

Improved Techniques for Registration Number Traffic Surveys

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In order to obtain current traffic data for four localised areas of congestion in central Edinburgh, 21 peak hour registration number traffic surveys were carried out in March and April, 1965. This data was required to enable management and other short-term traffic solutions to be evaluated. The purpose of this article is to bring to the notice of traffic engineers a satisfactory application of a traffic technique which has not always proved popular or successful in the past.

THE usual advantages of the registration number survey method are that:

- (1) the information is factual and sufficiently detailed for the purpose;
- (2) traffic is not delayed and no police control or advance publicity is required; and
- (3) journey times for economic assessment purposes can be readily obtained.

The disadvantages are that:

- (1) origin and destination information is limited to the extent of the cordon;
- (2) a large number of observers are required, as all stations must be manned simultaneously;
- (3) mistakes in recording can introduce bias into the results; and
- (4) analysis is tedious.

The fact that information is limited to the extent of the cordon is not a disadvantage in the present context. In these surveys the other disadvantages have been minimised to a considerable degree by the

use of tape recorders, computer techniques and adequate preparation and organisation.

The four survey areas are indicated in Fig 1. Each area was enclosed by a cordon of observers who recorded on tape the registration numbers and times of vehicles entering and/or leaving each census point. Supplementary registration number parking surveys were carried out before and after the peak hour surveys to match numbers originating and terminating within the two larger areas. Internal stations were incorporated into the Large Cordon survey for local assignment purposes. Details of the stations, staffing and traffic volumes for each survey area are tabulated in Table I.

Observers and duties

University students were interviewed for the survey posts and given a short tape recorder test. Individual recording and transcription times were noted, and the range of the best 18 results was: recording rate - 1 600/2 690 veh/h; transcription time - 3.25 to 10 times recording time; and accuracy - 67 per cent to 94 per cent with six characters correct.

The students obtaining these results acted as tape recorder operators, and the remainder as classified traffic counters.

The method of posting observers at each survey station was:

- (1) Where the expected unidirectional peak hour flow was less than 300 vehicles, a manual record of registration numbers only was taken.
- (2) Where this flow exceeded 300 veh/h, a tape recorder operator and classified traffic counter worked together.

TABLE I. General data on surveys and personnel

Location	No. of surveys		No. of stations per survey			Personnel per survey					Approx. vols. vehs/survey
	a.m. peak	p.m. peak	Internal	External	Parking	Recorder operators	Manual recorders	Classified counters	Supervisors	Total	
Haymarket	3	3	—	16	—	13	1	12	3	29	8 000
Randolph Cres.	3	2	—	16	—	13	—	12	2	27	6 000
Tollcross	3	4	—	20	1	18	1	19	2	40	11 000
Large Cordon	1	2	7	32	7	21	11	17	3	52	21 000

The classified traffic counter using a multi-bank counter recorded the number of the various categories of vehicles passing his station and abstracted the running totals each minute. He also called out the time each minute to his tape recorder partner, for inclusion on the tape. The purpose of the classified count was to provide a check on the number of vehicles recorded on each tape, and to enable histograms of traffic intensity to be prepared. The tape recorder operators recorded the full registration numbers of all vehicles passing their stations except for motor-cycles and buses. Recording partial registration numbers and sampling techniques were considered, but neither method was considered sufficiently proven for the purpose.

Parking surveys were carried out by the tape recorder operators and manual recorders after the classified count had commenced. Each observer recorded parked vehicle registration numbers in an area near to his peak hour station as soon as practicable before and after the tape recorder survey.

After each survey the recorder operators transcribed their tapes onto data sheets using recorder headsets. The sheets were then checked against the classified count data and despatched for computer processing. Transcription time averaged about four hours. The use of a tape recorder was essential to the improvement of this technique, and several machines were tested under field conditions before a selection was made. The Grundig pocket EN 3 recorder was chosen, mainly because of its simplicity of operation.

From the viewpoint of planning further registration number surveys it is of interest to examine the upper flow limits of the tape recording technique. The interview test for one of the most capable tape recorder operators resulted in a recording rate of 2 370 veh/h and a six character accuracy of 87 per cent. His field station was Princes Street, outgoing from traffic signals, with vehicles in three lanes. He achieved rates of up to 1 680 veh/h without any missed vehicles and a maximum rate of 2 390 veh/h when the actual rate was in the range of 2 400/3 000 veh/h. He missed 46 out of 1 345 vehicles, and 74 per cent of his recorded numbers were matched.

Data processing

The first survey result matched 55 per cent of vehicles through the Haymarket cordon on full registration numbers. The computer output was in the form of an origin and destination table and a list of unmatched numbers. From a manual examination of the unmatched numbers a further origin and destination table was produced, comprising vehicles with at least four characters the same including the full numerical part of the registration number. This was considered to be the minimum requirement for a matched vehicle. The fourth character was not always required to be consecutive when a letter and a recognisable error. This procedure improved the match of the survey by 23 per cent to 78 per cent. A data processing technique was devised for a four character match. The six character unmatched

Fig 1. Edinburgh registration number traffic survey areas.



numbers were re-processed, those with letters first being reversed, and a second origin and destination table and list of unmatched numbers produced, based on a comparison of the first four characters. The reason for this reversal was that pairs of registration numbers were much more readily identified by their digits. This procedure considerably reduced the volume of unmatched data for hand matching in subsequent surveys.

Accuracy tests

Before data processing the remaining 17 surveys, a short investigation was carried out to determine whether four character matching really produced a worthwhile improvement in the accuracy of a survey, and also to check the four character minimum matching procedure. For one survey a comparison was made between vehicles matched on six characters and those matched on a combination of six plus four characters. Incoming vehicles were apportioned to exits as percentages for both cases and compared with actual exit flows. The combined forecast was found to be much the better. In neither case were the registration numbers considered to be at random, due to differences in the recording and writing capabilities of the operators.

As a check on the four character minimum criterion for a matched vehicle, the above procedure was repeated except that instead of a four character match in the combination, first a three and then a five character match were substituted. For both the four and five character matches, six times out of eight the calculated answer fell between the actual and the figure forecast on the basis of vehicles considered correctly matched. For the three character match this only occurred three times out of eight. There was, therefore, a marked falling off in accuracy for the three character match.

The procedure of six character and four character computer and/or manual matching was adopted for all subsequent surveys, on the basis that the more registration numbers matched before scaling up to the classified count figures, the more accurate the final result. On completion of the matching process the data for each survey was in the form of a composite origin and destination table. This table was then expanded to the classified p.c.u. values of each

TABLE III. Cost of the surveys

University students		£1 381
Data processing		£1 403
Equipment: 24 stop watches	£ 90	
12 tape recorders and accessories	£432	
Hire of other tape recorders	£ 20	
14 multi-tally counters	£ 93	
		£ 635
		£3 419

station using a method of successive approximation.

Details of matching and total vehicles recorded for some of the individual surveys are shown in Table II. The percentages in this Table are based on the assumption that the classified count is correct and that each pair of registration numbers is correctly matched. A check on these two types of error indicated that the possible error due to incorrect matching by the computer on a time basis, together with vehicles incorrectly matched by the four character procedure, was less than 1 per cent. It was not possible to check numbers which may have been incorrectly matched by human error and coincidence, but the time element considerably limits this risk.

Errors and costs

From the viewpoint of improving future surveys a short study was made of errors occurring before data processing, on one of the surveys. For this survey the computer had matched a further 449 vehicles on four characters. Twenty of these vehicles appeared incorrectly matched on a time basis. Each of the remaining 429 pairs of numbers was examined and the errors classified broadly: phonetic, 59 per cent; double transposition, 12 per cent; handwriting, 12 per cent; and others, 17 per cent. Of the phonetic and double transposition errors nearly 50 per cent were due to F being taken for S and vice versa, e.g. 6684SS and 6684SF. Other letters which accounted for more than 40 per cent of phonetic errors were B, C, D, E, G, J, P, T and V. The principal handwriting errors were: U and V, 20 per cent; C and G, 20 per cent; G and S, 10 per cent; X and K, 10 per cent; E and F, 5 per cent; and D and O, 5 per cent.

The cost of the surveys, excluding stationery and the use of office equipment, accommodation and the time of the permanent staff, is shown in Table III.

TABLE II. Details of matched registration numbers and vehicles recorded for each survey

Survey		% Registration numbers matched			Parking	Vehicles recorded						% Accuracy Recorded count
		After 6 digit computer match	After 4 digit computer match	After 4 digit hand match		By tape & manual recorders			By classified traffic counters			
						Internal stations	External stations	Total	Internal stations	External stations	Total	
Haymarket	1	54.6	—	77.6	—	—	8 210	8 210	—	8 319	8 319	Av. 98.0
"	2	49.3	69.1	76.8	—	—	7 558	7 558	—	7 762	7 762	
"	3	—	71.3	78.3	—	—	8 288	8 288	—	8 402	8 402	
"	4	52.3	—	77.0	—	—	7 373	7 373	—	7 508	7 508	
"	5	60.0	—	78.7	—	—	8 140	8 140	—	8 278	8 278	
"	6	55.8	—	74.4	—	—	7 701	7 701	—	7 955	7 955	
Randolph Cres.	1	70.5	—	89.0	—	—	5 428	5 428	—	5 566	5 566	97.5
Tollcross	6	69.4	76.7	85.5	728	—	8 952	9 680	—	9 091	9 818	98.5
"	7	71.9	79.0	87.8	951	—	10 477	11 428	—	10 558	11 509	99.0
Large Cordon	1	62.6	71.5	79.7	3 253	2 354	15 990	21 597	2 354	16 390	21 997	97.2
"	2	61.3	70.0	76.9	2 851	2 532	14 772	20 155	2 542	15 139	20 532	97.2
"	3	60.1	70.9	76.6	2 880	2 443	15 978	21 301	2 443	16 259	21 582	98.0

TABLE IV. A portion of one of the final origin and destination tables

Origin and Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total
1 Lothian Road	46	417		44		51	9	17	228	30	69	35		13	9	5	8	35	8	0	6	1030
2 Princes Street	579	99		8		6	0	3	22	48	375	390		28	2	0	0	14	11	5	23	1613
3 Rose Street	26	34		11		16	2	4	19	5	11	14		5	0	1	1	0	4	0	2	155
4 George Street	60	32		36		9	0	6	392	20	57	38		12	0	1	11	7	12	2	9	704
5 Young Street	7	1		41		20	13	2	10	1	2	9		4	0	0	1	1	2	0	2	116
6 Queen Street	81	6		41		32	22	11	195	17	86	94		14	12	8	14	3	13	0	18	667
7 Forres Street	22	1		7		44	0	1	3	0	4	7		1	2	0	0	1	1	0	6	100

Application of data

A portion of one of the final origin and destination tables is shown in Table IV. These tables were used to produce hand assigned flow diagrams, from which carriageway widths and traffic signal requirements were determined and composite schemes produced. Fig 2 shows one of several assignments to Tollcross for the temporary diversion of traffic during the construction of a large roundabout and adjoining redevelopment. This figure has been included purely to illustrate an application of the data.

Conclusion

The use of tape recorders has considerably increased the scope of registration number surveys and reduced the number of personnel required. Further reductions in personnel are possible in future, as the classified count which accounted for nearly half the observers on the present surveys may not always be considered essential.

The possibility of incorrectly matching vehicles was virtually eliminated by the supplementary parking surveys and analysis procedure. From Table II it will be noted that not less than 97 per cent of possible registration numbers were recorded for any survey and that the actual accuracy of matching was between 74 per cent and 92 per cent for the 20 surveys, before scaling up. The volume of tedious analysis which has been associated with these surveys in the past has been very considerably reduced in the present instance by the adoption of the procedures described.

The attribution of some 80 per cent of errors suggests improvements in the phonetic and writing

techniques, but as some 50 per cent of the errors were due to the local registration letters F and S, there may be insufficient justification for the four character computer match elsewhere. On similar surveys carried out by the author in Leicester in 1963 there was no necessity for a four character computer match, although these surveys were considerably improved by hand matching.

The transport section of the National Plan 1965 indicates that in the next few decades modification of the road systems in towns within the expenditure that can be afforded will be inadequate to cope with the great increase in traffic. The plan calls for improved urban networks and management techniques. In many cases the registration number survey will be better suited to the evaluation of appropriate management and other short term traffic solutions than any other survey of comparative cost and convenience.

ACKNOWLEDGMENTS

This article appears by kind permission of F. R. Dinms, M.I.C.E., M.I.MUN.E., A.M.T.P.I., City Engineer and Master of Works, Edinburgh.

Data processing was carried out by Independent Computer Services Ltd., Edinburgh (three surveys) and English Electric Ltd., Kidsgrove (17 surveys).

Fig 2. Traffic assignment diagram from Tollcross survey

