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MEASUREMENT OF SKIDDING RESISTANCE
PART I. GUIDE TO THE USE OF SCRIM

by

J R Hosking MSc ACSM and G C Woodford

Materials Division
Highways Department
Transport and Road Research Laboratory
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ABSTRACT

A road testing vehicle, SCRIM, has been developed by the Transport and Road Research Laboratory to provide a routine method of measuring the resistance to skidding (SFC) of wet roads.

This report outlines the basic principles underlying the design of SCRIM, describes the vehicle, test wheel, recording system and water supply and discusses ways in which the results can be analysed.

Causes of variation in SFC measured by SCRIM are discussed in relation to both research work and the monitoring of roads for maintenance purposes and methods are recommended that will keep variation to a minimum; these include the use of 'mean summer values', averaging results over at least 5 readings wherever possible and frequent calibration checks.

An Appendix gives details of recommended calibration procedures.

1. INTRODUCTION

SCRIM (Sideway-force Coefficient Routine Investigation Machine) has been developed by the Transport and Road Research Laboratory to provide a routine method of measuring the resistance to skidding of wet roads. This machine is a direct descendant of the fifth-wheel skid resistance testing machines that have been used by TRRL for research purposes since 1953 and which, in turn, were developed from the motor-cycle combination machine that was first used by the Ministry of Transport's experimental station at Harmondsworth (later to become the TRRL) in 1930.

At the time of writing there are 18 SCRIMs working all over the world and a series of three reports has been written to give guidance on the operation of the machine and on the interpretation of results. It is hoped that they will be of value not only to the SCRIM operator, but also to those who make use of the results. Although some sections of the reports (such as those dealing with seasonal variation) are particularly applicable to conditions in the United Kingdom, the information given should provide a basis for a modified procedure suited to other climatic conditions.

Part I gives an outline of the principles and operation of SCRIM, briefly discusses the causes of variation in results (these are dealt with more fully in Parts II and III) and recommends a procedure to be adopted for routine SFC measurement.

Part II[1] gives an account of the factors affecting the slipperiness of a road surface.

Part III[2] gives an account of the factors affecting measurements made with SCRIM.

The work reported in Parts I, II and III is limited to measurements made at lower speeds (50 km/h). It is intended that a further Part be published when current research has been completed, that will give an account of factors, such as macrotexture, which influence high-speed resistance to skidding.

2. PRINCIPLE OF MEASUREMENT

SCRIM uses the sideway-force method of measuring resistance to skidding, the alternative braking-force being less suitable for routine measurements[3,4]. A freely rotating test wheel fitted with a standard tyre is inclined at a large enough angle to the direction of motion of the vehicle to generate the maximum sideway-force on all surfaces requiring testing and to be insensitive to small changes in angle when the vehicle turns (see Part III). A smooth test tyre is used to eliminate any effects due to the wear of tread patterns. The ratio of the force developed at right angles to the plane of the wheel (the sideway-force) to the load on the wheel is the sideway-force coefficient (SFC). The main advantages of this method of measurement are that a continuous record of resistance to skidding is obtained and the test tyre has a reasonably long life. Tests are normally carried out at 50 km/h, but SCRIM is capable of measurements at speeds of up to 80 km/h.

3. DESCRIPTION OF SCRIM

3.1 The vehicle and test wheel

The test apparatus is fitted to a commercial vehicle chassis carrying a water tank of 2750 litres capacity (Plate 1). The standard machine has the test wheel mounted on the nearside of the vehicle in order to test the nearside wheel-track with the least interference to other traffic, but an alternative machine with two test wheels has been commissioned by some authorities because of its convenience when testing in urban conditions. The test wheel, fitted with a standardised 3.00 x 20 tyre, has an independent load and suspension system and is inclined at an angle of 20 degrees to the direction of travel.

3.2 The measuring and recording system

The sideway-force developed is measured by a transducer and vehicle speed is measured by a pulse generator driven directly from the vehicle transmission.

The mean SFC and speed are calculated for sub-section lengths of 5, 10 or 20 metres; they are then recorded by means of a high-speed tape punch using eight hole paper tape. The sub-section length is selected by a switch on the control panel (Fig 1), but provision is normally made for the switch to be over-ridden by an automatic change from 5 to 10 and from 10 to 20 metre sub-sections at speeds of approximately 50 and 75 km/h respectively, in order that the speed of collection of data will not exceed the capacity of the paper-tape recorder.

3.2.1 Basic information The information recorded on the paper tape can be varied according to user's needs; the minimum information consists of the values of SFC and speed, the sub-section length (denoted by the figures 5, 1 and 2 respectively for 5, 10 and 20 metre sub-sections) and an event marker (a number between 1 and 9) used to record the positions of features which will be of value in locating lengths of road during subsequent examination of the results. Some users include a record of distance measured since starting the last section or link in units of 10 metres.

On earlier recorders the results were also presented by a 20 column printer which gave a digital record (Fig 2). Because of the structure of the printer the visible readings on the record lagged behind the paper tape by about four readings. On the most recent recorder the printed output is optional and an instantaneous display of the results being punched is provided on the control panel (Fig 1).

3.2.2 Additional information In addition to the information described above, provision is made for inserting three other items.

(i) Before starting a test run and before starting the recorder it is possible to insert on the tape a 'Job Identity' consisting of a special character, unique to this item of information, followed by a ten-figure number. This identity may include information such as a route number, network reference, date of test, details of the machine and operator, and climatic conditions. The number to be inserted is selected by push buttons on the control panel and is displayed for checking before insertion. If the required information cannot be coded as a single ten-figure number a series of numbers may be used, each preceded by the special character.

(ii) During the test run it is possible to set up a 'Section identity' similar in pattern to the 'Job identity', but preceded by a different symbol. It is set up in the same way and can be inserted whilst the recorder is running. This identity appears only once on the tape, at the time of insertion, but when a printer is in use, appears on each line of the printer output until it is cancelled or replaced. It is intended that this 'Section identity' should be used to indicate the major sections of a road being tested.

(iii) If for any reason it is desired to stop recording and discard the results since the last section identity was inserted this can be done by pressing the 'Abort' button. On earlier recorders this caused the number 8 to be printed and punched in the sub-section length position. On the latest recorder it changes the plus sign which precedes each reading to a minus sign.

3.2.3 Capacity of the recorder The punched tape format used in the Laboratory's recorder has eight characters for each reading. It has been found that when using this format a standard reel of tape is adequate for about 140 km of testing at 10 metre sub-section length. Some other formats include the elapsed distance and incorporate spaces within the reading. This reduces the test mileage which can be recorded on one reel of tape.

3.3 The water supply

The water outlet on SCRIM has an elliptical cross-section of 5.5 cm^2 area and wets the road in front of the test wheel for a width of approximately 300 mm. The water jet is gravity fed from the tank and the flow varies with the head of water. The water control valve has been calibrated to deliver sufficient water to provide a mean film thickness of 1.1 $\pm$ 0.1 mm on a smooth road. Graduations are given for satisfactory flows at 50 and 80 km/h. For checking purposes the actual flows (litres/sec) are given in Table 1.

The effect of water film thickness on SFC is discussed in Part III.

TABLE 1

Flow of water required for SCRIM testing

Speed of test (km/h)	Flow required (litres/second)		
	Average (Target)	Full tank	Empty tank
50	0.95	1.04	0.86
80	1.64	1.81	1.37

3.4 Analysis of results

SCRIM is capable of producing large quantities of data. If only half an eight-hour day is devoted to testing, the remainder being occupied by travelling to the test site, filling with water and meal breaks, it is possible to test 200 km of road. On the 10 metre range this produces 20,000 individual readings. A computer is necessary in order to process fully this volume of information.

The number of ways in which the results can be presented by the computer is unlimited, but it is suggested that the following are the basic requirements for a program:

(1) It should be able to detect (and reject) any errors produced by the tape machine.

(2) Each measurement of speed and SFC should be printed.

(3) At the end of each section the mean values of speed and SFC, the standard deviation of speed and SFC and the length of road tested (or the number of readings) should be recorded.

Other features which are desirable in the program are:

(4) The chainage should be maintained; ie if any reading is rejected the position of subsequent readings relative to the start of the section should not be affected.

(5) Any unusually low values of SFC should be marked in some way to make them stand out from the other results.

(6) There should be a system of event marking to record such things as surface changes and subsidiary location points. It is invaluable to have additional reference points when identifying short lengths within a long test section.

(7) The maximum and minimum values of SFC measured in each section should be recorded.

(8) There should be facilities to reject observations made when the speed is not satisfactory and to exclude such readings from the summary. When testing in traffic there are always some instances when it is necessary to slow down. This leads to the reading of higher than normal SFCs which affect the average value for the section. However estimates of the SFC at 50km/h may be made by

applying a correction factor[2]. Any such corrected readings should be clearly marked on the print-out.

(9) A final summary for each job should be printed; this should include the maximum, minimum and average values of SFC, and the average speed for each section and for the whole job. The length of each section tested should also be shown.

A flow diagram for a program which will provide most of this information is given in Fig 3.

Other forms of output that have been found useful in particular applications are:

(10) A histogram presentation of the results either from individual sections or from whole jobs. An example of this type of output is shown in Fig 4 which indicates the higher SFC obtained from a short resurfaced length.

(11) A running chainage analysis which shows the consecutive lengths of road having SFC within given ranges. An example of this type of output is shown in Fig 5.

(12) The production by means of a graph-plotter of transparent overlays which show the locations of the roads tested on maps of the areas concerned. It is useful to use different coloured traces for different levels of SFC.

(13) A listing of the terminations (nodes) of road-sections (links) (Fig 6).

(14) A listing of different types of event, eg road junctions and pedestrian crossings (Fig 7).

(15) A tabulation of target values together with values measured and any deficiency.

4. DISCUSSION OF FACTORS AFFECTING THE SLIPPERINESS OF A ROAD SURFACE AND SCRIM MEASUREMENTS

The SFC measurements obtained by using SCRIM are dependent on both the actual slipperiness of the road and a number of factors affecting the measurement itself. Each of these two sets of factors is dealt with in detail in Parts II and III respectively of this series of Reports[1,2].

The slipperiness of a road is basically determined by the type and composition of the surfacing, traffic density, type of site and any texturing that has been performed. It is also affected by the other factors summarized in Table 2. Except for Factor 3 they are independent of SCRIM and its operation, but need to be taken into consideration when interpreting the results of SCRIM testing and when deciding what action needs to be taken. The use of mean summer measurements reduces the variation caused by Factors 5, 6 and 7 and enables a reasonably precise estimate to be obtained of the slipperiness of a road section. For much of the work of the TRRL, the means of three consecutive mean summer SFCs have been used; this reduces the effect of Factor 4, and further reduces the effects of Factors 5, 6 and 7. Temperature effects (Factor 7) are of particular interest in that formulae may be used to estimate the SFC at any required temperature from that obtained at the temperature of test. This can be of value when comparisons need to be made, but it must be remembered that the effective SFC of a surface is the measurement obtained under the conditions prevailing at the time of test.

TABLE 2

Factors affecting the slipperiness of a road surface

Reference Number	Factor	Standard deviation of SFC (where applicable)	Maximum likely difference in SFC	Remarks
1	Type and composition of the surfacing, traffic, age, road-site, and climate	–	from under 0.05 to over 1.00	These factors determine the basic SFC of the surface being measured.
2	Contamination of the road surface	–	about 0.10	Contamination by oil, rubber, dust, etc.
3	Wet or dry road	–	–	A perfectly dry road gives a constant SFC (≃0.90) for all surfaces: tests should be made on wet roads.
4	Between years (mean summer values)	0.02	±0.04 ⨍	Dependent on weather conditions.
5	Within year	0.06	±0.12⨍	Reduced if tests are made during summer period only: see below.
6	Within summer season	0.02	±0.04⨍	Reduces if mean summer values are used.
7	Temperature	–	±0.03*	Over full range of temperatures likely to be found in summer season. A correction factor may be applied.

* Proportional to SFC level, estimated for a SFC of 0.50
⨍ 95 per cent confidence limits

TABLE 3

Factors affecting SCRIM measurements

Reference Number	Factor	Standard deviation of SFC (where applicable)	Maximum likely difference in SFC	Remarks
1	Short-term machine variability	0.01*	±0.02*⨍	'Repeatability'.
2	Differences between machines	–	–	No figures available for present day equipment.
3	Tyre resilience	–	±0.01*	Over permitted 46±3 per cent resilience range.
4	Tyre wear	–	negligible	Over the full life of the test tyre.
5	Calibration	–	±0.01	Can be reduced for any particular part of the range being measured.
6	Recorder drift and warm up	–	<0.01	
7	Tyre pressure	–	negligible	If maintained within ±0.2 kg/cm^2.
8	Tracking	–	0 to +0.05	Can be much larger if badly out of track.
9	Speed	–	±0.005**	When regulated to ±2 km/h.
10	Water film thickness	–	±0.005	For normal surfaces. Can be eliminated by use of constant head tank.
11	Unevenness	–	not known	Detrimental to precise measurement.
12	Bends in road	–	negligible at radius 150 m	At radius 45 m, +0.18 for turns to the right and –0.08 for turns to the left.

* Proportional to SFC level, estimated for an SFC of 0.50

⨍ 95 per cent confidence limits

** About 0.03 when correction is applied down to 30 km/h

Table 3 gives a summary of the factors that are known to affect SCRIM measurements and gives estimates of the maximum likely error differences that can result from each in the case of a single measurement of a 100-metre section of the road. These estimates show that there are only relatively small 'errors' associated with the use of a single SCRIM to compare a number of sections during a limited period of time. Furthermore steps can be taken (as with temperature 'correction') to allow more precise comparisons to be made over longer periods of time, these steps include 'correction' for tyre resilience and speed, frequent rolling table calibration and the use of means of two or more runs.

Tables 2 and 3 highlight the need for care in both testing and interpretation of results when testing under difficult conditions, such as outside the summer period, on irregular surfaces (eg setts and pot-holed surfacings), at low speeds, on very short sections and on bends.

5. RECOMMENDATIONS

Present knowledge of the factors affecting SCRIM measurements and experience in SFC testing suggests that the following procedures should be adopted for routine SFC measurement.

Before testing:

(i) ensure that a new test tyre is of the correct resilience and keep a check on the amount of wear, which should not be more than 6 mm in tyre diameter corresponding to about 500 km of testing under average conditions.

(ii) carry out regular calibration checks (at least once a week) preferably by the rolling table method.

(iii) check tyre pressure which should be 3.5 $kg/cm^2 \pm 0.2$ kg/cm^2.

(iv) run the test tyre and recorder for a distance of at least 1 km immediately before the actual test.

While testing:

(v) pay attention to correct tracking and speed (50 km/h ± 2 km/h) and the elimination of results when they are incorrect.

(vi) ensure adequate event marking in order to facilitate pinpointing sections requiring maintenance.

(vii) ensure correct water film thickness.

(viii) note when results are obtained during abnormal conditions such as when the surface has been contaminated or is uneven, on bends and under extreme temperature conditions (air/road temperature outside the 8 to 45°C range).

When using results:

(ix) use mean summer SFCs, which are the means of at least three measurements spaced over the summer period (May to September inclusive in the United Kingdom).

(x) report results for 100 m test sections wherever practicable and, where possible, avoid sections with less than five readings.

(xi) take consideration of any abnormal conditions prevailing at the time of test (see (viii) above).

6. ACKNOWLEDGEMENTS

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8. APPENDIX 1

Methods of calibrating SCRIM

8.1 The rolling table method

This method of calibration relies on applying a known load to the test-wheel and observing the reading on the SCRIM recorder.

8.1.1 Apparatus The apparatus shown diagrammatically in Fig 8 consists of a 300 mm square steel plate set in a trough in the floor. Screws are provided to ensure that the plate, the top surface of which is ground flat, can be set level. A second plate with the lower surface ground flat is supported on the first by two steel rollers and can move freely on the level plate.

A cable attached centrally to one end of the top plate is taken round a series of pulleys in the trough to a stirrup hanging vertically from a pillar fixed about 2 metres from the plate. The plate and trough are inclined at an angle of 70 degrees to the pillar so that when the SCRIM vehicle is driven over the plate the test-wheel is at right-angles to the plate and the line of the cable. A piece of angle-iron can be fixed to the upper plate in a number of places across its width to bear against the test-wheel tyre.

The stirrup is manufactured to weigh 20 kg and provision is made for the addition of up to nine additional weights each of 20 kg. The pillar is fitted with a lever-and-peg arrangement to support the stirrup so that no force is applied to the cable whilst setting up the apparatus.

8.1.2 Calibration procedure

(i) Clean the two plates and the rollers. As these are below ground level they are particularly susceptible to dust and grit which prevents the system from moving freely.

(ii) Check that the two rollers are at right-angles to the direction of movement and that the upper plate is clear of the sides.

(iii) Position the vehicle over the plate so that the test-wheel is in the centre of the upper plate and fix the angle-iron as near to the wheel as possible. The stirrup should be resting on the peg at this time so that there is no weight applied. The angle-iron need not touch the tyre as the plate will slide into position as soon as any weight is applied, but the test-wheel and the angle-iron should be parallel.

(iv) Remove the peg and allow the stirrup to hang on the cable. The recorder should now show SFC of 0.10. If it does not, adjust the zero control in the recorder until it does.

(v) Add eight more weights. The recorder should read SFC = 0.90. If it does not, adjust the range potentiometer until it does.

(vi) Repeat the last two steps until the recorder is correct at both points.

(vii) Check the linearity of the recorder by adding 20 kg weights one at a time. The SFC shown by the recorder should rise by 0.10 for each increment.

8.2 Electronic calibration

This method uses a calibrated load-cell to provide the standard against which the SCRIM recorder is compared.

8.2.1 Apparatus The following equipment is required:

(a) A digital voltmeter with ranges of 20 volts and 20 millivolts

(b) A stabilised power supply to provide voltages in the range 0-12V

(c) A strain-gauge type load-cell which has been calibrated by loading with weights. By adjusting the input voltage to the cell it can be arranged that the output voltage increases by 1 millivolt (or other convenient value) for each increment of 20 kg. The input voltage and the no-load output voltage should be recorded.

(d) A yoke which fits across the axle-box and wheel-flange of the SCRIM and carries the calibrated cell and a screw for loading it and the SCRIM load-cell. The arrangement of such a yoke is shown in Figure 9.

8.2.2 Calibration procedure

(i) The test wheel is removed from SCRIM and the yoke with the calibrated cell is fixed to the axle-box by the two screws provided. Care must be taken to ensure that the hemisphere on the load-cell is correctly aligned with the dimple on the axle. There is sufficient adjustment on the fixing screws for this. When correctly sited the fixing screws should be locked by tightening the locking screws.

(ii) Set the stabilised voltage to the value determined when the cell was calibrated. It is not necessary to monitor this throughout the calibration, but it is desirable to check it at intervals.

(iii) Tighten the loading screw until the output of the calibrated cell shows the voltage equivalent to 20 kg. The SCRIM recorder should show 0.10 SFC*; if it does not, adjust to this value using the zero control.

(iv) Increase the load to 180 kg using the calibrated cell to determine this. If the SCRIM recorder does not show SFC = 0.90* adjust the range potentiometer to give this value.

(v) Repeat these two steps until the recorder is correct at both points.

(vi) Check the linearity of the recorder by loading in steps of 20 kg ie tighten the loading screw so that the output voltage of the calibrated cell increases in steps of 1 mV.

*These have been found to be convenient values for calibration purposes but other values near the ends of the scale would be equally effective.

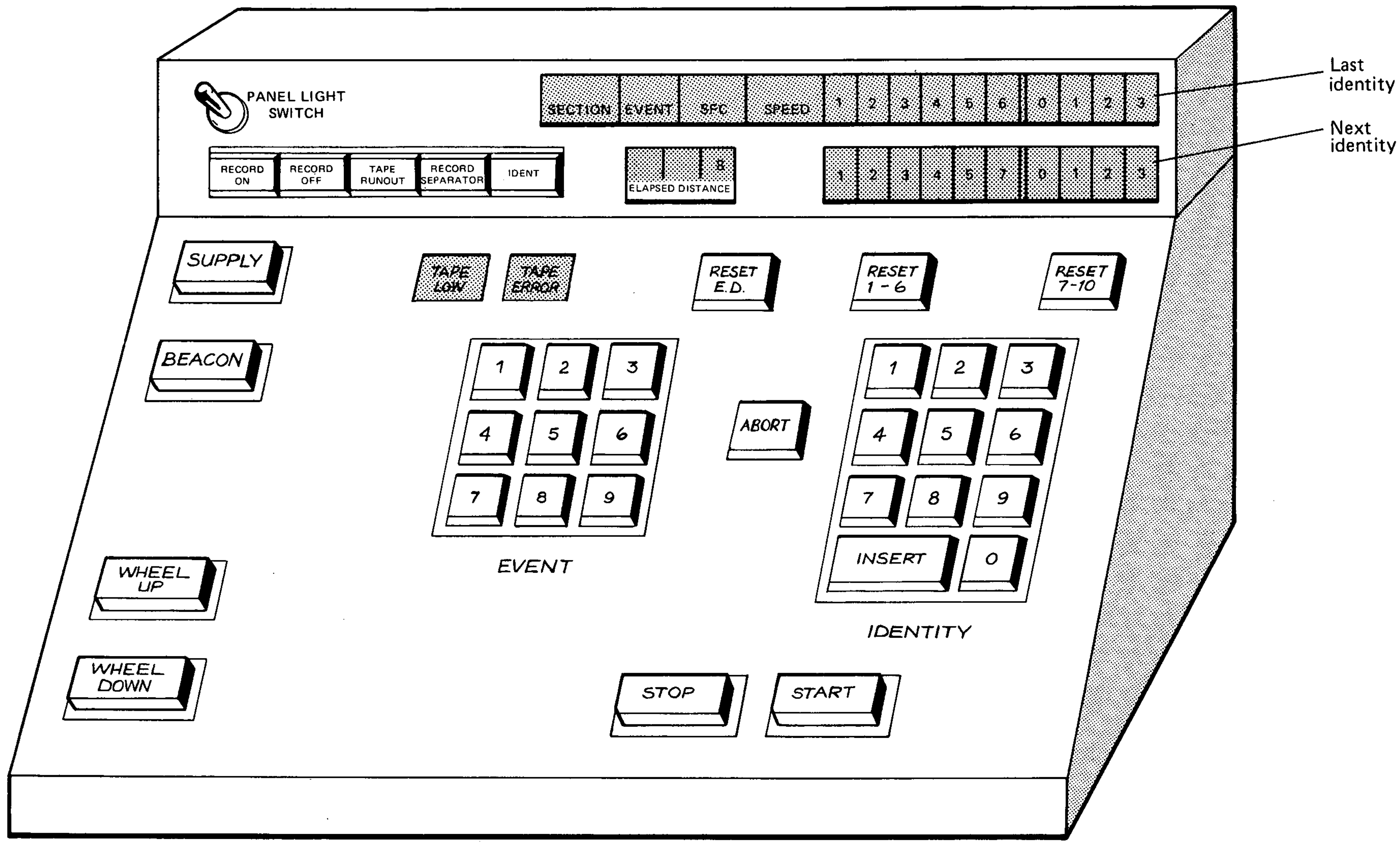

Fig. 1 THE CONTROL PANEL OF SCRIM (1975 MODEL)

Readings counter	Identity										Event marker	SFC		Speed		Subsection length
7	0	1	4	2	5	3	1	2	3	4	0	6	3	1	7	1
7	0	1	4	2	5	3	1	2	3	4	0	7	5	1	2	1
7	0	1	4	2	5	3	1	2	3	4	0	8	0	1	3	1
7	0	1	4	2	5	3	1	2	3	4	0	6	4	2	1	1
7	0	1	4	2	5	3	1	2	3	4	0	6	8	2	2	1
7	0	1	4	2	5	3	1	2	3	4	0	6	6	2	5	1
7	0	1	4	2	5	3	1	2	3	4	0	6	6	3	3	1
6	0	1	4	2	5	3	1	2	3	4	0	5	4	4	1	1
6	0	1	4	2	5	3	1	2	3	4	7	5	5	4	6	1
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6	0	1	4	2	5	3	1	2	3	4	0	5	6	4	8	1
6	0	1	4	2	5	3	1	2	3	4	6	5	9	4	8	1
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5	0	1	4	2	5	3	1	2	3	4	0	4	9	4	7	1
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5	0	1	4	2	5	3	1	2	3	4	0	5	0	4	6	1
4	0	1	4	2	5	3	1	2	3	4	1	6	4	4	6	1
4	0	1	4	2	5	3	1	2	3	4	0	6	4	4	4	1
4	0	1	4	2	5	3	1	2	3	4	0	5	1	4	2	1

Fig. 2 SPECIMEN PRINTER OUTPUT

i) In this diagram the letter L is used as the symbol to denote change of section

ii) Ten results are printed in each line

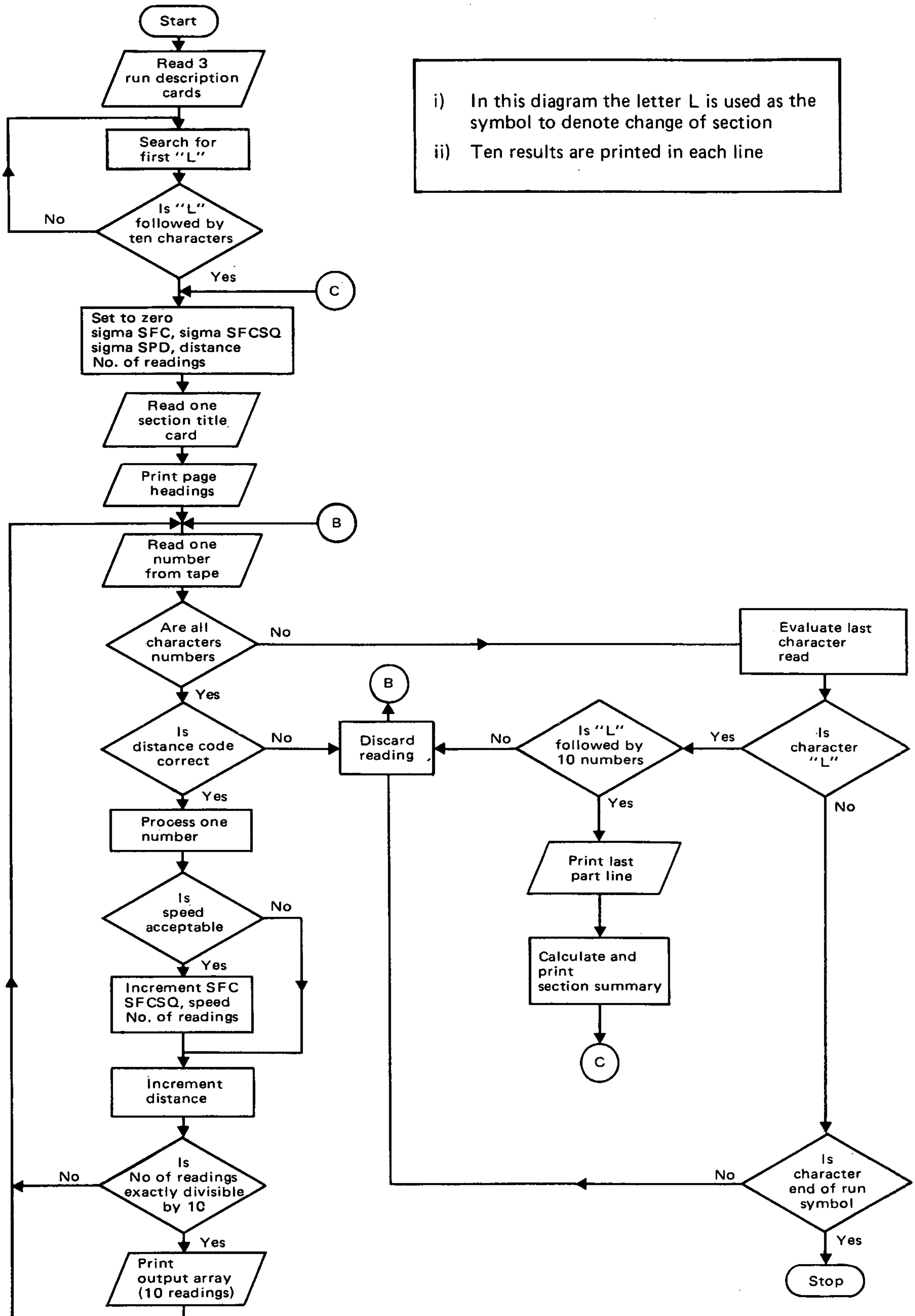

Fig. 3 FLOW DIAGRAM OF TYPICAL COMPUTER PROGRAM

Sideway force coefficient (SFC)

SFC	READINGS	%	READINGS (CUMULATIVE)	% (CUMULATIVE)	Number of results
<0.10	0	0.0	0	0.0	
0.10	0	0.0	0	0.0	
0.11	0	0.0	0	0.0	
0.12	0	0.0	0	0.0	
0.13	0	0.0	0	0.0	
0.14	0	0.0	0	0.0	
0.15	0	0.0	0	0.0	
0.16	0	0.0	0	0.0	
0.17	0	0.0	0	0.0	
0.18	0	0.0	0	0.0	
0.19	0	0.0	0	0.0	
0.20	0	0.0	0	0.0	
0.21	1	0.3	1	0.3	◊
0.22	1	0.3	2	0.5	◊
0.23	3	0.8	5	1.3	◊◊◊
0.24	3	0.8	8	2.0	◊◊◊
0.25	0	0.0	8	2.0	
0.26	6	1.5	14	3.6	◊◊◊◊◊◊
0.27	12	3.0	26	6.6	◊◊◊◊◊◊◊◊◊◊◊◊
0.28	9	2.3	35	8.9	◊◊◊◊◊◊◊◊◊
0.29	27	6.9	62	15.7	◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊
0.30	29	7.4	91	23.1	◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊
0.31	35	8.9	126	32.0	◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊
0.32	29	7.4	155	39.3	◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊
0.33	34	8.6	189	48.0	◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊
0.34	26	6.6	215	54.6	◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊
0.35	31	7.9	246	62.4	◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊
0.36	22	5.6	268	68.0	◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊
0.37	15	3.8	283	71.8	◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊
0.38	12	3.0	295	74.9	◊◊◊◊◊◊◊◊◊◊◊◊
0.39	10	2.5	305	77.4	◊◊◊◊◊◊◊◊◊◊
0.40	8	2.0	313	79.4	◊◊◊◊◊◊◊◊
0.41	7	1.8	320	81.2	◊◊◊◊◊◊◊
0.42	5	1.3	325	82.5	◊◊◊◊◊
0.43	1	0.3	326	82.7	◊
0.44	1	0.3	327	83.0	◊
0.45	1	0.3	328	83.2	◊
0.46	2	0.5	330	83.8	◊◊
0.47	1	0.3	331	84.0	◊
0.48	1	0.3	332	84.3	◊
0.49	0	0.0	332	84.3	
0.50	0	0.0	332	84.3	
0.51	1	0.3	333	84.5	◊
0.52	0	0.0	333	84.5	
0.53	0	0.0	333	84.5	
0.54	0	0.0	333	84.5	
0.55	0	0.0	333	84.5	
0.56	0	0.0	333	84.5	
0.57	1	0.3	334	84.8	◊
0.58	1	0.3	335	85.0	◊
0.59	0	0.0	335	85.0	
0.60	5	1.3	340	86.3	◊◊◊◊◊
0.61	9	2.3	349	88.6	◊◊◊◊◊◊◊◊◊
0.62	17	4.3	366	92.9	◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊◊ ← Resurfaced length
0.63	12	3.0	378	95.9	◊◊◊◊◊◊◊◊◊◊◊◊
0.64	6	1.5	384	97.5	◊◊◊◊◊◊
0.65	4	1.0	388	98.5	◊◊◊◊
0.66	3	0.8	391	99.2	◊◊◊
0.67	2	0.5	393	99.7	◊◊
0.68	1	0.3	394	100.0	◊
0.69	0	0.0	394	100.0	
0.70	0	0.0	394	100.0	
0.71	0	0.0	394	100.0	
0.72	0	0.0	394	100.0	

Fig.4 A HISTOGRAM ANALYSIS OF RESULTS FROM A TEST SECTION

RUNNING CHAINAGE ANALYSIS OF JUNCTION A TO JUNCTION B

* DENOTES SFC LESS THAN 0.20
** DENOTES SFC BETWEEN 0.20 & 0.29
*** DENOTES SFC BETWEEN 0.30 & 0.39
**** DENOTES SFC BETWEEN 0.40 & 0.49
***** DENOTES SFC BETWEEN 0.50 & 0.59
****** DENOTES SFC GREATER THAN 0.59

Distance along road

RATING	LOCATION (KM)	LENGTH (M)	SFC RANGE	MEAN SFC	MEAN SPD
****	0.000- 0.020	20	0.46	0.46	50
*****	0.020- 0.080	60	0.50-0.52	0.50	50
****	0.080- 0.460	380	0.41-0.48	0.45	50
*****	0.460- 0.480	20	0.50	0.50	50
****	0.480- 0.660	180	0.40-0.49	0.45	50
*****	0.660- 0.680	20	0.50	0.50	50
****	0.680- 0.760	80	0.46-0.48	0.46	50
*****	0.760- 0.780	20	0.50	0.50	50
****	0.780- 0.920	140	0.44-0.49	0.45	50
*****	0.920- 0.940	20	0.50	0.50	50
****	0.940- 1.040	100	0.46-0.48	0.47	50
*****	1.040- 1.100	60	0.50-0.51	0.50	50
****	1.100- 1.120	20	0.49	0.49	50
*****	1.120- 1.160	40	0.51	0.51	50
****	1.160- 1.180	20	0.49	0.49	50
*****	1.180- 1.200	20	0.50	0.50	50
****	1.200- 1.220	20	0.47	0.47	50
*****	1.220- 1.240	20	0.50	0.50	49
****	1.240- 1.260	20	0.46	0.46	50
*****	1.260- 1.300	40	0.50-0.52	0.51	50
****	1.300- 1.320	20	0.49	0.49	50
*****	1.320- 1.340	20	0.50	0.50	50
****	1.340- 1.360	20	0.46	0.46	50
*****	1.360- 1.380	20	0.53	0.53	50
****	1.380- 1.400	20	0.49	0.49	50
*****	1.400- 1.420	20	0.50	0.50	50
****	1.420- 1.440	20	0.46	0.46	50
*****	1.440- 1.460	20	0.52	0.52	50
****	1.460- 1.500	40	0.44-0.49	0.46	50
*****	1.500- 1.620	120	0.50-0.54	0.51	50
****	1.620- 1.660	40	0.47-0.49	0.48	50
*****	1.660- 1.680	20	0.52	0.52	50
****	1.680- 1.880	200	0.41-0.48	0.45	50
*****	1.880- 1.920	40	0.50	0.50	50
****	1.920- 2.020	100	0.45-0.49	0.46	50
*****	2.020- 2.040	20	0.51	0.51	50
****	2.040- 2.120	80	0.42-0.49	0.45	50
*****	2.120- 2.180	60	0.50-0.54	0.52	49
****	2.180- 2.220	40	0.49	0.49	49
*****	2.220- 2.340	120	0.51-0.56	0.52	49
****	2.340- 2.380	40	0.48-0.49	0.48	49
*****	2.380- 2.400	20	0.50	0.50	50
****	2.400- 2.440	40	0.48	0.48	50
*****	2.440- 2.660	220	0.50-0.57	0.54	49
****	2.660- 2.680	20	0.49	0.49	51
*****	2.680- 2.940	260	0.50-0.53	0.51	50
****	2.940- 2.980	40	0.49	0.49	48
*****	2.980- 3.380	400	0.50-0.57	0.53	49
****	3.380- 3.560	180	0.41-0.47	0.45	49

Fig.5 A RUNNING CHANGE ANALYSIS OF THE RESULTS FROM A TEST SECTION

SCRIM NODE ANALYSIS
***** **** ********

BOROUGH 19 BROMLEY

NODE NO	NODE DESCRIPTION	APPROACH NODE NO	LAST 4 VALUES SFC BEFORE NODE				MEAN
466	COLLEGE ROAD / LONDON LANE	419	0.54	0.58	0.61	0.61	0.59
467	BURNT ASH LANE / PLAISTOW LANE	466	0.61	0.59	0.63	0.60	0.61
479	CHISLEHURST HIGH STREET / CENTRE COMMON ROAD	500	0.56	0.60	0.62	0.60	0.60
481	CENTRE COMMON ROAD / HEATHFIELD LANE	479	0.73	0.73	0.72	0.73	0.73
482	BROMLEY ROAD / ROYAL PARADE	431	0.59	0.61	0.58	0.61	0.60
		709	0.60	0.56	0.55	0.57	0.57
500	CHISLEHURST HIGH STREET / WILLOW GROVE	504	0.57	0.50	0.51	0.51	0.52
504	RED HILL / ALBANY ROAD	707	0.61	0.61	0.54	0.64	0.60
529	TUBBENDON LANE / CROFTON ROAD	249	0.75	0.75	0.71	0.74	0.74
533	STATION ROAD / SPUR ROAD	529	0.66	0.64	0.71	0.65	0.67
		534	0.65	0.67	0.66	0.62	0.65
534	SPUR ROAD / ORPINGTON BYPASS	152	0.60	0.52	0.59	0.60	0.60
		533	0.65	0.63	0.63	0.61	0.63
543	CHISLEHURST ROAD / GROSVENOR ROAD / WILLETT WAY	572	0.74	0.72	0.70	0.71	0.72
544	CHISLEHURST ROAD / GROSVENOR ROAD	543	0.74	0.77	0.74	0.76	0.75
552	CHISLEHURST ROAD / HIGH STREET	544	0.00	0.00	0.00	0.00	****
556	LOWER ROAD / COURT ROAD	534	0.84	0.83	0.61	0.32	0.33
572	ST PAULS CRAY ROAD / LEESONS HILL	431	0.66	0.66	0.57	0.68	0.67
577	CRAY AVENUE / STATION ROAD	556	0.55	0.62	0.63	0.60	0.60

**** SPEED BELOW ACCEPTABLE LIMIT

Fig.6 A LISTING OF THE TERMINATIONS (NODES) OF ROAD SECTONS (LINKS)
(Reproduced by courtesy of the Greater London Council)

13 02 75

SCRIM EVENT ANALYSIS
***** ***** ********

BOROUGH 19 BROMLEY DATE: 18 12 74

EVENT CODE 1 = JUNCTION TO LEFT. 2 = CROSS ROADS. 3 = JUNCTION TO RIGHT. 4 = DEVIATION FROM TRACK. 5 = PEDESTRIAN CROSSING. 6 = PELICAN CROSSING. 7 = ROUNDABOUT. 8 = TRAFFIC LIGHTS. 9 = UNALLOCATED.

LINK NO	LINK DESCRIPTION	EVENT	SEQ NO	SFC LAST 4 VALUES BEFORE EVENT				MEAN
361 - 317	ELMERS END ROAD	6	38	0.66	0.67	0.65	0.61	0.64
366 - 323	CROYDON ROAD BECKENHAM	5	3		0.59	0.68	0.67	0.64
332 - 397	HIGH STREET BROMLEY	5	43	0.61	0.58	0.64	0.57	0.60
		5	54	0.67	0.54	0.53	0.47	0.55
428 - 354	BICKLEY PARK ROAD- SUMMER HILL - BROMLEY RD	9	73	0.49	0.64	0.62	0.56	0.57
412 - 361	ANERLEY ROAD	5	8	0.67	0.70	0.61	0.70	0.67
361 - 436	CROYDON ROAD PENGE	5	43	0.63	0.63	0.64	0.63	0.63
702 - 361	CROYDON ROAD PENGE	5	37	0.64	0.69	0.68	0.65	0.66
366 - 362	BECKENHAM ROAD	5	33	0.55	0.57	0.56	0.51	0.54
362 - 413	BECKENHAM ROAD	5	21	0.81	0.78	0.82	0.54	0.73
		5	54	0.63	0.60	0.59	0.55	0.59
367 - 366	HIGH STREET BECKENHAM	5	17	0.84	0.84	0.85	0.80	0.83
368 - 367	HIGH STREET BECKENHAM	5	5	0.54	0.58	0.52	0.60	0.56
416 - 372	SOUTHEND ROAD	5	16	0.69	0.69	0.70	0.65	0.68
384 - 376	BROMLEY ROAD	1	120	0.51	0.53	0.58	0.51	0.53
		5	137	0.58	0.50	0.54	0.59	0.55
391 - 384	BECKENHAM LANE	5	62	0.72	0.73	0.71	0.68	0.71
		8	73	0.77	0.77	0.78	0.67	0.74

Fig.7 A LISTING OF DIFFERENT TYPES OF EVENT AND THEIR SFC VALUES
(Reproduced by courtesy of the Greater London Council)

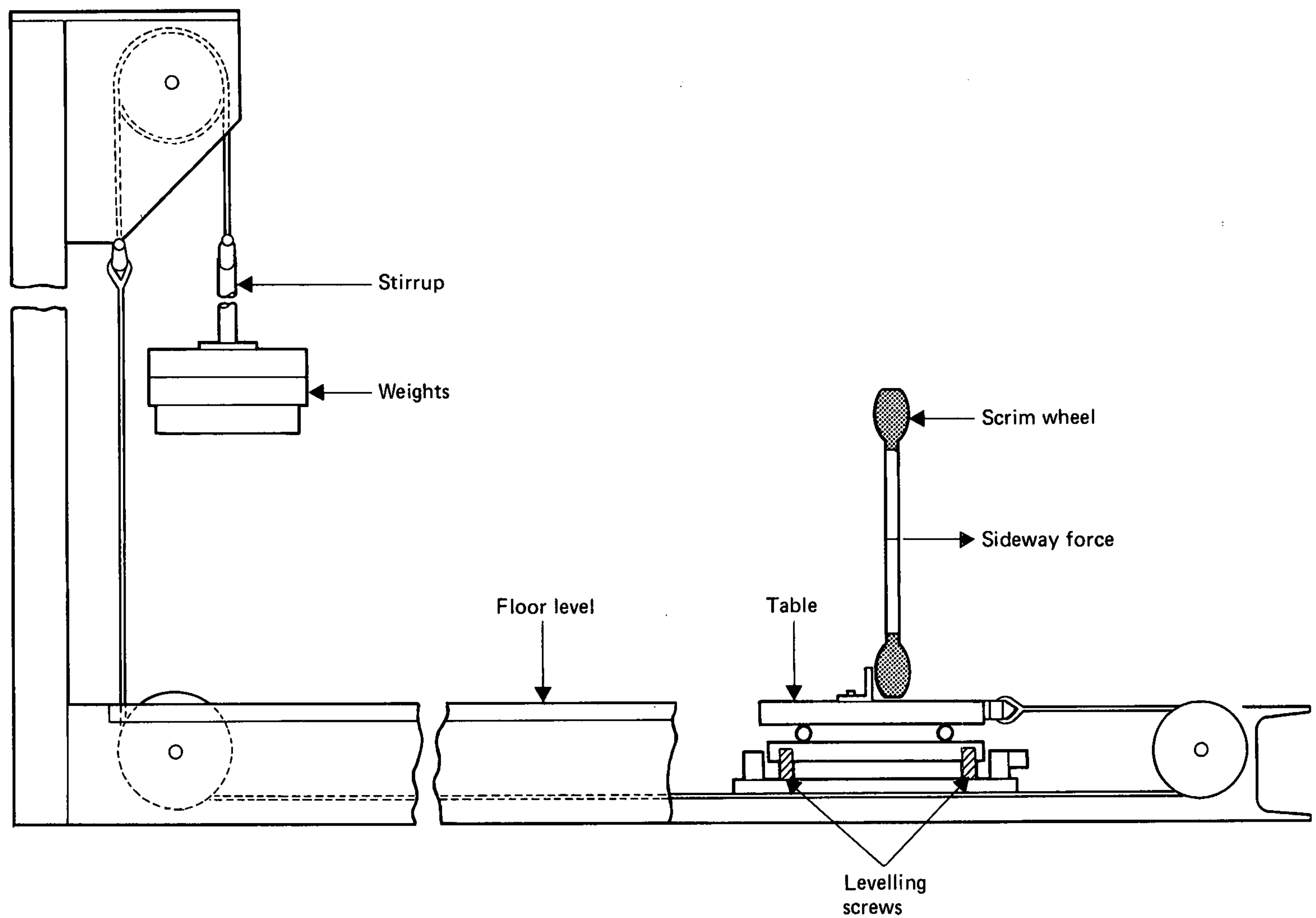

Fig. 8 DIAGRAM ILLUSTRATING THE ROLLING-TABLE METHOD OF CALIBRATION

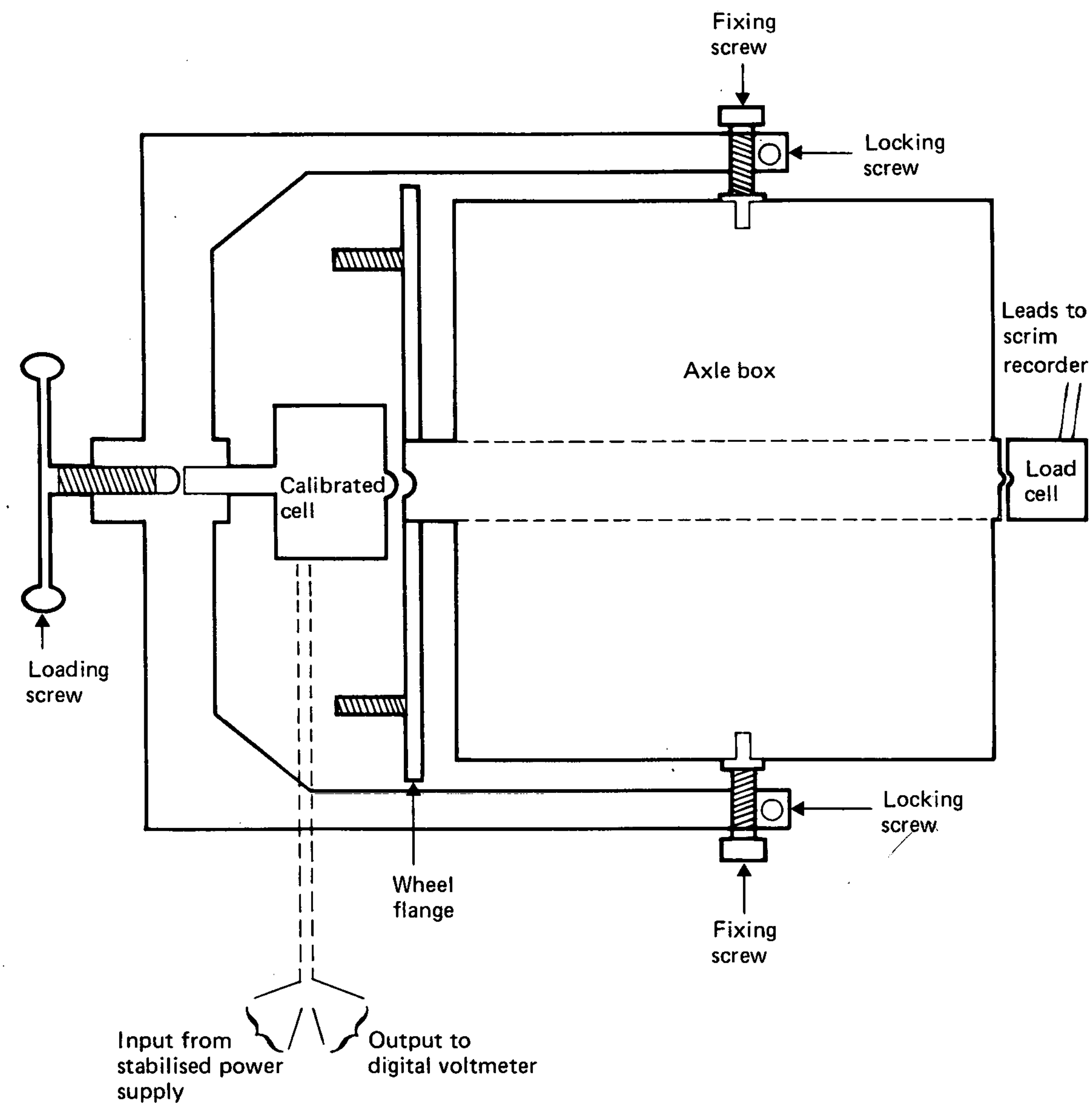

Fig. 9 DIAGRAM ILLUSTRATING THE ELECTRONIC METHOD OF CALIBRATION

Neg No B1418/70

PLATE 1. SCRIM with covers removed to show the test wheel

(1667) Dd209447 2M 11/76 HPLtd So'ton G1915
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This report outlines the basic principles underlying the design of SCRIM, describes the vehicle, test wheel, recording system and water supply and discusses ways in which the results can be analysed.

Causes of variation in SFC measured by SCRIM are discussed in relation to both research work and the monitoring of roads for maintenance purposes and methods are recommended that will keep variation to a minimum; these include the use of 'mean summer values', averaging results over at least 5 readings wherever possible and frequent calibration checks.

An Appendix gives details of recommended calibration procedures.

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