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VRU-TOO

Vulnerable Road User Traffic Observation and Optimization

DRIVE II Project V2005
Deliverable 12
Workpackage PP2

Assessment of the Effectiveness of the Portuguese Implementation

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EXECUTIVE SUMMARY

The work of VRU-TOO is targeted specifically at the application of ATT for the reduction of risk and the improvement of comfort for vulnerable road users, namely pedestrians. To achieve this, the project has combined pilot implementations in three countries (UK, Greece and Portugal) with behavioural studies and the development of computer simulation techniques. At the same time the pilot implementations have been co-ordinated with local and national policy priorities.

This deliverable presents the results from a trial that was carried out on a major arterial road just outside the central area of Porto, Portugal. The objective of the trial was to show that it was possible to improve the safety and mobility of pedestrians at a junction and crossing facility which was situated adjacent to a large school by intelligent manipulation of the signal settings.

Pedestrian detectors were attached to the traffic signals in order to detect pedestrians as they approached the crossing point. As a result of this detection, in certain circumstances, the signal cycle would be advanced so as to reduce the time until the signals would change to present the pedestrian with an opportunity to cross the road. The detectors would also allow the green time for pedestrians to be extended if there was sufficient demand, allowing safer and more comfortable crossing periods. Finally the pedestrian green time could also be reduced in order to avoid wasted time, if there was no pedestrian demand, thus allowing a more optimised functioning of the junction.

In order to evaluate the effectiveness of this treatment an extensive "before and after" analysis was carried out to determine the changes in safety and mobility, especially for child pedestrians.

The evaluation of the trial was carried out by using the data collected to assess whether the pre-specified objectives have been achieved. The implications of the results are then discussed as well as their implication to the more general installation of such measures in the Portuguese context.

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1 INTRODUCTION

1.1 GENERAL BACKGROUND

The overall objective of the VRU-TOO project is to examine how the safety and mobility of pedestrians can be enhanced at signalised locations in urban areas. In order to accomplish this the project has adopted a three pronged approach.

a) Computer Modelling: The development of a meso-model (VULCAN 2) which will predict the changes in route choice (and subsequently safety levels) to be achieved by changes in the pedestrian facilities available.
b) Behavioural Studies: The formulation of standardised rules which will provide a greater understanding of the factors that affect the safety of pedestrians when crossing the road by creating detailed rules for the norma; (safe) and abnormal (unsafe)interaction of pedestrians and vehicles.
c)Pilot Project: The implementation of pre-arrival pedestrian detection systems to improve the safety and reduce the delay of pedestrians who wish to cross main roads controlled by signals in urban areas in three European countries.

This report gives full details of the pilot trial that was carried out in Porto, it gives details of the equipment used as well as the philosophy behind the trial. It explains how the pedestrian detection system was utilised within the existing junction control system and it also provides a full assessment of the results of a detailed "before" and "after" study to evaluate the results of the trial and determine whether the objectives, which were formulated before the trial, had been achieved.

Following this, the report also assesses the results and their implications for longer term and more comprehensive usage of the methodologies introduced by this trial.

1.2 OVERVIEW OF TRIAL

The safety and comfort of pedestrians using signalised crossings poses difficulties for local highway engineers in scheme design and the methods by which optimisation techniques can be used to maximise efficiency. From the point of view of pedestrians, they would like to have immediate priority over vehicular traffic, when they reach the crossing point, and ample time to cross in safety. These objectives can also be swayed by the age of the pedestrians; the young, and especially relevant in this trial, schoolchildren, tend to be impatient and do not like to wait for a significant time. The elderly however tend to be more appreciative of being allowed a longer safe crossing time. However considerations of street capacity for vehicle movements, especially when the road is a part of a city's principal road network, also needs priority and these two objectives are in conflict. It is therefore of great interest to Highway Authorities in urban areas to improve the solving of this type of problem and to develop ways in which the timings can reflect actual need in a real time environment.

In practise, at the present time this conflict is usually resolved at the expense of pedestrians and even at the locations where they are given the ability to call a pedestrian phase, usually by pressing buttons, the time allowance can be less than ideal. The weak link in this chain is that a specific action, pressing a button, is required by a pedestrian before they are allocated any formal priority at a crossing. There is also the constraint that the timings given for pedestrians, both in the frequency and length, is fixed and cannot be altered in a real time situation to respond to fluctuations in the number of pedestrians wishing to use the particular crossing point. These factors are in contrast to the ways commonly employed to cater for vehicular needs.

The use of microwave technology to detect pedestrians as utilised in this trial has the potential to solve some of these problems and thus provide safer and more comfortable conditions for crossing. In particular the Porto trial had two main attributes, in common with other trials, to help achieve this.

1) Advanced detection of pedestrians as they approach the crossing point and the subsequent activation of pedestrian demand

2) The increase of pedestrian green when there is the need for it; in this case when pedestrians are still arriving at the crossing point.

In addition this new type of real time detection was also used to improve the global functioning of the junction by allowing the pedestrian crossing periods to be reduced if there was no demand.

The characteristics of the system being used are summarised in Table 1.1. It should be noted that in terms of functionality, as proposed in Project V2056 (Cord Consortium, 1993), the application would come under F3.2 (SF3.2.1 & SF3.2.3). In terms of potential, the pedestrian detection techniques may be also used in traffic demand management schemes, etc.

TABLE 1.1: SYSTEM OVERVIEW

TEST SITE	SYSTEM	SYSTEM OBJECTIVES	FUNCTIONALITY	MAJOR TECHNOLOGY	COMMENTS
Urban signals, with pedestrian facilities, outside school in Porto, Portugal	**Microwave Detectors**	**Reduced pedestrian delay Increased pedestrian safety No increase in vehicle queue lengths No increase in vehicle journey times**	**Pre-arrival pedestrian detection**	**Microwave Technology used to detect pedestrians**	**Real Time response to pedestrian demand as they approach the crossing**

1.3 COMPARABILITY

This trial was one of three distinct trials that were carried out as part of the pilot project workarea of the overall project. Whilst all three of the trials were completely separate and will be evaluated as such, they did have common features in that:

a) They are situated in urban areas and on major roads.

b) The junctions are signalised and do have specific facilities for pedestrians.

c) The existing layouts are fairly typical of the individual country's approach to signalisation and they employ signal equipment that is in common use.

d) The signals have all been equipped with the same microwave detectors which will detect approaching pedestrians.

e) The information from these detectors is used to amend the signal timings.

This report only considers the details of one trial, Porto. However the project has ensured that common methodologies are employed throughout the project so that it will be possible to identify common results between the trials in the different countries.

2 EVALUATION AND OBJECTIVES OF TRIAL

2.1 THE DECISION CONTEXT

The aim of carrying out such a trial is to show that the use of pedestrian detection equipment can be integrated with the existing signal equipment and used to improve local conditions for pedestrians without a significant worsening for drivers. If this can be achieved then it obviously opens up the opportunities for both City and National Highway Authorities to utilise it within their approved technologies. In many countries within Europe it is being accepted that vehicle usage cannot be allowed to be dominant in a way previously accepted. However, the techniques that are presently available to respond in an intelligent way to the demands of other road users are at present very limited. It is hoped that this technology will provide a means to improve the opportunities open for pedestrians.

2.2 SPECIFIED OBJECTIVES

As has been mentioned in the introduction the generalised objectives of this trial are to improve the safety and mobility of pedestrians, especially school children at a specified location. The way of describing these objectives and the way in which the success or otherwise of the trial was specified well in advance of the trial being carried out.

The generalised assessment objectives are summarised in Table 2.1. Whilst in this instance the decision maker has been identified as the City Authorities, it is understood that in many instances it will be necessary to have National acceptance before widespread applications can be installed.

TABLE 2.1 ASSESSMENT OBJECTIVES

Decision Maker	Objective Category	Objective	Evaluation Category
City Municipality	Pedestrian Efficiency	Reduce waiting time for pedestrians	Technical Assessment
	Vehicle Efficiency	No increase in vehicle queues	Technical Assessment
	Safety	Increased safety for pedestrians	Technical Assessment

2.3 INTENDED IMPACTS AND IMPACTS ASSESSED

The potential impacts that need to assessed whilst for the installation of the detectors are:

Cost and Compatibility: The additional cost of installing pedestrian detection, both from the view of the actual cost of the detectors themselves and the cost of integrating them with the existing signals.

Travel Time: It is important that the travel time of **all** road users should be taken into account. Whilst the aim is to reduce times for pedestrians, knowledge needs to be gained as to how this will affect vehicle travel times. In the work of this trial, no separate costings have been allocated to the delays of the various road user groups, since it was felt that since all the road users should be treated equally it is not necessary to replace actual delay as a factor.

Safety: It is not possible to assess changes in safety by means of actual accident levels because the time scale is too short; therefore the use of other collectable proxies, such as conflicts and red light violations have been used.

These intended impacts are summarised in Table 2.2:

TABLE 2.2: INTENDED IMPACTS ON USERS

IMPACT TARGET	Journey Time	Safety	Environmental Pollution	Economic	Acceptability	Comfort	Behaviour
DRIVER	0	0	0	0	0	0	0
PEDESTRIAN	+	++	0	0	+	+	+
CITY MUNICIPALITY	+	++	+	0	+	+	+

(Key: 0 No change
+ Slight benefit
++ Significant benefit)

2.4 INDICATORS SELECTED

This report is concerned with the technical and operational performance of the system. In order to assess this the indicators as given in Table 2.3 have been used.

TABLE 2.3: INDICATORS SELECTED

OBJECTIVE AREA	OBJECTIVE	INDICATOR
Pedestrian Movement Efficiency	Reduce pedestrian delay when crossing road	Waiting Time at Kerb
Pedestrian Safety	Increase pedestrian safety	Conflicts between vehicles and pedestrians Red Light Violations
Traffic Movement Efficiency	No increase in traffic delays	Vehicular queue lengths Journey times

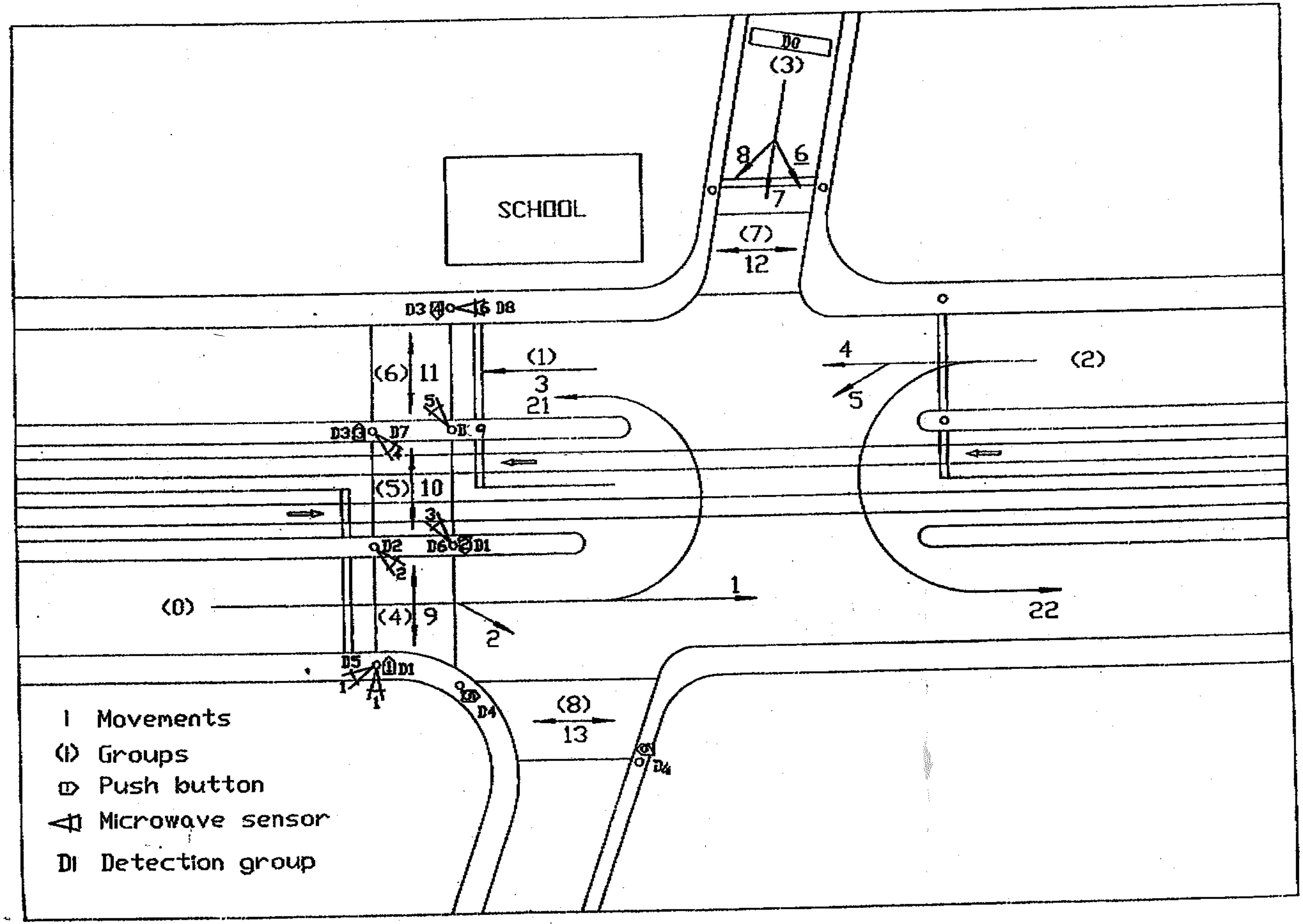


Fig 2: Junction Geometry.

3 DESCRIPTION OF ATT IN TRIAL

3.1 DESCRIPTION OF SITE

Figure 1 shows the location of the site with respect to the city of Porto. As can be clearly seen from this plan the location is on a major route which joins the city of Porto with the coastal industrial areas as well as some residential areas. For further details regarding the details of the city see Seco and Da Costa (1992). Figure 2 shows a schematic of the junction together with both the permitted traffic and pedestrian movements.

The site chosen in Porto is basically a signalised crossroads on a dual carriageway on the outskirts of the Porto central area. It is complicated by the fact that there is a school on one side of the junction with its main vehicle and pedestrian entrance adjacent to the pedestrian crossing facility across the main road. There are heavy traffic flows along the main road for nearly all the day and this is exacerbated at those times of the day when school children are entering or leaving the school. The road is also used as a regular bus route and there are trams running down the middle of the main road through the junction.

For all Portuguese sites in urban areas the responsibility for signal installations belongs to the relevant City Council. In the current implementation therefore, the responsibility rested with the Porto Municipality.

3.2 DESCRIPTION OF PEDESTRIAN DETECTORS

The pedestrian detectors used in this trial were supplied by Microsense (UK) and are of the type that were described in a previous deliverable (Sherborne,1992). Seven detectors were used and were installed in the positions shown in Figure 2 and connected to the controller. The detectors had been suitably modified by the manufacturers so that they can be used to detect the lower approach speeds of pedestrians.

3.3 DESCRIPTION OF SIGNAL CONTROL SYSTEMS

System Description

The system used throughout the trial at the junction consists of:

A signal controller SFIM Traffic Transport- type CASTOR EUROPE - 8000 Series, which uses microprocessor technology and is capable of dealing with up to 16 traffic lights groups and up to 15 separated input channels;

The microwave detectors were supplied by Microsense in accordance with the specification given in Sherborne (1992). The detectors were attached to the signal poles and thus connected directly to the controller.

The operation of signals is performed by resident software specific to the controller.

3.3.1 The Initial Situation (The "Before/Before" Situation)

As has already been explained before the selected experimental junction was already controlled by traffic signals. But, although the system incorporated in its logic, information collected with pedestrian push buttons, during the feasibility investigation it was found that the system was only working with a simple three stages signals setting where the green time allocated to the side road (Rua das Campinas) could only vary depending on the information collected by a car detector placed 10 metres back from its stop line.

Figure 3 shows the stages and range of timings used.

As can be seen in the Figure, although there is a pedestrian stage (stage B), it is so short (8 seconds) that it is not possible to cross the major road towards the school with a green light in just one cycle, thus forcing pedestrians to either experience extremely long delays or to take the chance of crossing part of the road with red. It should also be noted that the variability of the duration of stage C resulting from the utilisation of the real time information collected by the minor road vehicle detection is automatically compensated with a change in the duration of Stage A so that the cycle remains constant at 80 seconds.

Since the main aim of the pilot experiment was to improve the pedestrian crossing conditions (in terms of delays and safety), particularly of the main road, using "high-tech" solutions and since it was concluded that the existing situation could be significantly improved with straight forward existing state-of-the-art solutions, it was decided to implement a new, "low-tech" solution which could then be used as the "Before" situation in our study. This would in principle allow a better evaluation of the real impact of the "high-tech" solutions.

3.3.2 - The "Before" Situation

The selection of the new "low-tech" solution was done taking in to consideration three basic objectives:

1) The solution should have such characteristics that the future introduction of the "high-tech" features could be made with very limited changes to the infrastructure and the signal settings;

2) The logic of the program should take special care of the needs of pedestrians willing to cross the major road (e.g. enabling them to cross all the major road in one at movement at some point of the cycle irrespective of the direction of the movement) and making usage of information provided by the push buttons (later on however it was decided that because of the limited amount of time available between this and the previous phase, to let pedestrians adjust to the new need to press the push buttons, made it advisable to continue to ignore the information from the push button)

3) The overall vehicle capacity provided to the junction should still be enough to avoid congestion problems and only minor increases in vehicle delays would be acceptable.

The geometric layout and coding of the movements at the junction can be observed in Figure 4.

The main points which were altered in this new "before" situation have all been done in keeping with the overall objectives of the project. The following summary details these alterations:

a) The signal cycle varies between 80 and 96 seconds depending on the detections made by the minor road vehicle detector (D0);

b) A pedestrian wishing to cross the main road will always have a period in the cycle when she/he will be able to do it in one go;

c) The first side road vehicles in a queue will always face a red light when turning right into the main road;

d) The pedestrian signal (8) will only open during the cycle if there is a call through the push buttons. If, when there is a call, the cycle is in either Stage 1 or Stage 2 the pedestrian green light will come on 3/4 seconds after the push-button is pressed;

e) The pedestrian signal (7) is not connected to any push-button or sensor and will always come on during stages 1 and 2;

f) There is always an off-set of 4 seconds between the closure of the traffic light groups (2) and (1), which is greater than it would normally be, in order to guarantee that no vehicle doing movement [4] (see Figure 2), going straight on, is stopped at traffic signal (1) even if there are some vehicles entering the school and thus disturbing the normal flow of traffic;

g) The all red period between the closure of the traffic light group (2) and the opening of (3) was extended from the 1 second needed for safety reasons to 3 seconds in order to allow safe U-turns performed by vehicles approaching from the west and wishing to enter the school precinct;

h) The pedestrians crossing the full extent of the main road have a total of 20 seconds to do so (14 seconds of green + 3 seconds of flashing green + 3 seconds of all red). They have 12 seconds to cross the critical carriageway nearer to the school which is controlled by the traffic light group (6) (6 seconds of green + 3 seconds of flashing green + 3 seconds of all red);

i) The vehicles from the side road have a minimum of eighteen and a maximum of thirty two seconds of green (the highest values are to deal with extremely concentrated and short peaks occurring at the end of school periods). Normally there will be 48 seconds of green for the traffic lights group (0) and 53 seconds for (2).

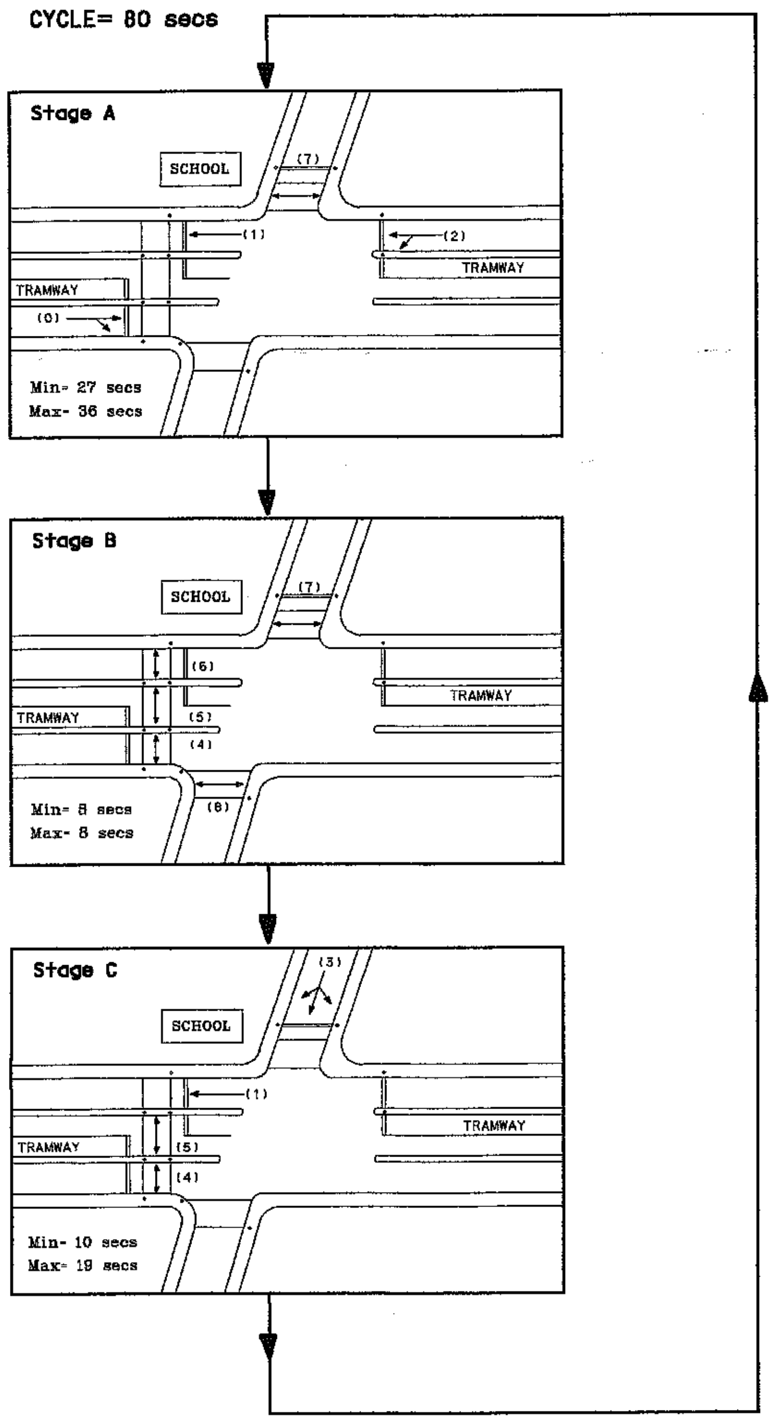


FIG. 3 - Signal Settings - The "Before - Before" Situation

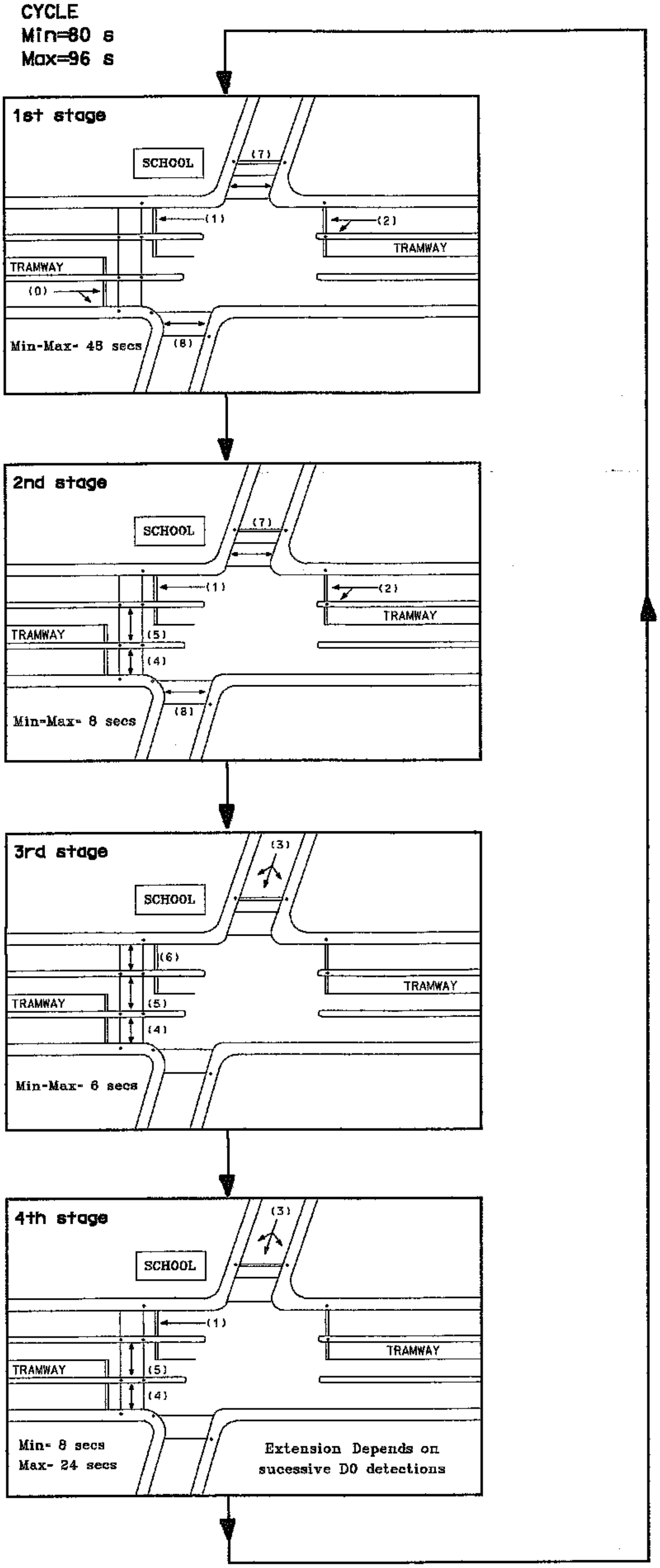


FIG. 4 - Signal Settings - The "Before" Situation

3.4 INTEGRATION OF SYSTEMS

The microwave detection system for pedestrians was fully coordinated with the existing signals at the junction.

3.4.1 The Objectives and Methodologies

The introduction of microwave detectors was selected since it enabled an increase of the junction micro regulation by allowing the improved knowledge about pedestrian behaviour to be taken into consideration. In any alteration of this type the main objective will be to reduce the average pedestrian expected delay time and improve their convenience in a way that will not only enable a reduction of the real pedestrian delay, but will also enable an increase in pedestrian safety by inducing them to behave in a more "proper" manner. A minor, but nevertheless important secondary objective, will always be to introduce this type of solution with a minimum cost (in terms of extra delays or congestion) for vehicles.

A few methodological approaches can, in principle, be used to fulfil the two previously presented objectives which could be interpreted as being intrinsically contradictory. These methodologies and possible strategies which enable both objectives to be achieved are described below:

To change the priority given to pedestrians (basically in terms of percentage of green time allocated in the cycle) in accordance to the relative importance of pedestrian and car movements. This can be done by directly or indirectly using the detector devices to evaluate the respective flows and then distributing the green periods using some kind of proportional rule;

To increase the time period during which pedestrian demand can be called within a cycle. Basically this can be done using automatic remote detection techniques which might or might not have to be confirmed by push button inputs, so that some information about the approach of pedestrians wishing to cross can be given to the controlling program and thus be used to extend the time window available for the pedestrian stage.

To increase the "safe" crossing periods when either a slow moving or a "late comer" pedestrian is detected crossing the junction in the latest moments of the normal green period. The remote detection by the sensors will enable pedestrians to be followed (in the present situations by pointing the detectors to the middle of the road and to the approaching path respectively) and thus the logic of the programme can be prepared to protect the pedestrians in the more vulnerable situations.

To increase the length of the crossing periods when a large number of pedestrians are trying to cross a junction. A counting procedure within the controller can be used to enable the program to take into consideration the special needs of big pedestrian groups in terms of additional crossing time;

To annul the need for pedestrians to positively express their desire to cross. This can eventually be achieved by adopting remote detection techniques (if one could be sure that all the pedestrians can be adequately detected and followed there would be no need to ask them to actively inform the system of their willingness to cross; this would have the obvious advantage of overcoming the generally poor understanding pedestrians have of push buttons; unfortunately no system is perfect yet so if no push buttons are used, missed detections cannot be corrected and mistaken ones will not be identified because no confirmation by push button will be asked for);

To reduce or eliminate unused pedestrian green periods occurring because the initially detected demand no longer exists. This might be done by continuing to follow the pedestrians after their detection and until they start crossing the roads.

The selection and combination of some or all of the above described possible solutions has to be made on a case by case base because of the very different layout characteristics and functioning of each crossing.

3.5 THE IMPLEMENTATION

In the current experiment three main strategies were selected to be used:

1) To increase the pedestrian share of green (by anticipating the pedestrian green stage) when a certain threshold of demand was reached in order to obtain a more balanced weighting of the importance of the modes. Two different parameters could be chosen from: number of pedestrians and occupancy rates. Since both were methodologically acceptable it was decided to use occupancy because its measurement was more reliable. In the selection of the threshold value to be used consideration had to be given to detections of non-crossing pedestrians. A value of 30% of occupancy was selected after a field evaluation;

2) To use extended pedestrian green periods to allow the safe crossing by late comers; these pedestrians can be detected using the microwave detectors directed to the approaches of the crossings in the middle of the dual carriageway and taking into consideration the times when these detections occur within the later stages of the pedestrian green periods. The fact that there are trams running in the middle of the carriageway was not a problem, because the logic of the program meant that detections were only registered in periods during which there were no trams crossing the detection area. So possible false detections due to them being registered by the system do not have any influence on the operation of the controller;

3) To reduce the pedestrian green periods when no crossing movement was observed in the early stages of the pedestrian green periods so that the wasted green time was minimum; the technique used can only detect moving pedestrians so only the lack of detections in those early stages could be used to verify the absence of pedestrians willing to cross in the green period.

The logic behind the signal settings is illustrated in Figure 5.

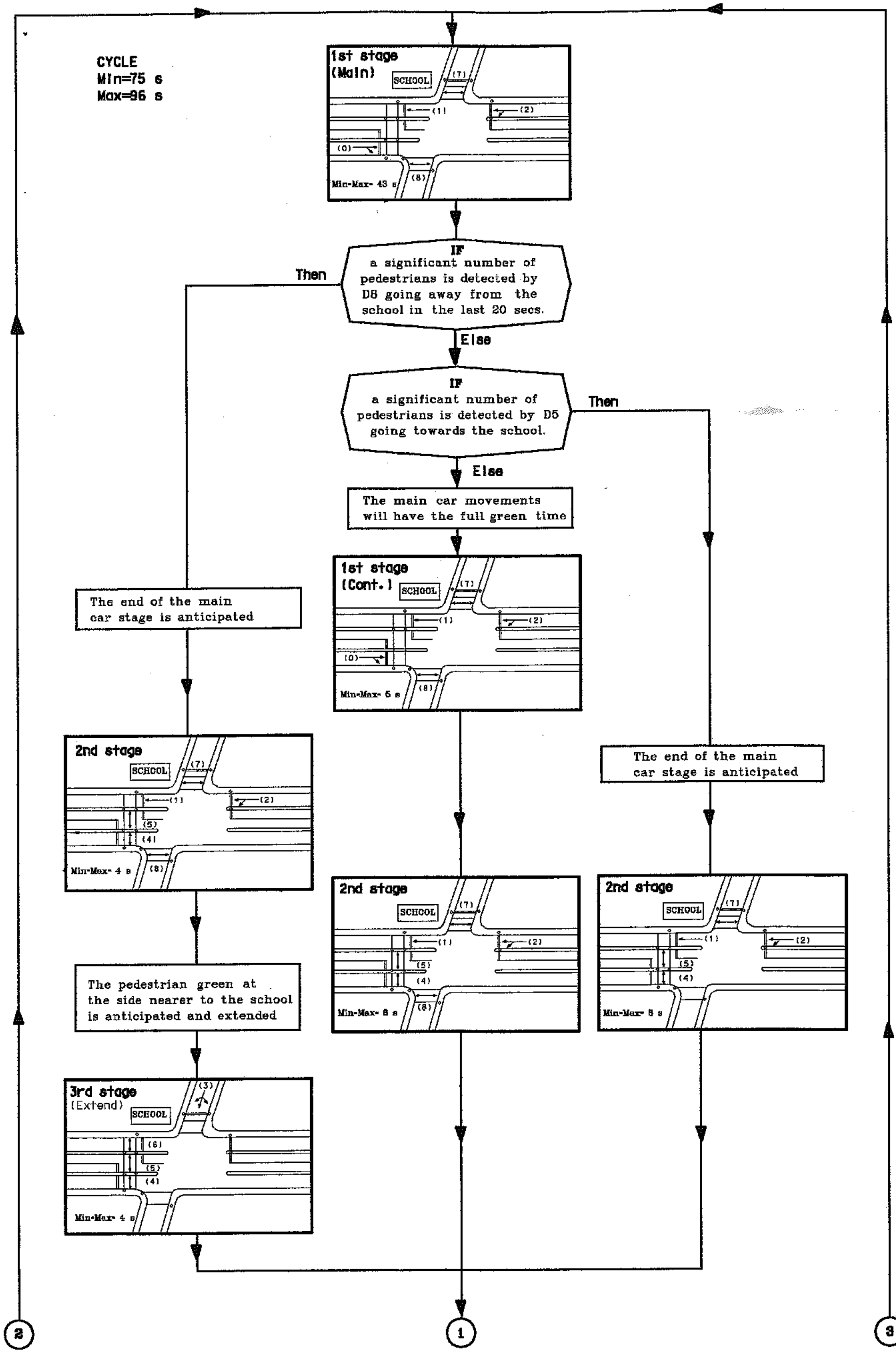


FIG. 5 - Signal Settings - The "After" Situation

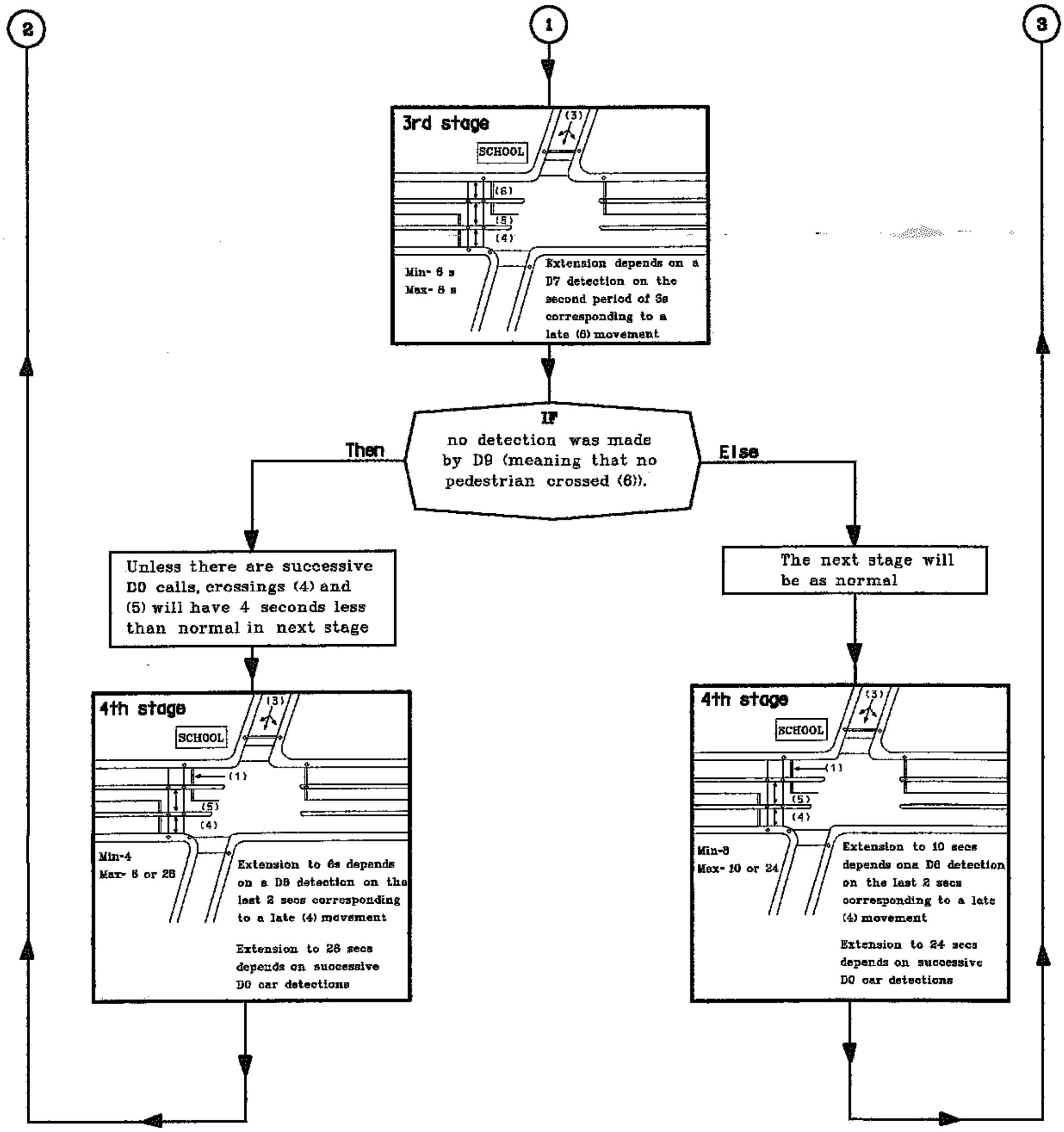


FIG. 5 - (Continuation) - Signal Settings - The "After" situation

The points presented before to explain the detailed functioning of the junction during the "before" period in 3.3.2 are generally applicable to the "after" situation. However the following specific points are particularly relevant to the way in which the trial has been prepared.

a) The cycle continues to vary between 75 and 96 seconds depending on the detections made by the minor road vehicle detector (D0) and pedestrian detectors (D5) and (D8);

b) The pedestrians crossing the full width of the main road now have a maximum of 24 seconds to do so (18 seconds of green + 3 seconds of flashing green + 3 seconds of all red) corresponding to the situation with all the extensions due to "late" comers being used; if there have been no extensions, the total time will be reduced to 20 seconds;

c) The vehicles from the side road continue to have a minimum of 16 and a maximum of 32 seconds of green and traffic light groups (0) and (2) will usually have 48 and 53 seconds respectively.

4 RESULTS

As specified in Section 2 the various aspects of the trial were evaluated on a "before" and "after" basis. As previously covered the major impacts that were to be evaluated included journey times, safety and comfort. It was also necessary to relate this evaluation to the other conditions appertaining to the site. This was so that it would be possible to accurately state that changes in the situation and in particular to any of the impacts had been caused by the implementation and not by other external conditions. The main factors that were monitored in this way were traffic flows and movements (both pedestrian and vehicles). In addition the normative behaviour of the pedestrians approaching and using the crossing facilities was monitored (more details about normative behaviour are given in Rothengatter et al. (1995)).

4.1 TRAFFIC FLOWS

Pedestrian and vehicle flows were collected over five hourly periods in both the "before" and "after" periods: 1 hour per day during 5 days, each day a different hour as follows:

Time Period	**Before**	**After**
0800-0900	19.10.93	11.02.94
0900-1000	18.10.93	09.02.94
1200-1300	15.10.93	08.02.94
1700-1800	13.10.93	07.02.94
1800-1900	14.10.93	10.02.94

<u>Pedestrians</u>
All pedestrian flows measured during the "before" and "after" periods are presented in Annexe I. A summary of the major pedestrian movements are given in Table 4.1; the directions of travel are thus shown in Figure 6. These results show that in the "after" period there was a small reduction in most of the individual pedestrian flows, but overall there was very little change in the mean pedestrian flows across the carriageway. It can also be clearly seen that there is a very high 5 minute peak associated with children leaving the school (movement 5), this is related to the starting/finishing time of school classes. In comparison there is no similar peak associated with entering the school.

<u>Vehicles</u>
All vehicle flows measured during the "before" and "after" periods are presented in Annexe II. A summary of the major vehicular movements on the main road are shown in Table 4.2. These figures show that although there were considerable fluctuations in the "minor" manoeuvres, but was little overall change in the number of vehicles which went across the crossing. On the side nearest the school there was a decrease of 7% and away from the school a reduction of 4%. Despite this there were still, on average, over 2000 vehicles per hour going through the site on the main road. It is also relevant to notice that the major road vehicle flows are nearly constant during all the observation periods (See as an example the volume profiles for vehicles going across the crossing [movements 1,2 and 21] shown in Figure 8).

TABLE 4.1 - PEDESTRIAN FLOW

After / Before	Movements						
	2	4	5	Total	7	8	Total
mean flow (ped/h) — After	22	31	81	134	29	60	89
mean flow (ped/h) — Before	36	34	67	137	32	68	100
max 5 min peak (ped/5min) — After	6	8	119		17	17	
max 5 min peak (ped/5min) — Before	13	10	97		20	18	

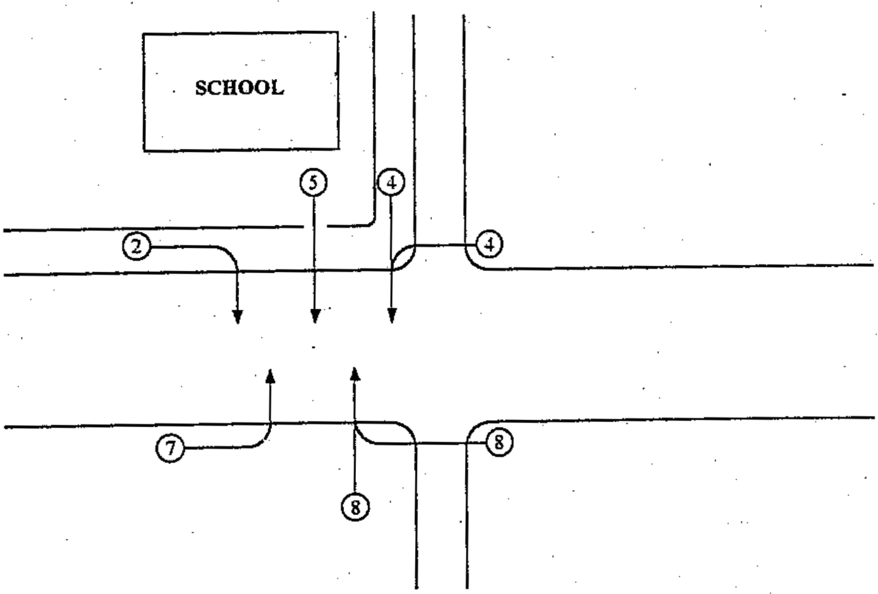


FIG. 6 - CROSSING PEDESTRIAN MOVEMENTS

FIG. 7 - PEDESTRIAN MOVEMENT 5 PROFILE

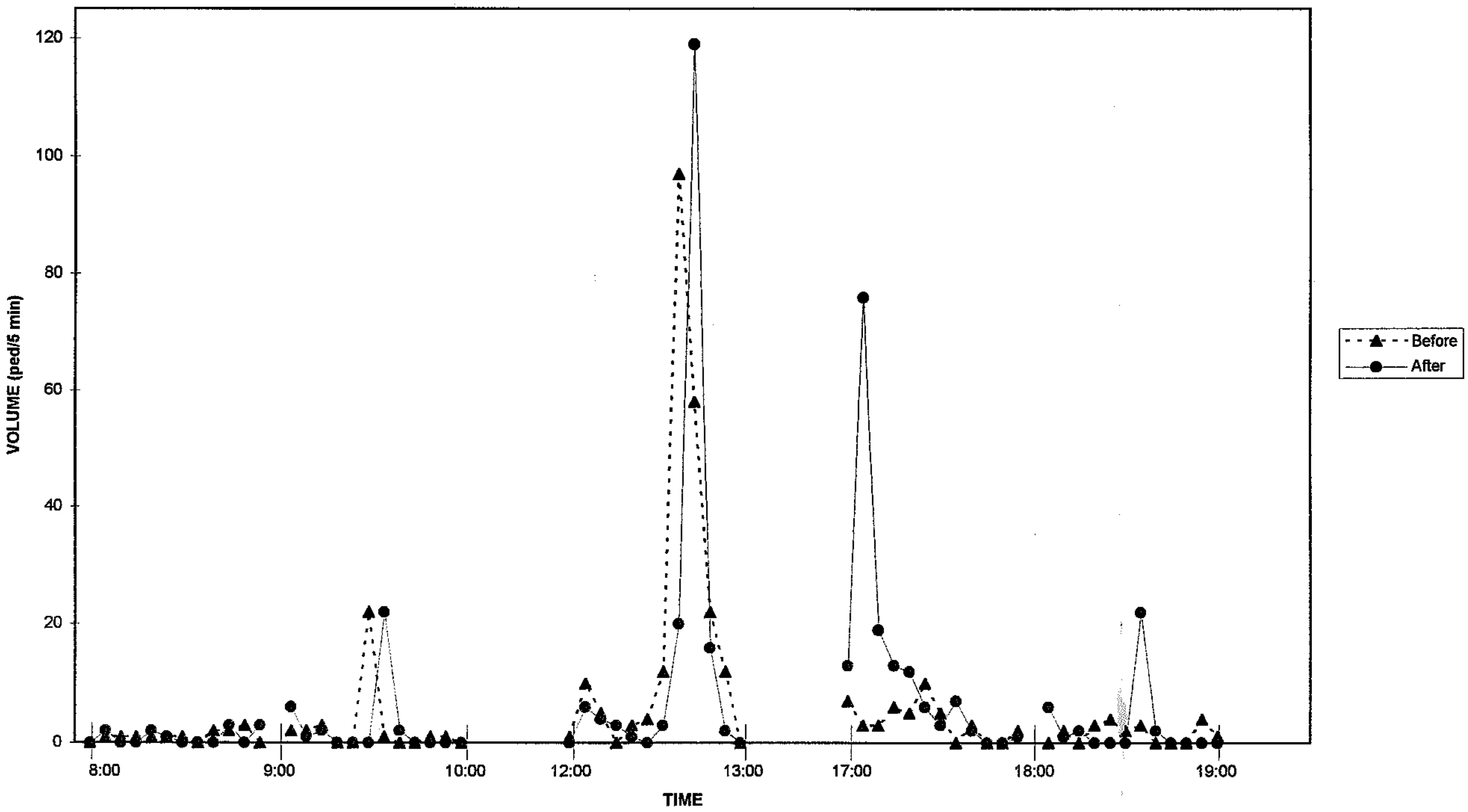


TABLE 4.2 - SUMMARY OF PORTO VEHICLE MOVEMENT DATA

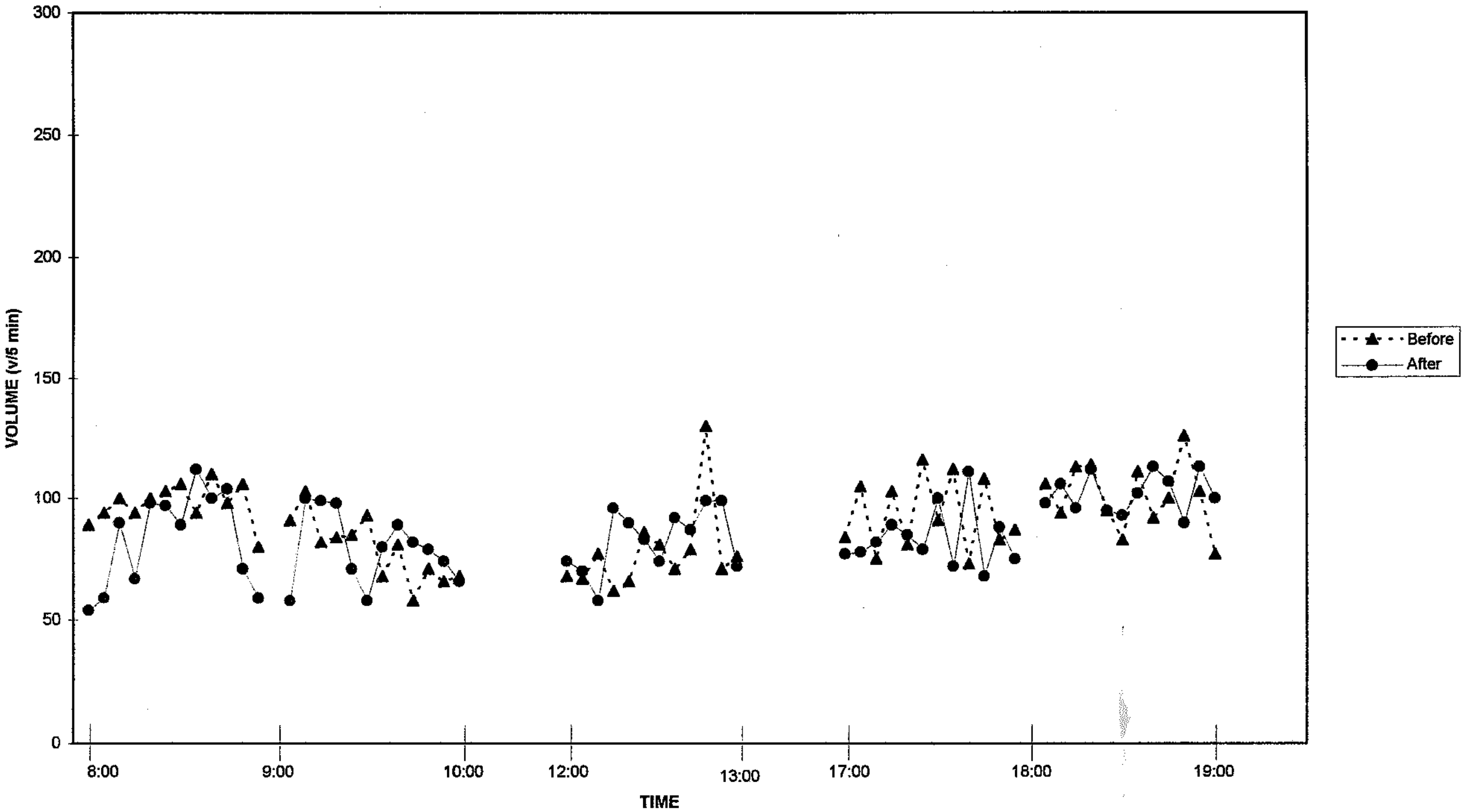
BEFORE

Movements / Time	Vehicles								
	1	2	21	4	5	22	7	8	6
08:00-09:00	1053	57	61	1005	184	19	251	246	293
09:00-10:00	898	35	17	896	245	29	172	176	219
12:00-13:00	870	52	12	1045	272	39	153	162	160
17:00-18:00	1062	39	17	1068	203	33	175	161	186
18:00-19:00	1144	65	5	1024	214	8	257	177	240
Mean Volume	1005	50	22	1008	224	26	202	184	220

AFTER

Movements / Time	Vehicles								
	1	2	21	4	5	22	7	8	6
08:00-09:00	918	38	44	814	30	6	120	199	307
09:00-10:00	911	26	17	885	30	5	136	178	243
12:00-13:00	935	35	24	994	37	8	108	136	187
17:00-18:00	959	27	18	996	34	4	153	135	199
18:00-19:00	1182	39	4	997	58	1	196	167	293
Mean Volume	981	33	21	937	38	5	143	163	246
Variation (Bef.-Aft.)	-2%	-33%	-4%	-7%	-83%	-81%	-29%	-12%	12%

FIG. 8 - VEHICLE MOVEMENTS 1, 2 AND 21 PROFILE



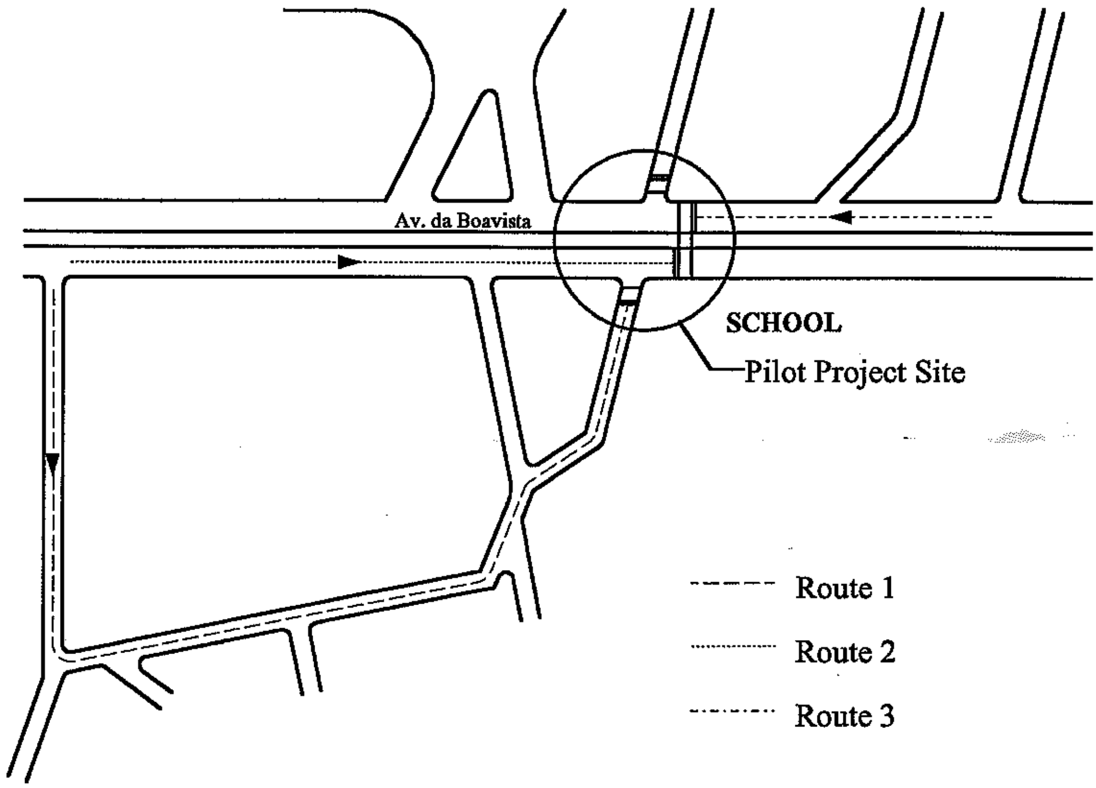


FIG. 9 - ROUTES FOR TRAVEL TIME DATA

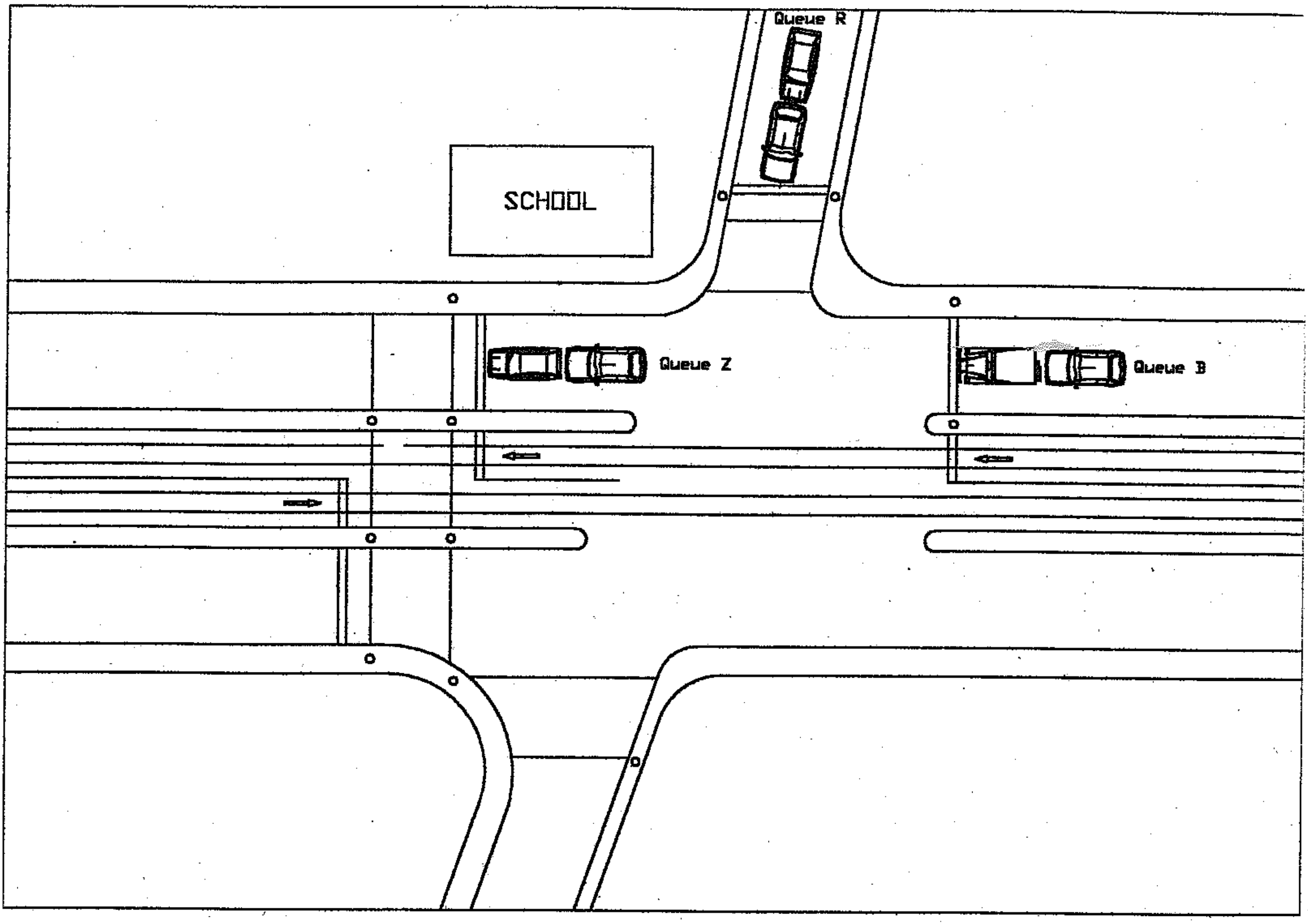


FIG. 10 - QUEUES

TABLE 4.4 - MEAN VEHICLE DELAY

Before \ After	Queue		
	B	R	Z
Mean Vehicle delay (sec) — Before	15.4	29.86	0.45
Mean Vehicle delay (sec) — After	14.26	27.02	0.46

4.2 VEHICLE MOVEMENT EFFICIENCY

Journey Times

In order to determine whether the implementation had any effects upon the traffic movement, the time taken for three different journeys was averaged for a series of journeys. The journeys taken are shown in Figure 9 and Table 4.3 summarises the results obtained. Although there was an increase in the journey times in all three cases this increase was not statistically significant.

TABLE 4.3 SUMMARY OF VEHICLE JOURNEY TIMES

	Before		After	
	No. of Runs	Time (s)	No. of Runs	Time (s)
Route 1	30	163.5	27	170.8
Route 2	30	106.3	28	109.1
Route 3	60	46.6	55	53.7

Delay and Queue Lengths

The length of the traffic queues at three of the stop lines (See Figure 10) was measured for all of the time intervals used during the trial. An example of the typical results is shown in Figure 8. The overall results were that there was no significant change between the "before" and "after" situation although there were considerable fluctuations. The mean vehicle delay figures are shown in Table 4.4.

4.3 SAFETY

Conflict Studies

The overall hypothesis within the project was that the number of serious conflicts would reduce between the before and after situations as a direct effect of the pilot project implementations. In addition a number of other hypotheses (specified below), were developed because they were more able to test fully any effects of the pilot project implementations.

H_1 The number of pedestrian-car conflicts will decrease.
H_2 The number of pedestrian-car conflicts per lane will decrease.
H_3 The number of conflicts for each pedestrian direction will decrease.
H_4 The number of pedestrian-car conflicts according to whether the pedestrian is in their first, second or last lane of crossing will decrease.
H_5 The ratio of pedestrians crossing to conflict will reduce.

The observation was for 15 days in both the before and after studies. Only serious pedestrian and car conflicts were recorded. Conflicts were only recorded during times when it was not raining. For more details about the techniques employed and the methodology behind the hypotheses see Hyden (1987). The conflict studies were done at both the two pedestrian crossings at the junction. The analysis of each lane was analysed separately where necessary. The coding for the site is as represented in Figure 9.

Hypothesis 1: The number of pedestrian-car conflicts will decrease.
Over a period of 15 days of observation in the before study a total of 133 pedestrian vehicle conflicts were observed and 130 were observed during the after study. This was not a significant reduction in the observed number of conflicts. Table 4.5 presents the number of conflicts per site, showing that there was a 6.3% reduction in the number of conflicts at Site 1 and a 3.7% increase at Site 2. Neither of these changes were statistically significant.

TABLE 4.5 NUMBER OF CONFLICTS PER SITE IN PORTO BEFORE AND AFTER IMPLEMENTATION

	SITE 1			SITE 2		
	BEFORE	AFTER	% CHANGE	BEFORE	AFTER	% CHANGE
Pedestrian/Vehicle conflicts	79	74	-6.3%	54	56	+3.7%

Hypothesis 2: The number of pedestrian-car conflicts per lane will decrease.
The number of observed conflicts in the before study in lane 1 was 28 and in the after study was 11. This was a significant difference. The probability was .0005 using a one-tailed test. In lane 2 there was an increase in the number of observed conflicts between the two studies. In the before study 51 conflicts were observed and in the after study 63 conflicts were observed. However, this was only a significant increase at the probability level of .10. 32 conflicts were observed at lane 3 in the before study and 27 were observed in the after study, but this reduction was not significant. At lane 4 there was an increase of 5 in the number of observed conflicts from 22 in the before study to 27 in the after study. This was not a significant increase.

Hypothesis 3: The number of conflicts for each pedestrian direction will decrease.
This hypothesis is very relevant to the situation in Porto because the implementations responded differently according to the pedestrian approach direction. The first tests related to the overall directions by pedestrians either to the tramlines in the centre of the road or from the tramlines. In the before study the number of conflicts involving pedestrians going to the centre of the road was 76 and in the after study this had increased to 90. This increase is only significant at a level of probability of .10 using a one-tailed test. There were 57 conflicts involving pedestrians going in the opposite direction, from the centre, in the before study and 40 in the after study. This was a significant reduction. This difference was tested using a one-tailed test and it was found that the probability associated with such a change was .025. The significant change therefore occurred on lanes 1 and 2 and not lanes 3 or 4.

Hypothesis 4: The number of pedestrian-car conflicts according to whether the pedestrian is in their first, second or last lane of crossing will decrease.
In lane 1 the number of observed conflicts involving pedestrians in their first lane of crossing was 14 in the before study and 8 in the after study. Using a Poisson distribution with a mean of 14

it was found that the probability of observing 8 events was .0305 which is a significant difference and less than the critical value of 95% probability. In the before study the number of conflicts involving pedestrians in their second lane of crossing, that is, going from the centre of the road, was 14 and 3 in the after study. The probability of such a change was .0004.

In lane 2 (which is on the same arm as lane 1), the number of observed conflicts involving pedestrians in their first lane of crossing the road (going from the centre of the road), in the before study was 18 and 13 in the after study. This was only a significant decrease at the P=.10 level. The number of conflicts at lane 2 involving pedestrians in their second lane of crossing in the before study was 33 and 50 in the after study. This was a significant increase in conflicts. p=.025, one-tailed test.

The number of conflicts involving pedestrians crossing their first lane at lane 3 in the before study was 10 and 7 in the after study. This has a level of probability of .0901. At the same lane the number of conflicts involving pedestrians crossing their second lane reduced between the studies from 22 to 20. This was not a significant decrease.

There was a significant increase in the number of conflicts involving pedestrians in their first lane of crossing at lane 4 from 7 to 12. This had a probability of .0263. The number of conflicts involving pedestrians crossing their second lane at lane 4 increased from 15 to 17 between the before and after studies, but this was not a significant change.

Hypothesis 5: The ratio of pedestrians crossing to a conflict will decrease
The fifth hypothesis related to the pedestrian crossing volumes. Pedestrians volumes were collected over a period of 5 hours. The ratio for site 1 in the first study was 66:1 and in the second it was 54:1 which suggests that the situation has become less safe. Site 2 had a ratio of 138:1 in the first study and 120:1 in the second which again suggests that the crossing has become less safe. Further analysis revealed that there were fewer pedestrians coming from the side of the crossing away from the school and crossing at site 1.

The mean number of vehicles per hour was 45 in the first study and 31 in the second. The overall numbers of vehicles going over the pedestrian crossing was 4,909 in the first study and 4,719 in the second study which is a reduction of 3.9% and not significant.

Summary

There has not been a significant change in the overall number of conflicts. However, the testing of the hypotheses has shown that there has been a significant reduction in the number of conflicts involving pedestrians crossing from the centre of the road. There has also been a significant reduction in the number of conflicts involving pedestrians in their first lane of crossing at lane 4. However, there was a significant increase in the number of conflicts involving pedestrians in their first lane of crossing at lane 2.

Pedestrian Red Light Violations

Red light violations by pedestrians were examined for the different sides of the road separately. At the side nearest the school there was an increase from 84% to 93%, which is non significant; whilst at site 2 there was a reduction from 83% to 67%. As far as violations concerning school children were concerned the increase at site 1 was from 91% to 97% and at site 2 the decrease was from 90% to 69%.

4.4 PEDESTRIAN COMFORT

This work related to the time pedestrians had to wait at the kerb before crossing and the number of pedestrians who arrived at the crossing when the pedestrian "green man" was showing. The implementation of the trial should have assisted the pedestrians in both these areas and consequently the hypotheses concerning these factors was specified prior to the trials.

Arrival on Green

At Site 1 the percentage of pedestrians who arrived on a green pedestrian signal doubled from 9% to 18%, and at Site 2 the percentage also doubled, but this time from 22% to 45%.

Delay

Table 4.6 shows the percentage of pedestrians who waited for longer than the stipulated times at the two sites. Once again the figures are separated for all pedestrians and for child pedestrians.

TABLE 4.6 WAITING TIMES OF PEDESTRIANS

(*=p<0.15; **=p<0.10; ***=p<0.05)

		SITE 1			Site 2		
		Before	After	Signif.	Before	After	Signif.
Waiting for >10 secs	All peds	33.7%	22.4%	*	31.0%	37.0%	-
	Children	26.5%	26.7%	-	15.8%	43.8%	**
Waiting for >20 secs	All peds	15.7%	10.5%	-	16.7%	22.2%	-
	Children	8.8%	6.7%	-	0%	18.8%	***
Waiting for >30 secs	All peds	12.4%	6.6%	-	7.1%	16.7%	-
	Children	5.9%	3.3%	-	0%	12.5%	*

A more detailed examination of the behavioural aspects of pedestrian movement features is given in Deliverable 15, but it is clear from these results that there has been a marked overall increase in the observed waiting times at Site 2, and in particular this affects children. The reasons for such a change are very difficult to explain since we already have high levels of pedestrian red light violation (which implies that the pedestrians do not wait) and the green time for pedestrians has also been increased.

4.5 OTHER FACTORS

Costs:

Another very important consideration that the Highway Engineers have to take into account when deciding what equipment to use at any particular location is the additional cost that the installation of detectors entails. Any benefits that accrue because of the additional flexibility of the system have to be balanced against the additional cost. In the case of the installation under investigation the before costs are calculated as follows:

Before		
	Equipment (Supply and installation)	20.0 Kecus
	Construction	7.5 Kecus
	SUB-TOTAL	27.5 Kecus

and the additional equipment costs are:

After		
	Equipment (Supply and installation)	7.5 Kecus

Therefore the additional costs in installing this equipment add a further 26% to the cost of the installation.

5 DISCUSSION OF IMPLICATIONS

5.1 IMPLICATIONS FOR PEDESTRIAN DETECTION EQUIPMENT

The detectors used during this implementation have been standard vehicle microwave detectors that have been modified, in terms of speed threshold to account for the low speed of pedestrians. Due to the limited angle of view, nominally 30 degrees, the siting of the detector can be critical. There is an in-built ambiguity in the siting of the detectors in that the aiming of the detectors needs to avoid identifying passing vehicles but needs to pick up all the pedestrians who wish to cross. This gives no problems at all at sites where there is plenty of space but can cause problems when there are restrictions. In the case of the Porto implementation there were no problems detecting pedestrians approaching from the southern side because of the layout. There were also no problems detecting pedestrians when they were on the tram tracks (ie having already crossed one carriageway and moving towards the other). However there were problems on the school side and the positioning of the detectors was not ideal in this respect. The reasons for this were mainly associated with the narrow pavement outside the school. Due to the large number of people who left the school and wanted to cross the road the change in the signal timings caused by the detection was not wasted (this was confirmed by studies in the feasibility stage), but there were some anomalies that were caused by children congregating by the pedestrian crossing but not always wishing to cross. (This could also be a reason for the apparent long delay times quoted in the results.)

However despite these relatively minor problems, the microwave detectors proved themselves very robust. Even though they were of a standard British construction they were easily attached to a Portuguese signal system and operated as expected. There were no reliability problems during the whole length of the trial.

5.2 IMPLICATIONS FOR PEDESTRIAN SAFETY AND COMFORT

The overall effect of the trial on pedestrians was positive, although there were marked differences between the measured effects on the different sites. However the results from the trial seemed to be overshadowed by the fact that there was a very high level of red light violation, especially by children. At the site nearest the school there was a non-significant reduction in the number of pedestrian/vehicle conflicts and an overall reduction in the waiting time for pedestrians wishing to cross the road despite this there was an increase in the number of red-light violations. At site two there was virtually no change in the number of conflicts, but increase in the number of red light violations and in the waiting time of pedestrians.

5.3 IMPLICATIONS FOR VEHICLES

The effect on vehicles was measured in terms of delay. This was done by measuring queue lengths at the junction and by journey times through the junction. In both cases there was no discernable change.

6 CONCLUSIONS

The work undertaken in the implementation has demonstrated that:

- It has been possible to fit amended microwave detectors to standard traffic control systems with a minimum of complications.

- The operation of the detectors has been straightforward with no problems related to reliability or vandalism.

- It is possible to amend the signal timings on a real time basis to respond to the arrival of pedestrians at a crossing point

- Conditions for pedestrians have been improved with little or no corresponding increase in vehicle delay.

- There are still problems in being able to respond to the needs of pedestrians, especially children, promptly enough to prevent them from crossing against a red light.

- When using microwave detectors in the manner used within this implementation a feasibility study is vital to ensure that the location is suitable.

7 REFERENCES

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Rothengatter, J A., van Houten, Y. and Hodgson, F. (1995). Micro-level Behavioural and Conflict changes in Pilot Projects. V2005 Deliverable 15. Traffic Research Centre, Groningen

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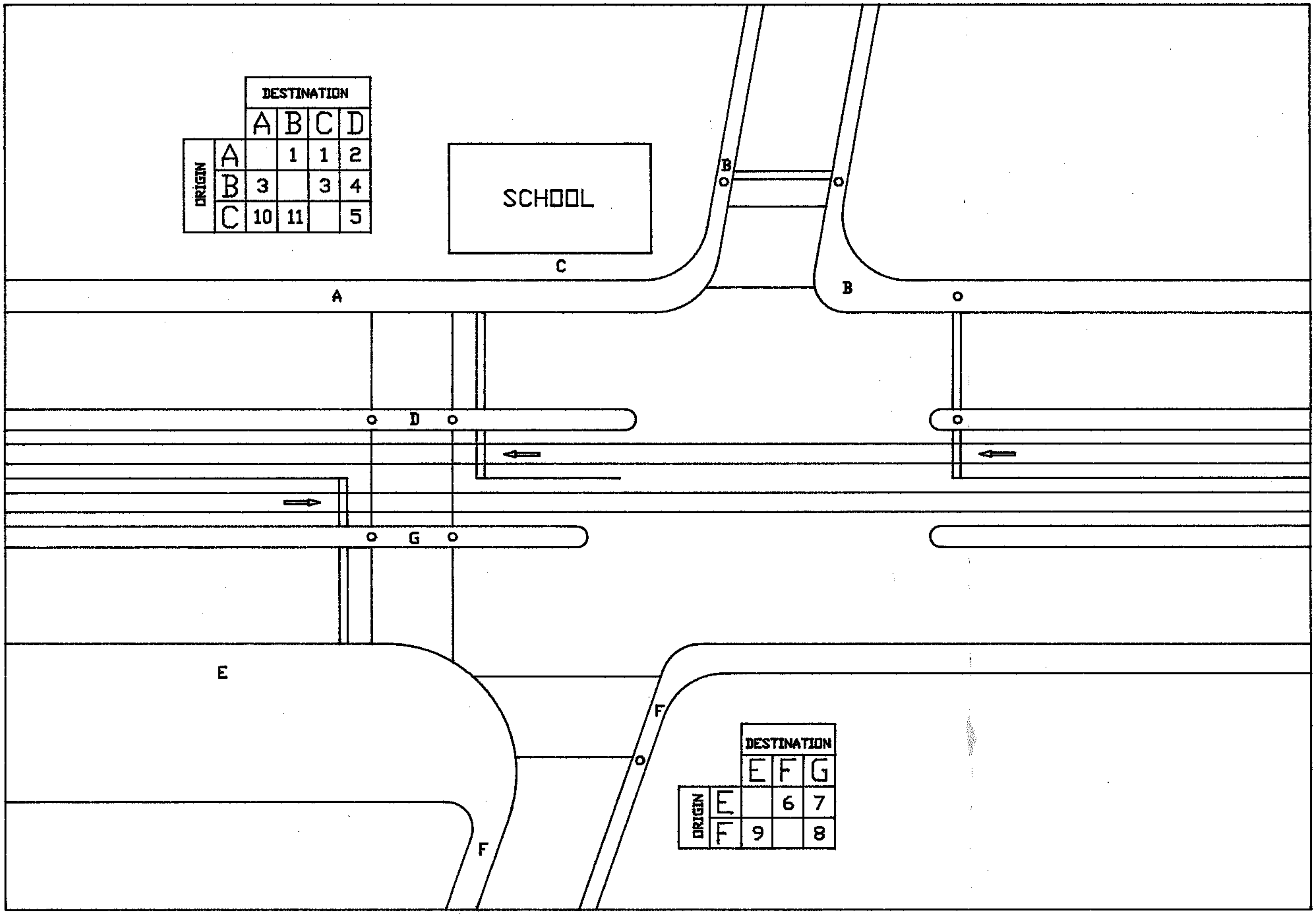
ANNEXE I

PEDESTRIAN MOVEMENTS



ORIGIN	DESTINATION A	B	C	D
A		1	1	2
B	3		3	4
C	10	11		5

ORIGIN	DESTINATION E	F	G
E		6	7
F	9		8

Pedestrian movements
"Before" data collection
(93/10/13)

Hour	Movements										
	1	2	3	4	5	6	7	8	9	10	11
17:00	5	10	1	7	7	4	4	3	2	5	3
17:05	2	1	2	4	3	6	1	2	5	1	0
17:10	1	0	2	1	3	8	2	0	6	4	3
17:15	7	0	0	0	6	2	0	3	5	5	0
17:20	7	9	1	1	5	0	3	6	15	6	0
17:25	1	0	1	3	10	5	2	12	19	0	0
17:30	2	0	2	2	5	3	1	6	11	1	0
17:35	4	1	2	2	0	1	0	5	4	1	0
17:40	2	0	3	2	3	7	0	4	3	2	0
17:45	4	9	0	2	0	5	1	2	10	0	0
17:50	1	2	4	0	0	5	0	4	3	0	0
17:55	5	9	2	6	2	1	0	10	11	2	0
Total	41	41	20	30	44	47	14	57	94	27	6

Pedestrian movements
"Before" data collection
(93/10/14)

Hour	Movements										
	1	2	3	4	5	6	7	8	9	10	11
18:00	1	4	2	2	0	3	2	4	5	2	0
18:05	3	0	2	6	2	4	0	2	10	1	0
18:10	1	2	4	4	0	2	0	6	3	1	0
18:15	2	1	2	2	3	7	0	10	3	1	1
18:20	0	6	4	3	4	0	0	5	6	3	0
18:25	5	8	1	1	2	3	0	3	3	0	0
18:30	1	0	0	2	3	3	0	17	4	5	0
18:35	2	3	2	6	0	1	3	3	3	3	0
18:40	5	4	4	1	0	4	0	8	5	0	0
18:45	3	2	1	2	0	3	1	6	2	0	0
18:50	1	0	2	4	4	3	3	6	1	4	0
18:55	11	8	1	0	1	2	0	1	0	1	0
Total	35	38	25	33	19	35	9	71	45	21	1

Pedestrian movements
"Before" data collection
(93/10/15)

Hour	Movements										
	1	2	3	4	5	6	7	8	9	10	11
12:00	3	1	1	5	1	3	0	2	6	0	1
12:05	0	0	0	10	10	2	3	6	1	0	1
12:10	5	6	0	1	5	2	3	3	5	3	4
12:15	2	3	1	0	0	4	5	9	2	0	1
12:20	6	1	0	2	3	4	1	7	4	0	0
12:25	1	0	2	0	4	7	2	5	2	0	0
12:30	14	2	1	1	12	0	2	4	14	10	0
12:35	3	1	1	1	97	6	5	13	8	39	4
12:40	30	13	2	3	58	11	1	18	5	28	12
12:45	7	1	9	0	22	3	6	14	6	7	3
12:50	0	0	0	0	12	2	1	14	16	0	3
12:55	4	3	0	0	0	3	2	5	10	0	0
Total	75	31	17	23	224	47	31	100	79	87	29

Pedestrian movements
"Before" data collection
(93/10/18)

Hour	Movements										
	1	2	3	4	5	6	7	8	9	10	11
9:00	3	3	3	1	2	2	4	3	6	0	0
9:05	4	0	4	4	2	3	5	2	3	0	1
9:10	5	11	4	4	3	1	0	6	3	1	1
9:15	1	0	8	5	0	1	1	3	5	0	0
9:20	4	2	1	4	0	1	3	3	9	0	0
9:25	2	3	2	4	22	1	0	0	7	0	0
9:30	3	0	1	2	1	3	0	11	6	0	0
9:35	0	0	1	4	0	2	14	7	7	0	0
9:40	2	7	1	4	0	3	2	3	4	0	0
9:45	0	0	5	2	1	3	2	2	2	0	0
9:50	5	2	1	4	1	1	0	9	6	0	0
9:55	1	2	2	1	0	0	0	6	6	0	0
Total	30	30	33	39	32	21	31	55	64	1	2

Pedestrian movements
"Before" data collection
(93/10/19)

Hour	Movements										
	1	2	3	4	5	6	7	8	9	10	11
8:00	3	2	2	3	0	3	0	4	6	0	0
8:05	5	11	5	3	1	8	4	6	9	0	0
8:10	10	9	7	3	1	3	4	7	2	0	0
8:15	13	0	13	2	1	7	6	1	5	0	0
8:20	11	0	27	6	1	3	6	8	3	1	0
8:25	12	0	14	4	1	0	8	8	0	0	0
8:30	45	3	20	4	1	7	20	5	6	0	0
8:35	29	4	8	2	0	5	14	3	1	1	0
8:40	6	0	7	5	2	0	6	8	2	0	1
8:45	5	6	2	10	2	0	1	4	2	1	1
8:50	3	3	1	1	3	9	4	2	2	0	0
8:55	0	1	4	1	0	5	1	0	4	0	0
Total	142	39	110	44	13	50	74	56	42	3	2

Pedestrian movements
"After" data collection
(94/02/07)

Hour	Movements										
	1	2	3	4	5	6	7	8	9	10	11
17:00	8	1	3	1	13	3	0	3	5	6	1
17:05	5	3	3	1	76	5	6	4	6	68	31
17:10	5	0	2	2	19	3	0	7	4	12	12
17:15	3	0	1	0	13	1	1	1	2	7	2
17:20	0	6	1	1	12	6	1	2	6	2	5
17:25	0	0	1	1	6	0	3	2	1	0	0
17:30	8	0	1	3	3	0	1	2	0	2	1
17:35	3	2	0	3	7	1	3	2	24	2	0
17:40	2	0	4	0	2	3	0	14	20	0	3
17:45	2	0	1	3	0	4	0	8	7	0	0
17:50	1	0	3	3	0	5	0	0	0	0	3
17:55	0	0	0	2	1	6	1	8	4	0	0
Total	37	12	20	20	152	37	16	53	79	99	58

Pedestrian movements
"After" data collection
(94/02/08)

Hour	Movements										
	1	2	3	4	5	6	7	8	9	10	11
12:00	1	1	2	5	0	0	0	3	1	0	1
12:05	2	0	3	5	6	3	1	8	2	3	0
12:10	15	2	1	3	4	3	2	8	1	0	0
12:15	1	0	3	2	3	0	1	3	3	0	0
12:20	9	3	2	3	1	2	1	2	6	4	0
12:25	0	0	1	3	0	1	0	4	0	0	0
12:30	3	1	2	4	3	3	4	4	2	1	3
12:35	9	2	2	0	20	9	4	8	12	27	7
12:40	25	4	10	4	119	1	1	10	4	78	30
12:45	7	1	3	0	16	2	2	10	9	18	7
12:50	0	0	2	1	2	1	0	9	1	6	0
12:55	8	3	3	2	0	3	0	4	7	0	1
Total	80	17	34	32	174	28	16	73	48	137	49

Pedestrian movements
"After" data collection
(94/02/09)

Hour	Movements										
	1	2	3	4	5	6	7	8	9	10	11
09:00	2	5	3	0	6	1	0	4	1	1	1
09:05	3	2	0	5	1	0	1	4	3	1	0
09:10	0	0	0	6	2	2	2	4	2	1	0
09:15	5	0	0	2	0	1	2	3	3	0	1
09:20	0	0	1	1	0	1	0	4	4	0	1
09:25	1	5	1	8	0	2	0	3	4	0	0
09:30	2	0	0	0	22	1	1	4	1	0	0
09:35	3	0	3	3	2	4	17	3	3	1	0
09:40	5	3	4	2	0	2	0	1	3	0	0
09:45	0	0	1	1	0	4	0	5	4	1	0
09:50	1	0	1	3	0	1	0	0	5	0	0
09:55	1	2	1	1	0	0	0	4	2	0	0
Total	23	17	15	32	33	19	23	39	35	5	3

Pedestrian movements
"After" data collection
(94/02/10)

Hour	Movements										
	1	2	3	4	5	6	7	8	9	10	11
18:00	4	0	1	1	6	0	1	0	7	0	1
18:05	2	4	2	2	1	2	1	5	11	0	0
18:10	3	3	3	4	2	4	1	11	11	0	0
18:15	3	4	5	4	0	2	0	3	5	2	1
18:20	0	0	7	4	0	7	0	3	4	1	1
18:25	3	6	1	3	0	6	1	5	8	1	0
18:30	2	1	2	3	22	4	0	6	4	0	0
18:35	6	2	4	3	2	6	2	10	7	2	0
18:40	3	4	4	3	0	4	1	11	13	0	0
18:45	1	2	4	3	0	4	0	8	10	0	0
18:50	6	5	2	0	0	4	0	17	10	0	0
18:55	2	0	2	8	0	8	0	8	9	0	0
Totals	35	31	37	38	33	51	7	87	99	6	3

Pedestrian movements
"After" data collection
(94/02/11)

Hour	Movements										
	1	2	3	4	5	6	7	8	9	10	11
08:00	0	0	0	2	0	1	0	2	4	0	0
08:05	4	3	1	0	2	8	0	2	4	0	0
08:10	4	5	3	3	0	2	5	3	1	0	0
08:15	4	1	2	7	0	2	2	5	4	0	0
08:20	16	1	13	4	2	5	17	5	6	0	0
08:25	17	2	6	3	1	2	9	6	0	1	0
08:30	23	0	7	1	0	3	15	2	4	0	0
08:35	27	3	23	2	0	0	9	5	4	0	0
08:40	22	6	6	1	0	2	14	12	3	0	0
08:45	24	3	11	3	3	0	6	4	2	0	0
08:50	4	5	3	3	0	4	1	3	2	0	0
08:55	3	2	3	5	3	5	6	1	4	0	0
Total	148	31	78	34	11	34	84	50	38	1	0

ANNEXE II

VEHICLE MOVEMENTS

Before Data Collection (93/10/13)

		17:00	17:05	17:10	17:15	17:20	17:25	17:30	17:35	17:40	17:45	17:50	17:55	Total
1	2 Wheels	10	1	0	1	1	2	1	6	6	2	3	3	36
	Cars	73	87	64	89	66	105	83	99	63	91	72	69	961
	Heavy veh.	7	10	5	6	8	6	4	6	5	10	6	10	83
	Bus	0	0	3	3	1	1	1	2	1	2	2	2	18
	Trams	0	0	0	0	0	0	2	0	0	0	0	1	3
2	2 Wheels	0	0	0	0	0	0	0	1	0	0	0	0	1
	Cars	1	4	2	4	5	3	3	1	2	2	2	5	34
	Heavy veh.	0	1	1	0	0	0	0	2	1	0	0	0	5
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	3	2	0	1	1	1	0	2	1	3	1	1	16
	Heavy veh.	0	1	0	0	0	0	0	0	0	0	0	0	1
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2 Wheels	2	4	3	7	2	2	2	3	1	4	7	4	41
	Cars	70	78	96	88	59	86	57	87	84	87	88	96	976
	Heavy veh.	9	6	6	6	2	8	5	10	5	11	4	7	79
	Bus	1	1	0	2	1	1	0	1	0	3	1	2	13
	Trams	0	0	2	0	0	0	0	1	0	0	0	0	3
5	2 Wheels	0	0	0	0	1	0	0	0	0	1	0	0	2
	Cars	18	16	16	16	11	18	10	18	8	20	13	17	181
	Heavy veh.	2	0	0	4	2	1	4	2	2	0	3	2	22
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
22	2 Wheels	0	0	1	0	0	0	0	0	0	0	0	0	1
	Cars	2	2	3	2	1	2	3	5	4	1	2	0	27
	Heavy veh.	0	0	0	0	0	0	1	2	1	1	0	1	6
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
7	2 Wheels	0	0	0	1	0	1	0	0	0	0	0	1	3
	Cars	17	19	16	5	16	6	18	9	14	13	18	14	165
	Heavy veh.	1	0	1	1	1	2	0	0	0	1	1	2	10
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2 Wheels	0	1	0	0	0	0	0	0	0	0	2	0	3
	Cars	23	20	15	5	13	9	8	14	14	9	13	13	156
	Heavy veh.	0	0	1	1	0	0	0	0	2	1	0	0	5
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2 Wheels	0	0	0	0	0	0	1	0	0	0	1	0	2
	Cars	16	18	7	13	11	10	13	13	18	10	17	21	167
	Heavy veh.	0	3	2	1	0	4	1	0	2	2	2	2	19
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0

VEHICLE MOVEMENTS

Before Data Collection (93/10/14)

		18:00	18:05	18:10	18:15	18:20	18:25	18:30	18:35	18:40	18:45	18:50	18:55	Total
1	2 Wheels	1	6	8	2	2	10	4	4	1	1	1	5	45
	Cars	90	79	92	99	87	66	98	81	83	102	93	69	1039
	Heavy veh.	5	8	9	8	4	9	2	4	5	11	3	2	70
	Bus	2	1	1	2	0	3	1	4	5	11	3	2	35
	Trams	0	0	0	2	0	0	0	0	0	0	0	0	2
2	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	9	5	9	3	4	4	9	2	7	1	4	4	61
	Heavy veh.	0	0	1	1	0	0	1	0	0	1	0	0	4
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	0	1	1	1	0	1	0	1	0	0	0	0	5
	Heavy veh.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2 Wheels	10	2	7	7	3	3	2	4	4	7	1	3	53
	Cars	109	83	90	91	76	65	88	79	62	82	76	58	959
	Heavy veh.	3	7	9	2	3	2	4	1	2	3	4	5	45
	Bus	1	1	1	1	2	5	0	3	3	1	0	2	20
	Trams	0	0	0	0	0	2	1	0	0	0	0	0	3
5	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	2	2
	Cars	14	19	10	11	22	22	20	17	16	18	17	15	201
	Heavy veh.	2	1	3	1	1	1	1	0	0	1	2	0	13
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
22	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	0	0	1	0	3	1	0	0	0	0	1	2	8
	Heavy veh.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
7	2 Wheels	2	1	0	1	0	1	0	0	1	0	1	1	8
	Cars	12	21	20	20	22	19	24	24	27	16	18	23	246
	Heavy veh.	1	0	0	1	0	2	1	2	1	1	1	1	11
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2 Wheels	1	0	0	0	0	0	0	0	0	0	0	0	1
	Cars	5	21	14	16	9	12	16	22	16	14	8	18	171
	Heavy veh.	1	1	0	0	0	0	0	1	1	0	1	1	6
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2 Wheels	0	1	0	0	1	0	1	2	2	0	0	1	8
	Cars	4	28	15	21	21	17	12	27	19	18	22	20	224
	Heavy veh.	0	1	1	1	0	2	6	1	1	0	0	3	16
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0

VEHICLE MOVEMENTS

Before Data Collection (93/10/15)

		12:00	12:05	12:10	12:15	12:20	12:25	12:30	12:35	12:40	12:45	12:50	12:55	Total
1	2 Wheels	1	2	0	1	4	5	4	4	3	1	4	4	33
	Cars	55	57	61	49	56	76	70	64	65	116	61	66	796
	Heavy veh.	5	6	8	8	5	7	5	1	4	1	3	5	58
	Bus	2	2	2	2	0	1	1	1	1	1	1	2	16
	Trams	0	0	0	2	0	0	0	0	0	1	0	0	3
2	2 Wheels	0	0	1	0	0	0	0	0	0	1	0	0	2
	Cars	4	1	3	1	3	2	4	3	7	11	5	3	47
	Heavy veh.	1	1	0	0	1	0	1	0	0	0	1	0	5
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	1	0	3	2	1	0	0	2	2	1	0	0	12
	Heavy veh.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2 Wheels	3	8	5	4	5	6	4	6	3	3	2	3	52
	Cars	50	62	89	88	81	102	89	60	63	93	102	85	964
	Heavy veh.	12	7	10	5	7	6	3	6	0	1	1	6	64
	Bus	3	0	2	1	1	0	2	0	3	1	0	4	17
	Trams	1	0	0	1	0	1	0	0	0	1	0	0	4
5	2 Wheels	0	0	2	0	1	2	1	5	0	0	0	0	11
	Cars	15	14	20	24	28	18	14	22	22	19	31	26	253
	Heavy veh.	1	4	5	2	1	0	1	1	1	0	2	1	19
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
22	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	7	4	0	2	1	6	3	3	2	4	1	0	33
	Heavy veh.	1	0	0	0	1	0	0	0	0	0	0	0	2
	Bus	0	0	1	0	1	0	1	0	0	1	0	0	4
7	2 Wheels	0	0	1	0	1	0	1	0	0	0	0	0	3
	Cars	7	8	8	6	7	7	15	9	26	15	21	15	144
	Heavy veh.	1	2	2	0	0	0	0	0	4	0	0	0	9
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2 Wheels	0	0	0	0	0	0	0	1	0	0	0	0	1
	Cars	5	12	10	12	12	2	10	16	24	14	23	14	154
	Heavy veh.	1	0	1	1	1	0	0	2	0	0	1	1	8
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2 Wheels	1	0	0	0	0	0	0	4	1	0	0	0	6
	Cars	7	20	7	11	10	6	11	12	29	16	15	5	149
	Heavy veh.	0	3	0	2	3	0	0	1	1	0	1	0	11
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0

VEHICLE MOVEMENTS

Before Data Collection (93/10/18)

		09:00	09:05	09:10	09:15	09:20	09:25	09:30	09:35	09:40	09:45	09:50	09:55	Total
1	2 Wheels	3	1	3	5	1	1	1	3	1	1	3	2	25
	Cars	75	87	72	70	72	81	60	74	45	60	55	59	810
	Heavy veh.	6	7	3	10	6	5	7	5	5	4	9	4	71
	Bus	2	3	1	0	2	2	0	1	1	3	2	0	17
	Trams	0	0	0	1	0	0	0	0	1	0	0	1	3
2	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	1	3	6	2	4	1	0	0	5	2	0	5	29
	Heavy veh.	0	0	0	0	0	2	1	0	1	2	0	0	6
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2 Wheels	0	0	0	0	0	0	1	0	0	0	0	0	1
	Cars	7	3	0	2	1	2	0	1	1	0	0	0	17
	Heavy veh.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2 Wheels	4	1	1	0	3	2	7	3	3	3	2	4	33
	Cars	93	74	71	69	77	67	54	63	57	52	66	59	802
	Heavy veh.	9	2	7	6	5	5	5	4	11	8	10	7	79
	Bus	1	0	3	0	1	2	2	0	3	0	1	2	15
	Trams	1	0	0	0	0	1	0	1	1	0	0	0	4
5	2 Wheels	0	0	0	1	1	0	0	2	0	1	0	1	6
	Cars	18	14	15	17	28	14	18	22	13	18	14	15	206
	Heavy veh.	2	1	4	5	5	0	4	3	6	3	0	4	37
	Bus	0	0	2	0	0	0	0	0	0	0	0	0	2
22	2 Wheels	0	2	0	1	0	0	0	1	0	0	0	0	4
	Cars	0	0	2	3	2	4	1	2	3	3	3	0	23
	Heavy veh.	0	0	0	0	1	0	0	0	0	1	2	0	4
	Bus	0	2	0	0	0	0	0	0	0	0	0	0	2
7	2 Wheels	0	0	1	0	0	0	1	1	0	0	0	0	3
	Cars	24	17	13	22	11	16	8	10	12	13	8	9	163
	Heavy veh.	0	0	0	1	5	0	0	0	1	1	0	1	9
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2 Wheels	0	0	1	0	0	0	0	0	0	0	0	1	2
	Cars	23	26	19	14	11	11	8	15	9	16	7	8	167
	Heavy veh.	0	1	2	0	1	2	0	0	0	2	1	0	9
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2 Wheels	0	0	1	0	1	0	0	0	1	1	0	0	4
	Cars	20	15	33	16	8	16	9	12	26	12	13	19	199
	Heavy veh.	0	2	2	1	0	4	1	2	2	2	1	3	20
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0

VEHICLE MOVEMENTS

Before Data Collection (93/10/19)

		08:00	08:05	08:10	08:15	08:20	08:25	08:30	08:35	08:40	08:45	08:50	08:55	Total
1	2 Wheels	2	4	1	1	0	3	1	1	1	0	0	0	14
	Cars	73	79	86	85	79	85	80	67	99	85	86	65	969
	Heavy veh.	8	5	8	1	6	2	6	6	3	4	7	6	62
	Bus	5	2	2	2	2	1	1	2	0	0	4	1	22
	Trams	0	0	1	0	0	0	1	0	0	0	1	0	3
2	2 Wheels	1	0	0	0	0	0	0	0	0	0	0	0	1
	Cars	1	7	2	2	4	5	6	9	6	5	3	4	54
	Heavy veh.	1	0	0	2	1	0	0	0	0	0	2	0	3
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2 Wheels	0	0	0	0	0	0	0	0	1	0	0	0	1
	Cars	1	1	2	2	8	9	13	9	2	4	4	4	59
	Heavy veh.	0	0	0	0	0	1	0	1	0	0	0	0	2
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2 Wheels	3	1	2	0	2	2	1	1	0	0	1	0	13
	Cars	62	64	72	66	84	82	100	75	77	73	69	89	913
	Heavy veh.	8	6	11	7	5	2	3	6	5	3	7	9	72
	Bus	1	1	3	1	0	2	2	2	0	3	3	2	20
	Trams	0	0	0	1	0	1	0	0	0	1	0	0	3
5	2 Wheels	0	0	0	0	0	0	1	0	0	0	0	0	1
	Cars	11	10	15	13	13	10	10	11	13	18	11	17	152
	Heavy veh.	5	3	4	1	3	2	4	2	1	3	3	1	32
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
22	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	2	2	2	3	1	1	3	2	0	1	1	0	18
	Heavy veh.	1	0	0	0	0	0	0	0	0	0	0	0	1
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
7	2 Wheels	0	0	0	1	0	0	1	0	0	0	2	0	4
	Cars	6	9	14	16	17	26	21	19	28	28	22	24	230
	Heavy veh.	0	1	4	2	1	3	0	2	3	1	2	2	21
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2 Wheels	0	0	0	0	0	0	0	0	1	0	0	0	1
	Cars	5	10	15	23	20	25	23	20	32	18	20	27	238
	Heavy veh.	0	1	0	2	0	1	1	0	0	1	1	1	8
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2 Wheels	1	0	1	0	0	0	0	0	0	1	0	1	4
	Cars	18	13	20	25	30	30	20	34	26	30	22	17	285
	Heavy veh.	0	1	1	0	0	1	0	0	1	0	3	1	8
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0

VEHICLE MOVEMENTS

After Data Collection (94/02/07)

		17:00	17:05	17:10	17:15	17:20	17:25	17:30	17:35	17:40	17:45	17:50	17:55	Total
1	2 Wheels	2	3	1	1	1	0	0	2	0	3	2	1	16
	Cars	63	65	72	71	76	70	91	61	96	56	69	62	852
	Heavy veh.	6	6	5	8	6	7	7	4	10	9	11	10	89
	Bus	1	3	1	1	2	2	0	2	1	0	3	2	18
	Trams	0	1	0	1	0	0	0	0	0	0	0	2	4
2	2 Wheels	0	1	0	0	0	0	0	0	0	1	0	0	2
	Cars	5	0	0	6	0	0	1	3	4	2	4	1	26
	Heavy veh.	1	0	0	0	0	0	0	0	0	0	0	0	1
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2 Wheels	0	1	0	0	0	0	0	0	1	0	0	0	2
	Cars	1	4	4	3	1	0	1	2	0	1	1	0	18
	Heavy veh.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2 Wheels	1	3	4	6	1	0	2	3	4	2	1	1	28
	Cars	69	77	92	88	74	63	67	89	67	70	70	84	910
	Heavy veh.	8	6	4	6	12	5	6	6	6	4	3	7	73
	Bus	2	1	2	2	0	0	2	2	1	1	0	0	13
	Trams	1	0	0	1	0	0	0	1	0	1	0	0	4
5	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	3	2	3	1	3	6	1	4	3	0	3	4	33
	Heavy veh.	0	0	0	0	0	1	0	0	0	0	0	0	1
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
22	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	0	1	1	0	0	1	0	0	0	0	0	0	3
	Heavy veh.	0	0	1	0	0	0	0	0	0	0	0	0	1
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
7	2 Wheels	0	0	1	0	0	0	0	0	0	0	0	0	1
	Cars	7	15	11	21	14	20	8	12	10	10	9	8	145
	Heavy veh.	2	0	2	0	2	1	0	0	1	0	0	0	8
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2 Wheels	0	1	0	0	0	0	0	0	0	0	0	0	1
	Cars	6	13	12	10	14	4	3	7	14	14	16	12	125
	Heavy veh.	1	2	1	0	0	0	0	2	1	1	1	1	10
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2 Wheels	0	0	0	1	0	0	1	0	1	0	0	1	4
	Cars	12	19	24	14	16	16	10	18	19	14	15	8	185
	Heavy veh.	2	2	3	1	1	2	0	0	1	2	0	0	14
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0

VEHICLE MOVEMENTS

After Data Collection (94/02/08)

		12:00	12:05	12:10	12:15	12:20	12:25	12:30	12:35	12:40	12:45	12:50	12:55	Total
1	2 Wheels	5	0	1	2	2	1	4	2	3	2	2	3	27
	Cars	60	57	50	83	73	68	62	84	80	86	87	67	857
	Heavy veh.	7	7	5	5	7	10	3	1	2	6	6	2	61
	Bus	1	1	1	3	4	0	2	2	0	0	3	0	17
	Trams	1	0	0	0	0	0	0	1	0	0	0	1	3
2	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	5	3	2	2	3	2	3	3	3	3	0	2	31
	Heavy veh.	0	1	0	2	1	0	0	0	0	0	0	0	4
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	1	1	0	1	2	3	4	2	1	4	3	1	23
	Heavy veh.	0	0	0	0	0	0	0	0	1	0	0	0	1
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2 Wheels	0	2	4	2	1	2	3	5	0	0	4	1	24
	Cars	53	69	49	63	73	82	75	97	60	80	119	95	915
	Heavy veh.	8	2	5	6	8	6	2	7	3	7	6	4	64
	Bus	1	0	2	1	1	2	0	1	3	0	1	3	15
	Trams	0	1	0	1	0	1	0	0	0	1	0	0	4
5	2 Wheels	0	0	0	0	0	1	0	0	1	0	0	0	2
	Cars	2	2	1	3	6	1	2	1	4	1	5	7	35
	Heavy veh.	0	0	0	1	0	0	0	1	0	0	0	0	2
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
22	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	0	0	0	0	0	0	2	1	1	1	2	0	7
	Heavy veh.	0	0	0	0	0	0	0	0	1	0	0	0	1
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
7	2 Wheels	1	0	1	0	0	0	0	1	0	1	0	0	4
	Cars	7	1	7	4	7	2	10	7	14	17	12	11	99
	Heavy veh.	0	0	1	1	1	1	0	1	0	1	1	2	9
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2 Wheels	0	0	0	0	0	0	0	0	0	1	0	0	1
	Cars	7	7	2	4	4	10	12	11	17	26	20	15	135
	Heavy veh.	0	0	0	0	0	1	0	0	0	0	0	0	1
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2 Wheels	1	0	1	0	0	0	0	1	1	0	2	1	7
	Cars	6	8	6	12	5	8	11	16	32	34	18	19	175
	Heavy veh.	1	1	1	2	4	0	1	0	0	1	0	1	12
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0

VEHICLE MOVEMENTS

After Data Collection (94/02/09)

		09:00	09:05	09:10	09:15	09:20	09:25	09:30	09:35	09:40	09:45	09:50	09:55	Total
1	2 Wheels	2	1	1	0	0	2	1	1	1	1	0	1	11
	Cars	48	84	88	79	64	52	68	85	72	67	65	58	830
	Heavy veh.	5	6	4	7	5	2	5	1	6	9	7	5	62
	Bus	1	2	2	2	0	2	4	1	1	1	1	2	19
	Trams	0	1	0	0	0	0	0	0	0	1	0	0	2
2	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	2	2	3	7	1	2	2	2	3	0	1	1	26
	Heavy veh.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	2	5	2	3	1	0	1	0	0	2	0	0	16
	Heavy veh.	0	1	0	0	0	0	0	0	0	0	0	0	1
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2 Wheels	1	0	0	2	1	1	0	2	2	1	1	1	12
	Cars	50	75	92	82	77	55	70	56	65	56	57	46	781
	Heavy veh.	4	5	8	7	6	5	7	10	9	7	12	2	82
	Bus	0	1	0	4	2	4	0	3	3	1	2	2	22
	Trams	1	0	0	1	0	0	0	0	0	1	0	0	3
5	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	3	4	3	2	5	1	1	2	2	2	1	0	26
	Heavy veh.	0	0	1	0	0	0	0	1	1	0	0	1	4
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
22	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	2	0	0	1	1	1	0	0	0	0	0	0	5
	Heavy veh.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
7	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	20	15	6	13	7	7	14	11	8	9	7	3	120
	Heavy veh.	2	0	1	2	1	0	2	1	3	2	1	1	16
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	31	27	23	18	7	10	14	4	12	9	13	4	172
	Heavy veh.	1	1	0	0	0	0	1	2	0	0	1	0	6
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2 Wheels	0	0	0	0	1	0	1	0	0	0	1	0	3
	Cars	26	30	20	28	16	19	21	15	20	14	8	11	228
	Heavy veh.	1	0	0	0	2	0	0	4	2	3	1	2	15
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0

VEHICLE MOVEMENTS

After Data Collection (94/02/10)

		18:00	18:05	18:10	18:15	18:20	18:25	18:30	18:35	18:40	18:45	18:50	18:55	Total
1	2 Wheels	4	4	4	2	4	2	1	3	1	1	5	4	35
	Cars	94	96	80	102	79	79	91	97	97	85	100	92	1092
	Heavy veh.	0	7	8	7	8	6	7	11	5	3	6	3	71
	Bus	1	1	2	1	2	3	0	3	2	1	2	1	19
	Trams	0	0	1	0	1	0	0	1	0	0	1	0	4
2	2 Wheels	0	0	0	0	0	0	0	1	0	0	0	0	1
	Cars	3	1	6	2	3	5	4	1	3	1	5	3	37
	Heavy veh.	0	0	0	0	0	0	0	1	0	0	0	1	2
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	0	1	0	0	3	0	0	0	0	0	0	0	4
	Heavy veh.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2 Wheels	4	5	5	4	0	5	3	3	2	6	4	3	44
	Cars	90	85	66	78	65	86	80	68	76	79	71	88	932
	Heavy veh.	6	6	7	2	5	1	4	4	3	1	5	1	45
	Bus	2	2	2	4	1	3	0	2	2	2	0	0	20
	Trams	0	1	0	0	1	0	0	0	0	0	2	0	4
5	2 Wheels	1	0	0	0	0	0	1	0	0	0	0	0	2
	Cars	3	6	4	4	6	6	4	1	5	1	4	6	50
	Heavy veh.	2	0	0	1	2	0	1	0	0	1	1	0	8
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
22	2 Wheels	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	1	0	0	0	0	0	0	0	0	0	0	0	1
	Heavy veh.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
7	2 Wheels	0	0	2	0	0	0	1	1	0	0	2	0	6
	Cars	6	13	14	13	8	24	17	17	16	24	17	17	186
	Heavy veh.	0	0	1	1	0	1	1	3	1	0	1	1	10
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2 Wheels	0	0	0	0	1	0	0	0	0	0	0	0	1
	Cars	11	12	13	12	14	22	17	14	12	12	11	9	159
	Heavy veh.	0	0	0	0	1	0	1	1	2	1	1	1	8
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2 Wheels	0	0	0	0	0	0	3	0	0	0	4	0	7
	Cars	22	25	24	30	16	30	23	16	18	28	24	16	272
	Heavy veh.	0	2	2	3	2	2	0	2	1	2	3	2	21
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0

VEHICLE MOVEMENTS

After Data Collection (94/02/11)

		08:00	08:05	08:10	08:15	08:20	08:25	08:30	08:35	08:40	08:45	08:50	08:55	Total
1	2 Whells	1	1	2	0	0	0	3	1	2	3	1	2	16
	Cars	41	54	76	55	84	89	73	87	81	88	56	45	829
	Heavy veh.	5	2	5	8	7	4	8	8	2	8	8	2	67
	Bus	2	2	2	1	3	0	3	0	2	3	1	3	22
	Trams	0	0	1	1	0	0	1	0	0	1	0	0	4
2	2 Whells	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	3	1	5	1	0	3	2	9	6	1	3	1	35
	Heavy veh.	1	0	2	0	0	0	0	0	0	0	0	0	3
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2 Whells	0	0	0	1	0	0	0	1	0	0	0	0	2
	Cars	1	0	0	2	4	1	3	8	9	4	3	8	43
	Heavy veh.	1	0	0	0	0	0	0	0	0	0	0	0	1
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2 Whells	0	1	2	0	2	1	1	1	0	2	0	2	12
	Cars	47	39	60	58	81	73	94	71	81	70	53	58	785
	Heavy veh.	4	4	8	3	8	5	4	5	9	6	8	6	70
	Bus	1	2	2	1	1	2	2	1	1	2	3	1	19
	Trams	1	0	1	0	0	0	0	0	1	1	0	0	4
5	2 Whells	0	0	1	0	0	0	0	0	0	0	0	0	1
	Cars	0	3	3	1	4	4	1	3	2	3	2	1	27
	Heavy veh.	0	0	0	0	1	0	0	0	0	2	0	0	3
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
22	2 Whells	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	0	0	0	0	0	0	0	4	1	1	0	0	6
	Heavy veh.	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
7	2 Whells	0	0	1	0	0	0	0	0	0	0	0	0	1
	Cars	3	4	3	6	13	10	7	12	13	14	10	19	114
	Heavy veh.	0	1	0	1	0	0	1	1	0	1	0	1	6
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2 Whells	0	0	1	0	0	0	0	0	0	1	0	0	2
	Cars	0	9	7	3	17	19	21	22	34	15	13	22	182
	Heavy veh.	0	1	2	1	0	0	2	2	2	2	5	0	17
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2 Whells	1	1	0	0	0	1	2	0	0	0	0	0	5
	Cars	5	13	14	20	17	30	31	33	41	29	35	28	296
	Heavy veh.	1	1	1	0	3	0	2	0	1	0	0	2	11
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	0