UNIVERSITY OF JOHANNESBURG

PROGRAM	:	Baccalaureus Ingeneriae (BIng) *CIVIL ENGINEERING*
SUBJECT	:	**TRANSPORTATION ENGINEERING**
CODE	:	**VVI 3A11**
DATE	:	JUNE EXAMINATION, 2016
DURATION	:	3 HOURS
WEIGHT	:	50:50
TOTAL MARKS	:	100

EXAMINER	:	DR HA QUAINOO
MODERATOR	:	DR FN OKONTA
NUMBER OF PAGES	:	12 PAGES

INSTRUCTIONS	:	QUESTION PAPERS MUST BE HANDED IN.
REQUIREMENTS	:	NONE

INSTRUCTIONS TO CANDIDATES:

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1

A falling gradient 4% meets a rising gradient of 5% at chainage 2450 m and level 215.50 m. At chainage 2350 m, the underside of the bridge has a level of 235.54 m (as shown in Figure 1 with *I* as the centre of the parabolic curve).

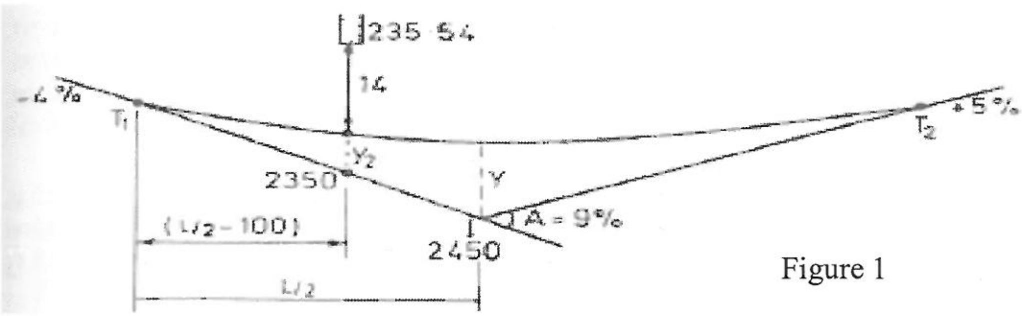


Figure 1

The two grades are joined by a vertical parabolic curve giving 14 m clearance under the bridge.

(i) Determine the offset at chainage 2350 m

(ii) What is the length of the vertical curve?

(iii) Calculate the offsets at chainage 0, 50, 100, 150 and 200 metres

(iv) In relation to question 1 (iii), list the corresponding levels along the curve at the specified chainage.

[25 marks]

QUESTION 2

In a speed-headway traffic study along a roadway, an observer located two points Y – Ý and Z – Ź respectively (the second point is at a distance of 20 m away from the first). Six vehicles (V1, V2, V3 ....V6) were counted crossing the first observation point Y – Ý in 30 seconds. The second observation point Z – Ź used for speed trap measurement yielded the results tabulated in Table 2 alongside vehicle times for crossing the first observation point Y – Ý.

Table 2: Speed-trap-headway measurement

Vehicle Number	Time passing Y – Ý (seconds)	Time passing Z – Ź (seconds)	Trap Time (seconds)	Trap Speed (km/h)
V1	1.50	3.44		
V2	7.30	8.78		
V3	9.60	10.96		
V4	14.07	15.67		
V5	17.77	19.36		
V6	22.60	24.12		

(a) Complete the above table by estimating the Trap Times and Trap speeds of each vehicle

(b) Hence calculate the following traffic stream parameters:

(i) Traffic flow pass the point the point Y – Ý (in veh/h)

(ii) Time headways, h_t between successive vehicles with reference to point Y – Ý

(iii) Average headway time (in seconds per vehicle)

(iv) Time Mean Speed, TMS (km/h)

(v) Space Mean Speed, SMS (km/h)

(vi) Traffic density on the roadway.

NB: SMS = N / {∑ (reciprocals of all spot speeds)}

OR

SMS = (Total travel distance by all vehicles) / (Total travel time)

[25 marks]

QUESTION 3

A proposed six-lane, two-way freeway is to be constructed within a moderately dry region. It is estimated that the present Average Daily Traffic is 6 500 vehicles per day. Proportions of commercial vehicles in the traffic count are as follows:

Overloaded vehicles	20% at 6.0 E80s each
Empty trucks	5% at 3.5E80s each
Buses	15% at 2.2E80s each.

Traffic growth rates are expected to be 5% until the road is first opened to traffic in 4 years' time, then 7.5% up to the end of its design life. The Structural Design Period of the freeway is 30 years.

(a) Calculate the design traffic and state the pavement class and design bearing capacity for the proposed freeway if the lane distribution factor is 0.95.

(b) Propose a full granular-base pavement design for the freeway if the California Bearing Ratio of the in-situ subgrade averages 5% and 8% along the selected route.

[25 marks]

Question 4

A newly constructed section of a road is to be surfaced with 13.2 + 6.7 mm double seal. Details of the road, conditions and specifications are as follows:

- Traffic: Heavy vehicles = 80 per day per lane
  Light vehicles = 2800 per day per lane
- Terrain: Rolling with gradient greater than 4%. Design speed of slow-moving vehicles is 35 km/h for which an adjustment of 6% is required for the net cold binder.
- Climate: Wet region, and requires an adjustment of 10% of net cold binder
- Texture Depth: The existing texture depth is uniform on this section with an average of 0.45 mm
- Embedment Potential The average corrected Ball Penetration value on this section is less t than 1.0 mm
- Aggregate: The aggregates delivered on site conforms to SANS specifications
  - ALD of 13.2 mm aggregate = 8.2 mm with flakiness index of 10%
  - ALD of 6.7 mm aggregate = 3.4 mm with flakiness index of 15%
- Policies:
  - Aggregate spread rate: a dense shoulder-to-shoulder matrix is preferred for the first aggregate layer
  - Pre-coating of the second layer is recommended (which implies Tack Coat =55%; Penetration Coat = 45%, Fog Spray =0%)
  - Hot spray: 80/100 Penetration Grade bitumen is to be used.

Using the TRH3 design catalogue, provide a full double seal design surfacing for the road. **[25 marks]**

EQUATIONS, FUNCTIONS, MISCELLANEOUS INFORMATION, & DESIGN CHARTS

$E80 = (\text{axle load} / 80)^4$

where the axle load is in kN

$E80 \text{ total} = AADE_{\text{initial}} \times f_y$

$$f_y = 365 \times \frac{(1 + i/100) \times [(1 + i/100)^y - 1]}{i/100}$$

where i = growth rate in %
y = structural design period in years
AADE = annual average daily equivalent E80 traffic

See attached catalogue of design

Table 22: Subgrade design (TRH4 1996)

Design CBR of subgrade	< 3	3 to 7	7 to 15	> 15
Layerwork	Special treatment essential	150 mm G7 150 mm G9	150 mm G7 --	-- --
Roadbed		R + R, 150mm G10	R + R, 150mm G9	R + R, 150mm G7

GRANULAR BASES

(MODERATE OR DRY REGIONS) DATE 1996

ROAD CAT.	PAVEMENT CLASS AND DESIGN BEARING CAPACITY (80 kN AXLES/LANE)										Foundation
	ES0.003 < 3000	ES0.01 $0,3\text{-}1,0\times10^4$	ES0.03 $1,0\text{-}3,0\times10^4$	ES0.1 $3,0\text{-}10\times10^4$	ES0.3 $0,1\text{-}0,3\times10^6$	ES1 $0,3\text{-}1,0\times10^6$	ES3 $1,0\text{-}3,0\times10^6$	ES10 $3,0\text{-}10\times10^6$	ES30 $10\text{-}30\times10^6$	ES100 $30\text{-}100\times10^6$	
A							40A 125 G2 150 C3 40A 150 G2 150 G5	40A 150 G2 250 C3	50A 150 G1 250 C3	50A 150 G1 300 C3	
B						S 125 G4 150 C4 S 150 G4 150 G5	S*/30A 150 G3 150 C4 S*/30A 150 G3 150 G5	40A 150 G2 200 C4 30A 150 G2 200 G5			150 G7 150 G9 G10
C				S 100 G5 125 C4 S 125 G4 125 G6	S 125 G5 125 C4 S 125 G4 150 G6	S 125 G4 125 C4 S 125 G4 150 G5	S 150 G3 150 C4 S 150 G3 150 G5				
D	S1 100 G5 100 G7	S1 100 G5 125 G7	S1 100 G4 125 G7	S1 100 G4 125 G6 S1 100 G5 100 C4	S 125 G4 125 G6 S 100 G5 125 C4	S 125 G4 150 G6 S 125 G5 150 C4					150 G9 G10

Symbol A denotes AG, AC, OR AS. A0, AP may be recommended as a surfacing measure for improved skid resistance when wet or to reduce water spray.

S denotes Double Surface Treatment (seal or combinations of seal and slurry)

S1 denotes Single Surface Treatment

* If seal is used, increase C4 and G5 subbase thickness to 200mm.

TABLE 12

Traffic growth factor (f_y) for calculation of cumulative traffic over prediction period from initial (daily) traffic

Prediction period, y (years)	f_y for traffic increase, I (% per annum)									
	2	4	6	8	10	12	14	16	18	20
4	1 534	1 611	1 692	1 776	1 863	1 953	2 047	2 145	2 246	2 351
5	1 937	2 056	2 180	2 312	2 451	2 597	2 750	2 911	3 081	3 259
6	2 348	2 517	2 698	2 891	3 097	3 317	3 551	3 801	4 066	4 349
7	2 767	2 998	3 247	3 517	3 809	4 124	4 464	4 832	5 229	5 657
8	3 195	3 497	3 829	4 192	4 591	5 028	5 506	6 029	6 601	7 226
9	3 631	4 017	4 445	4 922	5 452	6 040	6 693	7 417	8 220	9 109
10	4 076	4 557	5 099	5 710	6 398	7 173	8 046	9 027	10 130	11 369
11	4 530	5 119	5 792	6 561	7 440	8 443	9 588	10 895	12 384	14 081
12	4 993	5 703	6 526	7 480	8 585	9 865	11 347	13 061	15 044	17 336
13	5 465	6 311	7 305	8 473	9 845	11 458	13 352	15 575	18 183	21 241
14	5 947	6 943	8 130	9 545	11 231	13 242	15 637	18 490	21 887	25 927
15	6 438	7 600	9 005	10 703	12 756	15 239	18 242	21 872	26 257	31 551
16	6 939	8 284	9 932	11 953	14 433	17 477	21 212	25 795	31 414	38 299
17	7 450	8 995	10 915	13 304	16 278	19 983	24 598	30 346	37 500	46 397
18	7 971	9 734	11 957	14 762	18 308	22 790	28 458	35 625	44 680	56 115
19	8 503	10 503	13 061	16 338	20 540	25 934	32 859	41 748	53 154	67 776
20	9 045	11 303	14 232	18 039	22 995	29 455	37 875	48 851	63 152	81 769
25	11 924	15 808	21 227	28 818	39 486	54 506	75 676	105 517	147 559	206 727
30	15 103	21 289	30 587	44 656	66 044	98 656	148 459	224 533	340 661	517 664
35	18 612	27 958	43 114	67 927	108 816	176 464	288 595	474 509	782 431	1 291 373
40	22 487	36 071	59 877	102 120	177 700	313 586	558 416	999 544	1 793 095	3 216 609

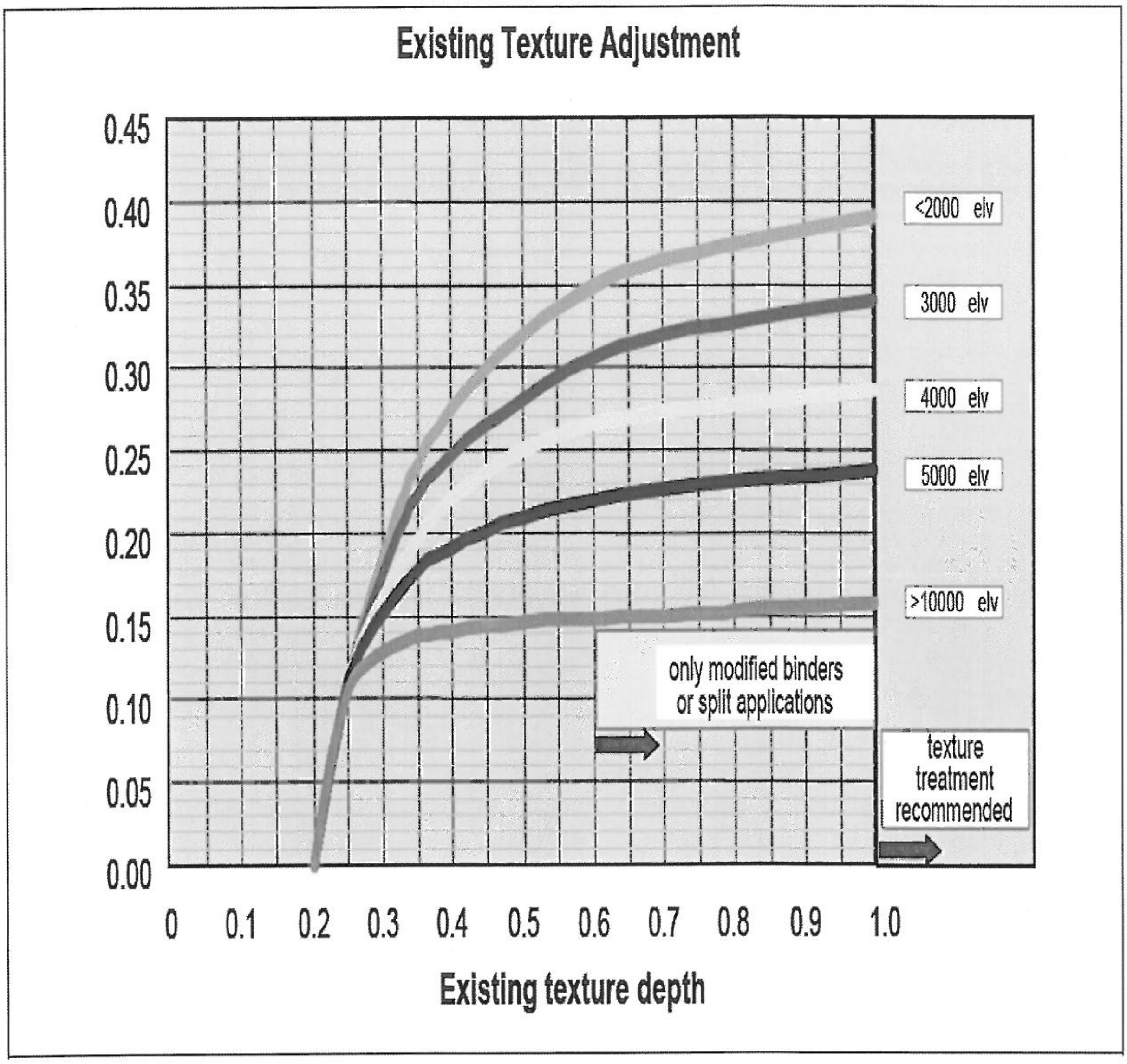
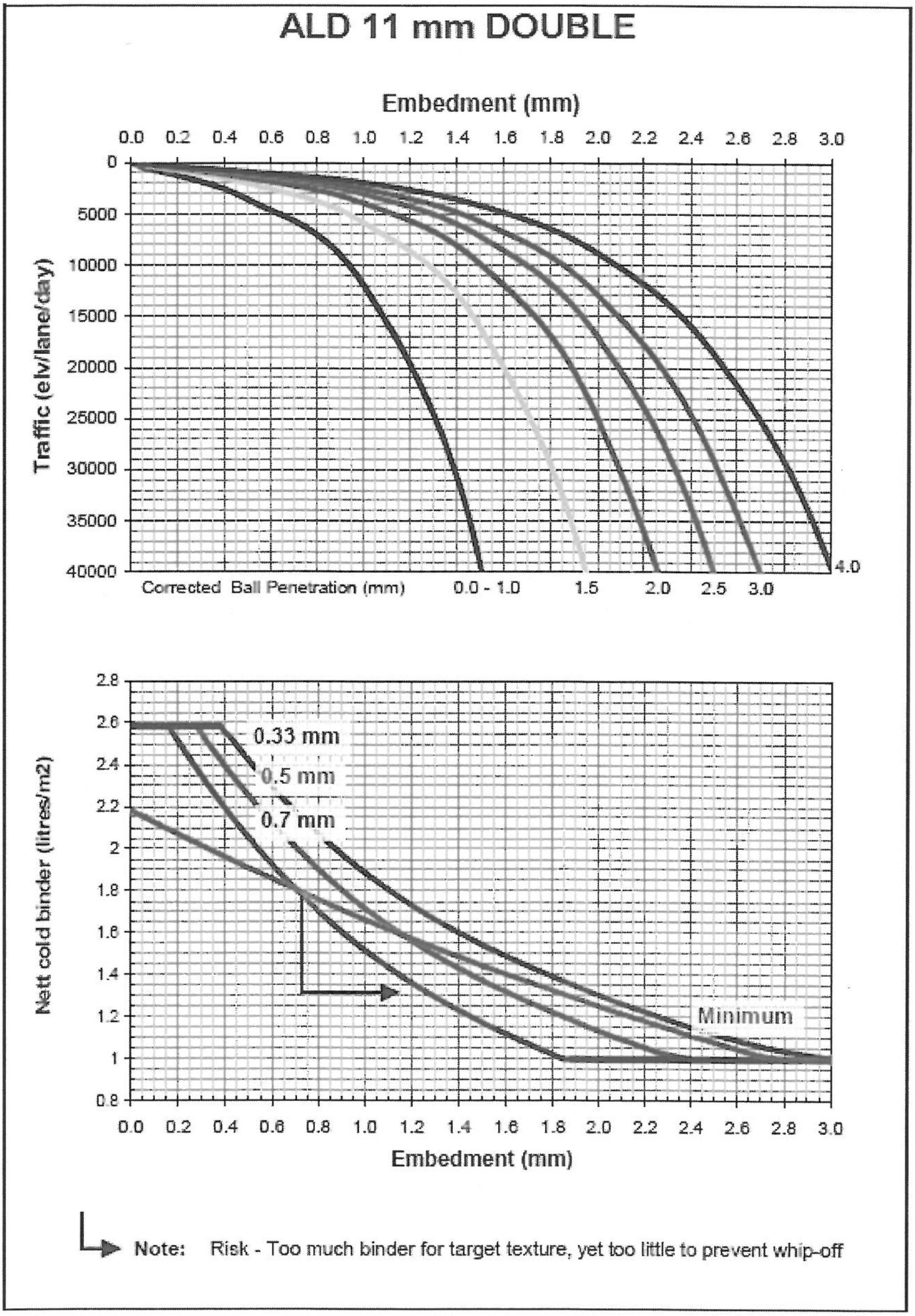

Existing Texture Adjustment
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Existing texture depth
<2000 elv
3000 elv
4000 elv
5000 elv
>10000 elv
only modified binders or split applications
texture treatment recommended

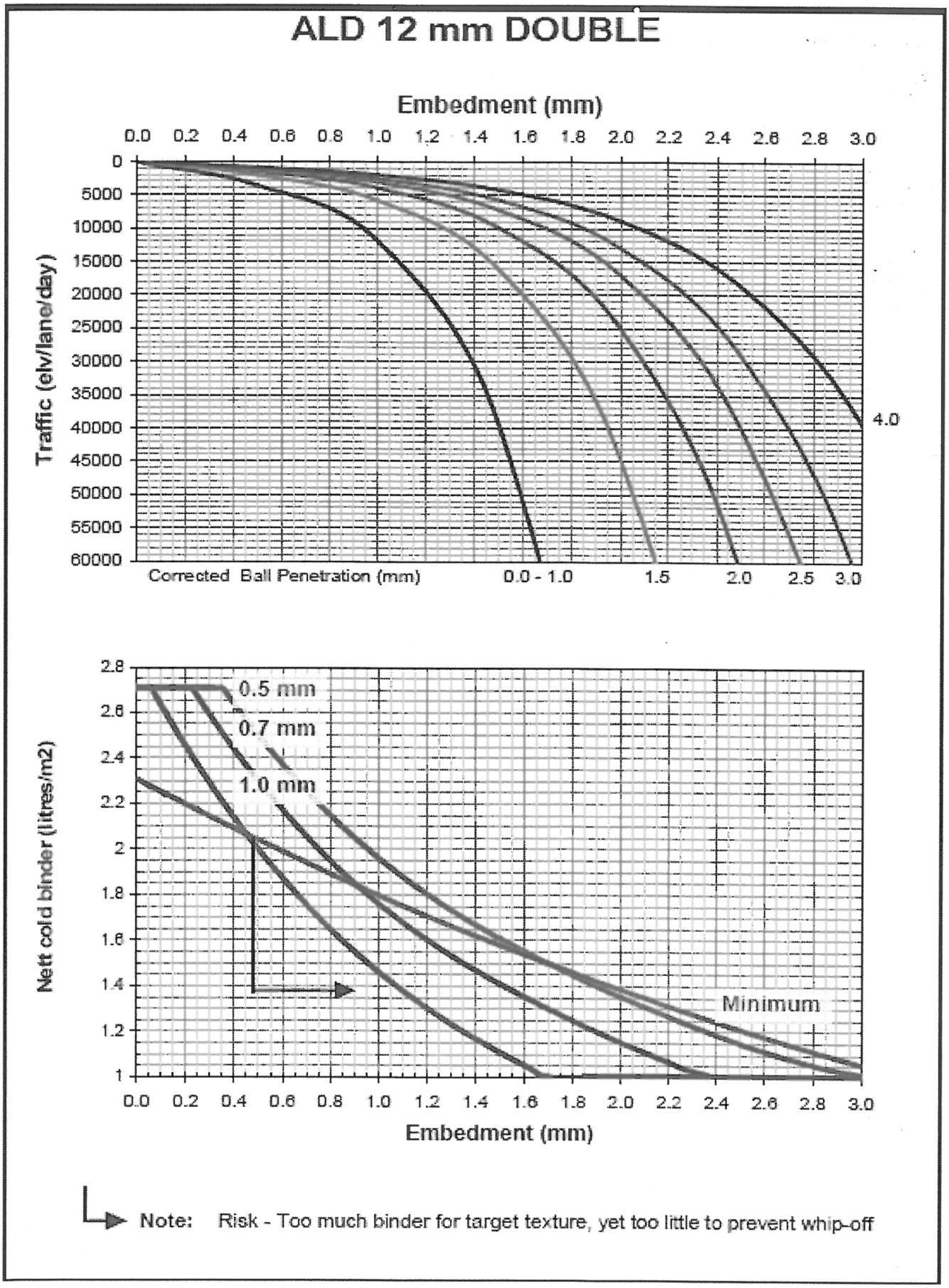
Table 7-3 - Factors for converting net cold residual binder to hot spray rates and storage and spraying temperatures

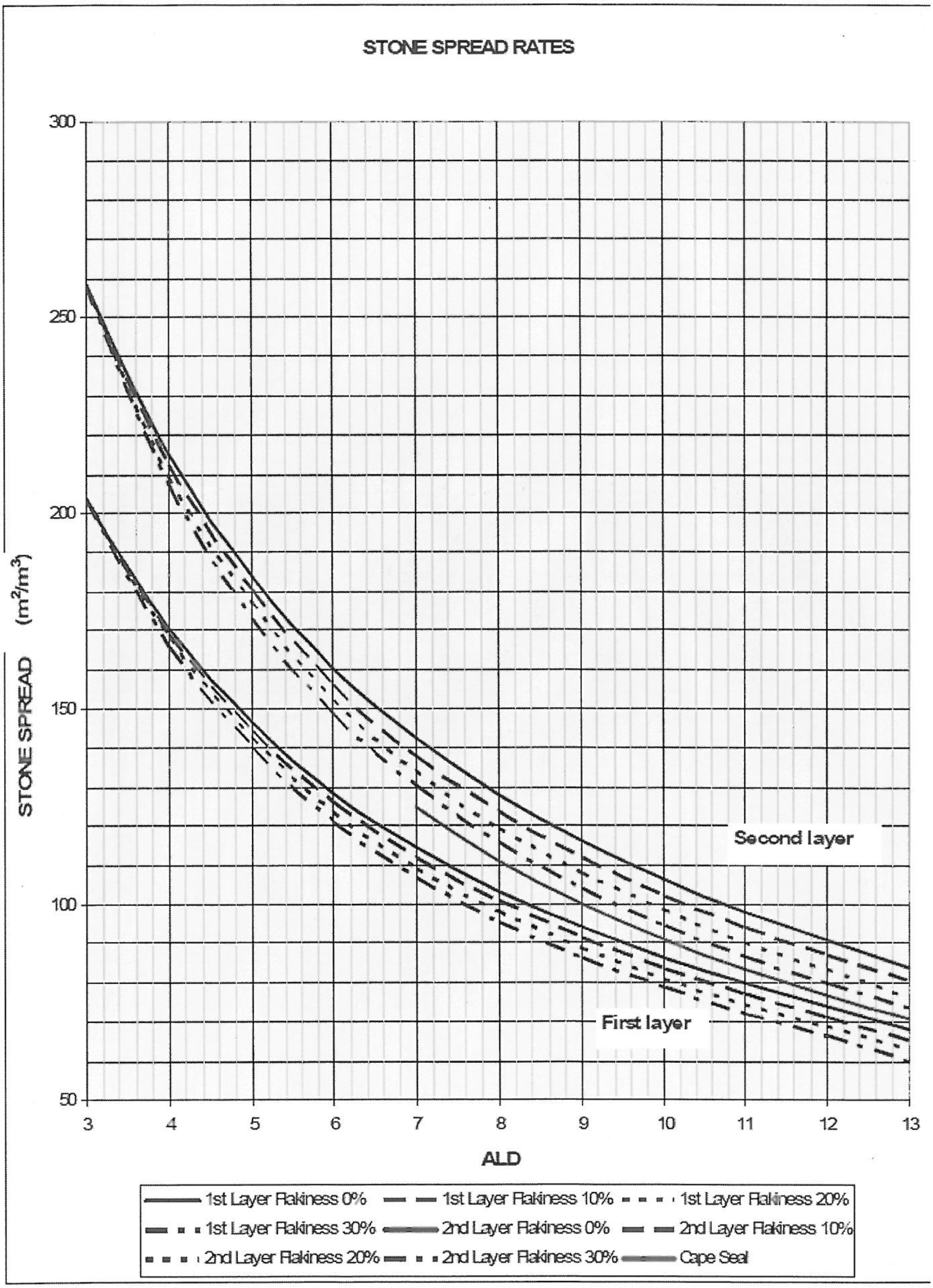
Type of binder	Conversion *** factor	Spray temperature (℃)	Max. storage temperature (℃)
Cutback bitumen			
MC 3000	1.19 – 1.27	130 - 155	100
MC 70	1.63 – 1.72	60 - 80	Ambient
MC 30	1.88 – 1.99	45 - 65	Ambient
Penetration grade bitumen			
150/200 pen	1.09	145 - 185	115
80/100 pen	1.09	160 - 200	125
Polymer modified bitumen			
S-E1	1.08	165 - 190	150
S-E2	1.06	165 - 190	150
Bitumen rubber (S-R1)	1.07	195 - 205	-
Bitumen emulsions			
60% emulsion	1.68	60	Ambient
65% emulsion	1.55	60	Ambient
70% emulsion	1.44	70	Ambient

DESIGN CHART FOR DOUBLE SEALS: Design ALD = 11mm



DESIGN CHART FOR DOUBLE SEALS: Design ALD = 12mm




STONE SPREAD RATES
300
250
200
150
100
50
STONE SPREAD (m²/m³)
3
4
5
6
7
8
9
10
11
12
13
ALD
Second layer
First layer
1st Layer Flakiness 0%
1st Layer Flakiness 10%
1st Layer Flakiness 20%
1st Layer Flakiness 30%
2nd Layer Flakiness 0%
2nd Layer Flakiness 10%
2nd Layer Flakiness 20%
2nd Layer Flakiness 30%
Cape Seal

UNIVERSITY OF JOHANNESBURG

PROGRAM	:	Baccalaureus Ingeneriae (BIng) *CIVIL ENGINEERING SCIENCE*
SUBJECT	:	**TRANSPORTATION ENGINEERING**
CODE	:	**VVI3A11**
DATE	:	SUPPLEMENTARY EXAMINATION JULY 2016
DURATION	:	THREE (3) HOURS
WEIGHT	:	50 : 50
TOTAL MARKS	:	100

EXAMINER	:	DR HA QUAINOO
MODERATOR	:	DR FN OKONTA
NUMBER OF PAGES	:	12 PAGES

INSTRUCTIONS	:	PLEASE ANSWER ALL THE QUESTIONS.
REQUIREMENTS	:	NONE

Question 1

A road gradient of 1 in 60 down is followed by an up gradient of 1 in 30, the valley thus formed being smoothed by a circular curve of radius 1000 m in the vertical plane. The grades, if produced, would intersect at a point having a reduced level of 299.65 m and a chainage of 4020 m (Figure 1)

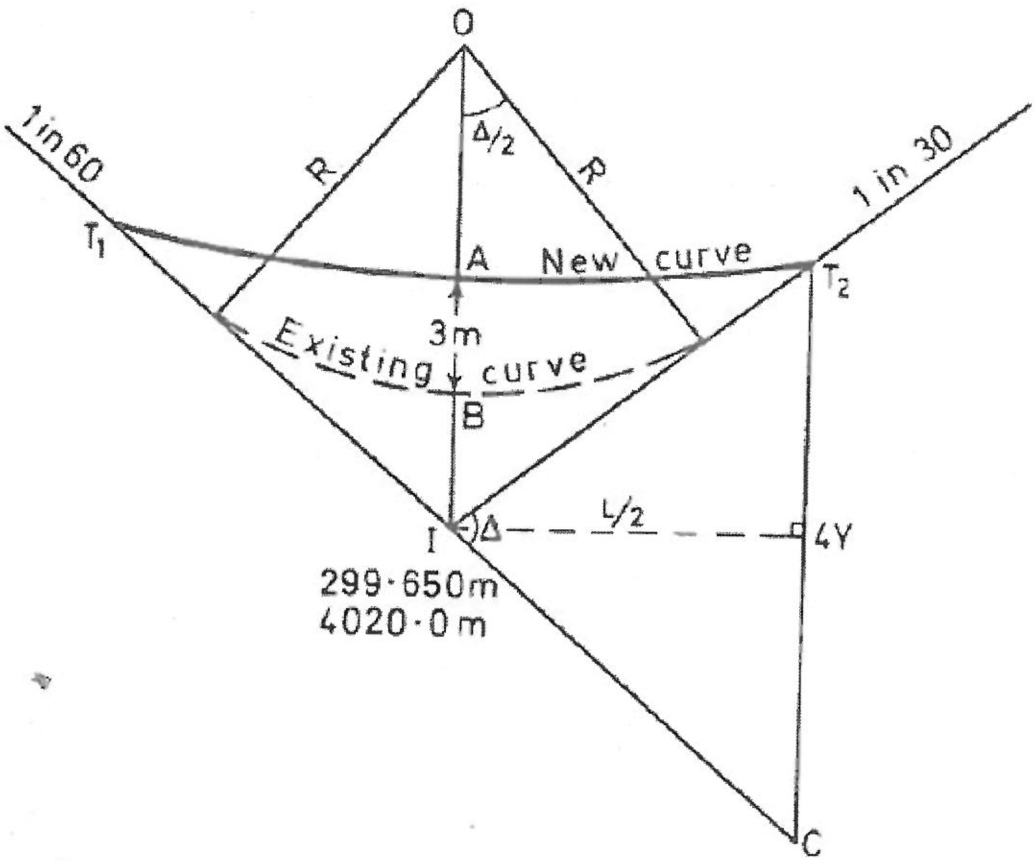


Figure 1.

It is proposed to improve the road by introducing a longer curve, parabolic in form, and in order to limit the amount of filling it is decided that the level of the new road at chainage 4020 shall be 3 m above the existing surface.

Determine:

(a) The length of the new curve.
(b) The levels of the tangent points.
(c) The levels of the quarter points.
(d) The chainage of the lowest point on the new curve.

[25 marks]

...

Question 2

(a) On a specific westbound section of highway, studies show that the speed –density relationship is

$$U = U_f \; [1 - (K/K_j)^{3.5}]$$

The capacity of the highway is 3800 vehicles per hour and the jam density is 140 vehicles per kilometre.

(i) Determine the space-mean-speed of the traffic at capacity
(ii) Hence calculate the free-flow speed

[13 marks]

(b) A section of highway has the following flow-density relationship:

$$Q = 50K - 0.156K^2$$

Fully analyse and sketch the three fundamental traffic flow curves relating to the relationship above. (NB: Sketch Speed vrs. Density, Flow vrs. Density and Speed vrs. Flow)

[9 marks]

(c) Briefly discuss the significance of density as a fundamental traffic flow parameter. **[3 marks]**

Question 3

Use TRH 3 to design a double seal of 19.0 mm stone and 9.5 mm stone, with 150/200 pen-grade bitumen binder, on new work. The predicted traffic is 3000 light vehicles and 200 heavy vehicles per lane per day. Climate is wet (and requires an adjustment of 10%). Aggregate properties are: 19.0 mm stone: ALD = 8.2 mm, flakiness is 10%; 9.5 mm stone: ALD = 4.4 mm, flakiness is 15%. Ball penetration values (corrected) averaged 1.3 mm, gradients are greater than 4% (and requires an adjustment by 5.5%), and base texture depth is 0.5 mm.

Policies:

- Aggregate spread rate: Dense should-to-shoulder matrix preferred for the first aggregate layer.
- No pre-coating of aggregates (i.e. Tack Coat = 45%; Penetration Coat = 55%; Fog Spray = 0%)

[25 marks]

...

Question 4

A proposed 4-lane 2-way road that would take 5 years to design and construct has been planned for a municipality in Kwa-Zulu Natal. The current ADT is 4500 vehicles per day of which heavy vehicles make up 35% averaging 1.2E80s each. The design life of the road is 30 years. From the day traffic counting was done up to when road construction would be completed and opened to traffic, the traffic growth rate is estimated at 6.5% , and then 8.5% per annum after the road is opened to traffic. If the road is in a wet region, and is a category A Road, calculate the following:

(i) The design traffic and pavement class if the lane distribution factor is 0.97

(ii) Show the full pavement design if the CBR of the in-situ subgrade averages 4, 9 and 16.

[25 marks]

...

TABLE 12

Traffic growth factor (f_y) for calculation of cumulative traffic over prediction period from initial (daily) traffic

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	2	4	6	8	10	12	14	16	18	20
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6	2 348	2 517	2 698	2 891	3 097	3 317	3 551	3 801	4 066	4 349
7	2 767	2 998	3 247	3 517	3 809	4 124	4 464	4 832	5 229	5 657
8	3 195	3 497	3 829	4 192	4 591	5 028	5 506	6 029	6 601	7 226
9	3 631	4 017	4 445	4 922	5 452	6 040	6 693	7 417	8 220	9 109
10	4 076	4 557	5 099	5 710	6 398	7 173	8 046	9 027	10 130	11 369
11	4 530	5 119	5 792	6 561	7 440	8 443	9 588	10 895	12 384	14 081
12	4 993	5 703	6 526	7 480	8 585	9 865	11 347	13 061	15 044	17 336
13	5 465	6 311	7 305	8 473	9 845	11 458	13 352	15 575	18 183	21 241
14	5 947	6 943	8 130	9 545	11 231	13 242	15 637	18 490	21 887	25 927
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17	7 450	8 995	10 915	13 304	16 278	19 983	24 598	30 346	37 500	46 397
18	7 971	9 734	11 957	14 762	18 308	22 790	28 458	35 625	44 680	56 115
19	8 503	10 503	13 061	16 338	20 540	25 934	32 859	41 748	53 154	67 776
20	9 045	11 303	14 232	18 039	22 995	29 455	37 875	48 851	63 152	81 769
25	11 924	15 808	21 227	28 818	39 486	54 506	75 676	105 517	147 559	206 727
30	15 103	21 289	30 587	44 656	66 044	98 656	148 459	224 533	340 661	517 664
35	18 612	27 958	43 114	67 927	108 816	176 464	288 595	474 509	782 431	1 291 373
40	22 487	36 071	59 877	102 120	177 700	313 586	558 416	999 544	1 793 095	3 216 609

* $f_y = 365.(1 + 0{,}01.I).[(1 + 0{,}01.I)^y - 1]/(0{,}01.I)$

TABLE 22

Preparation of subgrade/roadbed and required selected layers for the different subgrade design CBRs (Categories A, B, C and D)

Subgrade CBR Class	SG4	SG3	SG2	SG1
Design CBR of subgrade	**< 3**	**3 - 7**	**7 - 15**	**> 15**
Add selected layers: Upper Lower	 Not applicable	 150 mm G7 150 mm G9*	 150 mm G7 —	 — —
Treatment of in situ subgrade	Special treatment required	Rip and re-compact to 150 mm G10	Rip and re-compact to 150 mm G9	Rip and re-compact to 150 mm G7

* If the in situ subgrade is expected to be very wet, or in wet regions (Section 6), an additional 150 mm layer of G9 or a pioneer layer (CSRA, 1987) could be used.

8.4.3 Interpolation between traffic classes

The pavement structures in the Catalogue are considered adequate to carry the total design traffic according to the ***upper*** value of the traffic class defined in Section 4 (Table 4). The total design traffic may be predicted with more accuracy than is implied by the traffic classes. In such a case, the designer may use a simple linear interpolation technique. This is possible because for many designs the only difference between the structures for the various classes of traffic is a change in the layer thickness. However, there is often a change in material quality as well as in layer thickness. Simple interpolation is then inadequate and the designer will have to use proper design methods (Theyse et al., 1995; Freeme et al., 1982; Walker et al., 1977; Yoder et al., 1975; Shell, 1978).

9. COST ANALYSIS

9.1 GENERAL

Alternative pavement designs should be compared on the basis of the present worth of the life cycle costs. *The cost analysis should be regarded as an aid to decision-making. It does not necessarily include all the factors leading to a decision and should therefore not override all other considerations.* The main economic factors which determine the cost of a facility are the analysis period, the structural design period, the construction cost, the maintenance costs and the

GRANULAR BASES (WET REGIONS)

DATE 1996

ROAD CAT.	ES0.003 < 3000	ES0.01 $0{,}3\text{-}1{,}0 \times 10^4$	ES0.03 $1{,}0\text{-}3{,}0 \times 10^4$	ES0.1 $3{,}0\text{-}10 \times 10^4$	ES0.3 $0{,}1\text{-}0{,}3 \times 10^6$	ES1 $0{,}3\text{-}1{,}0 \times 10^6$	ES3 $1{,}0\text{-}3{,}0 \times 10^6$	ES10 $3{,}0\text{-}10 \times 10^6$	ES30 $10\text{-}30 \times 10^6$	ES100 $30\text{-}100 \times 10^6$	Foundation
	PAVEMENT CLASS AND DESIGN BEARING CAPACITY (80 kN AXLES/LANE)										
A							30A 150 G1** 200 C3	40A 150 G1 300 C3 *(250 C3)	50A 150 G1 400 C3 *(300 C3)		
B						S 150 G2 150 C4 S 150 G2 200 G5	S/30A 150 G1** 200 C4	40A 150 G1 300 C4 *(250 C4)			150 G7 150 G9 G10
C				S 100 G5 125 C4 S 125 G4 125 G6	S 125 G5 125 C4 S 150 G4 150 G6	S 125 G2 150 C4 S 150 G2 150 G5	S 150 G2** 200 C4 S 150 G2 150 G4				
D	S1 100 G5 100 G7	S1 100 G5 125 G7	S1 100 G4 125 G7	S1 100 G4 125 G6 S1 100 G5 100 C4	S 125 G4 125 G6 S 100 G5 125 C4	S 150 G4 150 G6 S 125 G5 150 C4					150 G9 G10

Symbol A denotes AG, AC, OR AS. A0, AP may be recommended as a surfacing measure for improved skid resistance when wet or to reduce water spray.

S denotes Double Surface Treatment (seal or combinations of seal and slurry)

S1 denotes Single Surface Treatment

* If water is prevented from entering the base, the subbase thickness may be reduced to the values indicated in brackets.

** Base thickness may be reduced by 25 mm if cemented subbase thickness is increased by 50 mm.

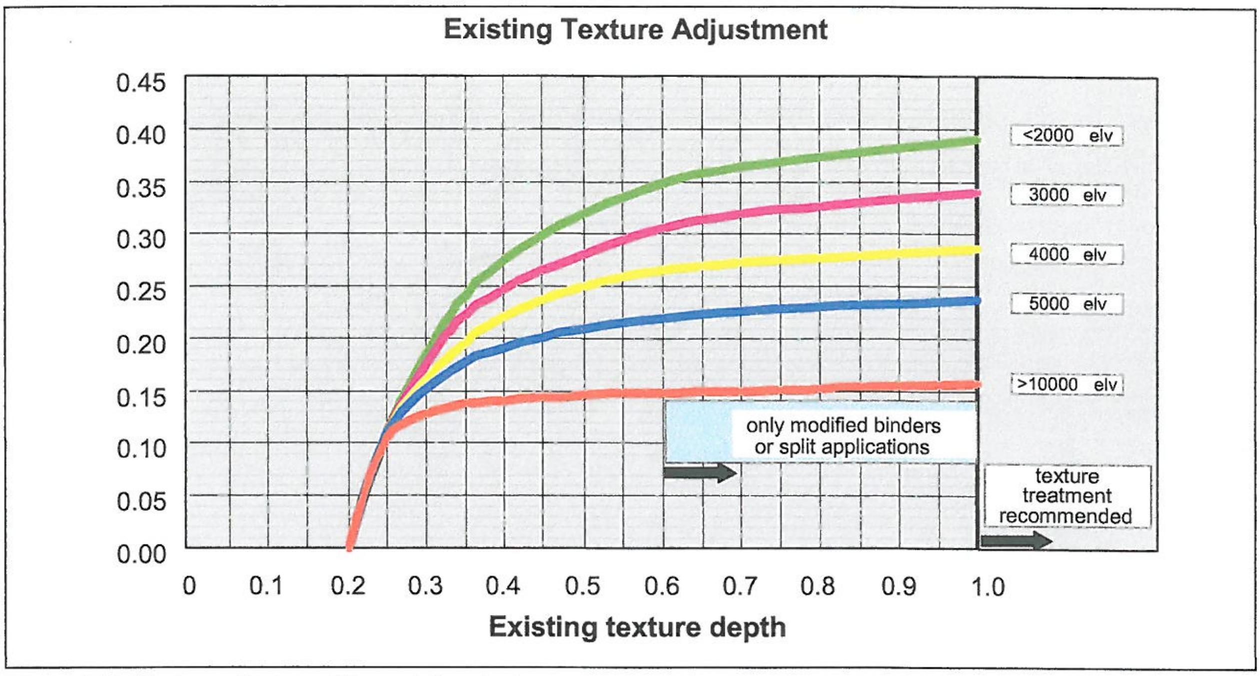


Figure 7-2 Binder adjustment for existing texture

7.6.3 Design process for double seals

7.6.3.1 Application rate

The steps are similar to those taken for the determination of application rates for single seals except for the following:

a) The design ALD of the double seal is calculated as follows:
Design ALD (double seal) = ALD of first layer + ALD of the second layer.

b) Use the relevant charts in APPENDIX E to determine the total binder application rate required for the double seal.

c) Binder distribution

Current practice differs from one road authority to the next with regard to the split in binder between the tack coat and penetration coat. However, it is generally agreed that this split is governed by the minimum application rates required for each layer to prevent whip-off or by the minimum rate that can be sprayed accurately (in the case of a fog spray).

The following guidelines may be used:

- Determine the total net cold binder required for the double seal.
- Subtract half of the binder required for the fog spray e.g. 0,33/2 = 0,17 ℓ/m^2 (if a fogspray will be applied). It is assumed that only half the binder will flow down - the remainder will stick to the top and sides of the aggregate, i.e. will be non-effective in terms of filling the voids.

The minimum quantity of net cold binder required for the penetration coat depends on the aggregate size of the second layer. (Table 7-4 may be used as a guideline.)

If traffic has to be accommodated on the first layer (this is not recommended), it is advisable to design the next layer separately as a second single seal.

The minimum quantity of residual binder required for the tack coat depends on the size of the aggregate used in the first layer. (See Table 7-5.)

The concepts of adjustment and sensitivity analysis of application rates, as used in the single seal design, should also be used in the design of double seal. They are not repeated here.

Concept of risk

Areas are indicated on the design graphs where the use of the curves constitutes a risk. Theoretically, in these areas the application rate is too low to prevent whip-off but is also too high to ensure the required texture depth. Therefore, the probability of the seal having a shorter life than normal is very high.

Table 7-3 - Factors for converting net cold residual binder to hot spray rates and storage and spraying temperatures

Type of binder	Conversion *** factor	Spray temperature (℃)	Max. storage temperature (℃)
Cutback bitumen			
MC 3000	1.19 – 1.27	130 - 155	100
MC 70	1.63 – 1.72	60 - 80	Ambient
MC 30	1.88 – 1.99	45 - 65	Ambient
Penetration grade bitumen			
150/200 pen	1.09	145 - 185	115
80/100 pen	1.09	160 - 200	125
Polymer modified bitumen			
S-E1	1.08	165 - 190	150
S-E2	1.06	165 - 190	150
Bitumen rubber (S-R1)	1.07	195 - 205	-
Bitumen emulsions			
60% emulsion	1.68	60	Ambient
65% emulsion	1.55	60	Ambient
70% emulsion	1.44	70	Ambient

Note:

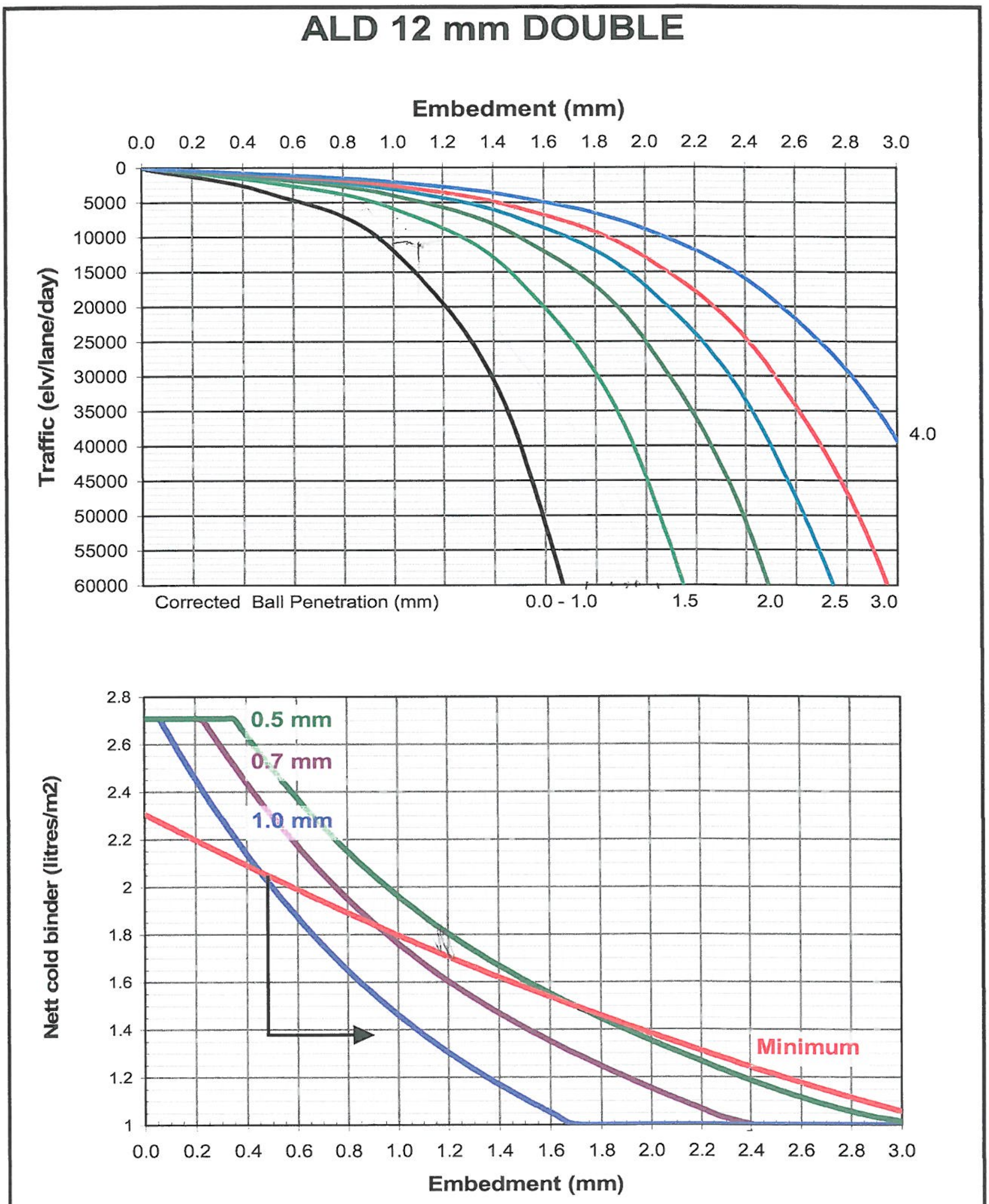
**** Binders from different sources have different temperature conversion factors. The user should refer to the manufacturer.*

Table 7-4 - Minimum quantity of net cold binder required for penetration coat

Aggregate size in top layer	4,75 mm or less	6,7 mm	9,5 mm
Minimum net binder required	0,3 ℓ/m²	0,6 ℓ/m²	0,7 ℓ/m²

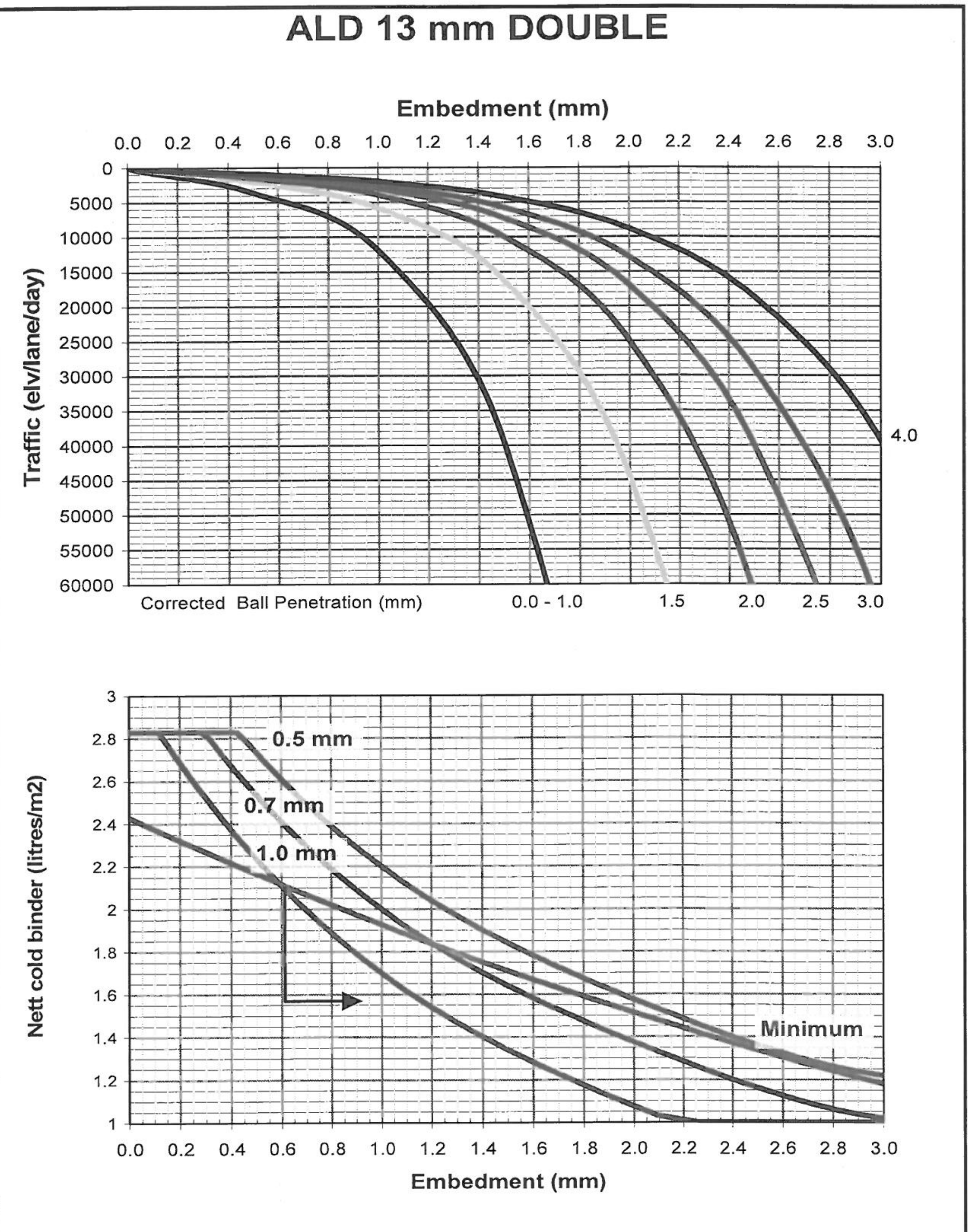
Table 7-5 - Minimum quantity of net cold binder required for tack coat

DESIGN CHART FOR DOUBLE SEALS: Design ALD = 12mm



Note: Risk - Too much binder for target texture, yet too little to prevent whip-off

DESIGN CHART FOR DOUBLE SEALS: Design ALD = 13mm



Note: Risk - Too much binder for target texture, yet too little to prevent whip-off

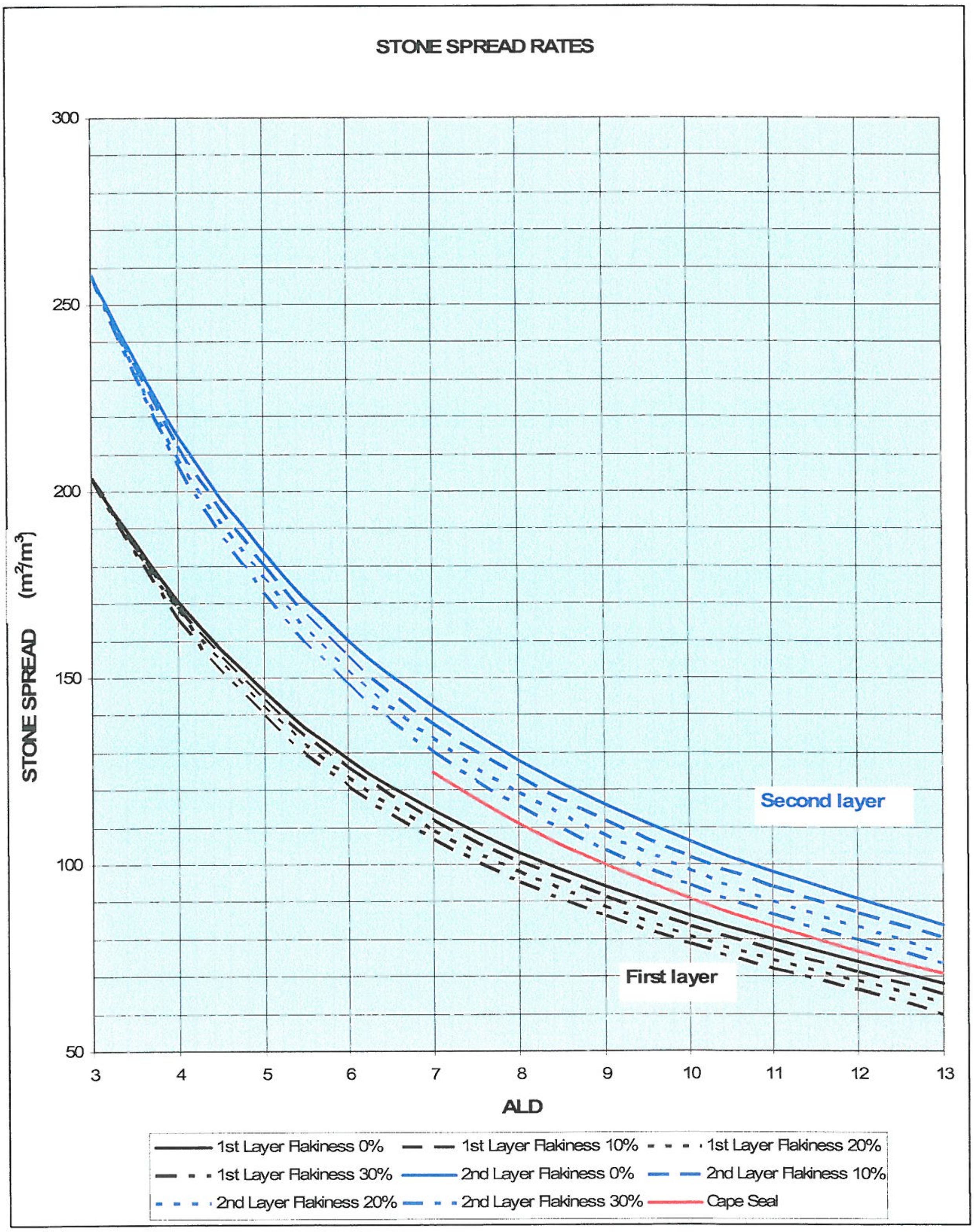


Figure F-2 Approximate spread rates for seal aggregate