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AN EXPERIMENT TO INVESTIGATE ROLLED ASPHALTS WITH CRUSHED-ROCK FINE AGGREGATE: A303 MERE, WILTSHIRE

by

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ABSTRACT

The use of crushed-rock fine aggregates in rolled-asphalt wearing-courses has produced mixtures with a good road performance but these materials can be difficult to lay and compact particularly in adverse weather conditions. To improve the workability, asphalts can be made with softer binders than the more usual 50 pen grade bitumen.

This report describes the laying of 12-experimental sections of asphalt, each 100 m long, made with 200, 100 and 50 pen grade bitumens with a range of binder contents, on Trunk Road, A303 at Mere, Wiltshire in November 1982.

1. INTRODUCTION

The use of crushed-rock fine-aggregate is permitted in the specifications for hot rolled asphalt wearing-course but its sole use without blending with sand is virtually excluded by the requirement that the stockpile material must not contain more than 5 per cent by mass passing the 75 μm BS sieve. The advantages of crushed rock are that it can produce mixtures with a higher resistance to deformation than sand fine aggregate and in some areas, particularly where there is no locally available asphalt sand, it is economically attractive.

Independently of the virtual exclusion from BS 594, a provisional specification for rolled asphalt wearing course with all-crushed-rock fine-aggregate was introduced in Clause 2801 of the Department of Transport's "Specification for Road and Bridge Works"[1] in 1976. The main differences from BS 594 were that the grading of the fine aggregate in the stockpile permitted the use of most crushed-rock fine-aggregates as produced but because of the high resistance to embedment, the rate of spread of chippings was reduced to 7.5 ± 1 kg/m^2 for 14 mm nominal size and 9.5 ± 1 kg/m^2 for 20 mm nominal size. Subsequently in Clause 2809 issued in Departmental Standard HD/2/79[2], provision was made for the crushed-rock asphalt to be designed using the Marshall Test in accordance with the procedure given in Section 3 of BS 594:1973. Limits on the Marshall Test results related to traffic intensity were included in this Clause.

Although this material has often been used successfully[3] it has been found that the rough texture of the fine aggregate can reduce the workability of the asphalt to an unacceptable level in adverse weather conditions. To improve the workability and ease of compaction Clause 2809 permits the use of a binder content up to 0.75 per cent of total mix above the design optimum value. However with 50 grade bitumen even this concession is not sufficient to produce adequate workability under the most severe conditions. Laboratory design tests suggest that when markedly softer bitumens are used, such as 100 and 200 pen grades, the test criteria required by Departmental Standard HD/2/79[2] can be met even at binder contents above the optimum.

This report describes the laying of experimental surfacings to examine the performance of rolled-asphalt wearing-courses made with crushed-rock fine-aggregate and containing a range of binder contents and a range of binder viscosities.

2. SITE OF THE EXPERIMENT

The site of the experiment shown in Fig 1, is a 1200 m length of two-lane, single carriageway on Trunk Road A303 just east of the dual-carriageway section of Mere by-pass (Map ref ST 826328). A traffic count on 26 April 1983 indicated that the total number of vehicles per day in each direction was 3500 of which 750 were commercial vehicles.

Just before the experimental surfacings were laid the existing twelve-year-old asphalt surfacing, approximately 40 mm thick, was removed. At the western end of the site there is about 600 m of level road but the remaining 600 m is on a gradient of about 4 per cent.

Cores taken from the old road indicated that for the most part the underlying material was dense bituminous surfacing but in some areas there was evidence of lean concrete having been used as the road base.

3. SCOPE OF THE EXPERIMENT

The purpose of the experiment was to examine the performance of rolled-asphalt wearing-courses made with all crushed-rock fine-aggregate containing a range of binder contents and a range of binder viscosities. The binders chosen were a standard 50 pen grade bitumen, together with 100 and 200 pen grade bitumens aimed at improving workability. The retention of adequate stability was one of the factors in doubt with the softer binders and it was anticipated that the 200 pen grade bitumen would be adequate at this site at certain binder contents but might lead to deformation on more heavily-trafficked roads. The layout of the experimental sections is shown in Fig 2.

The proposed coarse aggregate was a 14 mm nominal size basalt from Moon's Hill Quarry, near Shepton Mallet, Somerset; the fine aggregate was a blend of 15 parts of the same basalt with 85 parts of a sandstone also obtained from the same quarry.

Asphalts containing these aggregates were designed before the laying of the experimental asphalts in accordance with the proposed procedure given in the revision of BS 594: 1973 and the complete mixture tested contained 30 per cent of coarse aggregate. The results indicated that each of the binders produced asphalts with an optimum binder content of 6.5 per cent and that all had a suitable Marshall stability for this site. These ranged from 11.0 kN for the 200 pen bitumen to 14.3 kN for the 50 pen grade bitumen. Subsequently verification tests were made using constituents actually used for the experiment and these are reported later.

The following asphalts were laid 40 mm thick in sections 100 m long the full width of the 7.5 m wide, two lane single carriageway:

(a) *Three sections (1 to 3) with 200 pen grade bitumen.* Specified binder contents: 6.5, 7.5 and 8.5 per cent.

(b) *Six sections (4 to 9) with 100 pen grade bitumen.* Specified binder contents: 6.0, 6.8, 7.5, 8.3, 9.0 and 9.8 per cent.

(c) *Three sections (10 to 12) with 50 pen grade bitumen.* Specified binder contents: 6.5, 7.5 and 8.5 per cent. The mixture containing 8.5 per cent of 50 pen bitumen had been used successfully at other sites within the county and could therefore be considered as a control.

Coated chippings of 20 mm nominal size were spread at the rate specified in Clause 2801 of the Specification for Road and Bridge Works viz. 9.5 ± 1 kg/m^2. The chippings were specified to have a polished stone value of 59 or more and the chippings selected were a sandstone (psv = 60) from Nash Rocks Quarry, Presteign, Hereford and Worcester.

Samples for testing of the aggregates and binders used for the experimental surfacings were taken from the hot storage bins and storage tanks respectively. The properties of the constituent materials and the design mixes were determined and are reported later.

4. MIXING AND LAYING

Mixing and laying of the experimental asphalts was started on 15 November 1982 and continued, with some interruptions, until 24 November. The materials were mixed on a Parker Starmix plant at Moons Hill Quarry, Stoke St Michael near Shepton Mallet, Somerset some 20 miles from the site and laid by a separate contractor, RMC Ltd, using a Blaw Knox paver. Two 3-point steel rollers were used, an 8–10 ton followed by a 10–12 back roller.

Laying started on the north side (eastbound lane) of the road with two loads of asphalt, each about 19 tonnes, for the 100 m length of Section 1N. This was immediately followed by a similar quantity of material for Section 2N. When these materials had cooled sufficiently surface texture measurements were made using the sand patch method[4].

At the same time cores, 200 mm in diameter were taken for subsequent measurements of density and for Wheel-tracking Tests to assess resistance to deformation. By this time the temperature of the surfacing was low enough to take traffic and asphalts to the same specification had been delivered for corresponding sections on the south (westbound) side of the road. The total length of the two sections on the southside were made to be the same as those on the north so that overnight there was only one transverse ramp across the full width of the road. For the most part this pattern of working was followed throughout the rest of the construction.

Air temperatures were mostly close to 10°C as shown in Table 1 and the weather was changeable; some very heavy rain occurred on a few occasions. During the laying of Section 8S, the rainfall was so heavy that work had to be stopped. Because the direction of work was upwards on the gradient, large quantities of water flowed into the asphalt causing premature cooling and clouds of condensed water vapour.

On many days there was little or no wind with velocities in the range 2 to 15 km/h (Table 1) but for parts of Section 12 which was 160 m long and had to be laid in three rips, wind velocities reached a maximum of 30 km/h. Except when the work was flooded on Section 8S, there were no difficulties of workability under these conditions: the material appeared to be well compacted and the coated chipping embedded easily when rolled. However, fretting did subsequently occur over the last 5 m of Section 11S and the first 5 m of the adjacent Section 12S. It appeared that these materials, which contained 50 pen grade bitumen, were less workable, were too cool when rolled and were not easily compacted. This junction of the two Sections was at the exit to a lay-by and so the degree of fretting may have been enhanced by sharply turning traffic leaving the parking area.

When laid and trafficked none of the asphalts looked unduly rich or unduly dry even though the binder contents ranged from specified values of 6.0 to 9.8 per cent in the asphalts containing 100 pen grade bitumen. The first 10 m of Section 1N which was the first material to be laid, was very cool by the time it was rolled,

TABLE 1

A303 Mere: laying conditions

Section number	Date laid	Air temperature – °C	Wind velocity – km/h	Comments
1N 2N 1S 2S	15.11.82	7°C	2–15	Dry, cool and sunny. Road level. Dry, cool and sunny. Road level. Dry, cool and sunny. Road level. Dry, cool and sunny. Road level.
3N 4N 3S 4S	16.11.82	10°C	0–4	Overcast, drizzle. Road level. Heavier rain. Drizzle. Some ponding of water before gulley.
5N 6N 5S 6S	17.11.82	10°C	2–15	Dry cool. Gradient of road increasing. Wind at upper end of range. Chipper gate wide open but rate light.
7N 8N 7S 8S	18.11.82	11°C	4–15	Back chipping to increase rate of spread on gradient Slight drizzle soon after laying started. Very heavy rain flooding work. Laying stopped.
9S 9N	19.11.82	10°C	6–20	Dry, sunny at first, rain later. New chip spreader. Wind velocity at high end of range. Road wet.
10N 11N 10S 11S	22.11.82	6°C	3–16	Dry, sunny, cool. Light breeze 3–6 km/h. Wind velocity increasing. Some contaminated chippings at end of section.
12N 12S	24.11.82	6°C	0–31	Cloudy at first. Centre rip also laid. Wind and rain increasing towards end of section.

partly because the delivery temperature of the asphalt was relatively low (135°C) and partly because of the usual delays at the start of laying. The following day there was a considerable loss of chippings and subsequently this small area was replaced.

The changeable wet weather led to marked changes in the moisture content of the fine aggregate and this produced variable mixing temperatures, as shown in Table 2, that ranged from 140 -190°C and to variable filler contents because the fluctuations in the amount of dust extracted from the drier. Table 2 also shows that laying and rolling temperatures were affected and this was partly responsible for the variability in texture depths which ranged from 1.0 to 1.8 mm (Table 3). However some difficulty was experienced in metering the chippings from one spreader and this had to be replaced. This is reflected in the rates of spread of chippings (Table 3) which ranged from 7.7 to 12.5 kg/m^2.

TABLE 2

A303 Mere: mixing, laying and rolling temperatures of rolled asphalt

Section Number	Penetration grade of bitumen	Specified binder content – per cent	Temperature – ^{o}C		
			Mixing	Laying	Rolling
1N	200	6.5	150–155	135–140	100–120
1S	200	6.5	140–160	140–145	100–120
2N	200	7.5	155–160	150–160	115–130
2S	200	7.5	150–155	145	100–125
3N	200	8.5	140–175	135–170	110–135
3S	200	8.5	155–180	140–180	120–135
4N	100	6.0	170–185	160–180	130–140
4S	100	6.0	160–175	140–165	135–150
5N	100	6.8	165–170	120–165	110–140
5S	100	6.8	170–190	175–190	120–165
6N	100	7.5	160–185	170–180	135–150
6S	100	7.5	150–170	150–170	125–135
7N	100	8.3	165–170	155–170	125–135
7S	100	8.3	165–170	155–170	125–140
8N	100	9.0	155–160	135–150	110–130
8S	100	9.0	150–175	150–155	125–140
9N	100	9.8	170–180	160–170	125–150
9S	100	9.8	160–175	160–170	120–145
10N	50	6.5	155–185	150–165	130–150
10S	50	6.5	160–180	150–170	120–150
11N	50	7.5	145–160	145–155	125–140
11S	50	7.5	160–175	155–170	130–150
12N	50	8.5	150–160	150–160	120–145
12S	50	8.5	160–190	170–190	130–150

5. ANALYSIS AND COMPOSITION

Samples of the constituent materials were taken at the plant during the manufacture of the experimental surfacings. Samples of the binders taken from the storage tanks showed that the 50 pen grade bitumen had a penetration of 42 and a softening point (R&B) of 54^{o}C. The nominal 100 pen grade bitumen had a penetration of 72 and a softening point of 45^{o}C while the 200 pen grade binder had a penetration of 172 and a softening point of 38^{o}C. Although all three binders had penetrations near or below the minimum specified for the grade the range covered is sufficiently wide for conclusions to be drawn from the road performance.

The gradings of the coarse and fine aggregate are given in Table 4 together with values of their relative densities. The grading of the coarse aggregate complied with the specification but on analysis of the mixed material it contained 21 per cent of material passing 10 mm BS sieve (specification 0–60), compared with only 2 per cent measured on the stockpile. Other work suggests that this should have little or no effect on performance. The grading of the fine aggregate was slightly finer than the specification with 64 per cent (standard deviation = 3) passing 600 μm BS sieve compared with the 30–60 per cent specified.

TABLE 3

A303 Mere: rate of spread of chippings and texture depth

Section Number	Rate of spread of chippings – kg/m²	Texture depth (sand-patch method) – mm	
		Across 50 m diagonal	Nearside wheel-track
1N	10.7	1.4	1.1
1S	9.9	1.2	1.3
2N	10.2	1.5	1.5
2S	9.7	1.3	1.3
3N	9.8	–	–
3S	11.1	1.3	1.3
4N	10.8	–	–
4S	11.1	1.3	1.3
5N	10.6	1.2	1.5
5S	9.2	1.0	1.0
6N	11.4	1.3	1.4
6S	8.5	1.2	1.3
7N	7.7	1.5	1.3
7S	8.8	1.1	1.2
8N	8.8	1.6	1.5
8S	10.2	1.1	1.4
9N	11.3	1.5	1.7
9S	12.5	1.6	1.5
10N	10.7	1.4	1.7
10S	11.3	1.6	1.7
11N	11.4	1.6	1.5
11S	11.5	1.8	1.8
12N	11.1	1.6	–
12S	11.1	–	–
Mean	10.39	1.39	1.42
Standard deviation	1.15	0.21	0.21

5.1 Analysis of road samples

Samples of each of the experimental asphalts were taken from the screws of the paver and a compositional analysis was made. The results, given in Table 5, show that on average the binder contents were about 0.5 per cent of total mix lower than the specified values. The values are consistently different from that specified and so the binder contents shown in Fig 2 are nominally the values found as well as the values specified.

TABLE 4

A303 Mere: grading and relative density of aggregates

Coarse aggregate (basalt)				Fine aggregate (blend of 85 per cent sandstone and 15 per cent basalt)		
BS sieve size	Per cent by mass passing			BS sieve size	Per cent by mass passing	
	Stockpile	On analysis	Specified		Stockpile	Specified
28 mm	100	100	100	6.3 mm	100	100
20 mm	100	100	85–100	2.36 mm	93	80–100
14 mm	87	93	0–100	1.18 mm	79	–
10 mm	2	21	0–60	600 μm	64	30–60
6.3 mm	0	12	–	425 μm	52	–
				300 μm	38	–
				212 μm	27	12–30
				150 μm	19	–
				75 μm	9.9	0–15
Apparent relative density		2.76			2.69	
Relative density on an oven-dried basis		2.65			–	

The filler contents are also significantly different from the 9 per cent specified. The value found on analysis was adjusted in accordance with Table 18 of BS 594:1973 to the specified stone content of 30 per cent and the adjusted value ranged from 5.4 to 9.2 per cent, averaging 7.5 per cent ie 1.5 per cent below the specified value. The average stone content was 31 per cent and with three exceptions the values were within the permitted tolerance of ± 5 per cent.

6. LABORATORY TESTS

The laboratory tests were divided into two groups. The first was an assessment of the resistance to tracking of cores taken from the experimental surfacings immediately after they had been laid. The second was a verification of the mix design using the actual materials obtained for the manufacture of the experimental asphalts.

6.1 Wheel-tracking Tests

Wheel-tracking Tests (45°C)[5] were made on cores 200 mm in diameter and the results are shown in Fig 3. The three asphalts containing 50 pen grade bitumen and binder contents between 6 and 8 per cent all had similar low rates of tracking of between 1 and 2 mm/h. The cores with 100 pen bitumen which had a wider range of binder contents (6 to 9 per cent) were more sensitive to changes in binder content. At the lowest binder content tested, 5 per cent, the rate of tracking was about 2 mm/h and with 9 per cent of bitumen the rate was 11 mm/h. The asphalts containing 200 pen bitumen had rates of tracking that were even more sensitive to changes in binder content than those containing 100 pen bitumen and the mixture containing 8 per cent of 200 pen

TABLE 5

A303 Mere: results of compositional analysis

Section Number	Specified binder content per cent & (penetration)	Found on analysis per cent by mass			Adjusted to 30 per cent coarse aggregate per cent	
		Coarse aggregate ret. 2.36 mm	Filler passing 75 μm	Binder	Filler (Spec.9.0)	Binder
1N	6.5 (200)	28.8	9.3	6.4	9.2	6.3
1S	6.5 (200)	28.5	7.0	6.1	6.8	5.9
2N	7.5 (200)	30.4	5.4	7.0	5.4	7.0
2S	7.5 (200)	37.5	8.0	6.3	8.8	7.1
3N	8.5 (200)	28.6	9.3	7.8	9.2	7.7
3S	8.5 (200)	30.5	7.3	7.9	7.4	8.0
4N	6.0 (100)	26.8	7.8	5.6	7.5	5.3
4S	6.0 (100)	29.6	7.6	6.0	7.6	6.0
5N	6.8 (100)	36.6	6.3	5.8	7.0	6.5
5S	6.8 (100)	30.9	7.0	6.3	7.1	6.4
6N	7.5 (100)	31.2	6.5	6.9	6.6	7.0
6S	7.5 (100)	30.3	7.7	6.8	7.7	6.8
7N	8.3 (100)	32.1	6.7	7.5	6.9	7.7
7S	8.3 (100)	32.4	6.5	7.4	6.7	7.6
8N	9.0 (100)	32.0	6.8	8.2	7.0	8.4
8S	9.0 (100)	34.7	7.8	7.8	8.3	8.3
9N	9.8 (100)	28.3	6.4	9.2	6.2	9.0
9S	9.8 (100)	31.4	6.7	9.0	6.8	9.1
10N	6.5 (50)	32.6	7.9	5.8	8.2	6.1
10S	6.5 (50)	30.8	7.7	6.0	7.8	6.1
11N	7.5 (50)	27.6	8.0	6.9	7.8	6.7
11S	7.5 (50)	35.0	8.3	6.7	8.8	7.2
12N	8.5 (50)	24.7	8.8	8.3	8.3	7.8
12S	8.5 (50)	35.5	6.3	7.6	6.9	8.3
Mean	7.70 –	31.12	7.38	7.05	7.50	7.18
Standard deviation	– –	3.14	0.98	–	0.96	–

bitumen had a rate of tracking comparable with that of asphalts containing 9 per cent of 100 pen bitumen. It has been shown[6] that in order for traffic to produce an average rut depth of less than 0.5 mm per year the rate of tracking should be less than

$$\frac{14000}{C+100} \text{ mm/h}$$

where C is the number of commercial vehicles per lane per day. Thus none of the asphalts in this experiment is expected to fail by deformation in the next 20 years, under the present levels of traffic.

6.2 Marshall Tests

Samples of the constituent aggregates and binders were obtained at the time of manufacture of the full-scale experimental asphalts and were used for making three series of Marshall Test specimens. These tests were carried out in accordance with the draft procedure that has been proposed for the revision of BS 594:1973 ie complete mixtures, including coarse aggregate, were tested. The results of these tests are shown in Fig 4 where the influence of the three grades of binder, 50, 100 and 200 pen bitumen are shown.

These mixtures were intended to represent the materials as laid and did not therefore contain any additional filler to that naturally present in the blend of fine aggregates. This was 6 per cent instead of the 9 per cent specified. When mixed, the materials were very tolerant of changes in binder content; mixtures with only 5 per cent of bitumen coated easily and the rich mixes with 10 per cent bitumen were not unduly mobile. This effect was also observed in the materials (with 5.5 to 9.0 per cent bitumen) laid on the road. This tolerance to binder content led to results which when plotted graphically did not give such clearly defined peaks for stability and density as are normally obtained for rolled asphalt wearing-courses.

The results given in Fig 4 and summarised in Table 6 show that the optimum binder content was about 7.5 per cent for all three grades of binder. (Observers of the full-scale materials judged this to be the best asphalt laid, solely for visual appearances). The most important differences between the mixtures was the Marshall stability. At optimum binder content these were 13.2 kN for the asphalts made with 50 pen grade bitumen, 10.3 kN for 100 pen and 6.7 kN for 200 pen. These mixes were made from a blend of stockpile coarse and fine aggregates and as previously stated this resulted in a filler content of 6.0 per cent of the total mix. This is lower than the average value, 7.5 per cent, found on analysis of road samples but is within the range (5.4 to 9.2 per cent) found for individual sections of asphalt.

TABLE 6

A303 Mere: design test results

Criteria	Optimum binder content – per cent by mass of total mix			
	200 pen	100 pen	50 pen	100 pen with specified filler content
Stability	7.5	7.7	7.2	6.0
Mix density	8.7	8.1	8.2	6.7
Aggregate density	6.5	6.8	6.8	5.8
Mean	7.6	7.5	7.4	6.2
Properties at optimum binder content				
Marshall stability – kN	6.7	10.3	13.2	12.8
Flow value – mm	3.3	4.2	4.2	4.4
Marshall quotient – kN/mm	2.03	2.45	3.14	2.91
Void content – per cent	4.8	3.8	3.8	3.6

In order to assess the effect of filler content, resulting from this wide range, the design procedure was repeated for asphalts made with added filler to produce the specified value of 9.0 per cent in the complete mix; this was with 100 pen grade bitumen. (This composition was similar to the one used before the experiment was started in order to assess the range of binder contents that should be used and which indicated an optimum binder content of 6.5 per cent). The mixtures with 9 per cent of filler appeared to be more sensitive to changes in binder content than those with 6 per cent; at low binder contents it was more difficult to coat the aggregate with binder during mixing and at high binder contents the mixtures were much more mobile.

The results of these design tests are given in Fig 5 where they are compared with those obtained for mixtures containing 6.0 per cent of aggregate passing 75 μm BS sieve and 100 pen grade bitumen. The results are also summarised in Table 6 and those show that the mixtures with the specified (higher) filler content have the lower optimum binder content, ie 6.2 per cent compared with 7.5 per cent for the mixture with the lower filler content of 6 per cent. They also have a higher Marshall stability (12.8 kN compared with 10.3 kN). At optimum binder content the void contents of about 3.7 per cent are similar as are the flow values at about 4.3 mm.

These results suggest that at the average filler content of 7.5 per cent, the optimum binder content should be about 7 per cent. The minimum binder content used on the road for the 50 pen and 200 pen materials was intended to be the design optimum value because previous experience had suggested that a more reliable performance could be achieved at binder contents above this value. However because the found binder and filler contents were lower than the specified values the binder contents on the road equally span the design optimum. It is therefore anticipated that some of the drier mixtures will fret in service.

7. METHODS OF ASSESSMENT

One of the primary objects of the full-scale experiment was to produce asphalts that could be laid and compacted in adverse weather conditions. Measurements of cores taken immediately after laying suggest that adequate compaction for impermeability, durability and resistance to deformation was achieved for the major part of the work. However, one or two small areas, previously described, at the beginning or end of a day's work were not satisfactory.

Although workability is an important property it is equally necessary for a road surfacing to perform satisfactorily for the whole of its life of, say, 20 years.

To measure this performance, the rut depth in the wheel-tracks, the texture depth and the resistance to skidding will be measured at regular intervals of time. Other conditions such as fretting and cracking cannot be quantified by these measurements and so they will be supplemented periodically by visual assessments of the condition of the surfacings made by the Panel for the Inspection of Full-scale Road Experiments.

8. ACKNOWLEDGEMENTS

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9. REFERENCES

1. DEPARTMENT OF TRANSPORT. Specification for road and bridge works, London 1976 (Her Majesty's Stationery Office).

2. DEPARTMENT OF TRANSPORT. Specification for road and bridge works. Rolled asphalt wearing course. *Departmental Standard* HD/2/79. London 1979 (Department of Transport).

3. JACOBS, F.A. The performance of asphalt wearing courses containing crushed-rock fine aggregate: A30 Blackbushe (1962). *Department of the Environment. TRRL Laboratory Report* 648. Crowthorne 1974 (Transport and Road Research Laboratory).

4. DEPARTMENT OF TRANSPORT. Specification for road and bridge works. Texture depth of bituminous surfacings for high speed roads. *Departmental Standard* HD/3/80. London 1980 (Department of Transport).

5. JACOBS, F.A. Hot rolled asphalt: effect of binder properties on resistance to deformation: *Department of the Environment, Department of Transport. TRRL Laboratory Report* 1003. Crowthorne 1981 (Transport and Road Research Laboratory).

6. SZATKOWSKI, W.S. and F.A. JACOBS. Dense wearing courses in Britain with high resistance to deformation. *Colloquium 77, Plastic deformability of bituminous mixes.* Zurich 1977, pp 65–77 (Institut fur Strassen Eisenbahn and Felsbau an der Eidgenossischen Technischen Hochschule, Zurich).

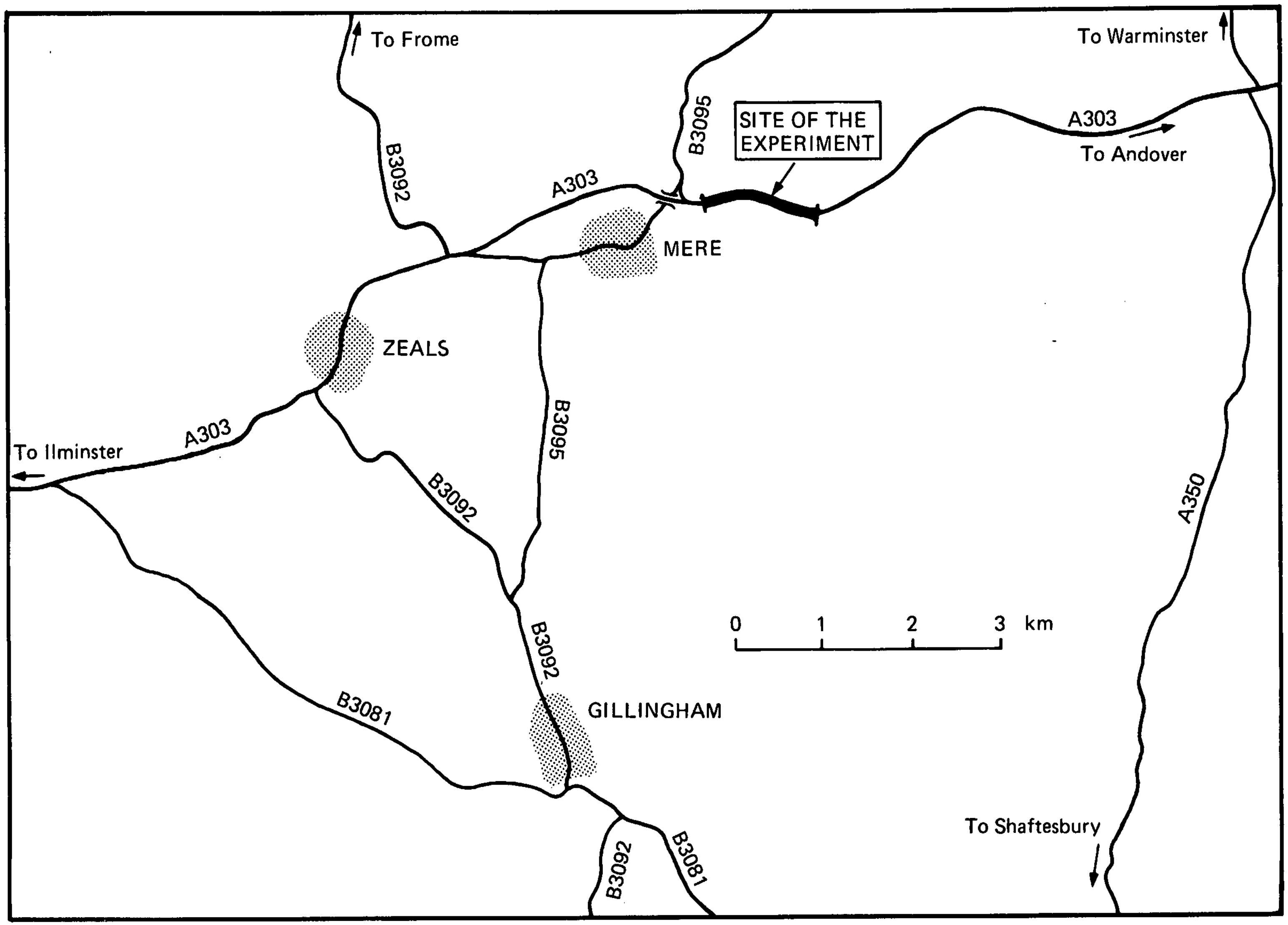

Fig. 1 A303 MERE:1982 site of the experiment

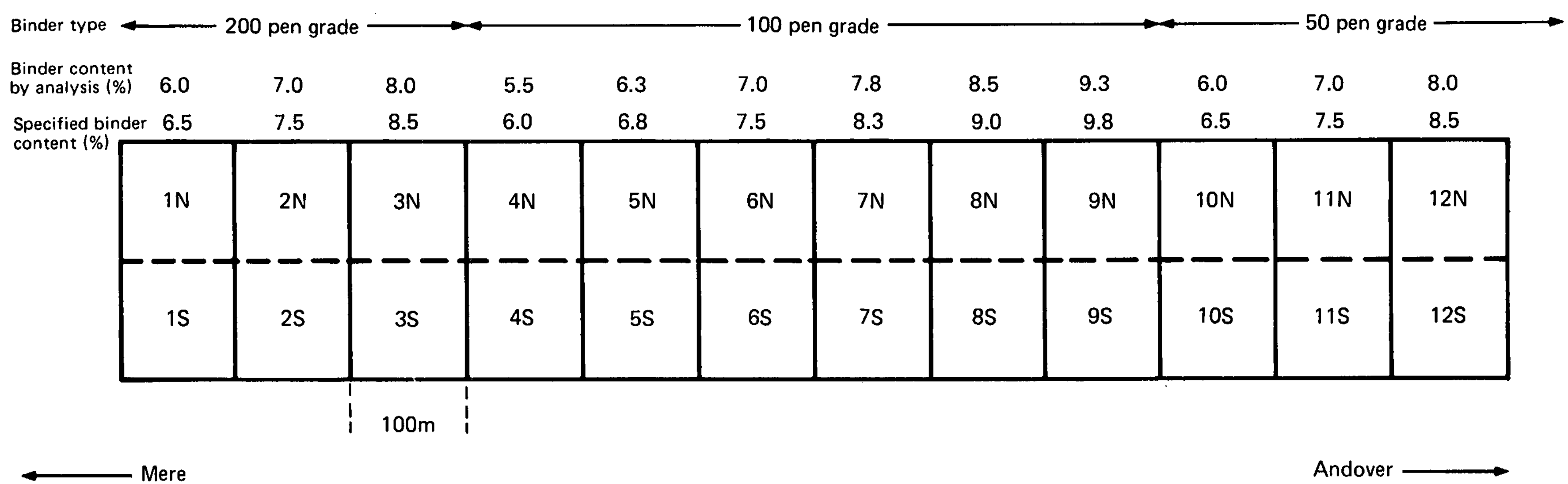

Fig. 2 A303 MERE 1982 : Layout and composition of experimental sections of rolled asphalt containing crushed rock fine aggregate

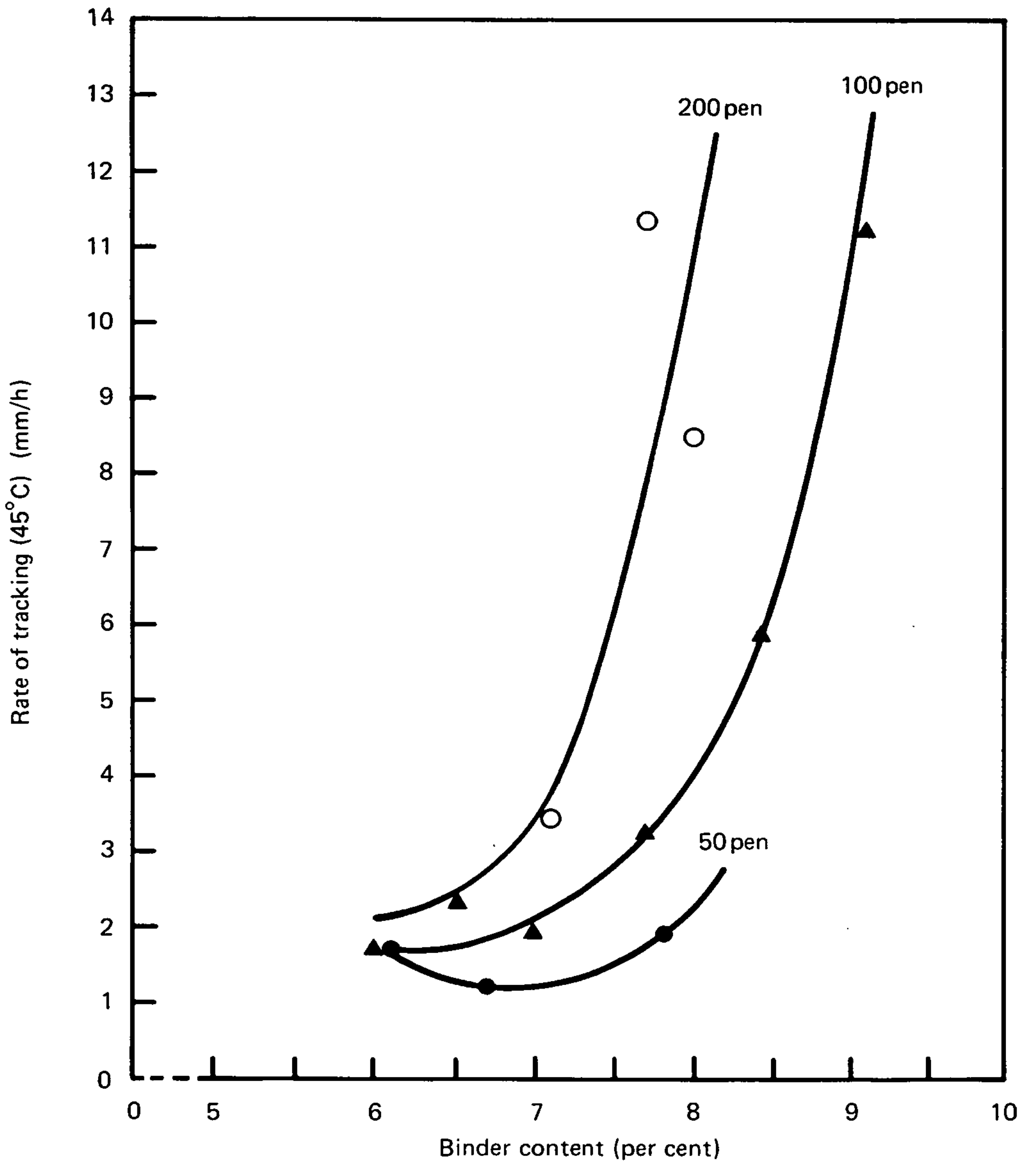

Fig. 3 A303 Mere: rate of tracking of cores taken from the experimental asphalts

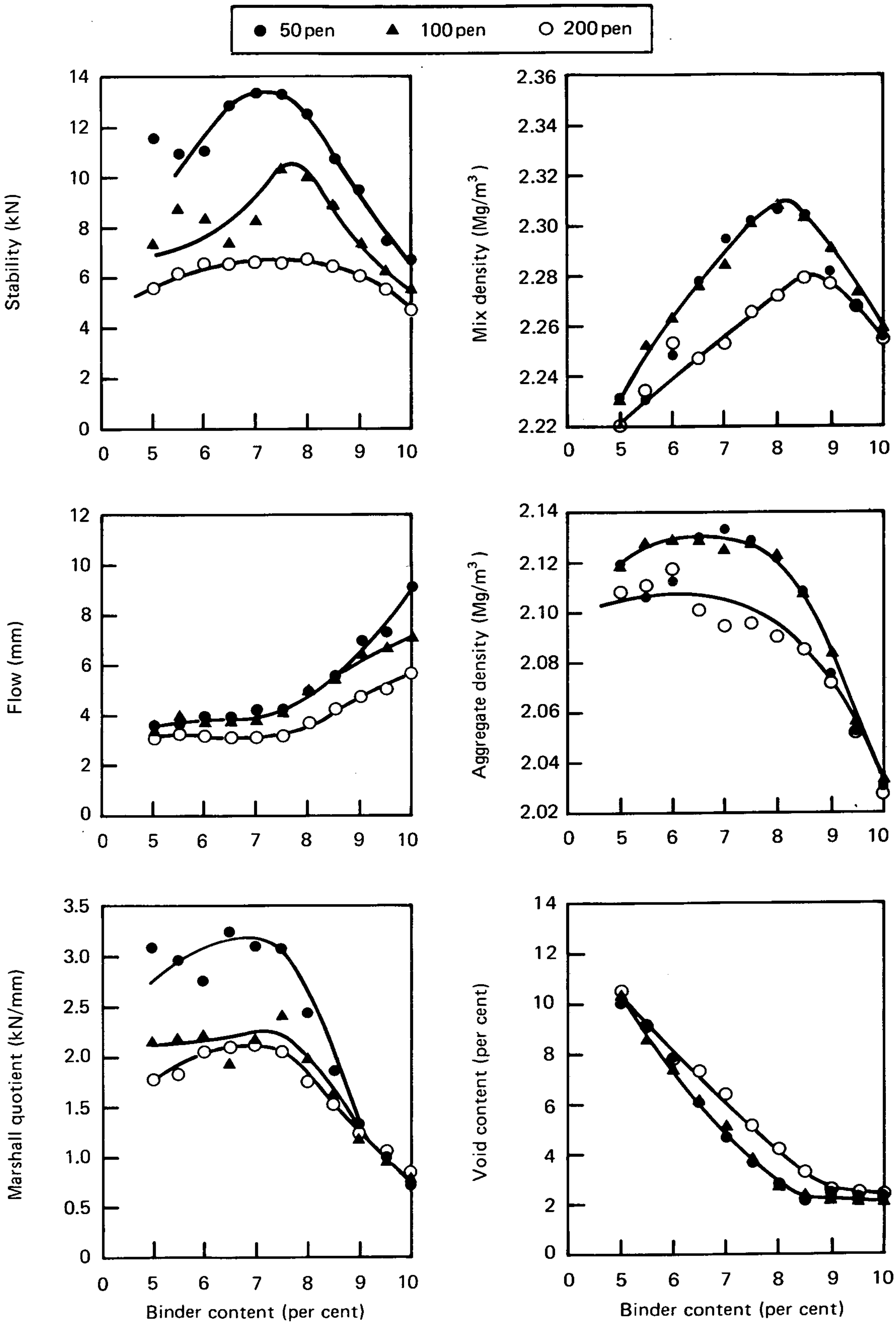

Fig. 4 A303 Mere: design of experimental asphalts using Marshall Test

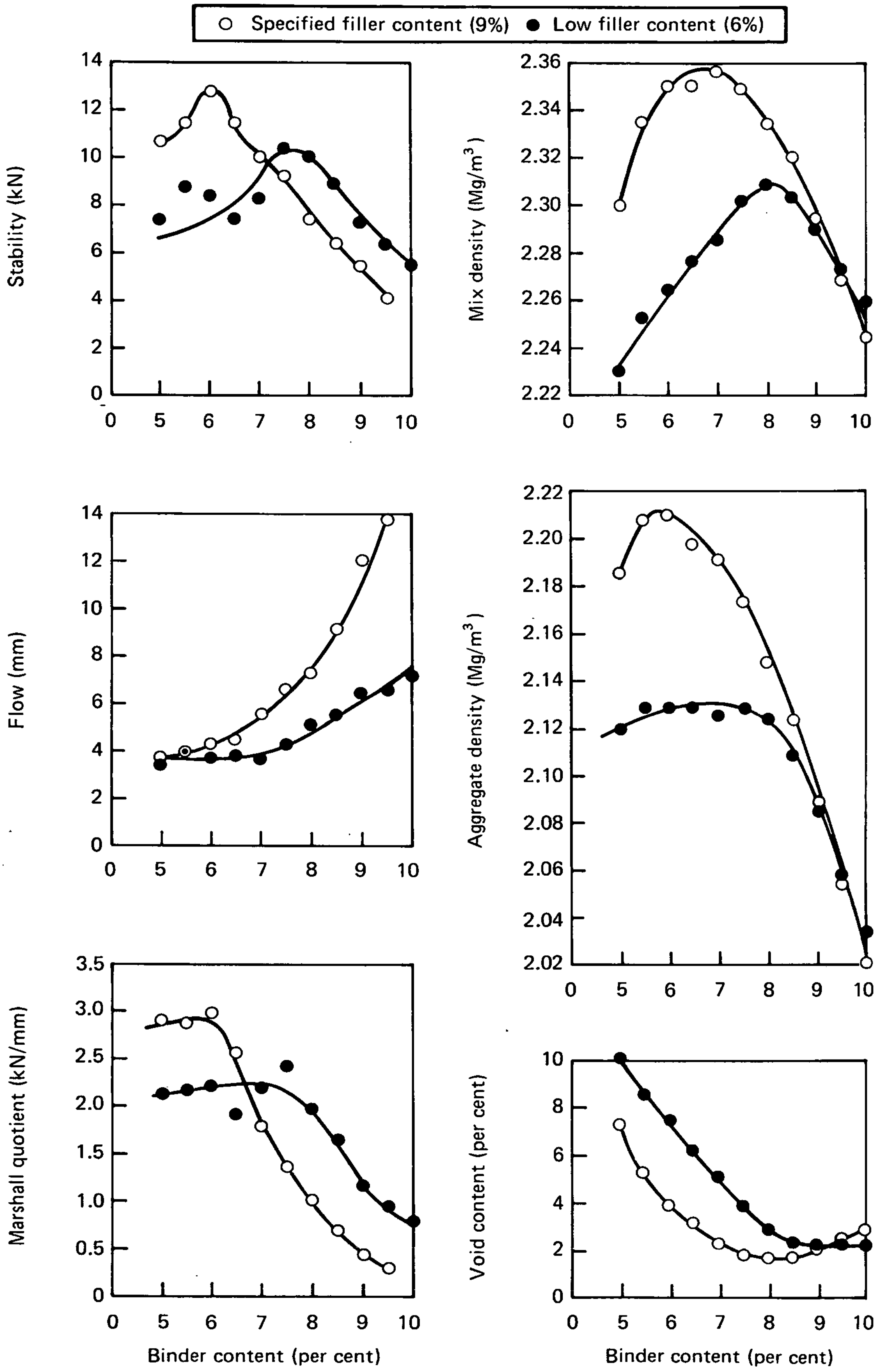

Fig. 5 A303 Mere: effect of filler content on Marshall Test design of experimental asphalts

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ABSTRACT

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