre amounts to 28 per cent. These percentages have been adjusted for changes in neighbouring areas where no measures were taken. The decline in the number of accidents in these residential suburbs appears barely to depend on the package of measures applied, for that matter.
The improved safety of residential streets in the demonstration area most certainly does not apply to moped riders; safety levels for this category has increased in comparison.
From accidents research it appears that measures in the demonstration area have no negative influence on traffic safety in the surrounding area.

An important finding, for that matter, is the observation that around 80 per cent of injury-causing accidents in urban areas takes place on traffic arteries. From the viewpoint of traffic safety the biggest achievements of the measures can be expected in this area.
In order to be able to take adequate measures for traffic arteries the government has ordered research into the problem situations arising. This research has so far provided the following provisional problem situations: a) stretches of roads whereby parking takes place by means of a provision on the main driving lane; b) stretches of road with a single main lane and parallel provisions on either side for bicycles, mopeds and any other forms of traffic.

30 KM/H ZONES

Given the high cost of the woonerf measure, attention has been given to a cheaper area-geared approach in the form of 30 km/h zones.
Since 1 April 1983 it has become possible to impose a maximum 30 km/h speed limit within built-up areas/inner cities. As of 1 January 1984 it also become possible to indicate this limit by means of zone signs. The background to this measure is that it will have a positive influence on traffic safety. In order to confirm this by research 15 areas have been selected where the effects on safety, traffic behaviour and the opinions about the traffic environment will be determined.
In the meantime, nearly all research results concerning aspects of traffic and residents' opinions are now known.

The evaluation of these results has not yet taken place, but initial impressions show that the speeds in the zones are indeed reduced after this measure has been taken and that the measure is appreciated by the residents. The reduction in speed achieved strongly depends on the type of measure chosen for a zone. Data from accidents research will only be available at the end of 1989. For the time being German research in Berlin-Charlottenburg is being used as an indication of what changes may be expected in our country.

A MORE INTEGRATED APPROACH

An area-geared approach to increasing traffic safety has already been used in a number of countries for some time.

The most important research conclusions can be summarised as follows
- a widely implemented differentiation of roads in accordance with their traffic function leads to safer residential areas;
- a complete division of fast- and slow-moving traffic is accompanied with very low accident figures;
- integration of types of traffic (woonerf) reduces the number of accidents by approximately half.

What have area-geared plans achieved up to the present?
1. Area-geared plans have a demonstrably positive influence on traffic safety.
2. Area-geared plans have until now focussed almost exclusively on residential areas. Only in Germany, Britain and Denmark can examples be found in research still under way of an approach involving large parts of a city or even an entire municipal area.
3. Not directly following on from the above, the following fundamental question can still be stated: how do you educate the youth in our traffic-orientated society, how do you approach them, so that the backlog in their education and experience of traffic can be compensated or overcome?
4. It is becoming more and more apparent that the municipal approach to traffic safety requires the co-operation of local groups.

On the basis of developments in the recent past, the observed positive effects on traffic safety and the somewhat lower political priority for traffic safety on its own, the following approach is proposed and recommended to promote traffic safety even further.

MUNICIPAL POLICY FOR TRAFFIC SAFETY

Measures taken to increase traffic safety in urban areas often have an effect on other aspects of the town-planning, economic and socio-cultural system as well. Therefore the municipal traffic-safety policy should, now

more than ever, be integrated in structural planning (suitable for indicating the divisions into residential and traffic areas), destination planning (suitable for establishing the layout), urban renewal planning, traffic circulation planning and traffic and transport planning. Only by explicitly raising within such areas the expected consequences for traffic safety can the interests of traffic safety be properly weighed against all other relevant interests. Furthermore, in such a manner an interconnected vision of traffic safety in the entire city can be developed, whereby the possibility of shifting problems into other areas is avoided.

It can be noted that in a number of West European countries co-operation within and between administrative levels in the field of traffic safety has gained increasing importance over recent years. In this context one may think of the "Minus 10 per cent" campaign in Austria, "Reagir" in France, "Minus 25 per cent" in the Netherlands and various forms of organisation in which national governments have transferred responsibilities to regional organisations (for example, in Britain and The Netherlands) and to municipalities.

However, a systematic approach to traffic-safety policy at the municipal level is still in its infancy. There is still barely any indication of an integrated approach being taken. New policy remains difficult to formulate.

It is also of essential importance for our children as traffic participants that an inter-connected policy is created in which traffic education is given an important status. In the interests of this same youth group attention must be given to safe school routes, safe residential environment, safe means of transport and effective information.

Nevertheless, in the thinking of parties involved a shift from an area-geared approach dealing with residential areas to a more integrated municipal planning can be noted.

This means a new approach within the context of the OECD. A new OECD group, "Integrated Urban Area Traffic Safety Planning and Management" has included the following basic principles in its background paper:

- Traffic accidents are distributed across the traffic arteries and residential areas; accidents are subject to statistical fluctuations; therefore it is misleading to take measures aimed at incidental accident locations.
- Traffic safety often does not enjoy a high priority in municipal politics; therefore it would be more sensible to incorporate basic principles for a traffic-safety policy in other policy programmes.
- Integrated municipal (traffic-safety) planning gives the best guarantee that a good overview is created at local level of all the possible problems which may occur and whereby priorities can be weighed against each other more effectively before deciding on action.

The OECD work group has tried to achieve a more effective alignment of theory and practice of the integrated approach. However, the practice has not yet developed far enough to make this alignment possible in all aspects. But what is possible is to support a theoretically optimum approach through a constructed practical example based on a number of practical examples itemised in the OECD countries.
The constructed example must make especially clear that an integrated approach consists of a phased process where within each phase other local actors (politicians, officials, police, education personnel) must or can play a role. The last phase of the integration process leads to a plan which includes all intended activities, including the financing.
If municipal authorities still appear to be unable to give substance to this integrated approach, then there is a role for the national government (in the form of the relevant department at the Transport Ministry, for example) to stimulate this approach and to encourage its application by using the appropriate organisational and financial means.

It is believed that such an integrated approach at municipal level can and will make a real contribution to the total urban traffic issue, therefore also to its negative aspects, such as the threat to public and traffic safety, traffic inconvenience, environmental pollution, and that it would eventually prove to be cost-effective.

LITERATURE

Towards safer residential areas. J.H. Kraay, M.P.M. Mathijssen & F.C.W. Wegman. SWOV, Leidschendam, 1984. 56 pp.

Reclassification and reconstruction of urban roads in the Netherlands. Effects on safety, the environment and commerce. M.P.M. Mathijssen (ed.), J.H. Kraay a.o. SWOV, Leidschendam, 1985. 36 pp.

Traffic safety in reconstructed streets. Lecture presented at the Technical University, Espoo, Finland, 14 May 1985. R-85-39. J.H. Kraay. SWOV, Leidschendam, 1985. 42 pp.

Woonerven and other experiments in the Netherlands. J.H. Kraay. R-86-23. SWOV, Leidschendam, 1986. 13 pp.
Article Built Environment 12 (1986) 1/2: 20-29.

Safety in residential areas; The European viewpoint. Presented to the Conference on Road Accidents in Childhood, organised by the Parliamentary Advisory Council for Transport Safety (PACTS), London, 3 November 1987. J.H. Kraay. R-87-20. SWOV, Leidschendam, 1987. 16 pp.

Traffic safety in residential areas. Organisation for Economic Co-operation and Development, Paris, 1979.

Integrated urban area traffic safety planning and management. A background paper. N. Muhlrad (INRETS, France), P.I.J. Wouters (SWOV, The Netherlands).

Safety effects of bicycle facilities; the Dutch experience. Contribu- tion to the International Road and Traffic Conference Roads and Traffic 2000, 16th International Study Week for Traffic Engineering and Safety, Berlin, 6-9 September 1988. Fred Wegman and Atze Dijkstra. R-88-21. SWOV, Leidschendam, 1988. 12 pp.