SOME ASPECTS OF TRAFFIC SAFETY IN RESIDENTIAL AREAS

Contributed to OECD Research Group Traffic Safety in Residential Areas

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INTRODUCTION

In the framework of international co-operation within the OECD Research Group Traffic Safety in Residential Areas the Netherlands have accepted the task of collecting Dutch data for a report. As far as Dutch research exists for the various chapters and sections of the tentative outline of the complete report, this can be found in this contribution.

TENTATIVE OUTLINE OF THE COMPLETE REPORT

Chapter I Introduction

Chapter II Scope and character of the problem
- II.1. Definition of a residential area
- II.2. Main problem areas: old and young pedestrians and cyclists
- II.3. Old and new area (basic differences in characterising the road accident situation)

Chapter III Countermeasures
- III.1. Planning
- III.2. Physical details
- III.3. Regulations
- III.4. Education

Chapter IV Implementation:
- Administration
- Information

Chapter V Measuring safety
- V.1. Accidents
- V.2. Conflicts
- V.3. Evaluations
- V.4. Subjective feeling of safety
- V.5. Behavioural factors

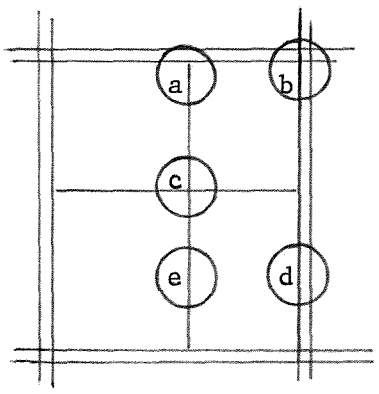
Chapter II. SCOPE AND CHARACTER OF THE PROBLEM

II.2. Main problem areas

Research in Rotterdam (Goos & Van der Linden, 1975) shows that most pedestrian accidents involving children up to 15 years happen in streets with a traffic density lower than 2,000 vehicles a day (Table 1). These quiet residential streets are part of the residential area where children move around and play.
This Rotterdam research also shows that a very large proportion, about 50 per cent, of accidents involving children (pedestrians and cyclists) happen within 300 metres (in a bee-line) from the family home (see Table 2).
If the table is considered per age group, 80 per cent of the 0-4 age group are found to be involved in accidents within 300 m. In the 5-9 age group the proportion is 63 per cent.

In Amsterdam (Wegman, 1977), the urban road system is subdivided into routes and non-routes. A route is defined as part of the road system having the primary function of catering for through traffic.
Distribution of accidents involving injury over the five possible location characteristics is as follows:

a. route/non-route intersection	25.8%
b. route/route intersection	17.6%
c. non-route/non-route intersection	9.8%
d. route road section	29.1%
e. non-route road section	17.7%
total	100.0%



This means that 27.5% of the accidents happen in residential streets. As compared with all other road users, moped riders have accidents relatively often in residential streets; motor cyclists, buses and trams comparatively infrequently.

Chapter III. COUNTERMEASURES

Introduction

It will be impossible in many cases to obviate potential conflicts between pedestrians and wheeled traffic. Where potential conflicts exist, traffic conditions should vary as little as possible. Less variety increases the predictability of events, and information furnished to road users (pedestrians and others) concerning such events will have more chance of success. This means that the task of road users is made easier and that consequently potential conflicts will materialise in fewer cases.

Literature research (Kraay, 1974; SWOV, 1974) has shown that measures aimed at influencing social behaviour do not have the desired effect on road safety. These include legal rules, technical measures such as zebra crossings, initiatives for children's road safety training, information and publicity campaigns.
On the other hand, it is found that urban planning measures are likely to have more direct effect, with both a short and long-term influence on behaviour.

III.1. Urban planning

Urban planning can be expected to produce more than merely a low percentage improvement in safety. Many potential conflicts can already be precluded in urban development projects.

The most obvious urban planning measure is the physical segregation of traffic categories, whereby the area is designed in such a way that hardly any more (pedestrian/motorist) conflicts occur. It is a clear, comprehensible system determined by its design. In other words, physical (urban) planning determines and stimulates certain forms of traffic behaviour.

The SCAFT Group in Sweden (SCAFT, 1968) believe in the principle that pedestrian "errors" are of secondary importance in studying pedestrian safety. The main reason for the pedestrian's lack of safety is the traffic environment, creating situations with a specific risk of "errors". The environment should be such that a pedestrian "error" does not immediately lead to a conflict or accident.

Such measures, however, have a number of drawbacks, especially in existing cities:
a. their high absolute costs;
b. lack of space or the structural impracticability of carrying out specific plans;
c. the difficulty of harmonising the various networks for pedestrians, cyclists, mopeds and fast traffic.

In view of a residential area's many social functions, it is questionable whether physical segregation of traffic is, in fact, desirable.

Since strict traffic segregation would put too many limitations on the great variety of activities and contacts for which the direct residential surroundings are normally used, The Netherlands found a growing need for a new approach to road safety in residential

areas, based on traffic integration. The benefits of physical segregation as just mentioned can also be built into mixed traffic. A number of towns have made small-scale attempts to integrate traffic in a limited number of residential streets. For application to larger areas the Dutch examples of Delt, Emmen and other towns may be mentioned. They relate to both new and renovated neighbourhoods.

Urban planners in some towns in The Netherlands in designing residential areas have been guided by the principle that conflicts, especially involving young children in their immediate living environment, must be obviated. The planners' objective in Delft and some other towns is: .... to create an environment which children in particular can use more fully and in a more varied way without this causing conflicts with other users of the area, or, if conflicts occur, they should be of the minimum severity.

Such mixed traffic in the immediate environment has led to the establishment of residential yards (VNG, 1975).
Residential yards are areas where the space open to the public is designed primarily so that the sojourning functions of walking and playing should be done full justice to; and only local traffic is allowed in them.
Unlike incidental measures (such as simple thresholds, localised road narrowings, etc.), this involves a systematic approach in which areas are integrally designed or redesigned as residential yards. This relates to a complex of physical and visual measures in and upon the space open to the public.
The residential yard's function differs particularly from a conventionally designed residential street in that the same paved area can be and is (partly) used for various functions such as driving, playing, cycling, walking and parking. In a conventional street, the carriageway is already often used for walking and playing, though this is not allowed by law.
From the viewpoint of recognisability by the road user and his mental load, it would seem preferable for a residential yard to comprise more than a single street or single street section.

But if traffic densities are very high and with excessive parking, residential yards are not the solution. A possibility is to solve the parking problem or else to seek totally different solutions if the parking problem continues to exist.
Special (behavioural) regulations apply to traffic in the residential yards.

In Amsterdam (Wegman, 1975), research was made into road hazards for children up to 12 years (up to primary school pupils). The investigations compared eleven city districts with respect to hazards for children. The hazard indicator chosen was: the number of casualties (injured or killed) per thousand children living in the district concerned. The children had to be pedestrians or cyclists and not vehicle passengers. Areas were selected which were comparable neighbourhoods functionally and in urban structure. Data were collected for 1973 and 1974 (see Table 3).
A city map shows that the most dangerous districts are those built before the Second World War. The areas outside the pre-war city are unsafer again than the city centre. These are characterised by having a high proportion of through traffic and a high parking rate. In the relatively safest district - Bijlmermeer - traffic categories have been consistently segregated. This area is $2\frac{1}{2}$ times as safe as the average for all districts together.
In Amsterdam, the road system is subdivided into roads catering mainly for through traffic and those which do not. On such through roads, 72.5 per cent of all accidents involving injury take place. For children, the proportion is only 46.5 per cent.

III.2. Physical details

One-way traffic

One-way traffic is widely applied in urban areas as a means of regulating traffic, improving traffic flows and simplifying traffic movements. As yet there is no certainty regarding the effect of one-way traffic on road safety.

In order to obtain more knowledge regarding views on one-way traffic, interviews were organised in twelve large municipalities in The Netherlands (SSVV, 1977). They showed that in nearly all cities one-way traffic had been introduced in one or more residential areas. The arguments for introducing it are: promotion of traffic flows (6 out of 12), limiting through traffic (6 out of 12), promoting road safety (9 out of 12), increasing parking space (8 out of 12). Differences of opinion exist on the way of giving effect to it, for instance on exceptions for mopeds and cyclists.
The reasons why people expect an improvement in road safety vary greatly: smoother traffic pattern, no oncoming vehicles, no headlamp glare, fewer conflict directions and satisfied residents.

Research has been carried out in The Netherlands into the effect of one-way traffic on road safety (SSVV, 1977). These were comparative investigations of the before- and after-study type with control neighbourhoods, in four cities, evaluating a total of twenty-nine districts. The before- and after periods were taken as one year. The research and control areas can be described as residential areas, with the surrounding traffic arteries also being assessed as far as traffic movement was influenced by the introduction of one-way streets.
The conclusion from this research is that the introduction of one-way traffic does not influence the occurrence of accidents (involving only material damage and injuries). The available material did not permit assessment of the effect of one-way traffic on the occurrence of accidents involving injuries and the casualties these involved.

Inverted saucers in the road surface

In investigations in Rotterdam (Goos & Van den Berge, 1976), inverted saucers were built onto the road surface of a busy traffic artery before and after a mid-block zebra crossing. These elevations are 25 cm in diameter with a maximum height of 1.5 cm.
The research was concerned with the effect these had on motorists' driving behaviour (and speed behaviour). The use of the zebra crossing by pedestrians was also examined, together with their road-crossing behaviour.
It was found that after the saucers were placed in the Oranjeboom-straat and after they were removed about 75 to 80 per cent of the motorists drove no faster than 50 km/h.
But even after the saucers have been placed, it was still possible for 2 to 3 per cent of the motorists (50 - 100 cars per day of research) to drive faster than 60 km/h. About 50 per cent of the measurements disclosed speeds between 40 and 50 km/h.
The complaint by residents that after the saucers had been placed the Oranjeboomstraat had become a "race track" were not correct, therefore; the saucers did not encourage motorists to drive faster. Perhaps this was suggested by the noise produced by driving over them. Nor can it be claimed that they had any effect in reducing speeds. The saucers in the Oranjeboomstraat had no effect on motorists' speed behaviour.
After the saucers had been placed, the three days' investigations showed that a total of 270 pedestrians used the zebra crossing. Of these, 65.2 per cent (176) did not come into conflict with the other traffic, i.e. they crossed when there was no approaching traffic. Of the 94 pedestrians who came into confrontation with a car, only 6.8 per cent (six) were allowed a right of way. During the control investigations, 49 of the total of 68 zebra-crossing users did not come into conflict. The 19 who did come into conflict with a car were all denied their right of way.
The road-surface saucers in the Oranjeboomstraat had no effect on motorists' driving behaviour (readiness to stop).

The following causes can be given for the lack of favourable effects from these saucers in the Oranjeboomstraat:

During three days' investigations, a total of 734 road-crossing pedestrians were observed. 36.8 per cent (270) used the zebra, which means that only an average of about nine persons an hour used it. The other crossed over between the zebra and the intersection before it.

The pedestrian apparently has no reason or need to prefer the zebra for crossing the road. The width of the carriageway in the Oranjeboomstraat most likely plays a part in this.

Comparison of the results with the saucers and after they had been removed also showed no increase in use of the zebra while the saucers were there.

III.3. Regulations

In The Netherlands the most outstanding new traffic regulations applying in residential yards are:

- Roads located within a designated residential yard may be used over their entire width by pedestrians and children at play.
- Drivers must move with the greatest caution within a residential yard. They must allow particularly for the possible presence of pedestrians and children at play, for unindicated objects and irregularities in the road surface and route. In no event must they drive faster than walking pace.
- Drivers must not inconvenience pedestrians or playing children within a residential yard.
- Pedestrians and children must not unnecessarily obstruct the progress of drivers.
- Motor vehicles on more than two wheels can park in a residential yard only at places with a sign or a letter "p" in a space on the road surface.
- A new traffic sign indicates residential areas designated as residential yards at the boundaries.

Chapter V. MEASURING SAFETY

V.1. Accidents

If action is to be taken on the basis of accident analyses, then there must be reliable accident statistics. They should also furnish the most detailed information possible.

But it is a known fact that collection, recording and analysis of accident data have considerable drawbacks. Some deficiences in The Netherlands are:

1. Accident statistics contain information only on recorded accidents and not on unrecorded ones. But only part of all accidents are recorded.

- In 1966 a change in recording policy was announced. What this actually amounted to was that from 1st January 1967 the police were only to record accidents involving death, injury, or damage exceeding Fl. 1000.- and/or if there was a serious traffic offence. Consequently, the number of recorded accidents was greatly reduced.
- The new recording criteria for traffic accidents involving only material damage no longer provided reliable statistics, and from 1967 publication of these figures was discontinued.
- SWOV has estimated that the number still recorded since 1966 is 34% lower than if accident records had not been limited.
- There are indications that only one-third of the actual number of all traffic accidents in The Netherlands are recorded (Blokpoel & Carlquist, 1972).

2. Since accidents are comparatively rare, it is often impossible to obtain reliable accident data. Too much time is often needed to collect enough data for statistical processing for scientific research. Moreover, over a long period of accident data collection, different conditions and circumstances are liable to occur.

3. The present standard records contain no detailed information. In order to take action it is very important to have very specific

accident data. SWOV is therefore at present examining the possibilities of providing this specific information (including pre-crash manoeuvres).

Since traffic accidents do not occur in sufficient numbers in a residential area for statistical research, it is impossible to use accidents as a criterion of traffic safety for short-term research.

V.2. Conflicts

Another indicator of the concept of traffic safety is the near-miss accident or serious conflict behaviour between road users. The number of near-misses, or serious conflicts, is likely to be greater than the number of actual accident.

As regards the method's validity as an alternative criterion for accidents in statistical road safety research, the following can be said. The literature on this subject shows that there is not a very close correlation between all conflicts and accidents (Oppe, 1977). Better results are obtained if only serious conflicts are taken. But research into this has so far been limited.

The development of a conflict observation technique usable as a reliable measuring instrument in various urban planning designs for determining road-user behaviour is therefore a primary requirement. With a view to this, SWOV requisitioned research from The Netherlands Institute for Preventive Medicine NIPG-TNO, Leiden, (Güttinger & Kraay, 1976). This research concentrated on children as the most intensive users of the residential environment.
This Dutch research defines an encounter as a reaction by a party or both of the parties involved in a traffic situation towards the other, with a distance of 20 metres or less between those involved. The various types of encounters are as follows: serious conflict, conflict, intensive contact-conflict, contact-conflict, intensive contact and contact. Serious conflict and conflict are defined as follows:
Serious conflict: a sudden motor reaction by a party or both of the parties involved in a traffic situation towards the other, with a distance of about 1 metre or less between those involved.
Conflict: a sudden motor reaction by a party or both of the parties involved in a traffic situation towards the other, with a distance of about two metres or more (maximum 20 metres) between those involved.

The first part of the research showed that it is quite possible in a test situation to make the developed conflict observation technique reliable.

As a new conflict technique should be applicable in a wide variety of neighbourhoods, two very differently planned parts of Delft were selected. The field research carried out here was the second part of the investigation.
The applicability of the conflict observation technique proved to be good under field conditions. Nor was influence of the observers detectable upon the behaviour of the children they followed.
This research has demonstrated that with the technique developed, an amount of information can be collected within a fairly short period, which gives a good idea of what happens in a residential area.

Since the research concentrated on developing a reliable technique, little can be said at present as regards its validity, i.e. whether serious conflicts can also be suitably used to predict traffic accidents.

V.4. Subjective feeling of safety

Subjective experience of residential yards

In Enschede (in The Netherlands) an evaluation has been made of a residential yard (Slis & Keyzer, 1976).
The interviews centred on all households in the residential yard, with an equal distribution of men and women. The total response was about 90 per cent. Statistical checks showed no significant correlation in any case. On the one hand, this is due to the low cell-frequency (N=115), while on the other it is explained by the homogeneous population. This applies both to age structure and to education and occupation.
The general impression is an overall assessment of the new situation. 92 per cent of the residents had a definitely favourable opinion of the new layout. The assessments were often expressed as "nicer, more sociable, looks better, etc.". Marginal criticisms both by those in favour and those against related mainly to improper use of some parts of the residential yard. For instance: dogs fouling the playground, the "pavement" being used for cycling.
The most interesting results of the investigations are:
1. The big majority of the residents in the area believe the humps in the road are useful. In their vies, they make cars drive slower and the yard is avoided by traffic from outside. The humps are not dangerous, it is easy to drive over them and they are clearly recognisable. Detectability of obstacles could be improved at night with lighting and reflectors.
2. The question whether there is enough room for cars to drive since the new layout was answered in the affirmative by 64 per cent of the respondents; but 26 per cent thought there was too little room. It was concluded that too little room has nothing to do with the width of the lane but with the presence of physical and visual obstacles in the contour of the street.
3. The respondents were asked about road safety in these new conditions. It was remarkable that 56 per cent of them considered the situation less safe for pedestrians than it used to be. They felt they were

threatened by the moving vehicles, they were not used to "walking in the road". To a certain extent it was stressed that the functions ought to be desegregated by means of a protected pedestrian lane.

4. The way the yard was arranged was more in keeping with the children's need to play. The inverviewers asked only if the residents believed that more children played there than before. The answers, however, do not adequately indicate that more children play there: 44 per cent said Yes, 39 per cent said No.

5. The interview included questions of whether the residents themselves were prepared to plant flowers or shrubs and to look after them themselves where possible. About 40 per cent of the residents would consider planting things themselves; 75 per cent were in favour of looking after flower boxes. The younger they were, the more they were willing to look after the flower boxes. These percentages would probably the favourably influenced by selective information and guidance by the Public Parks and Gardens Department.

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TABLES

Density	Sex		Total
	boys	girls	
< 2,000	143	73	216
2,000 - 5,000	7	4	11
5,000 - 15,000	36	20	56
15,000 - 25,000	36	21	57
> 25,000	16	13	29
Total	238	131	369

Table 1. Distribution of recorded pedestrian casualties aged 0 to 15 in Rotterdam according to daily traffic density in 1971. (Source: Goos & Van der Linden, 1975).

Distance in metres (bee-line)	Age 0 to 4	5 to 9	10 to 14	Total
0 - 100	45	80	16	141
100 - 200	16	44	29	89
200 - 300	2	39	34	75
300 - 400	4	27	17	48
400 - 500	2	16	15	33
500 - 600	1	11	15	27
600 - 700	-	12	18	30
700 - 800	-	4	11	15
800 - 900	-	1	12	13
900 - 1,000	-	2	11	13
1,000 - 2,000	3	13	61	77
2,000 - 5,000	3	8	37	48
5,000 - 10,000	2	2	12	16
> 10,000	1	2	2	5
Total	79	261	290	630

Table 2. Pedestrian and cyclist accidents in the up to 15 age group in Rotterdam in 1971. (Source: Goos & Van der Linden, 1975).

City district		Number of children (inhabitants)	Average number of casualties 1973 and 1974	Number of casualties per 1000 children	Rank order
I	City Centre	7623	32	4.2	4
II	Oud-Oost	12656	45.5	3.6	6
III	Oud-West-a	20216	83	4.1	5
IV	Oud-Noord	6162	29	4.7	2
V	Watergraafsmeer	3449	18.5	5.4	1
VI	Oud-Zuid	20016	55.5	2.8	8/9
VII	Oud-West-b	12916	58	4.5	3
VIII	Nieuw-Noord	9987	16	1.6	10
IX	Nieuw-West	20331	61.5	3.0	7
X	Buitenveldert	3577	10	2.8	8/9
XI	Bijlmermeer	4604	6	1.3	11
Total		121537	415	3.4	

Table 3. Road hazards for children up to 12 in Amsterdam, 1973 and 1974. (Source: Wegman, 1975).