A PILOT STUDY FOR THE PROJECT

PEDESTRIAN SAFETY IN BUILT-UP AREAS

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with a preface by Ir. E. Asmussen, Director of SWOV

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PREFACE

At the request of the Minister of Transport and Waterways, the Institute for Road Safety Research (SWOV) put research into pedestrian safety in built-up areas on its programme.

The project was divided into three parts:

1. Research into the factors affecting pedestrian safety in built-up areas.
2. Evaluating existing measures.
3. Indicating criteria for providing various types of safety systems.

Preliminary enquiries showed that there was little unanimity among the many public works departments and police forces in Holland about the way the danger to pedestrians in built-up areas could be reduced.

At the same time, however, there proved to be a great need for more and better information so that measures could be taken with some chance of lasting success.

Accident records per city, however, were unsuitable for statistical processing either qualitatively or quantitatively.

Since the first part of the terms of reference is very general and provides scope for fundamental and applied research, it was decided to put it on the fundamental research programme.

By arrangement with the Minister, research was then limited for the time being to the second part, i.e. evaluating existing measures.

In its investigations regarding the criteria for installing zebra crossings, the SWOV decided to examine whether these investigations could be done in Amsterdam whose accident statistics are more comprehensive and more extensive than other cities'.

Firstly, however, it had to be ascertained whether the accident pattern in Amsterdam was properly representative of that in other cities.

Ten cities were selected from all over the country. After classifying and processing these comparative statistics, the SWOV concluded that research in Amsterdam could furnish results that might be applicable to other Dutch towns.

Ir. E. Asmussen

INTRODUCTION

The nature and scope of statistical research into pedestrian safety in built-up areas requires mechanical processing of the collected data. The city of Amsterdam has accident statistics which can be directly processed mechanically; this does not apply to the same extent to other cities in Holland. Moreover, Amsterdam's accident records contain more comprehensive and more extensive information than those of the others.

In order to ascertain whether the accident pattern in Amsterdam was representative of the country as a whole, ten police forces were sent questionnaires in 1967, relating to zebra crossings and pedestrian accidents.

The following summarises the results of this pilot study, with several conclusions.

RESULTS OF PILOT STUDY

It can be established from the police statistics:

1. that there is a very wide distribution in absolute and relative numbers of zebra crossings and pedestrian accidents.
2. that in most cases the numbers involved are very small.
3. that nothing is known as regards the validity of the recording method and the reliability of the resulting data.

It follows that there is little purpose in trying to establish by purely statistical means whether Amsterdam differs significantly from other cities. It is quite possible to ascertain whether Amsterdam can be used for statistica research into pedestrian safety. This is conditional upon no remarkably big or typical differences in the pattern of accidents being established as compared with that in other cities.

What is a pedestrian crossing?

A pedestrian crossing is any place where crossing by pedestrians is controlled with some regularity (in days and times). This does not include places which use only dotted lines etc. to channel road-crossing pedestrians and which have no legal implications.
Nor does it include place where, for several (rush) hours, traffic is controlled solely by means of transportable lights or by a police officer.

Pedestrian crossings can be sub-divided into a number of types:

1. Zebra crossings

The definition is the same as the legal meaning. These are crossings with zebra markings but without any other form of control. A zebra crossing at a junction with traffic lights (provided with pedestrian lights) is not a zebra crossing within the meaning of Arts. 99 and 100 of the Traffic Rules and Symbols Regulations when the lights are operating.

2. Controlled crossings

These are crossings where there is some form of light-control which is operating as such. A crossing with part-time light-control is only a controlled crossing when the lights are working.

3. Pedestrian bridges and subways

This category is disregarded for present purposes.

Pedestrian crossings

For table 1, the first comment is that Hilversum has very few pedestrian crossings (22). This means that only 5 or 6 junctions have zebra markings and 1 or 2 junctions have part-time light-control, which is very little for a city with 100,000 inhabitants.

The table furthermore shows that most crossings in Amsterdam are at junctions (99%), which corresponds to the pattern in the other cities (97%).

As regards the type of crossing, Amsterdam has a relatively small number of zebras per 10,000 inhabitants as compared with the (average) number in other cities. It must be remembered that this (average) number (7) is largely influenced by that in Rotterdam (13). The number of controlled crossings per 10,000 inhabitants in Amsterdam is found to be just as big as the average for the other towns.

It must also be pointed out that the investigations in Amsterdam covered only the area within the Ringspoorbaan (Circular Rail Route). There will obviously be more controlled crossings in this area than outside. On the other hand, crossings outside the area will mostly be zebras.

For investigations in Amsterdam this is not a drawback, because the entire city area can then be included.

The consequences of unfamiliarity with or non-uniform application of any criterion for installing a crossing can also be seen from this table.

The distribution of the number of crossings per 10,000 inhabitants (5 - 18) and the percentage of zebras (35 - 72) is so great that any general opinion based on these data must be avoided. (In view of the divergent conditions in Hilversum, the figures for that city have been disregarded).

Accidents

It is noticeable in table 2b that the rate of accidents affecting and/or caused by pedestrians at junctions in Amsterdam (63%) is higher than the average in the other towns (45%). This pattern results especially from the higher accident rate in Amsterdam on non-controlled jurdions (not having zebras either). Research into the particular behaviour of Amsterdam pedestrians is urgently needed to find out to what extent this affects the accident rate. It is also possible that the pattern has been influenced by leaving the suburbs out of account.

The rate of accidents affecting and/or caused by pedestrians on zebras at junctions in Amsterdam shows the same pattern as that in the other cities (25.5% and 25%). In the case of zebras not at junctions, Amsterdam is very favourable (0.5% compared with 6%), which may be partly due to Amsterdam having few zebras otherwise than at junctions.

The rate of accidents affecting and/or caused by pedestrians on controlled crossings is 11.5% for Amsterdam compared with 9% for the other cities, though both Amsterdam and the other cities have 6 controlled crossings per 10,000 inhabitants (table 1). The Amsterdam pattern is practically the same as that in other cities.

Apart from at junctions there are practically no accidents affecting and caused by pedestrians on controlled crossings either in Amsterdam or other cities; this is partly explained by the fact that 99% and 97% respectively of crossings are at junctions (table 1).

This applies to the same extent for controlled crossings.

As it was found that accident statistics in Eindhoven and Nijmegen did not include the number of accidents for which pedestrians were responsible (not therefore incorporated in tables 2a and 2b), the question arose of the extent to which this category of accidents influences the overal pattern.
Tables 3a and 3b were then drawn up, similarly to tables 2a and 2b, but disregarding "pedestrians causing accidents".
The most striking feature then is that in Amsterdam the accident ratio at junctions compared with non-junctions is reversed (from 63 - 37 to 47 - 53) and most accidents now occur at 'non-junctions' as in other cities. Furthermor the column "not at junctions - not during control" is more uniform than in table 2b. Accidents caused by pedestrians were primarily in the "at junctions" columns (in view of the switch in the percentages of accidents at and not at junctions), which indicates more systematic occurrence of this type of accident.
In view of this, pedestrian-caused accidents have also been disregarded below.

Table 4 sub-divides the number of pedestrian accidents and those per 100,000 inhabitants so as to show their occurrence on zebras, controlled crossings and elsewhere. Despite the fact that Amsterdam has fewer zebras per 10,000 inhabitants (3 as against 7) there are more accidents there on zebras per 100,000 inhabitants (15 to 11). At first sight this suggests that Amsterdam's zebras are not as safe as those in other cities, at least if the road-crossing behaviour of Amsterdam pedestrians is like that of pedestrians in other cities In other words, as long as nothing is known about road-crossing behaviour in all the cities, these figures mean little.
The same pattern is found for controlled crossings. In Amsterdam there are as many controlled crossings per 10,000 inhabitants (5 to 5), but more pedestrian accidents on controlled crossings happen there per 100,000 inhabitants than in the other cities (24 to 9).

It is again pointed out that in Amsterdam only the area within the Ringspoorba was investigated.

Tables 5 and 6 go into the influence of lighting conditions. The ten cities were combined for this purpose.

Table 5 showing the accident rate distribution according to lighting condition gives a slight difference for Amsterdam as regards day and night. This may be due to the difference in density of wheeled and pedestrian traffic. Amsterdam's well-known busy nightlife probably causes higher traffic densities in the evening and at night than in the other towns.

Table 6 indicates that Amsterdam has more pedestrian accidents per 100,000 inhabitants than the other cities (183 as against 126). In Amsterdam, 77% of such accidents (142 per 100,000) occur in daytime; in the other towns 82% (104 per 100,000 inhabitants). This corresponds to the figures in table 5.

As regards zebra-crossing accidents per 100,000 inhabitants it can be seen that there are fewer of these in Amsterdam than in the other towns (15 against 18), which can be explained by a small number of zebras per 10,000 inhabitants (3 against 7). On the other hand the number of zebra accidents in Amsterdam after dark (per 100,000 inhabitants) is a little high, which was also noted from the figures in table 5. Zebra accidents in daytime in Amsterdam reveal a pattern corresponding to that in the other towns, as Amsterdam also has comparatively fewer zebras.

As regards these figures, correct interpretation again requires a knowledge of the extent to which wheeled and pedestrian traffic densities in Amsterdam and the other cities correspond. In other words, the exposure factor is very important.

SOME CONCLUSIONS

Provisional and cautious conclusions for Amsterdam and ten other towns:

1. The category "pedestrians causing accidents" appears to be very subjective; it is not applied uniformly in the towns in question.
2. It will have to be examined how far the slight differences between Amsterdam and the other towns are influenced and explainable by differences in wheeled and pedestrian traffic densities, and by differences in the average number of times pedestrians cross roads.
3. To answer the question regarding the representiveness of Amsterdam for extensive statistical research it can be stated that Amsterdam only has differences of degree compared with the other cities in this country.

Table 1

Pedestrian crossings showing number, number per 10,000 inhabitants,

City	Inhabitants	Crossing	per 10^4 inhabitants	Crossings at junctions		Zebras			Controlled		
	Number	Number (I)	Number	Number	% of I	Number	% of I	per 10^4 inh.	Number	% of I	per 10^4 inh.
Apeldoorn	100.000	49	5	46	92	16	33	2	33	67	3
Breda	100.000	74	7	73	98	40	54	4	34	46	3
Delft	80.000	89	11	84	94	47	53	6	42	47	5
Den Haag	600.000	606	10	591	98	285	47	5	321	53	5
Eindhoven	180.000	253	14	241	95	94	37	5	159	63	9
Groningen	150.000	166	11	163	98	67	40	4	99	60	7
Hilversum	100.000	22	2	20	91	17	78	2	5	22	1
Nijmegen	150.000	119	8	117	98	39	33	3	80	67	5
Rotterdam	700.000	1262	18	1217	95	908	72	13	354	28	5
Zeist	50.000	34	7	33	97	12	35	2	22	65	5
Total	2.210.000	2674	12	2585	97	1525	57	7	1149	43	5
Amsterdam	616.000	467	8	463	99	161	35	3	306	65	5

City	Total accidents	at junctions (number)				not at junctions (number)			
		not during control		during control		not during control		during control	
	Number	∉	Z zebra	∉	Z controlled	∉	Z zebra	∉	Z controlled
Apeldoorn	96	9	12	2	4	67			2
Breda	141	24	4	5	17	91			
Delft	134	14	7		7	97	9		
Den Haag	1254	202	204	20	118	664	39	1	6
Groningen	262	38	27	3	27	141	26		
Hilversum	127	37	22		5	50	12	1	
Rotterdam	1865	89	702		159	769	142		4
Zeist	65	8	27		4	26			
Total		421	1005	30	341	1905	228	2	12
	3944	1797				2147			
Amsterdam		410	471	71	209	673	9	2	3
	1848	1161				687			

∉ - not on/near zebra

Z - on/near zebra

Table 2a

Number of accidents affecting and/or caused by pedestrians, showing location and whether during control, per city, in 1966 (Source: municipal police, and for Amsterdam: Statistical Office City of Amsterdam).

City	Total accidents I	at junctions (% of I)				not at junctions (% of I)			
		not during control		during control		not during control		during control	
	%	Ƶ	Z zebra	Ƶ	Z controlled	Ƶ	Z zebra	Ƶ	Z controlled
Apeldoorn	100	9	12,5	2	4	70,5			2
Breda	100	17	3	3,5	12	64,5			
Delft	100	10,5	5		5	72,5	7		
Den Haag	100	16,5	16,5	1,5	9,5	52,5	3		0,5
Groningen	100	14,5	10,5	1	10,5	53,5	10		
Hilversum	100	29	17,5		4	39,5	9	1	
Rotterdam	100	5	37,5		8,5	41,5	7,5		
Zeist	100	12,5	41,5		6	40			
Average		11	25	1	9	48	6	-	-
	100	46				54			
Amsterdam		22	25,5	4	11,5	36,5	0,5	-	-
	100	63				37			

Ƶ - not on/near zebra

Z - on/near zebra

Table 2b

Accidents affecting and/or caused by pedestrians as a percentage of total number of accidents affecting and/or caused by pedestrians, showing location and whether during control, per city, in 1966 (Source: municipal police, and for Amsterdam: Statistical Office City of Amsterdam).

City	Total accident	at junctions (number)				not at junctions (number)			
		not during control		during control		not during control		during control	
	Number	∠	zebra Z	∠	controlled Z	∠	zebra Z	∠	controlled Z
Apeldoorn	49	5	2	2	2	37			1
Breda	119	19	1	3	8	88			
Delft	110	10	6		7	79	8		
Den Haag	939	165	95	16	64	576	17	1	5
Eindhoven	147	14	12		15	103		3	
Groningen	192	26	9	2	14	132	8	1	
Hilversum	95	36	4		3	49	2	1	
Nijmegen	104	7	5		9	82	1		
Rotterdam	1076	70	205		69	689	40		3
Zeist	42	8	4		4	26			
Total		360	343	23	195	1861	76	6	9
	2873	921				1952			
Amsterdam		301	89	49	88	608	2	2	2
	1141	527				614			

∠ - not on/near zebra

Z - on/near zebra

Table 3a

Number of pedestrian accidents, showing location and whether during control, per city, in 1966 (Source: municipal police, and for Amsterdam: Statistical Office City of Amsterdam).

City	Total accidents I	at junctions (% of I)				not at junctions (% of I)			
		not during control		during control		not during control		during control	
	%	∠	zebra Z	∠	controlled Z	∠	zebra Z	∠	controlled Z
Apeldoorn	100	10	5	5	5	75			
Breda	100	16		3	7	74			
Delft	100	9	6		6	72	7		
Den Haag	100	18	10	2	7	61	2		
Eindhoven	100	10	9		10	70		1	
Groningen	100	14	4	1	7	70	4		
Hilversum	100	38	4		3	52	2	1	
Nijmegen	100	6	4		9	80	1		
Rotterdam	100	7	19		6	64	4		
Zeist	100	19	10		9	62			
Average		15	7	1	7	68	2	-	-
	100	30				70			
Amsterdam		26	8	5	8	53	-	-	-
	100	47				53			

∠ - not on/near zebra

Z - on/near zebra

Table 3b

Pedestrian accidents as a percentage of total number of pedestrian accidents, showing location and whether during control, per city, in 1966 (Source: municipal police, and for Amsterdam: Statistical Office City of Amsterdam).

City	Total accidents		on zebra		on controlled crossing		elsewhere	
	number	per 10^5 inhab.	number	per 10^5 inhab.	number	per 10^5 inhab.	number	per 10^5 inhab.
Apeldoorn	49	49	2	2	5	5	42	42
Breda	119	119	1	1	11	11	107	107
Delft	110	138	14	18	7	9	89	111
Den Haag	939	157	112	19	86	14	741	124
Eindhoven	147	82	12	7	18	10	117	65
Groningen	192	127	17	11	17	11	158	105
Hilversum	95	95	6	6	4	4	85	85
Nijmegen	104	70	6	4	9	6	89	60
Rotterdam	1076	153	245	35	72	10	759	108
Zeist	42	84	4	8	4	8	34	68
Total	2873		419		233		2221	
Average		108		11		9		88
Amsterdam	1141	191	91	15	141	24	909	152

Table 4

Pedestrian accidents in number and per 100,000 inhabitants according to type of crossing or elsewhere, per city, in 1966 (Source: municipal police, and for Amsterdam: Statistical Office of City of Amsterdam).

City	Total accidents		Daytime		Dusk		After dark	
	Number	%	Number	%	Number	%	Number	%
10 cities	2873	100	2286	80	95	3	492	17
Amsterdam	1141	100	853	76	43	3	245	21

Table 5

Numbers and percentages of pedestrian accidents, showing lighting conditions, in 1966 (Source: municipal police, and for Amsterdam: Statistical Office City of Amsterdam).

City	All accidents						Accidents on zebras					
	daytime		after dark		total		daytime		after dark		total	
	number	per 10^5 inhabitants	number	per 10^5 inhabitants	number	per 10^5 inhabitants	number	per 10^5 inhabitants	number	per 10^5 inhabitants	number	per 10^5 inhabitants
10 cities	2286	104	492	22	2278	126	292	13	116	5	408	18
Amsterdam	853	142	245	41	1098	183	55	9	34	6	89	15

Table 6

Pedestrian accidents in number and per 100,000 inhabitants and those for one type of crossing (zebra), showing lighting conditions, in 1966 (Source: municipal police, and for Amsterdam: Statistical Office City of Amsterdam).