UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang 1987/88

REE 425 - Rekabentuk Jalan Dan Lebuhraya

Tarikh: 6 November 1987 Masa: 9.00 pagi - 12.00 t/hari
(3 jam)

Sila pastikan bahawa kertas peperiksaan ini mengandungi EMPAT muka surat dan DUA BELAS muka surat Lampiran yang tercetak sebelum anda memulakan peperiksaan ini.

Jawab LIMA soalan.

1. Lebuhraya direkabentuk untuk membolehkan pemandu menggerakkan kenderaannya dengan selamat dan selesa. Sebutkan sifat-sifat pemandu dan kenderaan yang mempengaruhi rekabentuk lebuhraya.

(20 markah)

2. (a) Catatkan apa yang anda fahami tentang istilah 'rekabentuk geometri'.

(b) Berikan definisi 'kelajuan rekabentuk'. Bincangkan panduan umum untuk menetapkan nilai kelajuan rekabentuk sebatang lebuhraya.

(c) Terangkan prinsip-prinsip (primer dan sekunder) yang dijadikan sebagai garispanduan penentuan laluan.

(20 markah)

...2/-

3. (a) Bagaimanakah daya emparan diimbangi apabila kenderaan melalui selekoh yang permukaannya :-

(i) datar?

(ii) disendeng?

Dapatkan rumus untuk jejari lengkok supaya kenderaan tidak tergelincir bagi kedua-dua keadaan.

(b) Kenapakah lengkok peralihan diperlukan di dalam penjajaran datar lebuhraya?

(c) Bezakan fungsi cerun membujur dan sendengan.

(20 markah)

4. (a) Tulis nota-nota ringkas berhubung dengan istilah-istilah berikut:-

(i) tempoh antara hijau

(ii) tempoh semua-merah

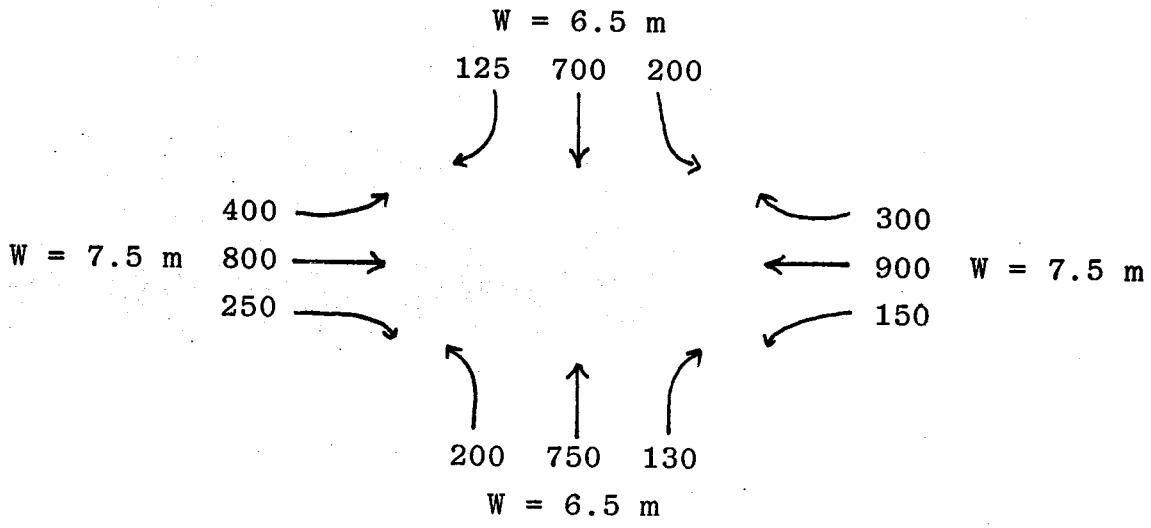
(iii) aliran tepuan (termasuk faktor-faktor yang mempengaruhi magnitudnya)

(iv) setara unit kereta penumpang

(v) masa hilang

...3/-

(b) Aliran lalulintas dan lebar ruang masuk, W, untuk satu simpang lampu isyarat adalah seperti berikut:-



Berdasarkan aliran trafik (dinyatakan di dalam unit kereta penumpang sejam) di atas, rekabentuk satu lampu isyarat dua fasa untuk simpang empat ini. Nyatakan andaian nilai masa hilang setiap fasa, masa kuning dan merah, masa kuning dan tempoh antara hijau.

(20 markah)

5. (a) Terangkan secara ringkas maksud istilah berikut di dalam konteks mekanik tanah:-

(i) had keplastikan

(ii) keliangan

(iii) ketelapan

(iv) pengecutan

(v) pengukuhan

...4/-

(b) Bincangkan secara ringkas masalah yang bakal dihadapi apabila membina sebatang lebuhraya untuk merentasi kawasan tanah:-

(i) liat

(ii) berpasir (termasuk padang pasir)

(iii) laterit

(iv) sabkha

Sebutkan langkah-langkah yang akan diambil bagi mengatasi masalah.

(20 markah)

6. Data-data berhubung dengan rekabentuk turapan adalah seperti berikut:-

Hayat rekabentuk = 30 tahun

Jumlah kenderaan perdagangan di dalam kedua arah setiap minggu = 14,000

Kadar petumbuhan trafik = 6%

Jenis subgred ialah tanah kelodak dan aras airbumi ialah 1.5 m di bawah aras bentukan.

Berpandukan data-data di atas, rekabentuk:-

(i) sebuah turapan fleksibel

(ii) sebuah turapan tegar

menggunakan carta dan jadual dari Nota Jalan 29 seperti di dalam Lampiran 1.

(20 markah)

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Table 1 **Commercial traffic flows recommended for use in the design of roads in residential and associated developments when more accurate assessments are not available**

Type of road	*Estimated traffic flow of commercial vehicles per day* **(in each direction)** *at the time of construction*
1 Cul-de-sacs and minor residential roads	10
2 Through roads and roads carrying regular bus routes involving up to 25 public service vehicles per day **in each direction**	75
3 Major through roads carrying regular bus routes involving 25–50 public service vehicles per day **in each direction**	175
4 Main shopping centre of a large development carrying goods deliveries and main through roads carrying more than 50 public service vehicles per day **in each direction**	350

Table 2 **Conversion factors to be used to obtain the equivalent number of standard axles from the number of commercial vehicles**

Type of road	*Number of axles per commercial vehicle (see paragraph 14) (a)*	*Number of standard axles per commercial axle (b)*	*Number of standard axles per commercial vehicle (a) × (b)*
Motorways and trunk roads designed to carry over 1000 commercial vehicles per day **in each direction** at the time of construction	2·7	0·4	1·08
Roads designed to carry between 250 and 1000 commercial vehicles per day **in each direction** at the time of construction	2·4	0·3	0·72
All other public roads	2·25	0·2	0·45

Table 3 **Estimated laboratory CBR values for British soils compacted at the natural moisture content**

Type of soil	*Plasticity index (per cent)*	*CBR (per cent)*	
		Depth of water-table below formation level	
		More than 600 mm	*600 mm or less*
Heavy clay	70	2	1*
	60	2	1·5*
	50	2·5	2
	40	3	2
Silty clay	30	5	3
Sandy clay	20	6	4
	10	7	5
Silt	—	2	1*
Sand (poorly graded)	non-plastic	20	10
Sand (well graded)	non-plastic	40	15
Well-graded sandy gravel	non-plastic	60	20

* See para. 27

Table 4 **Recommended bituminous surfacings for newly constructed flexible pavements** (see Note 1)

Traffic (cumulative number of standard axles)			
Over 11 millions (1)	*2·5–11 millions* (2)	*0·5–2·5 millions* (3)	*Less than 0·5 million* (4)
Wearing course (crushed rock or slag coarse aggregate only) **Minimum thickness 40 mm** Rolled asphalt to BS 594 (pitch-bitumen binder may be used) (Clause 907)		**Wearing course** **Minimum thickness 20 mm** Rolled asphalt to BS 594 (pitch-bitumen binder may be used) (Clause 907) Dense tar surfacing to BTIA Specification (Clause 909) Cold asphalt to BS 1690 (Clause 910) (see note 4) Medium-textured tarmacadam to BS 802 (Clause 913) (to be surface-dressed immediately or as soon as possible—see Note 4) Dense bitumen macadam to BS 1621 (Clause 908) (see Note 4) Open-textured bitumen macadam to BS 1621 (Clause 912) (see Note 4)	**Two-course** (a) **Wearing course—** **Minimum thickness 20 mm** Cold asphalt to BS 1690 (Clause 910) (see Note 4) Coated macadam to BS 802 BS 1621, BS 1241 or BS 2040 (Clause 913, 912 or 908) (see Notes 2 and 4) (b) **Basecourse** Coated macadam to BS 802, BS 1621, BS 1241 or BS 2040 (Clause 906 or 905) (see Note 2) **Single course** Rolled asphalt to BS 594 (pitch-bitumen binder may be used) Dense tar surfacing to BTIA Specification (Clause 909) Medium-textured tarmacadam to BS 802 (Clause 913) (to be surface-dressed immediately or as soon as possible—see Note 4)
Basecourse **Minimum thickness 60 mm** Rolled asphalt to BS 594 (Clause 902) (see Note 2) Dense bitumen macadam or dense tarmacadam (crushed rock or slag only) (Clause 903 or 904)	**Basecourse** Rolled asphalt to BS 594 (Clause 902) (see Note 2) Dense bitumen macadam or dense tarmacadam (Clause 903 or 904) (see Note 3)	**Basecourse** Rolled asphalt to BS 594 (Clause 902) (see Note 2) Dense bitumen macadam or dense tarmacadam (Clause 903 or 904) Single-course tarmacadam to BS 802 (Clause 906) or BS 1241 (see Notes 2 and 5) Single-course bitumen macadam to BS 1621 (Clause 905) or BS 2040 (see Notes 2 and 5)	Dense bitumen macadam to BS 1621 (Clause 908) (see Note 4) 60 mm of single-coarse tarmacadam to BS 802 (Clause 906) or BS 1241 (to be surface-dressed immediately or as soon as possible—see Note 4) 60 mm of single-course bitumen macadam to BS 1621 (Clause 905) or BS 2040 (see Note 4)

Notes:

1 The thicknesses of all layers of bituminous surfacings should be consistent with the appropriate British Standard Specification

2 When gravel, other than limestone, is used, 2 per cent of Portland cement should be added to the mix and the percentage of fine aggregate reduced accordingly

3 Gravel tarmacadam is not recommended as a basecourse for roads designed to carry more than 2·5 million standard axles

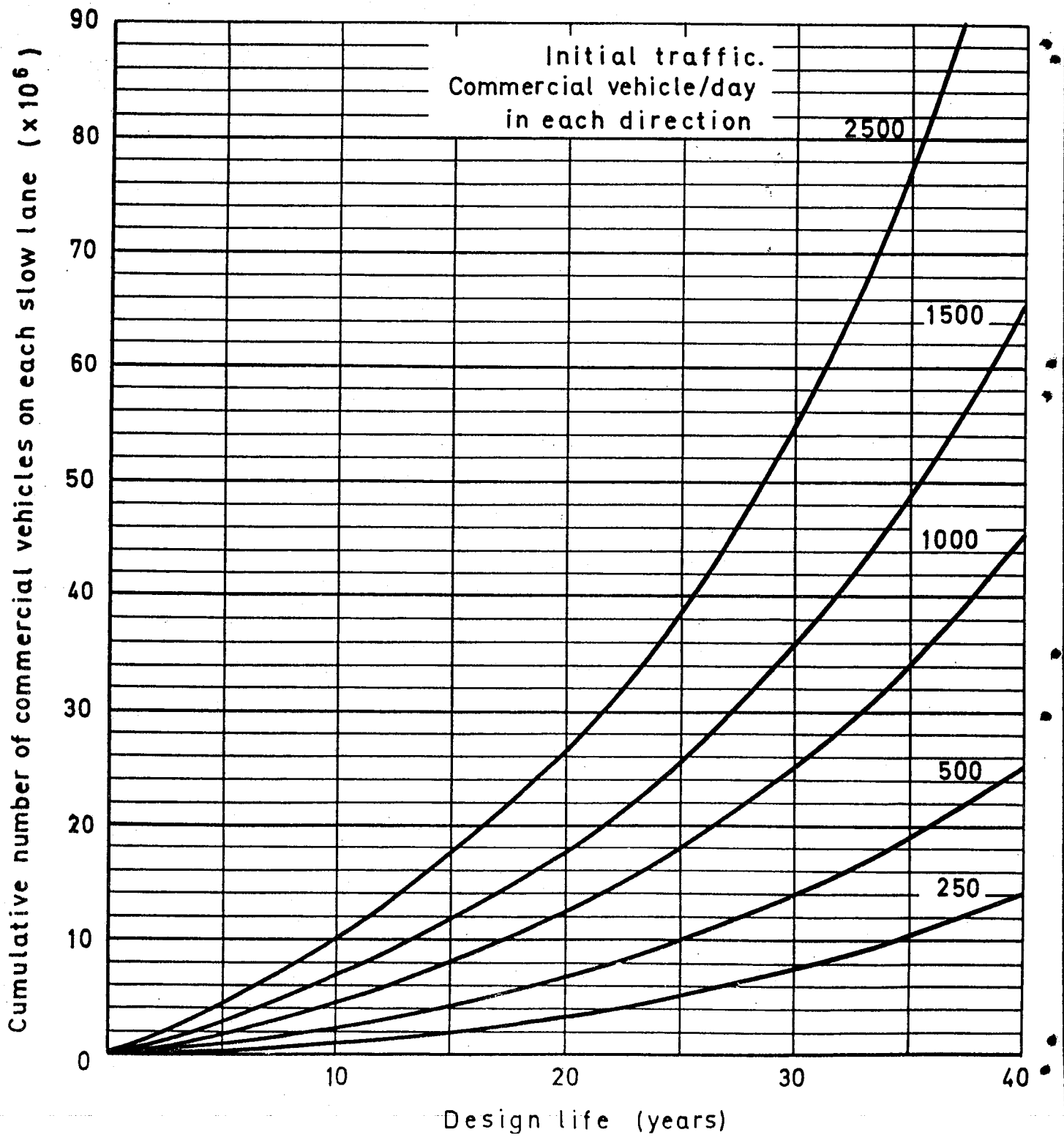
4 When the wearing course is neither rolled asphalt nor dense tar surfacing and where it is not intended to apply a surface-dressing immediately to the wearing course, it is essential to seal the construction against the ingress of water by applying a surface dressing either to the roadbase or to the basecourse

Under a wearing course of rolled asphalt or dense tar surfacing the basecourse should consist of rolled asphalt to BS 594 (Clause 902) or of dense coated macadam (Clause 903 or 904)

Table 5 **Classification of subgrades for concrete roads and minimum thicknesses of sub-base required**

Type of subgrade	*Definition*	*Minimum thickness of sub-base required*
Weak	All subgrades of CBR value 2 per cent or less as defined in Table 3	150mm
Normal	Subgrades other than those defined by the other categories	80mm
Very stable	All subgrades of CBR value 15 per cent or more as defined in Table 3 This category includes undisturbed foundations of old roads	0

Figure 4 **Relation between cumulative number of commercial vehicles carried by each slow lane and design life – growth rate 6 per cent**



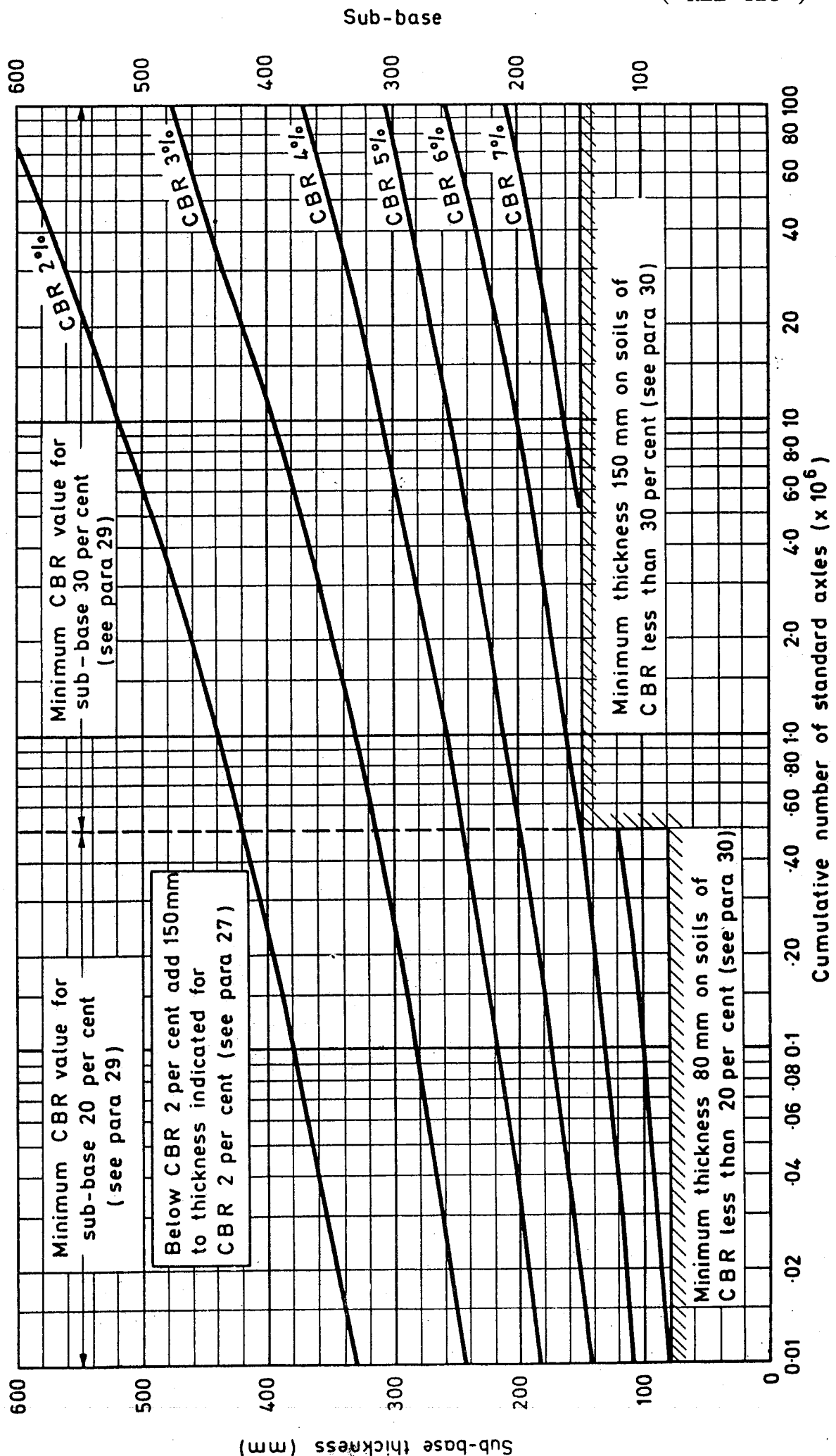


Figure 6 **Thickness of sub-base**

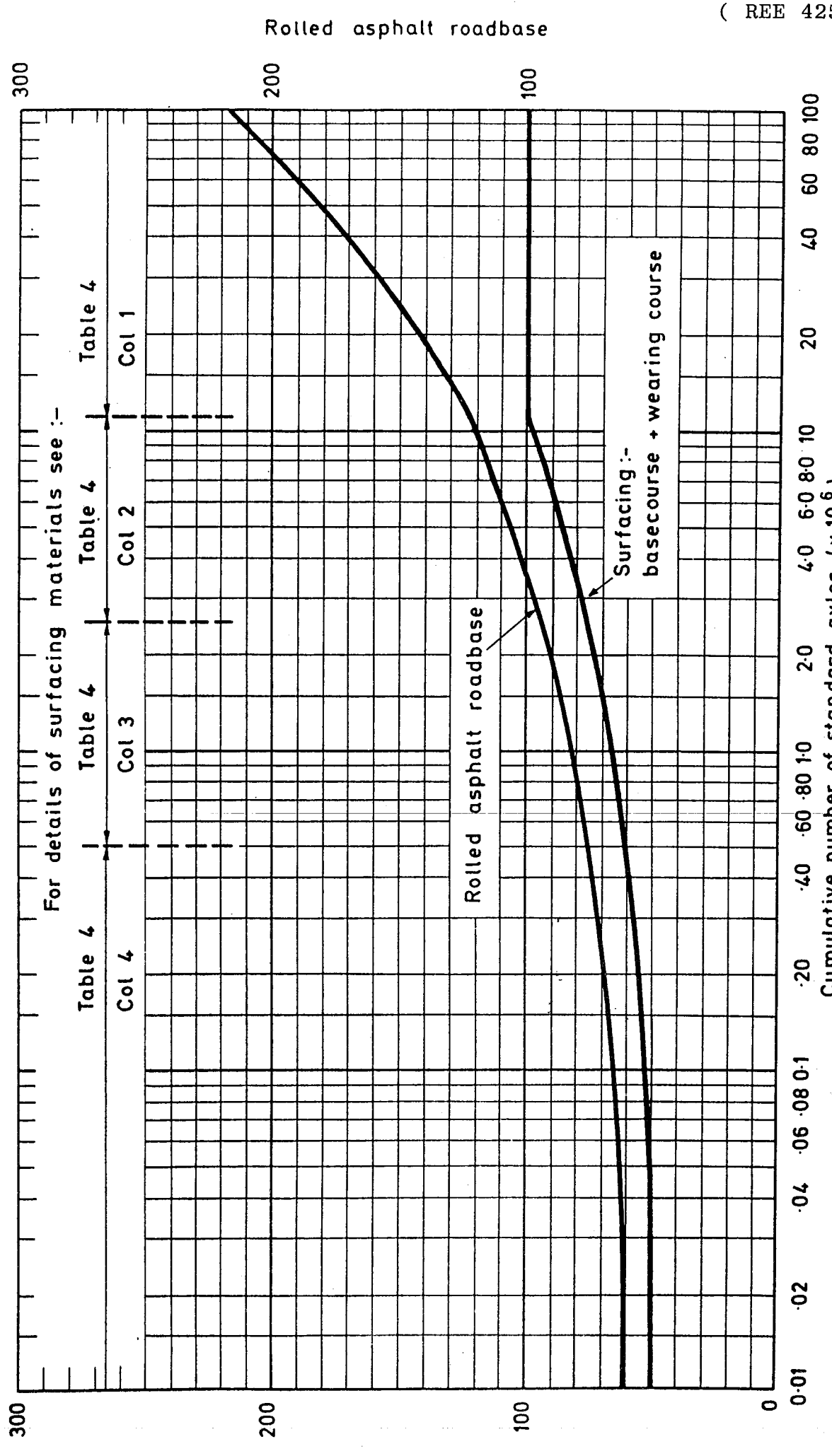


Figure 7 **Rolled asphalt roadbase: minimum thickness of surfacing and roadbase**

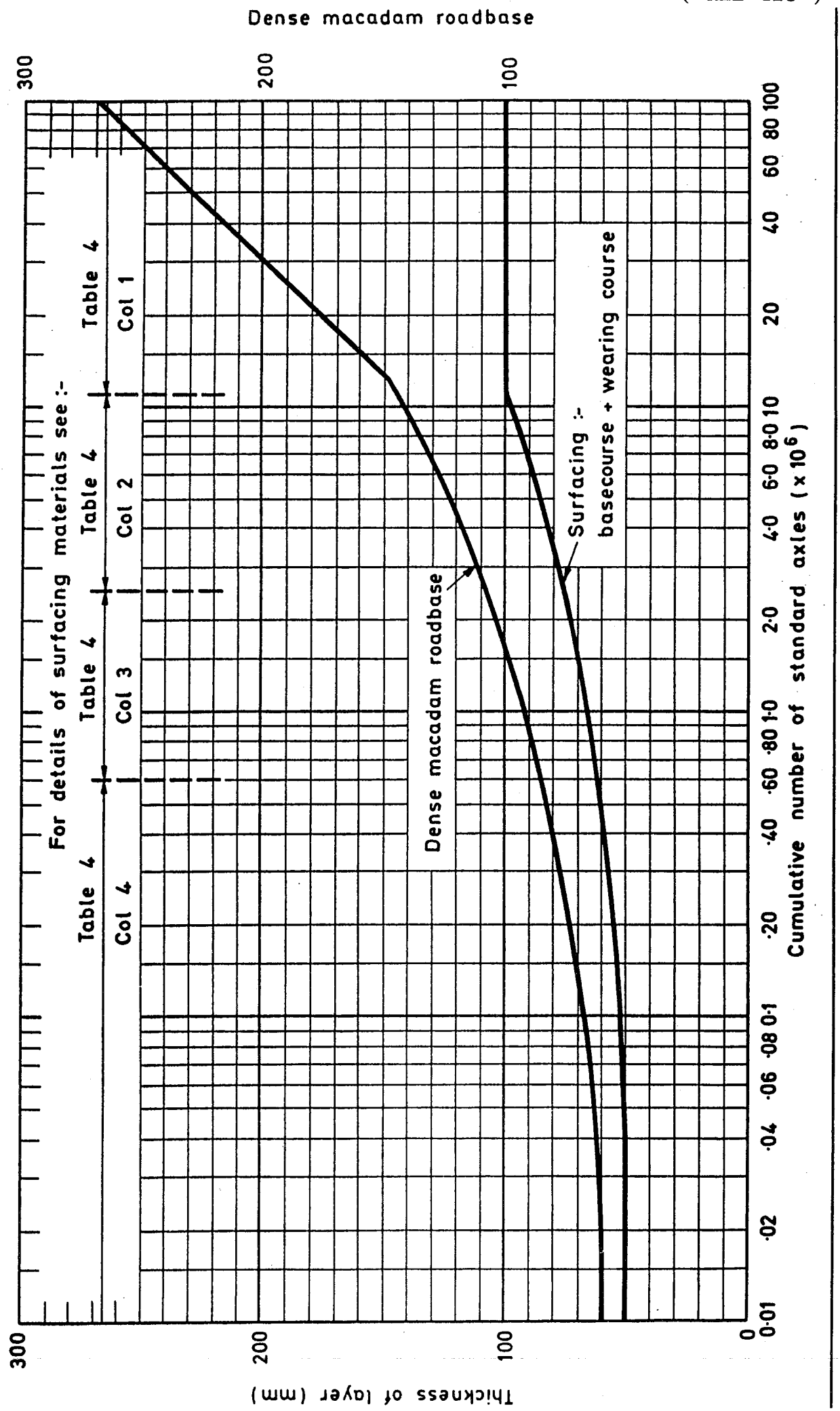


Figure 8 **Dense macadam roadbase: minimum thickness of surfacing and roadbase**

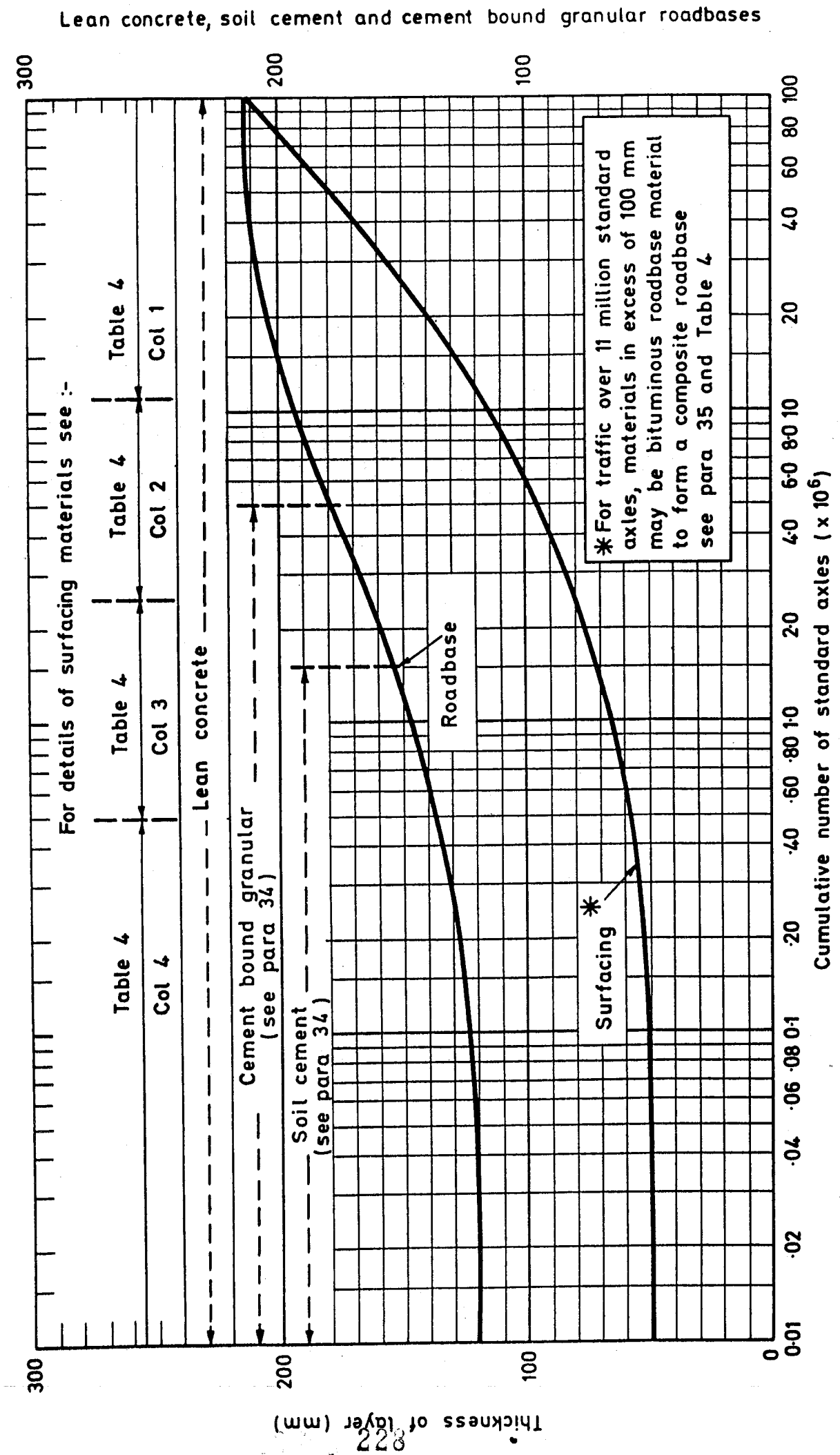
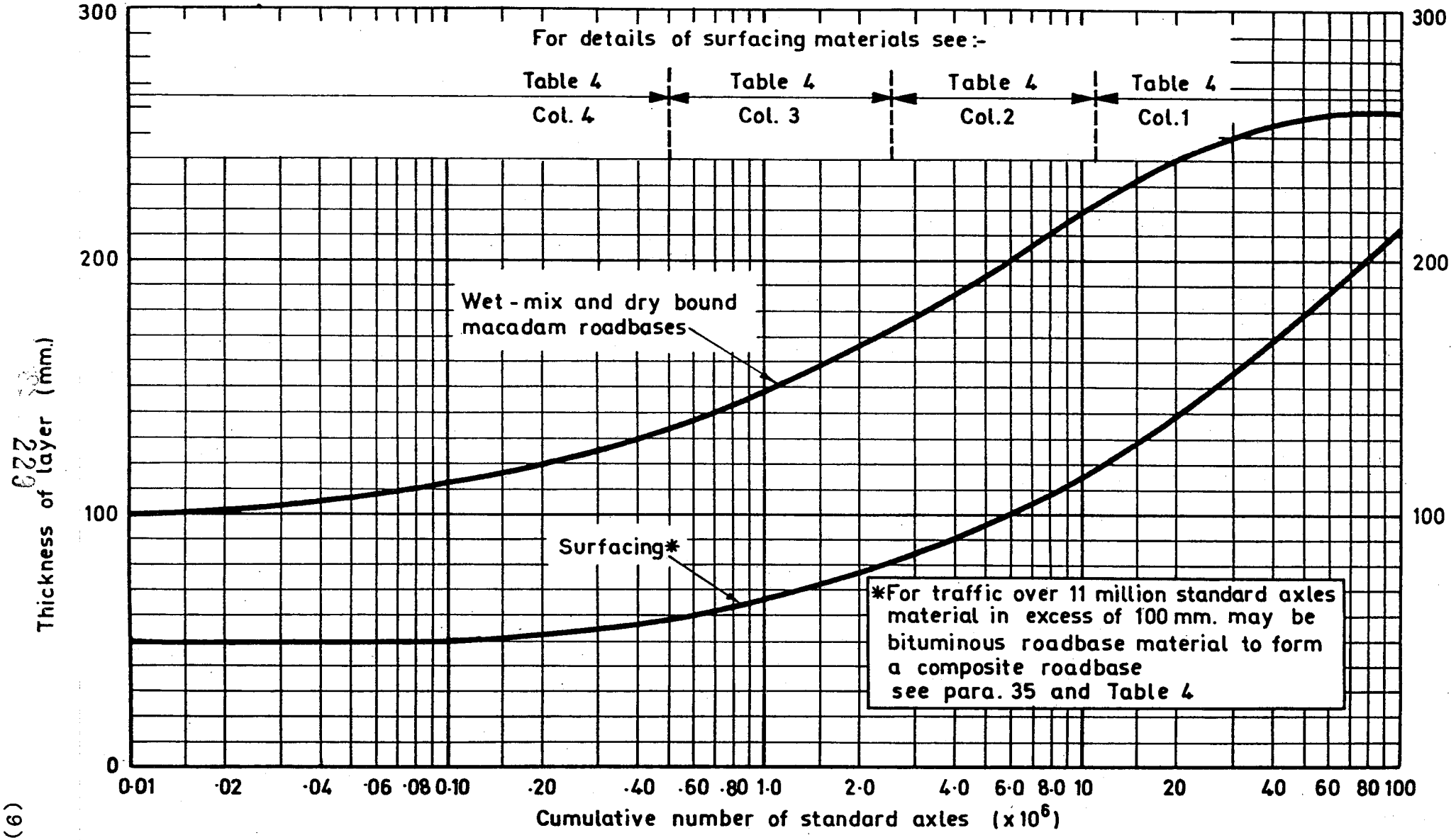


Figure 9 Lean concrete, soil cement and cement-bound granular roadbases: minimum thickness of surfacing and roadbase

Figure 10 **Wet-mix and dry-bound macadam roadbases: minimum thickness of surfacing and roadbase**



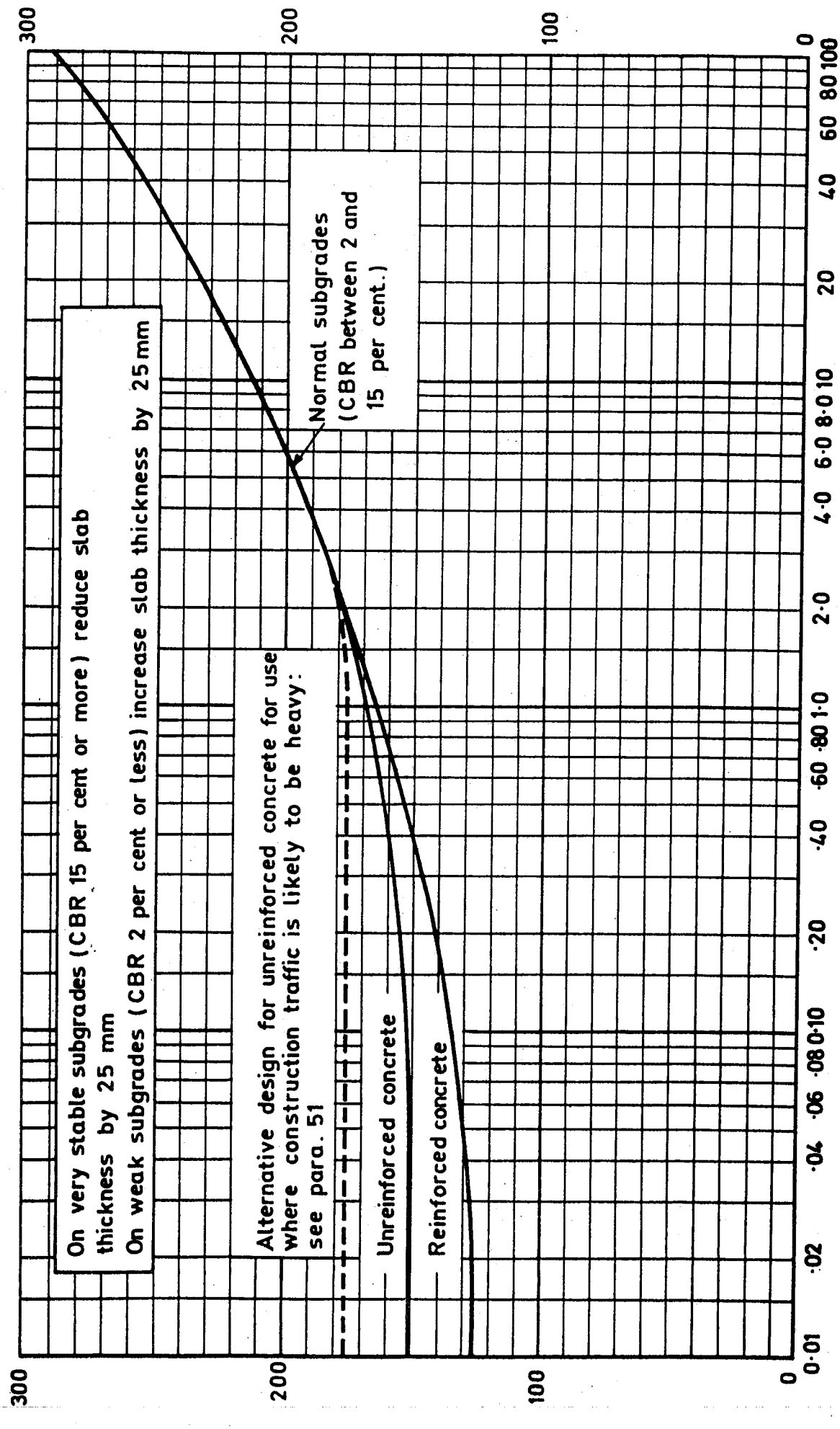


Figure 11 Concrete: minimum thickness of slabs

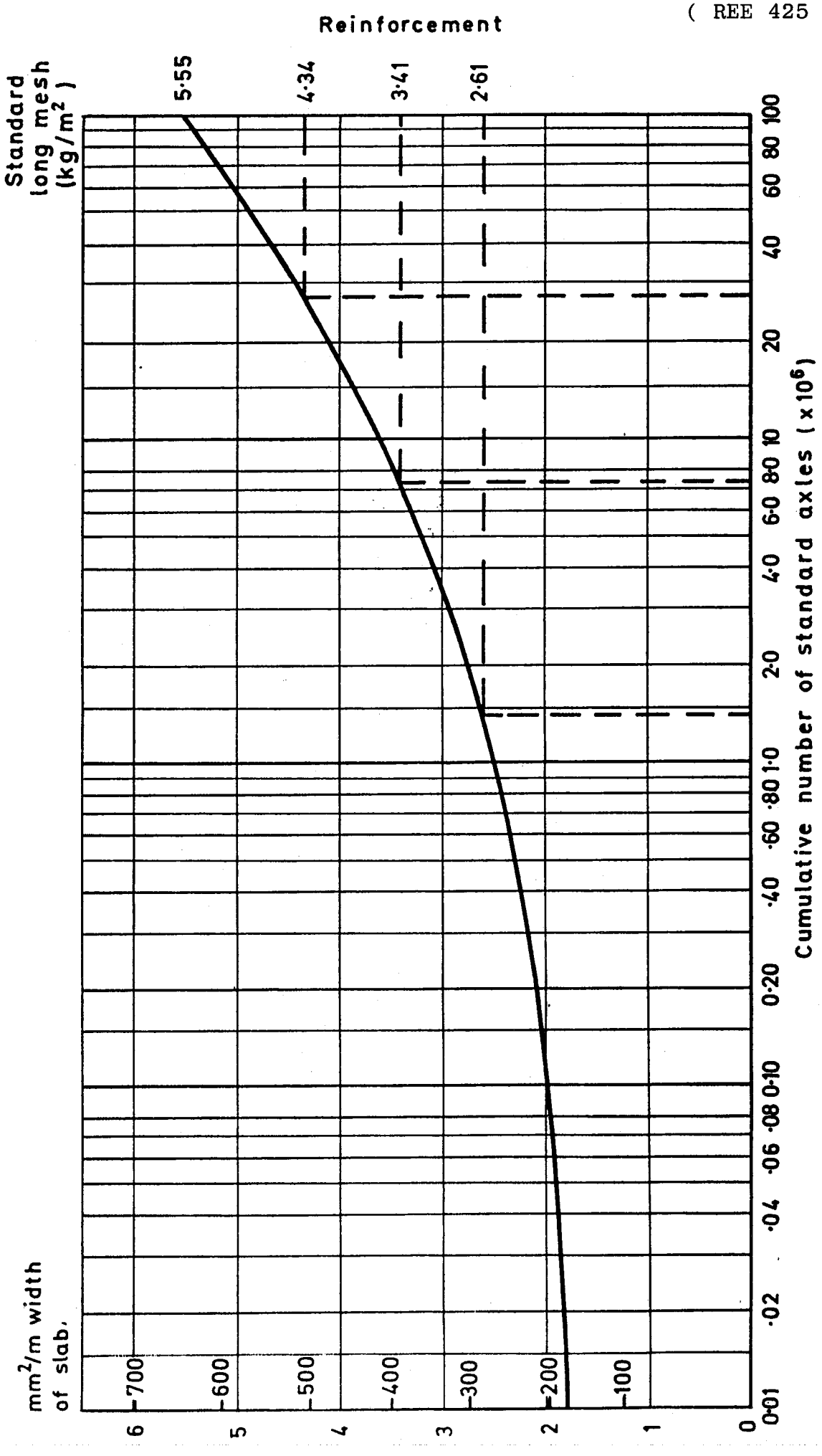


Figure 12 **Reinforcement: minimum weight for concrete slabs**

Figure 13 **Maximum spacing of joints for reinforced concrete slabs**