

TABEL

KONSTRUKSI JALAN RAYA

DISERTAI CONTOH PENGGUNAAN



Cipta Science Team

DATA LENGKUNG HORIZONTAL (PERHITUNGAN DENGAN MENGGUNAKAN TABEL)

1.1 MENENTUKAN BENTUK LENGKUNG

a. CIRCLE (TC-CT)

Lihat Table 1 (halaman 1-1 s/d 1-3), diatas garis tebal dianjurkan menggunakan spiral peralihan, tetapi tidak diharuskan.

Pada kolom yang sesuai dengan kecepatan rencana (Vr) tentukan harga panjang lengkung spiral peralihan minimal (Ls min) dalam baris yang sama dengan harga R yang sesuai.

R ditentukan secara grafis pada gambar rencana (plan) dengan menggunakan maal (template).

b. SPIRAL-CIRCLE-SPIRAL (TS-SC-CS-ST)

Lihat Table 2 (halaman 2-1 s/d 2-25).

R ditentukan secara grafis pada plan. Pada baris yang sesuai dengan harga R tersebut di atas, dapat dibaca harga-harga untuk θ_s , p dan k.

Hitung dahulu harga $\Delta' = \Delta - 2 \theta_s$, kemudian hitung harga L' dengan rumus $L' = R \cdot \Delta' \frac{\pi}{180}$.

(pemakaian rumus diatas, ditulis dalam satuan derajat atau degree ditulis dalam desimal).

Syarat = $L' > 20$ meter

c. SPIRAL-SPIRAL (TS- $\frac{SC}{CS}$ -ST)

Digunakan bila $L' < 20$ meter. Table yang digunakan adalah Table 3 (halaman 3-1 s/d 3-5).

1.2 RUMUS-RUMUS UMUM

a. CIRCLE (TC-CT)

$$T = R \cdot \tan \frac{1}{2} \Delta \quad \dots\dots\dots (1-1)$$

$$E = T \cdot \tan \frac{1}{4} \Delta \quad \dots\dots\dots (1-2)$$

$$L = \frac{\pi}{180} \Delta \cdot R \quad \dots\dots\dots (1-3)$$

Harga Δ dihitung secara analitis berdasarkan koordinat-koordinat P₁. Harga R ditentukan secara grafis pada plan dengan menggunakan maal (template)

b. SPIRAL-CIRCLE-SPIRAL (TS-SC-CS-ST)

Harga dihitung lebih dahulu secara analitis (seperti pada a) diatas, dengan demikian pula harga R ditentukan secara grafis pada plan.

Lihat Table 2 pada baris yang sesuai dengan harga R tersebut dapat dibaca harga-harga yang sesuai untuk θ_s , p dan k.

Rumus-rumus yang digunakan adalah :

$$Ts = (R+p) \operatorname{tg} \frac{1}{2} \Delta + k \quad \text{.....} \quad (\text{II}-1)$$

$$Es = \frac{(R+p)}{\cos \frac{1}{2} \Delta} - R \quad \text{.....} \quad (\text{II}-2)$$

$$L = L' + 2 Ls \quad \text{.....} \quad (\text{II}-3)$$

$$\text{dimana } L' = \frac{\Delta'}{360} \cdot 2 \cdot \pi \cdot R \quad \text{.....} \quad (\text{II}-4)$$

$$\Delta' = \Delta - 2\theta_s \quad \text{.....} \quad (\text{II}-5)$$

Kontrol I : $L' > 20$ meter

Harga e (super elevasi) dilihat pada Tabel 1 (halaman 1-1 s/d 1-3)

Kontrol II : $L < 2 Ts$

c. SPIRAL-SPIRAL (TS-ST)

Harga Δ dihitung lebih dahulu secara analitis seperti pada a) diatas.

Hitung harga $\theta_s = \frac{1}{2} \Delta$ (bila $\Delta' = 0$, maka harga $\theta_s = \frac{1}{2} \Delta$), kemudian berdasarkan harga θ_s ini dibaca harga-harga untuk p* dan k* pada Tabel 3 (halaman 3-1 s/d 3-5) pada baris yang sesuai dengan harga θ_s .

Rumus-rumus yang digunakan adalah :

$$Ls = \frac{\theta_s}{28,648} \cdot R \quad \text{.....} \quad (\text{III}-0)$$

$$Ts = (R+p) \operatorname{tg} \frac{1}{2} \Delta + k \quad \text{.....} \quad (\text{III}-1)$$

$$Es = \frac{(R+p)}{\cos \frac{1}{2} \Delta} - R \quad \text{.....} \quad (\text{III}-2)$$

$$L = 2 Ls \quad \text{Kontrol : } 2Ls < 2 Ts$$

$$\text{dimana : } p = p^* \cdot Ls$$

$$k = k^* \cdot Ls$$

harga-harga p* dan k* adalah harga-harga yang dibaca dari Table 3.

Tabel I - 1

R dalam meter	Vr = 20 km / jam			Vr = 30 km / jam			Vr = 40 km / jam		
	e %	b'	Ls min	e %	b'	Ls min	e %	b'	Ls min
400							2.0	0.50	25
360							2.7	0.50	25
320							2.5	0.50	25
300							2.7	0.50	25
280							2.9	0.50	25
240							3.4	0.50	25
200				2.2	0.50	20	4.0	0.75	25
180				2.5	0.50	20	4.4	0.75	30
160				2.8	0.75	20	4.9	0.75	30
140				3.2	0.75	20	5.5	0.75	30
130				3.4	0.75	20	5.8	0.87	30
120				3.7	0.75	20	6.2	1.00	40
100				4.5	1.00	25	7.2	1.00	40
90				5.0	1.00	25	7.6	1.00	40
85	2.0								
80	2.1			5.6	1.00	25		1.25	40
75	2.2								
70	2.4			6.3	1.25	30	8.8	1.25	50
65	2.5								
60	2.6	1.000	15	7.1	1.25	30	9.4	1.50	50
55	2.8	1.000	15						
50	2.9	1.000	15	8.0	1.50	40	9.9	1.50	50
45	3.0	1.000	15	8.4	1.50	40			
40	3.1	1.500	15	8.9	1.75	40			
35	3.2	1.500	20	9.4	2.00	40			
30	3.4	1.500	20	9.8	2.25	40			
25	3.5	1.500	20						
20	3.6	1.500	20						
15	4.0	3.700	20						
5	4.0	3.700	20						

Tabel I - 2

R dalam meter	Vr = 30 km / jam		Vr = 60 km / jam		Vr = 70 km / jam		Vr = 80 km / jam	
	e %	Ls min	e %	Ls min	e %	Ls min	e %	Ls min
2.200								
2.000								
1.900								
1.700							L.N	-
1.600							L.N	-
1.500					L.N	-	2.1	50
1.400					L.N	-	2.2	50
1.300					L.P	40	2.3	50
1.200					2.2	40	2.7	50
1.100			L.N	-	2.4	40	2.9	50
1.000			L.N	-	2.7	40	3.2	50
950			2.1	40	2.8	40	3.4	50
900			2.2	40	2.9	40	3.6	50
850			2.4	40	3.1	40	3.8	50
800			2.5	40	3.3	40	4.0	50
750	L.N	-	2.7	40	3.5	40	4.2	50
700	L.N	-	2.9	40	3.8	40	4.6	50
650	2.1	30	3.1	40	4.1	40	4.9	50
600	2.3	30	3.3	40	4.4	40	5.3	50
560	2.5	30	3.5	40	4.6	50	5.6	60
550	2.5	30	3.5	40	4.7	50	5.7	60
520	2.7	30	3.7	40	4.9	50	6.0	60
500	2.8	30	3.9	40	5.1	50	6.2	60
480	2.9	30	4.0	40	5.3	50	6.4	60
475	2.9	30	4.0	40	5.4	50	6.5	60
450	3.1	30	4.2	40	5.7	50	6.8	60
440	3.2	30	4.3	40	5.8	50	7.0	70
425	3.25	30	4.5	40	5.9	50	7.1	70
400	3.4	30	4.7	40	6.2	60	7.3	70
375	3.8	30	5.0	40	6.5	60	7.8	70
360	3.8	30	5.1	40	6.7	60	8.0	70
350	3.8	30	5.3	40	6.9	60	8.2	70
325	4.1	30	5.6	50	7.3	60	8.5	80
320	4.2	30	5.7	50	7.5	60	8.6	80
300	4.4	40	6.0	50	7.7	60	8.9	80
280	4.7	40	6.3	50	8.1	70	9.2	80
260	5.0	40	6.7	50	8.4	70	9.5	80
250	5.1	40	6.9	50	8.6	70	9.6	80
240	5.3	40	7.1	50	8.8	70	9.8	90
220	5.7	40	7.5	60	9.1	70	10.0	90
200	6.2	40	8.0	60	9.4	70		
180	6.7	50	8.6	60	9.7	80		
160	7.2	50	9.1	70	10.0	80		
150	7.5	50	9.3	70				
140	7.8	50	9.5	70				
120	8.6	60	9.9	70				
100	9.4	60						
80	9.9	60						
50								

Diatas garis tebal, spiral peralihan dianjurkan tetapi tidak diharuskan.

R dalam meter	Vr = 90 km / jam		Vr = 100 km / jam		Vr = 110 km / jam		Vr = 120 km / jam	
	e %	Ls min	e %	Ls min	e %	Ls min	e %	Ls min
3.000					L.N	-	L.N	-
2.800					L.N	-	L.P	70
2.600					L.P	60	2.1	70
2.500			L.N	-	L.P	60	2.2	70
2.400			L.N	-	L.P	60	2.3	70
2.200			L.P	60	2.1	60	2.5	70
2.000	L.N	-	2.15	60	2.4	60	2.7	70
1.900	L.P	50	2.2	60	2.5	60	2.85	70
1.800	2.1	50	2.4	60	2.68	60	3.0	70
1.700	2.2	50	2.5	60	2.8	60	3.2	70
1.600	2.3	50	2.7	60	3.0	60	3.4	70
1.500	2.5	50	2.8	60	3.2	60	3.6	70
1.400	2.6	50	3.0	60	3.4	60	3.8	70
1.300	2.8	50	3.3	60	3.7	60	4.2	70
1.200	3.1	50	3.6	60	4.0	60	4.5	70
1.100	3.7	50	3.9	60	4.3	60	4.9	70
1.000	3.7	50	4.3	60	4.8	70	5.4	80
950	3.9	50	4.5	60	5.0	70	5.7	80
900	4.1	50	4.8	60	5.3	70	6.0	80
850	4.4	50	5.0	60	5.6	70	6.4	90
800	4.6	50	5.3	60	6.0	80	6.8	90
750	5.0	60	5.7	70	6.3	80	7.2	90
700	5.3	60	6.1	70	6.8	80	7.8	100
650	5.8	60	6.6	80	7.3	90	8.3	100
600	6.2	70	7.1	80	8.0	90	9.0	100
580	6.7	70	7.7	80	8.5	100	9.7	100
550	6.8	70	7.8	80	8.7	100	9.9	100
520	7.2	70	8.2	90	9.1	100		
500	7.4	80	8.5	90	9.4	100		
480	7.7	80	8.7	90	9.6	100		
475	7.8	80	8.8	90	9.6	100		
450	8.1	80	9.0	100	9.8	100		
440	8.3	80	9.1	100	9.9	100		
425	8.5	80	9.4	100				
400	8.8	90	9.6	100				
375	9.1	90	9.8	100				
360	9.2	90	9.9	100				
350	9.3	90	10.0	100				
325	9.6	90						
320	9.65	90						
300	9.8	90						
280	9.9	90						
260								
250								
240								
220								
200								
180								
160								
150								

Diatas garis tebal, spiral peralihan dianjurkan tetapi tidak diharuskan.

Tabel II - 1

<u>Ls = 1</u>				
θ_s	r	K	X	Y
0	0.0000000	0.5000000	1.0000000	0.0000000
0.1	1455	0000	0.9999997	0.0005818
0.2	2909	0.4999998	9988	0.0011636
0.3	4363	9996	9973	0.0017453
0.4	5818	9992	9951	0.0023271
0.5	7272	9987	9924	0.0029089
0.6	8727	9982	9890	0.0034906
0.7	0.0010181	9975	9851	0.0040724
0.8	1635	9968	9805	0.0046541
0.9	3090	9959	9753	0.0052359
1.0	4544	9949	9695	0.0058176
1.1	5999	9939	9631	0.0063994
1.2	7453	9927	9561	0.0069811
1.3	8907	9914	9485	0.0075629
1.4	0.0020362	9900	9403	0.0081445
1.5	1816	9886	9315	0.0087262
1.6	3270	9870	9220	0.0093079
1.7	4725	9853	9120	0.0098896
1.8	6179	9835	9013	0.0104712
1.9	7633	9817	8900	0.0110529
2.0	9000	9797	8782	0.0116345
2.1	0.0030542	9776	8627	0.0122161
2.2	1996	9754	8526	0.0127977
2.3	3450	9731	8389	0.0133793
2.4	4904	9707	8245	0.0139609
2.5	6359	9683	8096	0.0145424
2.6	7813	9657	7941	0.0151240
2.7	9267	9630	7780	0.0157055
2.8	0.0040721	9602	7612	0.0162870
2.9	2175	9573	7438	0.0174499
3.0	3629	9543	7258	0.0174499

Tabel II - 2

<u>Ls = 1</u>				
θ_s	P	K	X	Y
3.0	0.0043629	0.4999543	0.9997258	0.0174499
3.1	5083	9512	7073	0.0180213
3.2	6537	9480	6881	0.0186127
3.3	7991	9447	6683	0.0191941
3.4	9445	9413	6479	0.0197754
3.5	0.0050899	9378	6269	0.0203567
3.6	2352	9342	6063	0.0209380
3.7	3806	9205	5831	0.0215193
3.8	5260	9267	5602	0.0221006
3.9	6714	9228	5368	0.0226818
4.0	8168	9188	5127	0.0232630
4.1	9621	9147	4881	0.0238441
4.2	0.0061075	9105	4628	0.0244252
4.3	2528	9061	4369	0.0250063
4.4	3982	9017	4104	0.0255874
4.5	5435	8972	3833	0.0261684
4.6	6889	8926	3556	0.0267494
4.7	8342	8879	3273	0.0273304
4.8	9796	8830	2984	0.0279113
4.9	0.0071249	8781	2689	0.0284922
5.0	2702	8731	2387	0.0290730
5.1	4155	8680	2080	0.0296538
5.2	5609	8628	1766	0.0302346
5.3	7062	8574	1447	0.0308153
5.4	8515	8520	1121	0.0313960
5.5	9968	8465	0789	0.0319766
5.6	0.0081421	8408	0451	0.0325573
5.7	2874	8351	0108	0.0331378
5.8	4372	8393	0.9989758	0.0348793
5.9	5780	8233	9401	0.0342988
6.0	0.0087232	8123	0.9989039	0.0348793

<u>Ls = 1</u>				
θ_s	P	K	X	Y
6.0	0.0087232	0.4998123	0.9989039	0.0348793
6.1	8685	8111	8671	0.0354596
6.2	0.0090138	8049	8297	0.0360400
6.3	1590	7986	7917	0.0366203
6.4	3043	7921	7530	0.0372005
6.5	4495	7856	7138	0.0377807
6.6	5948	7789	6739	0.0383609
6.7	7400	7722	6334	0.0389410
6.8	8852	7653	5924	0.0395210
6.9	0.0100304	7584	5507	0.0401010
7.0	1757	7513	5084	0.0406810
7.1	3209	7442	4655	0.0412608
7.2	4661	7369	4220	0.0418407
7.3	6113	7296	3779	0.0424205
7.4	7565	7221	3332	0.0430002
7.5	9016	7146	2879	0.0435799
7.6	0.0110468	7069	2420	0.0441595
7.7	1920	6991	1954	0.0447390
7.8	3371	6913	1483	0.0453185
7.9	4823	6833	1006	0.0458980
8.0	6274	6753	0522	0.0464773
8.1	7726	6671	0033	0.0470567
8.2	9177	6588	0.9979537	0.0476359
8.3	0.0120628	6505	9035	0.0487942
8.4	2079	6420	8528	0.0487942
8.5	3530	6636	8014	0.0493733
8.6	4981	6247	7494	0.0499523
8.7	6432	6160	6968	0.0505313
8.8	7883	6071	6436	0.0511101
8.9	9334	5981	5838	0.0516889
9.0	0.01030784	5890	5354	0.0522677

<u>Ls = 1</u>				
θ_s	P	K	X	Y
9.0	0.0130784	0.4995890	0.9975354	0.0522677
9.1	2235	5799	4804	0.0528463
9.2	2685	5706	4248	0.0534249
9.3	5136	5612	3686	0.0540035
9.4	6585	5517	3118	0.0545819
9.5	8036	5422	2543	0.0551603
9.6	9486	5325	1963	0.0557386
9.7	0.0140936	5227	1377	0.0563169
9.8	2386	5128	0784	0.0568951
9.9	3836	5028	0186	0.0574732
10.0	5286	4927	0.9969581	0.0580512
10.1	6736	4825	8971	0.0586291
10.2	8185	4723	8354	0.0592070
10.3	9635	4619	7731	0.0597848
10.4	0.0151084	4514	7103	0.0603625
10.5	2533	4408	6468	0.0615177
10.6	3982	4301	5827	0.0615177
10.7	5431	4193	5181	0.0620952
10.8	6880	4084	4528	0.0626726
10.9	8329	3974	3869	0.0632499
11.0	9778	3863	3204	0.0638271
11.1	0.0161227	2751	2533	0.0644043
11.2	2675	3628	1856	0.0649813
11.3	4124	3524	1173	0.0655583
11.4	5572	3409	0484	0.0661352
11.5	7020	3293	00.9959789	0.0667120
11.6	8468	3076	9088	0.0672887
11.7	9916	2828	8381	0.0678654
11.8	0.0171364	2889	7668	0.0684419
11.9	2812	2819	6949	0.0690184
12.0	4260	2698	6224	0.0695947

L_s = 30 M

R	θ_s	P	K	X	Y
650	1.322	0.0577	14.9997	29.9984	0.2308
600	1.4324	0.0625	14.9997	29.9981	0.2500
560	1.5347	0.0670	14.9996	29.9978	0.2628
550	1.5626	0.0682	14.9996	29.9978	0.2727
520	1.6528	0.0721	14.9996	29.9975	0.2884
500	1.7189	0.0750	14.9995	29.9975	0.3000
480	1.7905	0.0781	14.9995	29.9971	0.3125
475	1.8093	0.0789	14.9995	29.9971	0.3158
450	1.9099	0.0833	14.9994	29.9967	0.3333
440	1.9533	0.0852	14.9994	29.9965	0.3409
425	2.0222	0.0882	14.9994	29.9983	0.3529
400	2.1486	0.0937	14.9993	29.9960	0.3750
375	2.2918	0.1000	14.9992	29.9952	0.4000
360	2.3873	0.1042	14.9991	29.9948	0.4166
350	2.4555	0.1071	14.9991	29.9945	0.4285
325	2.6444	0.1154	14.9989	29.9936	0.4615
320	2.6857	0.1172	14.9989	29.9934	0.4687
300	2.8648	0.1250	14.9987	29.9925	0.4999
280	3.0694	0.1339	14.9986	29.9914	0.5356
260	3.3055	0.1442	14.9983	29.9900	0.5768
250	3.4377	0.1500	14.9982	29.9892	0.5998
240	3.5010	0.1562	14.9980	29.9883	0.6248
220	3.9065	0.1704	14.9977	29.9881	0.6816
200	4.2972	0.1875	14.9972	29.9881	0.7497
180	4.7746	0.2883	14.9965	29.9792	0.9369
160	5.3715	0.2343	14.9956	29.9786	0.9369
150	5.7236	0.2499	14.9950	29.9700	0.9993
140	6.1388	0.2677	14.9943	29.9656	1.0705
120	7.1620	0.3123	14.9922	29.9592	1.2486
100	8.5944	0.3747	14.9888	29.9326	1.4976
80	10.7420	0.4682	14.9824	29.8947	1.4976
50	17.1887	0.7476	14.9551	29.7071	2.9808

<u>Ls = 40 M</u>					
R	θ_s	P	K	X	Y
1300	0.8815	0.0513	19.9998	39.9991	0.2051
1200	0.9549	0.0556	19.9998	39.9989	0.2222
1100	1.0417	0.0606	19.9998	39.9987	0.2424
1000	1.1459	0.0667	19.9997	39.9984	0.2667
950	1.2062	0.0702	19.9997	39.9982	0.2807
900	1.2732	0.0741	19.9997	39.9980	0.2963
850	1.3481	0.0786	19.9996	39.9978	0.3137
800	1.4324	0.0833	19.9996	39.9975	0.3333
750	1.5279	0.0889	19.9995	39.9972	0.3555
650	1.7629	0.1026	19.9994	39.9962	0.4102
600	1.9099	0.1111	19.9993	39.9956	0.4444
560	2.0463	0.1190	19.9991	39.9949	0.4761
550	2.0835	0.1212	19.9991	39.9947	0.4848
520	2.2037	0.1282	19.9990	39.9941	0.5128
700	1.6370	0.0952	19.9995	39.9967	0.3809

Ls = 40 M

R	θ_s	P	K	X	Y
500	2.2918	0.1333	19.9989	39.9936	0.5333
480	2.3873	0.1389	19.9988	39.9931	0.5555
475	2.4125	0.1403	19.9988	39.9929	0.5613
450	2.5465	0.1481	19.9987	39.9921	0.5925
440	2.6044	0.1515	19.9986	39.9917	0.6060
425	2.6963	0.1569	19.9985	39.9911	0.6274
400	2.8648	0.1667	19.9983	39.9900	0.6665
375	3.0558	0.1778	19.9981	39.9886	0.7110
360	3.1831	0.1852	19.9979	39.9877	0.7406
350	3.2740	0.1905	19.9978	39.9869	0.7617
325	3.5259	0.2051	19.9975	39.9849	0.8203
320	3.5810	0.2083	19.9974	39.9844	0.8331
300	3.8197	0.2222	19.9970	39.9822	0.8886
280	4.0926	0.2381	19.9966	39.9796	0.9520
260	4.4074	0.2564	19.9961	39.9763	1.0252
250	4.5837	0.2666	19.9957	39.9744	1.0662
240	4.7746	0.2777	19.9954	39.9722	1.1106
220	5.2087	0.3029	19.9945	39.9670	1.2114
200	5.7296	0.3372	19.9932	39.9600	1.3324
180	6.3662	0.3702	19.9908	39.9506	1.4802
160	7.1620	0.4164	19.9896	39.9375	1.6648
150	7.6394	0.4442	19.9882	39.9289	1.7755
140	8.1851	0.4854	19.9884	39.9184	1.9020
120	9.5493	0.5550	19.9815	39.8896	2.2178
100	11.4592	0.6657	19.9734	39.8093	2.6591
80	24.3239	0.1315	19.9504	39.7507	3.3185
50	22.9183	1.3257	19.8102	39.3647	5.2727

<u>Ls = 50 M</u>					
R	θ_s	P	K	X	Y
1900	0.7539	0.0548	24.9999	49.9991	0.2193
1800	0.7958	0.0579	24.9998	49.9990	0.2315
1700	0.8426	0.0613	24.9998	49.9989	0.2451
1600	0.8952	0.0651	24.9998	49.9988	0.2604
1500	0.9549	0.0694	24.9998	49.9986	0.2778
1400	1.0231	0.0744	24.9997	49.9984	0.2976
1300	1.1018	0.0801	24.9997	49.9981	0.3205
1200	1.1937	0.0868	24.9996	49.9976	0.3472
1100	1.3022	0.0947	24.9996	49.9974	0.3788
1000	1.4324	0.1042	24.9995	49.9969	0.4166
950	1.5078	0.1096	24.9994	49.9965	0.4386
900	1.5915	0.1157	24.9994	49.9961	0.4629
850	1.6852	0.1225	24.9993	49.9957	0.4902
800	1.7905	0.1302	24.9992	49.9951	0.5208
750	1.9099	0.1389	24.9991	49.9944	0.5555
700	2.0463	0.1488	24.9989	49.9936	0.5952
650	2.2037	0.1608	24.9988	49.9926	0.6410
600	2.3873	0.1786	24.9986	49.9913	0.6944
560	2.5578	0.1860	24.9983	49.9900	0.7439
550	2.6044	0.1894	24.9983	49.9897	0.7575
520	2.7546	0.2003	24.9981	49.9884	0.8012

L _s = 50 M					
R	θ_s	P	K	X	Y
500	2.864	0.2083	24.9979	49.9875	0.8332
480	2.9842	0.2170	24.9977	49.9964	0.8679
475	3.0156	0.2193	24.9977	49.9862	0.8770
450	3.1831	0.2315	24.9974	49.9846	0.9257
440	3.2554	0.2367	24.9973	49.9839	0.9468
425	3.3703	0.2451	24.9971	49.9827	0.9801
400	3.5810	0.2604	24.9967	49.9805	1.0414
375	3.8197	0.2777	24.9963	49.9778	1.1108
360	3.9789	0.2893	24.9960	49.9759	1.1570
350	4.0926	0.2976	24.9958	49.9745	1.1900
325	4.4074	0.3204	24.9951	49.9704	1.2815
320	4.4762	0.3254	24.9949	49.9695	1.3015
300	4.7746	0.3471	24.9942	49.9602	1.4872
280	5.1157	0.3719	24.9934	49.9602	1.4872
260	5.5092	0.4005	24.9923	49.9538	1.6015
250	5.7296	0.4165	24.9917	49.9500	1.6655
240	5.983	0.4339	24.9910	49.9458	1.7348
220	6.5109	0.4733	24.9892	49.9355	1.8922
200	7.1620	0.5205	24.9870	49.9219	2.0810
180	7.9577	0.5783	24.9839	49.9036	2.3116
160	8.9525	0.6505	24.9797	49.8781	2.5996
150	9.5493	0.6938	24.9769	49.8613	2.7723
140	10.2314	0.7432	24.9735	49.8408	2.9694
120	11.9366	0.8667	24.9639	49.7834	3.4615
100	14.3239	1.0393	24.9480	49.6884	4.1481
80	17.9049	1.2976	24.9188	49.5139	5.1721
50	28.6479	2.0689	24.7331	49.7644	8.1857

<u>Ls = 60 M</u>					
R	θ_s	P	K	X	Y
2800	0.6139	0.0536	29.9999	59.9993	0.2143
2600	0.6611	0.0577	29.9999	59.9992	0.2308
2500	0.6875	0.0600	29.9999	59.9991	0.2400
2400	0.7162	0.0625	29.9998	59.9991	0.2500
2200	0.7813	0.0682	29.9998	59.9989	0.2727
2000	0.8594	0.0750	29.9998	59.9986	0.3000
1900	0.9047	0.0789	29.9998	59.9985	0.3158
1800	0.9549	0.0833	29.9997	59.9983	0.3333
1700	1.0111	0.0882	29.9997	59.9981	0.3529
1600	1.0743	0.0938	29.9996	59.9979	0.3750
1500	1.1459	0.1000	29.9996	59.9976	0.4000
1400	1.2278	0.1071	29.9995	59.9972	0.4286
1300	1.3222	0.1154	29.9995	59.9968	0.4615
1200	1.4324	0.1250	29.9994	59.9962	0.5000
1100	1.5626	0.1364	29.9993	59.9955	0.5454
1000	1.7189	0.1500	29.9991	59.9946	0.6000
950	1.8093	0.1579	29.9990	59.9940	0.6315
900	1.9099	0.1667	29.9989	59.9933	0.6666
850	2.0222	0.1765	29.9988	59.9925	0.7058
800	2.1486	0.1875	29.9986	59.9916	0.7499
750	2.2918	0.2000	29.9984	59.9904	0.7999
700	2.4555	0.2143	29.9982	59.9890	0.8570
650	2.6444	0.2308	29.9979	59.9872	0.9229
600	2.8648	0.2500	29.9975	59.9850	0.9998
560	3.0694	0.2678	29.9971	59.9828	1.0712
550	3.1252	0.2727	29.9970	59.9821	1.0907
520	3.3055	0.2884	29.9967	59.9800	1.1536

<u>Ls = 60 M</u>					
R	θ_s	P	K	X	Y
500	3.4377	0.3000	29.9966	59.9796	1.1648
480	3.5810	0.3125	29.9961	59.9766	1.2496
475	3.6187	0.3157	29.9960	59.9761	1.2628
450	3.8197	0.3333	29.9966	59.9733	1.3329
440	3.9065	0.3409	29.9954	59.9721	1.3632
425	4.0444	0.3529	29.9950	59.9701	1.4113
400	4.2972	0.3749	29.9944	59.9663	1.4994
375	4.5837	0.3999	29.9936	59.9616	1.5993
360	4.7746	0.4166	29.9931	59.9683	1.6658
350	4.9111	0.4285	29.9927	59.9559	1.7134
325	5.2888	0.4614	29.9915	59.9489	1.8450
320	5.3715	0.4686	29.9912	59.9473	1.8738
300	5.7296	0.4998	29.9900	59.9400	1.9986
280	6.1388	0.5355	29.9885	59.9312	2.1411
260	6.6111	0.5767	29.9867	59.9202	2.3055
250	6.8755	0.5997	29.9856	59.9137	2.3975
240	7.1620	0.6247	29.9844	59.9063	2.4972
220	7.8131	0.6814	29.9814	59.8885	2.7237
200	8.5944	0.7494	29.9775	59.8651	2.9952
180	9.5493	0.8325	29.9722	59.8335	3.3267
160	10.7430	0.9363	29.9649	59.7894	3.7406
150	11.4592	0.9986	29.9600	59.7604	3.9886
140	12.2777	1.0697	29.9541	59.7251	4.2717
120	14.3239	1.2472	29.9376	59.6261	4.9777
100	17.1887	1.4952	29.9102	59.4622	5.9615
80	21.4859	1.8656	29.8599	59.1617	7.4250
50	34.3775	2.9617	29.6436	59.8757	11.6950

Ls = 70 M					
R	θ_s	P	K	X	Y
2800	0.7162	0.0729	34.9998	69.9989	0.2917
2600	0.7713	0.0785	34.9998	69.9987	0.3141
2500	0.8021	0.0817	34.9998	69.9986	0.3267
2400	0.8356	0.0851	34.9998	69.9985	0.3403
2200	0.9115	0.0928	34.9997	69.9982	0.3712
2000	1.0027	0.1021	34.9996	69.9979	0.4083
1900	1.0554	0.1075	34.9996	69.9976	0.4298
1800	1.1141	0.1134	34.9996	69.9973	0.4537
1700	1.1796	0.1201	34.9995	69.9970	0.4804
1600	1.2533	0.1276	34.9994	69.9966	0.5104
1500	1.3369	0.1361	34.9994	69.9982	0.5444
1400	1.4324	0.1458	34.9993	69.9956	0.5833
1300	1.5426	0.1570	34.9992	69.9949	0.6282
1200	1.6711	0.1701	34.9990	69.9940	0.6805
1100	1.8230	0.1856	34.9988	69.9929	0.7424
1000	2.0054	0.2042	34.9986	69.9914	0.8166
950	2.1109	0.2149	34.9984	69.9905	0.8596
900	2.2282	0.2268	34.9982	69.9894	0.9073
850	2.3592	0.2402	34.9980	69.9881	0.9607
800	2.5067	0.2552	34.9978	69.9866	1.0207
750	2.6738	0.2722	34.9975	69.9848	1.0887
700	2.8648	0.2916	34.9971	69.9825	1.1665
650	3.0852	0.3141	34.9966	69.9797	1.2562
600	3.3423	0.3402	34.9960	69.9762	1.3608
560	3.5810	0.3645	34.9954	69.9727	1.4579
550	3.6461	0.3712	34.9953	69.9727	1.4844
520	3.8564	0.3926	34.9947	69.9683	1.5700

Ls = 70 M

R	θ_s	P	K	X	Y
500	4.010	0.4083	34.9943	69.9657	1.6328
480	4.1778	0.4253	34.9038	69.9628	1.7007
475	4.2218	0.4297	34.9937	69.9620	1.7186
450	4.4563	0.4536	34.9929	69.9577	1.8140
440	4.5576	0.4639	34.9926	69.9557	1.8552
425	4.7185	0.4803	34.9921	69.9525	1.9206
400	5.0134	0.5103	34.9911	69.9464	2.0406
375	5.3476	0.5443	34.9898	69.9390	2.1764
360	5.5704	0.5669	34.9890	69.9339	2.2670
350	5.7296	0.5831	34.9883	69.9300	2.3317
325	6.1703	0.6279	34.9865	69.9189	2.5107
320	6.2667	0.6377	34.9860	69.9163	2.5499
300	6.6845	0.6802	34.9841	69.9048	2.7196
280	7.1620	0.7288	34.9818	69.8907	2.9134
260	7.7129	0.7847	34.9789	69.8733	3.1370
250	8.0214	0.8161	34.9771	69.8629	3.2621
240	8.3556	0.8500	34.9752	69.8513	3.3976
220	9.1152	0.9272	34.9705	69.8230	3.7054
200	10.0286	1.0197	34.9643	69.7859	4.0744
180	11.1408	1.1327	34.9559	69.7358	4.5248
160	12.5335	1.2739	34.9442	69.6658	5.0867
150	13.3690	1.3585	34.9866	69.6198	5.4233
140	14.3239	1.4551	34.9272	69.5638	5.8073
120	16.7113	1.6962	34.9010	69.4069	6.7643
100	20.0535	2.0320	34.8576	69.1473	8.0955
80	25.0669	2.5347	34.7779	69.6720	10.0696
50	40.1070	4.0127	34.4360	66.6469	15.7706

Ls = 80 M					
R	θ_s	P	K	X	Y
2800	0.8185	0.0952	39.9997	79.9984	0.3809
2600	0.8815	0.1026	39.9997	79.9981	0.4102
2500	0.9167	0.1067	39.9997	79.9979	0.4267
2400	0.9549	0.1111	39.9996	79.9978	0.4444
2200	1.0417	0.1212	39.9996	79.9973	0.4848
2000	1.1459	0.1333	39.9995	79.9968	0.5833
1900	1.2062	0.1403	39.9994	79.9965	0.5614
1800	1.2732	0.1481	39.9993	79.9960	0.5926
1700	1.3481	0.1569	39.9993	79.9956	0.6274
1600	1.4324	0.1667	39.9992	79.9950	0.6666
1500	1.5279	0.1778	39.9991	79.9948	0.7111
1400	1.6370	0.1905	39.9989	79.9935	0.7619
1300	1.7629	0.2051	39.9987	79.9924	0.8205
1200	1.9099	0.2222	39.9985	79.9911	0.8888
1100	2.0835	0.2424	39.9982	79.9894	0.9696
1000	2.2918	0.2666	39.9979	79.9872	1.0665
950	2.4125	0.2807	39.9976	79.9858	1.1227
900	2.5465	0.2963	39.9974	79.9842	1.1850
850	2.6963	0.3137	39.9970	79.9823	1.2547
800	2.8648	0.3333	39.9967	79.9800	1.3331
750	3.0558	0.3555	39.9962	79.9772	1.4219
700	3.2740	0.3809	39.9956	79.9739	1.5235
650	3.5259	0.4102	39.9949	79.9697	1.6406
600	3.8197	0.4444	39.9941	79.9644	1.7772
560	4.0926	0.4761	39.9932	79.9592	1.9041
550	4.1670	0.4848	39.9930	79.9577	1.9387
520	4.4074	0.5127	39.9921	79.9527	2.0504

Ls = 80 M

R	θ_s	P	K	X	Y
500	4.5837	0.5332	39.9915	79.9488	2.1324
400	4.7746	0.5554	39.9907	79.9445	2.2211
475	4.8249	0.5613	39.9995	79.9433	2.2445
450	5.0930	0.5924	39.9895	79.9368	2.3690
440	5.2087	0.6059	39.9890	79.9339	2.4228
425	5.3925	0.6273	39.9882	79.9292	2.5082
400	5.7296	0.6664	39.9867	79.9200	2.6648
375	6.1115	0.7108	39.9848	79.9090	2.8421
360	6.3662	0.7404	39.9835	79.9013	2.9604
350	6.5481	0.9615	39.9826	79.8956	3.0448
325	7.0518	0.8201	39.9798	79.8789	3.2785
320	7.1620	0.8329	39.9792	79.8751	3.3296
300	7.6394	0.8883	39.9763	79.8579	3.5510
280	8.1851	0.9517	39.9728	79.8369	3.8040
260	8.8147	1.0248	39.9685	79.8109	4.0956
250	9.1673	1.0657	39.9659	79.7954	4.2589
240	9.5493	1.1100	39.9630	79.7781	4.4356
220	10.4174	1.2107	39.9560	79.7360	4.8370
200	11.4592	1.3314	39.9467	79.6806	5.3181
180	12.7324	1.4789	39.9342	79.6058	5.9051
160	14.3239	1.6630	39.9168	79.5014	6.6370
150	15.2789	1.7733	39.9054	79.4330	7.0751
140	16.3702	1.8992	39.8914	79.3494	7.5747
120	19.0986	2.2134	39.8523	79.1157	8.8186
100	22.9183	2.6515	39.7876	78.7294	10.5454
80	28.6479	3.3037	39.6690	78.0230	13.0971
50	45.8366	5.2133	39.1617	75.0295	20.3780

<u>Ls = 90 M</u>					
R	θ_s	P	K	X	Y
2800	0.9208	0.1205	48.9996	89.9977	0.4821
2600	0.9917	0.1298	48.9995	89.9973	0.5192
2500	1.0313	0.1350	48.9995	89.9971	0.5400
2400	1.0743	0.1406	48.9995	89.9968	0.5625
2200	1.1720	0.1534	48.9994	89.9962	0.6136
2000	1.2892	0.1687	48.9992	89.9954	0.6750
1900	1.3570	0.1776	48.9992	89.9949	0.7105
1800	1.4324	0.1875	48.9991	89.9944	0.7500
1700	1.5167	0.1985	48.9990	89.9937	0.7941
1600	1.6114	0.2109	48.9988	89.9929	0.8437
1500	1.7189	0.2250	48.9986	89.9919	0.8999
1400	1.8417	0.2411	48.9984	89.9907	0.9642
1300	1.9833	0.2596	48.9982	89.9892	1.0384
1200	2.1486	0.2812	48.9979	89.9873	1.1249
1100	2.3439	0.3068	48.9975	89.9849	1.2271
1000	2.5783	0.3375	48.9970	89.9818	1.3498
950	2.7140	0.3552	48.9966	89.9798	1.4208
900	2.8648	0.3750	48.9962	89.9775	1.4887
850	3.0333	0.3970	48.9958	89.9748	1.5879
800	3.2229	0.4218	48.9953	89.9715	1.6871
750	3.4377	0.4499	48.9946	89.9676	1.7995
700	3.6833	0.4821	48.9938	89.9628	1.9280
650	3.9666	0.5191	48.9928	89.9569	1.9280
600	4.2972	0.5624	48.9916	89.9494	2.2491
560	4.6041	0.6025	48.9903	89.9419	2.4096
550	4.6878	0.6135	48.9900	89.9398	2.4534
520	4.9583	0.6489	48.9888	89.9326	2.5948

L _s = 90 M					
R	θ_s	P	K	X	Y
500	5.156	0.6748	44.9879	89.9271	2.6984
480	5.3715	0.7029	44.9868	89.9209	2.8107
475	5.4280	0.7103	44.9865	89.9193	2.8403
450	5.7296	0.7497	44.9850	89.9100	2.9979
440	5.8598	0.7668	44.9843	89.9059	3.0659
425	6.0666	0.7938	44.9832	89.8991	3.1739
400	6.4458	0.8434	44.9810	89.8862	3.3719
375	6.8755	0.8995	44.9784	89.8705	3.5963
360	7.1620	0.9370	44.9766	89.8555	3.7458
350	7.3666	0.9637	44.9752	89.8513	3.8526
325	7.9333	1.0378	44.9713	89.8276	4.1482
320	8.0572	1.0539	44.9704	89.8222	4.2128
300	8.5944	1.1241	44.9663	89.7977	4.4928
280	9.2083	1.2042	44.9613	89.7679	4.8125
260	9.9166	1.2967	44.9551	89.7308	5.1812
250	10.3132	1.3484	44.9514	89.7088	5.3875
240	10.7430	1.4045	44.9473	89.6841	5.6109
220	11.7196	1.5318	44.9373	89.6242	6.1181
210	12.2777	1.6045	44.9312	89.5876	6.4075
200	12.8916	1.6845	44.9242	89.5454	6.7256
180	14.3239	1.8708	44.9064	89.4391	7.4666
160	16.1144	2.1034	44.8816	89.2907	8.3899
150	17.1887	2.2428	44.8653	89.1934	8.9423
140	18.4165	2.4018	44.8455	89.0746	9.5719
120	21.4859	2.7984	44.7899	88.7426	11.1375
100	25.7831	3.3507	44.6980	88.1945	13.3060
80	32.2289	4.1714	44.5295	87.1938	16.4975
50	51.5662	6.5586	43.8119	82.9783	25.4781

<u>Ls = 100 M</u>					
R	θ_s	P	K	X	Y
2800	1.0231	0.1488	49.9995	99.9968	0.5952
2600	1.1018	0.1603	49.9994	99.9963	0.6410
2500	1.1459	0.1667	49.9993	99.9960	0.6666
2400	1.1937	0.1736	49.9993	99.9957	0.6944
2200	1.3022	0.1894	49.9991	99.9948	0.7575
2000	1.4324	0.2083	49.9990	99.9937	0.8333
1900	1.5078	0.2193	49.9988	99.9931	0.8771
1800	1.5915	0.2315	49.9987	99.9923	0.9259
1700	1.6852	0.2451	49.9986	99.9913	0.9803
1600	1.7905	0.2604	49.9984	99.9902	1.0416
1500	1.9099	0.2779	49.9982	99.9889	1.1110
1400	2.0463	0.2976	49.9979	99.9872	1.1904
1300	2.2037	0.3205	49.9975	99.9852	1.2819
1200	2.3873	0.3472	49.9971	99.9826	1.3887
1100	2.6044	0.3788	49.9966	99.9793	1.5149
1000	2.8648	0.4166	49.9958	99.9750	1.6664
950	3.0156	0.4386	49.9954	99.9723	1.7540
900	3.1831	0.4629	49.9949	99.9691	1.8514
850	3.3703	0.4901	49.9942	99.9654	1.9603
800	3.5810	0.5208	49.9935	99.9609	2.0827
750	3.8197	0.5555	49.9926	99.9556	2.2215
700	4.0926	0.5951	49.9915	99.9490	2.3601
650	4.4074	0.6409	49.9901	99.9408	2.6630
600	4.7746	0.6943	49.9884	99.9306	2.7764
560	5.1157	0.7438	49.9867	99.9203	2.9745
550	5.2087	0.7574	49.9862	99.9174	3.0285
520	5.5092	0.8010	49.9846	99.9076	3.2030

L_s = 100 M

R	θ_s	P	K	X	Y
500	5.7296	0.8330	49.9833	99.9000	3.3310
480	5.9683	0.8677	49.9819	99.8915	3.4695
475	6.0311	0.8768	49.9815	99.8892	3.5060
450	6.3662	0.9255	49.9794	99.8766	3.7004
440	6.5109	0.9465	49.9785	99.8709	3.7844
425	6.7407	0.9799	49.9769	99.8617	3.9177
400	7.1620	1.0411	49.9740	99.8439	4.1620
375	7.6394	1.1104	49.9704	99.8224	4.4388
360	7.9577	1.1566	49.9679	99.8073	4.6233
350	8.1851	1.1896	49.9660	99.7961	4.7550
325	8.8147	1.2810	49.9606	99.7636	5.1195
320	8.9525	1.3009	49.9593	99.7561	5.1993
300	9.5493	1.3875	49.9539	99.7226	5.5445
280	10.2314	1.4864	49.9469	99.6816	5.9388
260	11.0184	1.6004	49.9384	99.6308	6.3933
250	11.4592	1.6643	49.9334	99.6007	6.6476
240	11.9366	1.7334	49.9277	99.5663	6.9229
220	13.0218	1.8904	49.9140	99.4847	7.5479
210	13.6419	1.9801	49.9057	99.4346	7.9044
200	14.3239	2.0787	49.8960	99.3768	8.2962
180	15.9155	2.3084	49.8717	99.2311	9.2084
160	17.9049	2.5951	49.8377	99.0278	10.3442
150	19.0986	2.7668	49.8154	98.8946	11.0232
140	20.4627	2.9627	49.7882	98.7320	11.7967
120	23.8732	3.4508	49.7120	98.2778	13.7176
100	28.6479	4.1297	49.5862	97.5288	16.3714
80	35.8099	5.1363	49.3560	96.1688	20.2593
50	57.2958	8.0433	48.3787	90.4523	31.0281

Ls = 120 M					
R	θ_s	P	K	X	Y
2800	1.2278	0.2143	59.9991	119.9945	0.8571
2600	1.3222	0.2308	59.9989	119.9936	0.9230
2500	1.3751	0.2400	59.9988	119.9931	0.9600
2400	1.4324	0.2500	59.9987	119.9925	1.0000
2200	1.5626	0.2727	59.9985	119.9911	1.0908
2000	1.7189	0.3000	59.9982	119.9892	1.1999
1900	1.8093	0.3158	59.9980	119.9880	1.2631
1800	1.9099	0.3333	59.9978	119.9866	1.3332
1700	2.0222	0.3529	59.9975	119.9851	1.4116
1600	2.1486	0.3750	59.9972	119.9831	1.4998
1500	2.2918	0.4000	59.9968	119.9808	1.5998
1400	2.4555	0.4385	59.9963	119.9779	1.7141
1300	2.6444	0.4615	59.9957	119.9744	1.8459
1200	2.8648	0.5000	59.9950	119.9700	1.9996
1100	3.1252	0.5454	59.9940	119.9643	2.1814
1000	3.4377	0.5999	59.9928	119.9568	2.3994
950	3.6187	0.6215	59.9920	119.9521	2.5256
900	3.8197	0.6666	59.9911	119.9467	2.6658
850	4.0444	0.7858	59.9900	119.9402	2.8225
800	4.2972	0.7898	59.9887	119.9325	2.9988
750	4.5837	0.7998	59.9872	119.9232	3.1985
700	4.9111	0.8569	59.9853	119.9119	3.4268
650	5.2888	0.9228	59.9830	119.8778	3.6901
600	5.7296	0.9996	59.9800	119.8801	3.9971
560	6.1388	1.0710	59.9770	119.8623	4.2822
550	6.2504	1.1124	59.9762	119.8573	4.3599
520	6.3411	1.3113	59.9754	119.8403	4.6110

$L_s = 120 \text{ M}$

R	θ_s	P	K	X	Y
500	6.875	1.1994	59.9712	119.8273	4.7951
480	7.1620	1.2493	59.9688	119.8126	4.9944
475	7.2374	1.2624	59.9681	119.8087	5.0469
450	7.6394	1.3325	59.9645	119.7868	5.3266
440	7.8131	1.3627	59.9628	119.7770	5.4473
425	8.0888	1.4108	59.9602	119.7611	5.6390
400	8.5944	1.4988	59.9550	119.7303	5.9904
375	9.1673	1.5985	59.9488	119.6932	6.3883
360	9.5493	1.6650	59.9445	119.6671	6.6534
350	9.8221	1.7125	59.9413	119.6478	6.8428
325	10.5777	1.8439	59.9318	119.5916	7.3667
320	10.7430	1.8726	59.9298	119.5788	7.4812
300	11.4592	1.9971	59.9281	119.5209	7.9772
280	12.2777	2.1393	59.9083	119.4501	8.5434
260	13.2221	2.3033	59.8936	119.3625	9.1957
250	13.7510	2.3951	59.8850	119.3106	9.5606
240	14.3239	2.4944	59.8752	119.2622	9.9554
220	15.6261	2.7200	59.8515	119.1105	10.8513
210	16.3702	2.8488	59.8371	119.0241	11.3621
200	17.1887	2.9904	59.8204	118.9245	11.9231
180	19.0986	3.3201	59.7785	118.6735	13.2279
160	21.4859	3.7312	59.7198	118.3235	14.8500
150	22.9183	3.9772	59.6814	118.0942	15.8181
140	24.5553	4.2577	59.6345	117.8146	16.9193
120	28.6479	4.2359	59.5035	117.0345	19.6457
100	34.3775	6.9235	59.2872	115.7514	23.3899
80	42.9718	7.3614	59.2324	113.4235	28.8162
50	68.7549				

Ls = 140 M					
R	θ_s	P	K	X	Y
2800	1.4324	0.2917	69.9985	139.9912	1.1666
2600	1.5426	0.3141	69.9983	139.9898	1.2563
2500	1.6043	0.3267	69.9982	139.9890	1.3066
2400	1.6711	0.3403	69.9980	139.9881	1.3610
2200	1.8230	0.3712	69.9976	139.9858	1.4847
2000	2.0054	0.4085	69.9071	139.9829	1.6332
1900	2.1109	0.4298	69.9968	139.9810	1.7191
1800	2.2282	0.4537	69.9965	139.9788	1.8146
1700	2.3592	0.4804	69.9960	139.9763	1.9213
1600	2.5067	0.5104	69.9955	139.9732	2.0414
1500	2.6738	0.5444	69.9949	139.9695	2.1774
1400	2.8648	0.5833	69.9947	139.9650	2.3329
1300	2.0852	0.6281	69.9932	139.9594	2.5123
1200	3.3423	0.6805	69.9931	139.9524	2.7216
1100	3.6461	0.7423	69.9905	139.9433	2.9688
1000	4.0107	0.8165	69.9886	139.9314	3.2655
950	4.2218	0.9595	69.9873	139.9240	3.4373
900	4.4563	0.9027	69.9859	139.9153	3.6281
850	4.7185	0.9605	69.9842	139.9051	3.8413
800	5.0134	1.0805	69.9821	139.8928	4.0811
750	5.3476	1.0886	69.9797	139.8781	4.3928
700	5.7296	1.1663	69.9767	139.8601	4.6633
650	6.1703	1.2559	69.9729	139.8377	5.0215
600	6.6845	1.3605	69.9653	139.8096	5.4392
560	7.1620	1.4575	69.9638	139.7814	5.8268
550	7.2922	1.4840	69.9622	139.7734	5.9325
520	7.7129	1.5035	69.9617	139.7465	6.2739

$L_s = 140 \text{ M}$

R	θ_s	P	K	X	Y
500	8.0214	1.6322	69.9543	139.7258	6.5242
480	8.3556	1.7001	69.9504	139.7025	6.7944
475	8.4436	1.7180	69.9494	139.6963	6.8665
450	8.9127	1.8132	69.9436	139.6616	7.2467
440	9.1152	1.8544	69.9410	139.6461	7.4108
425	9.4370	1.9197	69.9367	139.6207	7.6714
400	10.0268	2.0394	69.9286	139.5718	8.1488
375	10.6952	2.1751	69.9188	139.5130	8.6895
360	11.1408	2.2655	69.9119	139.4716	9.0496
350	11.4592	2.3300	69.9068	139.4410	9.3067
325	12.3406	2.5087	69.8919	139.3519	10.0180
320	12.5385	2.5477	69.8885	139.3316	10.1735
300	13.3690	2.7169	69.8732	139.2397	10.8466
280	14.3239	2.9102	69.8544	139.1275	11.6147
260	15.4258	3.1329	69.8312	138.9886	12.4992
250	16.0428	3.2575	69.8175	138.9064	12.9937
240	16.7113	3.3925	69.8020	138.8137	13.5286
220	18.2305	3.6987	69.7644	138.5893	14.7415
210	19.0986	3.8735	69.7415	138.4524	15.4325
200	20.0535	4.0655	69.7151	138.2947	16.1010
180	22.2817	4.5126	69.6486	137.8975	17.9530
160	25.0669	5.0694	69.5538	137.3440	20.1392
150	26.7380	5.4023	69.4949	136.9817	21.4414
140	28.6479	5.7815	69.4207	136.5403	22.9200
120	33.4225	6.7235	69.2135	135.3106	26.5677
100	40.1070	8.0254	68.8721	133.2939	31.5412
80	50.1338				
50	80.2141				

Ls = 160 M

R	θ_s	P	K	X	Y
2800	1.6270	0.3809	79.9978	159.9869	1.5237
2600	1.7629	0.4102	79.9975	159.9848	1.6409
2500	1.8335	0.4266	79.9973	159.9836	1.7065
2400	1.9099	0.4444	79.9970	159.9822	1.7776
2200	2.0835	0.4848	79.9965	159.9788	1.9392
2000	2.2918	0.3333	79.9957	159.9744	2.1331
1900	2.4125	0.5614	79.9953	159.9716	2.2453
1800	2.5465	0.5926	79.9947	159.9684	2.3700
1700	2.6963	0.6274	79.9941	159.9646	2.5094
1600	2.8658	0.6666	79.9933	159.9600	2.6662
1500	3.0558	0.7110	79.9924	159.9545	2.8439
1400	3.2740	0.7618	79.9913	159.9478	3.0469
1300	3.5259	0.8204	79.9899	159.9394	3.2812
1200	3.8197	0.8887	79.9881	159.9289	3.5544
1100	4.1670	0.9695	79.9859	159.9154	3.8773
1000	4.5837	1.0664	79.9829	159.8976	4.2647
950	4.8249	1.1225	79.9811	159.8866	4.4890
900	5.0930	1.1848	79.9789	159.8736	4.7381
850	5.3925	1.2545	79.9764	159.8583	5.0164
800	5.7296	1.3329	79.9733	159.8401	5.3295
750	6.1115	1.4216	79.9697	159.8180	5.6843
700	6.5481	1.5231	79.9652	159.7911	6.0896
650	7.0518	1.6401	79.9596	159.7576	6.5570
600	7.6394	1.7767	79.9526	159.7158	7.1021
560	8.1851	1.9034	79.9456	159.6730	7.6079
550	8.3339	1.9379	79.9436	159.6618	7.7459
520	8.8147	2.0495	79.9369	159.6217	8.1913

Ls = 160 M

R	Θs	P	K	X	Y
500	9.167	2.1314	79.9313	159.5909	8.5177
580	9.5495	2.2200	79.9260	159.5561	8.8713
475	9.6498	2.2433	79.9244	159.5467	8.9643
450	10.1859	2.3677	79.9158	159.4951	9.4601
440	10.4174	2.4214	79.9119	159.4719	9.6741
425	10.7851	2.5066	79.9056	159.4341	10.0138
400	11.4592	2.6629	79.8934	159.3612	10.6362
375	12.2231	2.8398	79.8788	159.2734	11.3408
360	12.7324	2.9577	79.8688	159.2117	11.3101
350	13.0962	3.0419	79.8609	159.1661	12.1451
325	14.1036	3.2750	79.8387	159.0332	13.0715
320	14.3239	3.3259	79.8336	159.1029	13.2739
300	15.2789	3.5465	79.8107	158.8660	14.1501
280	16.3702	3.7984	79.7828	158.6988	15.1495
260	17.6295	4.0887	79.7432	158.4918	16.2996
250	18.3346	4.2511	79.7277	158.3693	16.9422
240	19.0986	4.4269	79.7046	158.2313	17.6372
220	20.8348	4.8257	79.6487	157.8972	19.2115
210	21.8270	5.0531	79.6146	157.6936	20.1078
200	22.9183	5.3030	79.5752	157.4589	21.0908
180	25.4648	5.8843	79.4761	156.8683	23.3714
160	28.6479	6.6075	79.3379	156.0460	26.1943
150	30.5577	7.0393	79.2474	155.5084	27.8718
140	32.7404	7.5309	79.1371	154.8539	29.7728
120	38.1972	8.7492	78.8293	153.0337	34.4428
100	45.8366	10.4266	78.3233	150.0589	40.7559
80	57.2958				
50	91.6732				

TABLE III. SPIRAL-SPIRAL

0° - 5°

- FUNCTIONS OF TRANSITION FOR $L_s = 1$

θ	p*	k*	x	y	L.T	S.T	L.C	θ
0.0	.00000	.50000	1.00000	.00000	.66667	.33333	1.00000	0.0
.1	015	000	1.00000	058	67	33	1.00000	.1
.2	029	000	1.00000	116	67	34	1.00000	.2
.3	044	000	.99999	175	67	34	1.00000	.3
.4	058	000	999	233	67	34	1.00000	.4
.5	.00073	.50000	.99999	.00291	.66667	.33334	1.00000	.5
.6	088	000	999	349	667	334	1.00000	.6
.7	102	000	998	407	668	334	.99999	.7
.8	117	000	998	465	668	334	999	.8
.9	131	000	997	524	668	334	999	.9
1.0	.00146	.49999	.99997	.00582	.66668	.33334	.99999	1.0
.1	161	999	996	640	668	335	998	.1
.2	175	999	995	698	668	335	998	.2
.3	190	999	995	756	669	335	998	.3
.4	204	999	994	814	669	335	997	.4
.5	.00219	.49999	.99993	.00873	.66669	.33336	.99997	.5
.6	233	999	992	931	669	336	997	.6
.7	248	998	991	989	670	336	996	.7
.8	262	998	990	.01047	670	337	996	.8
.9	277	998	989	105	671	337	995	.9
2.0	.00291	.49998	.99988	.01163	.66671	.33337	.99995	2.0
.1	305	998	987	222	671	338	994	.1
.2	320	997	985	280	672	338	993	.2
.3	334	997	984	338	672	339	993	.3
.4	349	997	982	396	673	339	992	.4
.5	.00363	.49997	.99981	.01454	.66673	.33339	.99992	.5
.6	377	996	979	512	674	340	991	.6
.7	392	996	978	571	675	340	990	.7
.8	406	996	976	629	675	341	990	.8
.9	421	996	.975	687	676	341	989	.9
3.0	.00435	.49995	.99973	.01745	.66676	.33342	.99988	3.0
.1	450	995	971	803	677	343	987	.1
.2	464	994	969	861	678	343	986	.2
.3	479	994	967	919	678	344	985	.3
.4	493	994	965	978	679	345	984	.4
.5	.00508	.49994	.99963	.02036	.66680	.33345	.99983	.5
.6	523	993	961	094	681	346	982	.6
.7	537	993	958	152	681	347	981	.7
.8	552	993	956	210	682	347	980	.8
.9	566	992	953	268	683	348	979	.9
4.0	.00581	.49992	.99951	.02326	.66684	.33349	.99978	4.0
.1	596	991	948	384	685	350	977	.1
.2	610	991	946	443	686	350	976	.2
.3	625	991	943	501	686	351	975	.3
.4	639	990	941	559	687	352	974	.4
.5	.00654	.49990	.99938	.02617	.66688	.33353	.99973	.5
.6	669	989	935	675	689	354	971	.6
.7	683	989	932	733	690	355	970	.7
.8	698	988	930	791	691	356	969	.8
.9	712	988	927	849	692	357	967	.9
5.0	.00727	.49987	.99924	.02907	.66693	.33358	.99966	5.0

5° - 10°

- FUNCTIONS OF TRANSITION FOR $L_S = 1$

θ	p^*	k^*	x	y	L.T	S.T	L.C	θ
5.0	.00727	.49987	.99924	.02907	.66693	.33358	.99966	5.0
.1	742	987	921	965	694	359	965	.1
.2	756	986	918	.03023	696	360	963	.2
.3	771	986	914	082	697	361	962	.3
.4	785	985	911	140	698	362	961	.4
.5	.00800	.49985	.99908	.03198	.66699	.33363	.99959	.5
.6	814	984	904	256	700	364	958	.6
.7	829	984	901	314	701	365	956	.7
.8	843	983	894	430	704	367	953	.8
.9	858	983	894	430	704	367	953	.9
6.0	.00872	.49982	.99890	.03488	.66705	.33368	.99951	6.0
.1	887	981	886	546	706	369	950	.1
.2	901	981	882	604	708	371	948	.2
.3	916	980	879	662	709	372	946	.3
.4	930	979	875	720	710	373	944	.4
.5	.00945	.49979	.99871	.03778	.66712	.33374	.99943	.5
.6	960	978	867	836	713	376	941	.6
.7	974	977	863	894	715	377	939	.7
.8	989	976	859	952	716	378	937	.8
.9	.01003	.976	855	.04010	717	380	936	.9
7.0	.01018	.49975	.99851	.04068	.66719	.33381	.99934	7.0
.1	033	974	846	126	720	382	932	.1
.2	047	973	842	184	722	384	930	.2
.3	062	973	838	242	724	385	928	.3
.4	076	972	833	300	725	386	926	.4
.5	.01091	.49971	.99819	.04358	.66727	.33388	.99924	.5
.6	105	970	824	416	728	389	922	.6
.7	120	969	819	474	730	391	920	.7
.8	134	969	815	532	732	392	918	.8
.9	149	968	810	590	733	394	916	.9
8.0	.01163	.49967	.99805	.04648	.66735	.33395	.99913	8.0
.1	178	966	800	706	737	397	911	.1
.2	192	965	795	764	738	399	909	.2
.3	207	965	790	822	740	400	907	.3
.4	221	964	785	879	742	402	904	.4
.5	.01236	.49963	.99780	.04937	.66744	.33403	.99902	.5
.6	250	962	775	995	745	405	900	.6
.7	265	961	770	.05053	747	407	897	.7
.8	279	961	764	111	749	409	895	.8
.9	294	960	759	169	751	410	893	.9
9.0	.01308	.49959	.99754	.05227	.66753	.33412	.99890	9.0
.1	323	958	748	285	755	414	888	.1
.2	337	957	742	342	757	416	885	.2
.3	352	956	737	400	759	417	883	.3
.4	366	955	731	458	761	419	880	.4
.5	.01381	.49954	.99725	.05516	.66763	.33421	.99878	.5
.6	395	953	719	574	765	423	875	.6
.7	410	952	713	632	767	425	873	.7
.8	424	951	708	690	769	427	870	.8
.9	439	950	702	747	771	428	867	.9
10.0	.01453	.49949	.99696	.05805	.66773	.33430	.99865	10.0

10° - 15°

- FUNCTIONS OF TRANSITION FOR $L_s = 1$

θ	p^*	k^*	x	y	L.T	S.T	L.C	θ
10.0	.01453	.49949	.99696	.05805	.66773	.33430	.99865	10.0
.1	468	948	690	863	776	432	862	.1
.2	482	947	684	921	778	434	859	.2
.3	497	946	677	978	780	436	856	.3
.4	511	945	671	.06036	782	438	854	.4
.5	.01526	.49944	.99665	.06094	.66784	.33440	.99851	.5
.6	540	943	658	152	787	442	848	.6
.7	555	942	652	210	789	444	845	.7
.8	569	941	645	267	791	447	842	.8
.9	584	940	639	325	794	449	839	.9
11.0	.01598	.49939	.99632	.06383	.66796	.33451	.99836	11.0
.1	613	938	625	440	798	453	833	.1
.2	627	937	618	498	801	455	830	.2
.3	642	935	612	556	803	457	827	.3
.4	656	934	605	614	806	460	824	.4
.5	.01671	.49933	.99598	.06671	.66806	.33462	.99821	.5
.6	685	932	591	729	811	464	818	.6
.7	700	931	584	787	813	466	815	.7
.8	714	929	576	844	816	469	812	.8
.9	728	928	569	902	818	471	808	.9
12.0	.01743	.49927	.99562	.06956	.66821	.33473	.99805	12.0
.1	757	926	555	.07017	823	476	802	.1
.2	772	924	547	075	826	478	799	.2
.3	786	923	540	132	828	480	795	.3
.4	801	922	532	190	831	483	792	.4
.5	.01815	.49921	.99525	.07248	.66834	.33485	.99789	.5
.6	829	919	517	305	836	488	785	.6
.7	844	918	509	363	839	490	782	.7
.8	858	917	502	420	842	493	778	.8
.9	873	915	494	478	845	495	775	.9
13.0	.01887	.49914	.99496	.07535	.66847	.33498	.99771	13.0
.1	902	913	478	593	850	500	768	.1
.2	916	911	470	650	853	503	764	.2
.3	931	910	462	708	856	505	761	.3
.4	945	909	454	765	859	508	757	.4
.5	.01960	.49908	.99446	.07823	.66862	.33511	.99753	.5
.6	974	906	438	880	865	513	750	.6
.7	989	905	430	938	868	516	746	.7
.8	.02003	904	421	995	871	519	742	.8
.9	018	902	413	.08053	874	521	739	.9
14.0	.02032	.49901	.99405	.08110	.66877	.33524	.99735	14.0
.1	046	900	396	168	880	527	731	.1
.2	061	898	387	225	883	530	727	.2
.3	075	897	379	282	886	532	723	.3
.4	090	895	370	340	889	535	720	.4
.5	.02104	.49894	.99362	.08397	.66892	.33538	.99716	.5
.6	118	892	353	455	895	541	712	.6
.7	133	891	344	512	898	544	708	.7
.8	147	889	335	569	901	547	704	.8
.9	162	888	326	627	904	550	700	.9
15.0	.02176	.49886	.99317	.08684	.66908	.33553	.99696	15.0

15° - 20°

- FUNCTIONS OF TRANSITION FOR $L_s = 1$

θ	p^*	k^*	x	y	L.T	S.T	L.C	θ
15.0	.02176	.36	.99317	.08684	.66908	.33553	.99696	15.0
.1	190	884	308	741	911	556	692	.1
.2	205	883	299	799	914	559	688	.2
.3	219	881	289	856	918	561	683	.3
.4	234	880	280	913	921	564	679	.4
.5	.02248	.49878	.99271	.08970	.66924	.33567	.99675	.5
.6	262	876	261	.09028	928	571	671	.6
.7	277	875	252	085	931	574	667	.7
.8	291	873	242	142	934	577	662	.8
.9	306	872	233	200	938	580	658	.9
16.0	.02320	.49870	.99223	.09257	.66941	.33583	.99654	16.0
.1	335	868	213	314	945	586	649	.1
.2	349	867	203	371	948	589	645	.2
.3	364	865	194	428	952	593	641	.3
.4	378	864	184	485	955	596	636	.4
.5	.02393	.49862	.99174	.09543	.66959	.33599	.99632	.5
.6	407	860	164	600	962	602	627	.6
.7	422	859	154	657	966	606	623	.7
.8	436	857	143	714	970	609	618	.8
.9	451	856	133	771	973	612	614	.9
17.0	.02465	.49854	.99123	.09828	.66977	.33615	.99609	17.0
.1	479	852	113	885	981	619	605	.1
.2	494	850	102	942	984	622	600	.2
.3	508	849	092	999	988	626	595	.3
.4	522	847	081	.10056	992	629	591	.4
.5	.02537	.49845	.99071	.10113	.66995	.33632	.99586	.5
.6	551	843	060	170	999	636	581	.6
.7	565	841	050	227	.67003	639	576	.7
.8	579	840	.039	284	007	643	572	.8
.9	594	838	029	341	011	646	567	.9
18.0	.02608	.49836	.99018	.10398	.67015	.33650	.99562	18.0
.1	622	834	007	455	019	654	557	.1
.2	637	832	.98996	512	023	657	552	.2
.3	651	830	985	569	027	661	547	.3
.4	666	828	974	626	031	664	542	.4
.5	.02680	.49827	.98692	.10683	.67035	.33668	.99537	.5
.6	694	825	951	740	039	672	532	.6
.7	709	823	940	797	043	675	527	.7
.8	723	821	929	854	047	679	522	.8
.9	738	819	917	910	051	683	517	.9
19.0	.02752	.49817	.98906	.10967	.67055	.33687	.99512	19.0
.1	766	815	894	.11024	059	690	507	.1
.2	781	813	883	081	063	694	502	.2
.3	795	811	871	138	067	698	497	.3
.4	810	809	860	194	072	702	491	.4
.5	.02824	.49808	.98848	.11251	.67076	.33706	.99486	.5
.6	838	806	836	308	080	709	481	.6
.7	853	804	824	364	084	713	476	.7
.8	867	802	812	421	089	717	470	.8
.9	882	800	800	478	093	721	465	.9
20.0	.02896	.49798	.98788	.11535	.67097	.33725	.99460	20.0

20° - 25°

- FUNCTIONS OF TRANSITION FOR $L_s = 1$

θ	p^*	k^*	x	y	L.T	S.T	L.C	θ
20.0	.02896	.49798	.98788	.11535	.67097	.33725	.99460	20.0
.1	910	796	776	591	102	729	454	.1
.2	925	794	764	648	106	733	449	.2
.3	939	791	752	705	111	737	443	.3
.4	954	789	740	761	115	741	438	.4
.5	.02968	.49787	.98728	.11818	.67119	.33745	.99432	.5
.6	982	785	715	875	124	749	427	.6
.7	997	783	703	931	128	753	421	.7
.8	.03011	781	690	988	133	758	415	.8
.9	026	779	678	.12044	137	762	410	.9
21.0	.03040	.49777	.98665	.12101	.67142	.33766	.99404	21.0
.1	054	775	652	157	147	770	399	.1
.2	068	773	639	214	151	774	393	.2
.3	083	770	627	270	156	779	387	.3
.4	097	768	614	327	161	783	381	.4
.5	.03111	.49766	.98601	.12383	.67165	.33787	.99376	.5
.6	125	764	588	439	170	791	370	.6
.7	140	762	575	496	175	796	364	.7
.8	154	759	562	552	180	800	358	.8
.9	169	757	549	609	184	804	352	.9
22.0	.03183	.49755	.98536	.12665	.67189	.33809	.99346	22.0
.1	197	753	523	721	194	813	340	.1
.2	211	751	509	777	199	818	334	.2
.3	226	749	496	834	204	822	328	.3
.4	240	747	482	890	208	826	322	.4
.5	.03254	.49745	.98469	.12946	.67213	.33831	.99316	.5
.6	268	743	455	.13002	218	835	310	.6
.7	283	740	442	059	223	840	304	.7
.8	297	738	428	115	228	844	298	.8
.9	312	735	451	172	233	849	292	.9
23.0	.03326	.49733	.98401	.13228	.67238	.33854	.99286	23.0
.1	340	731	387	284	243	858	279	.1
.2	354	728	373	340	248	863	273	.2
.3	369	726	359	396	254	868	267	.3
.4	383	723	345	452	259	872	261	.4
.5	.03397	.49721	.98331	.13508	.67264	.33877	.99254	.5
.6	411	719	316	564	269	882	248	.6
.7	426	716	302	621	274	886	242	.7
.8	440	714	288	677	280	891	235	.8
.9	455	711	274	733	285	896	229	.9
24.0	.03469	.49709	.98260	.13789	.67290	.33901	.99222	24.0
.1	483	707	245	845	295	906	216	.1
.2	497	704	231	901	301	910	209	.2
.3	512	702	216	957	306	915	203	.3
.4	526	699	202	.14012	311	920	196	.4
.5	.03540	.49697	.98187	.14068	.67317	.33925	.99190	.5
.6	554	694	172	124	322	930	183	.6
.7	568	692	157	180	328	935	177	.7
.8	583	689	143	236	333	940	170	.8
.9	597	687	128	292	339	945	163	.9
25.0	.03611	.49684	.98113	.14348	.67344	.33950	.99157	25.0

25° - 30°

- FUNCTIONS OF TRANSITION FOR $L_s = 1$

θ	p^*	k^*	x	y	L.T	S.T	L.C	θ
25.0	.03611	.49684	.98113	.14348	.67344	.33950	.99157	25.0
.1	625	681	098	404	350	955	150	.1
.2	640	679	083	459	355	960	143	.2
.3	654	676	068	515	361	965	136	.3
.4	669	674	053	571	366	970	129	.4
.5	.03683	.49671	.98037	.14627	.67372	.33975	.99123	.5
.6	697	668	022	682	378	981	116	.6
.7	711	666	007	738	383	986	109	.7
.8	725	663	.97991	794	389	991	102	.8
.9	739	661	976	849	395	996	095	.9
26.0	.03753	.49658	.97960	.14905	.67400	.34001	.99088	26.0
.1	767	656	945	961	406	007	081	.1
.2	782	653	929	.15016	412	012	074	.2
.3	796	651	913	072	418	017	067	.3
.4	811	648	898	128	424	023	060	.4
.5	.03825	.49646	.97882	.15183	.67430	.34028	.99053	.5
.6	839	643	866	239	435	033	046	.6
.7	853	640	850	294	441	039	038	.7
.8	868	638	834	350	447	044	031	.8
.9	882	635	818	405	453	049	024	.9
27.0	.03896	.49632	.97802	.15461	.67459	.34055	.99017	27.0
.1	910	629	786	516	465	060	009	.1
.2	924	626	770	571	471	066	002	.2
.3	939	624	753	627	477	071	.98995	.3
.4	953	621	737	682	483	077	987	.4
.5	.03967	.49618	.97721	.15738	.67490	.34083	.98980	.5
.6	981	615	704	793	496	088	973	.6
.7	995	613	688	848	502	094	965	.7
.8	.04009	610	.671	903	508	099	958	.8
.9	023	608	655	959	514	105	950	.9
28.0	.04037	.49605	.97638	.16014	.67520	.34111	.98943	28.0
.1	051	602	621	069	527	116	935	.1
.2	065	599	604	124	533	122	928	.2
.3	080	596	588	180	539	128	920	.3
.4	094	593	571	235	546	134	913	.4
.5	.04108	.49590	.97554	.16290	.67552	.34139	.98905	.5
.6	122	587	537	345	558	145	897	.6
.7	136	584	520	400	565	151	890	.7
.8	151	582	503	455	571	157	882	.8
.9	165	579	486	510	578	163	874	.9
29.0	.04179	.49576	.97469	.16565	.67584	.34169	.98866	29.0
.1	193	573	452	620	591	165	859	.1
.2	207	570	434	675	597	171	851	.2
.3	222	567	417	730	604	177	843	.3
.4	236	564	399	785	610	193	835	.4
.5	.04250	.49561	.97382	.16840	.67617	.34199	.98827	.5
.6	264	558	364	895	623	205	819	.6
.7	278	555	346	950	630	211	811	.7
.8	293	552	329	.17005	637	217	803	.8
.9	307	549	311	060	643	223	795	.9
30.0	.04321	.49546	.97293	.17114	.67650	.34229	.98787	30.0

30° - 35°

- FUNCTIONS OF TRANSITION FOR $L_g = 1$

θ	p^*	k^*	x	y	L.T	S.T	L.C	θ
30.0	.04321	.49546	.97293	.17114	.67650	.34229	.98787	30.0
.1	335	543	275	169	657	235	779	.1
.2	349	540	257	224	664	241	771	.2
.3	363	537	239	279	670	248	763	.3
.4	377	534	221	333	677	254	755	.4
.5	.04391	.49531	.97203	.17388	.67684	.34260	.98746	.5
.6	405	528	185	443	691	266	738	.6
.7	419	525	167	498	698	273	730	.7
.8	434	522	148	552	705	279	722	.8
.9	448	519	130	607	712	285	713	.9
31.0	.04462	.49516	.97112	.17661	.67719	.34292	.98705	31.0
.1	476	513	094	716	726	298	697	.1
.2	490	510	075	770	733	304	688	.2
.3	504	506	057	825	740	311	680	.3
.4	518	503	038	879	747	317	672	.4
.5	.04532	.49500	.97020	.17934	.67754	.34324	.98663	.5
.6	546	497	001	988	761	330	655	.6
.7	560	494	.96982	.18043	768	337	646	.7
.8	574	490	963	097	775	343	638	.8
.9	588	487	944	152	783	350	629	.9
32.0	.04602	.49484	.96926	.18206	.67790	.34356	.98621	32.0
.1	616	481	907	260	797	363	612	.1
.2	630	478	887	315	804	370	603	.2
.3	645	475	868	369	812	376	595	.3
.4	659	472	849	424	819	383	586	.4
.5	.04673	.49469	.96830	.18478	.67826	.34390	.98577	.5
.6	687	466	811	532	834	397	569	.6
.7	701	462	791	586	841	403	560	.7
.8	715	459	772	640	849	410	551	.8
.9	729	455	752	694	856	417	542	.9
33.0	.04743	.49452	.96733	.18748	.67863	.34424	.98534	33.0
.1	757	449	713	803	871	431	525	.1
.2	771	445	694	857	878	438	516	.2
.3	785	442	674	911	886	444	507	.3
.4	799	438	655	965	894	451	498	.4
.5	.04813	.49435	.96635	.19019	.67901	.34458	.98489	.5
.6	827	432	615	073	909	465	480	.6
.7	841	429	595	127	916	472	471	.7
.8	855	425	576	181	924	479	462	.8
.9	869	422	556	234	932	486	453	.9
34.0	.04883	.49419	.96536	.19288	.67939	.34493	.98444	34.0
.1	897	415	516	342	947	500	435	.1
.2	911	412	496	396	955	508	425	.2
.3	925	408	475	450	963	515	416	.3
.4	939	405	455	504	971	522	407	.4
.5	.04953	.49401	.96435	.19557	.67979	.34529	.98398	.5
.6	967	398	414	611	987	536	389	.6
.7	981	395	394	665	994	544	379	.7
.8	995	391	373	718	.68002	551	370	.8
.9	.05009	388	353	772	010	558	361	.9
35.0	.05023	.49385	.96332	.19826	.68018	.34565	.98351	35.0

35° - 40°

- FUNCTIONS OF TRANSITION FOR $L_S = 1$

θ	p^*	k^*	x	y	L.T	S.T	L.C	θ
35.0	.05023	.385	.96332	.19826	.68018	.34565	.98351	35.0
.1	.037	.381	.311	.879	.026	.573	.342	.1
.2	.051	.378	.291	.933	.034	.580	.333	.2
.3	.065	.374	.270	.987	.042	.587	.323	.3
.4	.079	.371	.250	.20040	.051	.593	.314	.4
.5	.05093	.49367	.96229	.20094	.68059	.34602	.98304	.5
.6	.107	.363	.208	.147	.067	.610	.395	.6
.7	.121	.360	.187	.201	.075	.617	.285	.7
.8	.135	.356	.166	.254	.083	.625	.276	.8
.9	.149	.353	.145	.307	.092	.632	.266	.9
36.0	.05163	.49349	.96124	.20361	.68100	.34640	.98257	36.0
.1	.177	.345	.103	.414	.108	.647	.247	.1
.2	.191	.342	.081	.467	.116	.655	.237	.2
.3	.204	.338	.060	.521	.125	.663	.227	.3
.4	.218	.335	.038	.574	.133	.670	.218	.4
.5	.05232	.49331	.96017	.20627	.68141	.34678	.98208	.5
.6	.246	.327	.95996	.680	.150	.686	.198	.6
.7	.260	.324	.974	.734	.158	.693	.188	.7
.8	.273	.320	.953	.787	.167	.701	.179	.8
.9	.287	.317	.931	.840	.175	.709	.169	.9
37.0	.05301	.49313	.95910	.20893	.68184	.34717	.98159	37.0
.1	.315	.309	.888	.946	.192	.725	.149	.1
.2	.329	.306	.966	.999	.201	.732	.139	.2
.3	.343	.302	.844	.21052	.210	.740	.129	.3
.4	.357	.299	.822	.105	.218	.748	.119	.4
.5	.05371	.49295	.95800	.21158	.68227	.34756	.98109	.5
.6	.385	.291	.778	.211	.236	.764	.099	.6
.7	.399	.287	.756	.264	.244	.772	.089	.7
.8	.413	.284	.734	.317	.253	.780	.079	.8
.9	.427	.280	.712	.370	.262	.788	.069	.9
38.0	.05441	.49276	.95690	.21423	.68271	.34796	.98059	38.0
.1	.455	.272	.668	.475	.279	.804	.049	.1
.2	.469	.268	.645	.528	.288	.812	.038	.2
.3	.482	.264	.623	.581	.297	.820	.028	.3
.4	.496	.260	.601	.634	.306	.829	.018	.4
.5	.05510	.49256	.95578	.21686	.68315	.34837	.98008	.5
.6	.524	.252	.556	.739	.324	.845	.97997	.6
.7	.538	.249	.533	.792	.333	.853	.987	.7
.8	.551	.245	.511	.844	.342	.861	.977	.8
.9	.565	.212	.488	.897	.351	.870	.967	.9
39.0	.05579	.49238	.95466	.21949	.68360	.34878	.97956	39.0
.1	.593	.234	.443	.22002	.369	.886	.946	.1
.2	.607	.230	.420	.054	.379	.895	.935	.2
.3	.620	.226	.397	.107	.388	.903	.925	.3
.4	.634	.222	.374	.159	.397	.911	.914	.4
.5	.05648	.49218	.95351	.22212	.68406	.34920	.97904	.5
.6	.662	.214	.328	.264	.415	.928	.893	.6
.7	.676	.210	.305	.316	.424	.937	.883	.7
.8	.690	.207	.281	.369	.434	.945	.872	.8
.9	.704	.203	.258	.421	.443	.954	.861	.9
40.0	.05718	.49199	.95235	.22473	.68452	.34962	.97851	40.0

40° - 45°

- FUNCTIONS OF TRANSITION FOR $L_s = 1$

θ	p*	k*	x	y	L.T	S.T	L.C	θ
40.0	.05718	.49199	.95235	.22473	.68452	.34962	.97851	40.0
.1	732	195	212	526	462	971	840	.1
.2	745	191	188	578	481	980	829	.2
.3	759	187	165	630	490	997	819	.3
.4	772	183	141	682	490	997	808	.4
.5	.05786	.49179	.95118	.22734	.68500	.35006	.97797	.5
.6	800	175	094	786	509	014	786	.6
.7	814	171	071	838	519	023	775	.7
.8	827	167	047	890	528	032	765	.8
.9	841	163	023	942	538	041	754	.9
41.0	.05855	.49159	.95000	.22994	.68547	.35049	.97743	41.0
.1	869	155	.94976	.23046	557	058	732	.1
.2	883	151	952	098	567	067	721	.2
.3	896	146	928	150	577	076	710	.3
.4	910	142	904	202	586	085	699	.4
.5	.05924	.49138	.94880	.23254	.68596	.35094	.97688	.5
.6	938	134	856	306	606	103	677	.6
.7	952	130	832	358	616	112	666	.7
.8	965	126	807	409	626	121	655	.8
.9	979	122	783	461	635	130	643	.9
42.0	.05993	.49118	.94759	.23513	.68645	.35139	.97632	42.0
.1	.06007	114	734	564	655	148	621	.1
.2	020	110	710	616	665	158	610	.2
.3	034	105	685	667	675	167	599	.3
.4	047	101	661	719	685	176	587	.4
.5	.06061	.49097	.94636	.23771	.68695	.35185	.97576	.5
.6	075	093	612	822	706	194	565	.6
.7	089	088	587	874	716	204	553	.7
.8	102	084	562	925	726	213	542	.8
.9	116	079	538	976	736	222	531	.9
43.0	.06130	.49075	.94513	.24028	.68746	.35232	.97519	43.0
.1	144	071	488	079	756	241	508	.1
.2	157	067	463	130	767	250	496	.2
.3	171	062	438	182	777	260	485	.3
.4	184	058	413	233	787	260	473	.4
.5	.06198	.49054	.94388	.24284	.68798	.35279	.97462	.5
.6	212	050	363	335	808	288	450	.6
.7	226	045	337	387	818	298	438	.7
.8	239	041	312	438	829	307	427	.8
.9	253	036	287	489	839	317	415	.9
44.0	.06267	.49032	.94262	.24540	.68850	.35327	.97404	44.0
.1	281	028	236	591	860	336	392	.1
.2	294	024	211	642	871	346	380	.2
.3	308	019	185	693	882	356	368	.3
.4	321	015	160	744	892	365	357	.4
.5	.06335	.49011	.94134	.24795	.68903	.35375	.97345	.5
.6	349	007	108	846	914	385	333	.6
.7	362	003	082	896	924	395	321	.7
.8	376	.48998	057	947	935	405	309	.8
.9	389	994	031	998	946	415	297	.9
45.0	.06403	.48990	.94005	.25049	.68957	.35424	.97285	45.0

3.3. Contoh perhitungan

Contoh perhitungan berikut diambil berdasarkan rumus-rumus yang diberikan dalam "Pengantar Teknik Jalan Raya Bag. III" serta tabel-tabel AASHO dan Joseph Barnett.

Contoh I :

Diketahui : Suatu tikungan pada jalan raya (rural kelas IIB dengan ketentuan-ketentuan :

$$\Delta = 15^{\circ}30'00''$$

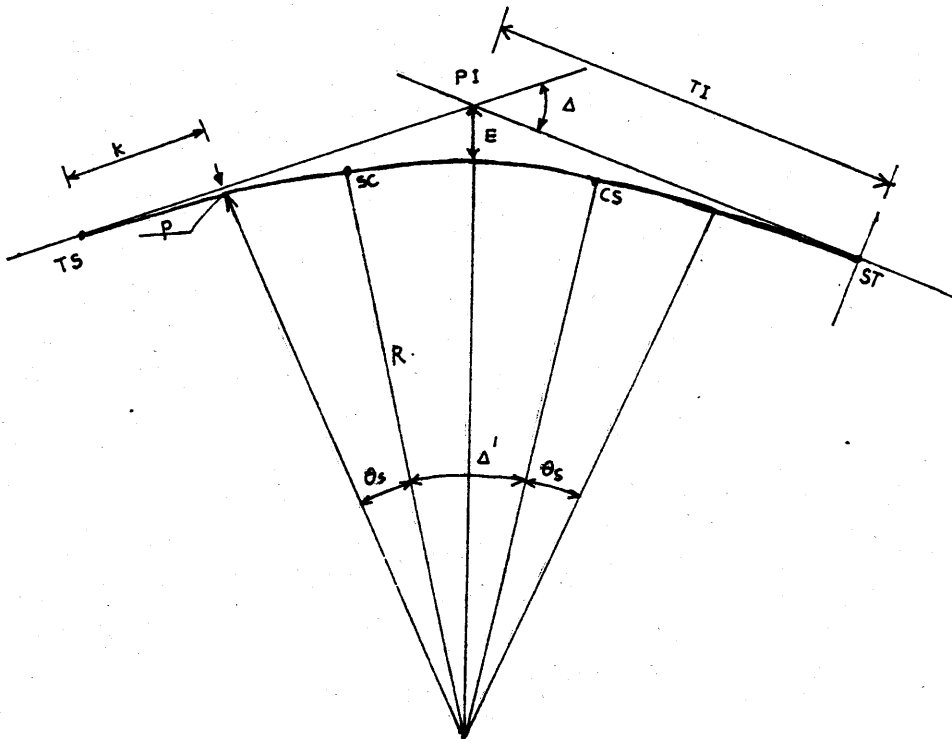
Lebar jalur jalan = 7.00 m

Klasifikasi medan = datar

Radius yang diambil = 400 m

Ditanyakan: - Perhitungan kurva data
- Diagram superelevasi

Perhitungan kurva data :



40° - 45°

- FUNCTIONS OF TRANSITION FOR $L_s = 1$

θ	p^*	k^*	x	y	L.T	S.T	L.C	θ
40.0	.05718	.49199	.95235	.22473	.68452	.34962	.97851	40.0
.1	732	195	212	526	462	971	840	.1
.2	745	191	188	578	481	980	829	.2
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.8	827	167	047	890	528	032	765	.8
.9	841	163	023	942	538	041	754	.9
41.0	.05855	.49159	.95000	.22994	.68547	.35049	.97743	41.0
.1	869	155	.94976	.23046	557	058	732	.1
.2	883	151	952	098	567	067	721	.2
.3	896	146	928	150	577	076	710	.3
.4	910	142	904	202	586	085	699	.4
.5	.05924	.49138	.94880	.23254	.68596	.35094	.97688	.5
.6	938	134	856	306	606	103	677	.6
.7	952	130	832	358	616	112	666	.7
.8	965	126	807	409	626	121	655	.8
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42.0	.05993	.49118	.94759	.23513	.68645	.35139	.97632	42.0
.1	.06007	114	734	564	655	148	621	.1
.2	020	110	710	616	665	158	610	.2
.3	034	105	685	667	675	167	599	.3
.4	047	101	661	719	685	176	587	.4
.5	.06061	.49097	.94636	.23771	.68695	.35185	.97576	.5
.6	075	093	612	822	706	194	565	.6
.7	089	088	587	874	716	204	553	.7
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.9	116	079	538	976	736	222	531	.9
43.0	.06130	.49075	.94513	.24028	.68746	.35232	.97519	43.0
.1	144	071	488	079	756	241	508	.1
.2	157	067	463	130	767	250	496	.2
.3	171	062	438	182	777	260	485	.3
.4	184	058	413	233	787	260	473	.4
.5	.06198	.49054	.94388	.24284	.68798	.35279	.97462	.5
.6	212	050	363	335	808	288	450	.6
.7	226	045	337	387	818	298	438	.7
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.1	281	028	236	591	860	336	392	.1
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.4	321	015	160	744	892	365	357	.4
.5	.06335	.49011	.94134	.24795	.68903	.35375	.97345	.5
.6	349	007	108	846	914	385	333	.6
.7	362	003	082	896	924	395	321	.7
.8	376	.48998	057	947	935	405	309	.8
.9	389	994	031	998	946	415	297	.9
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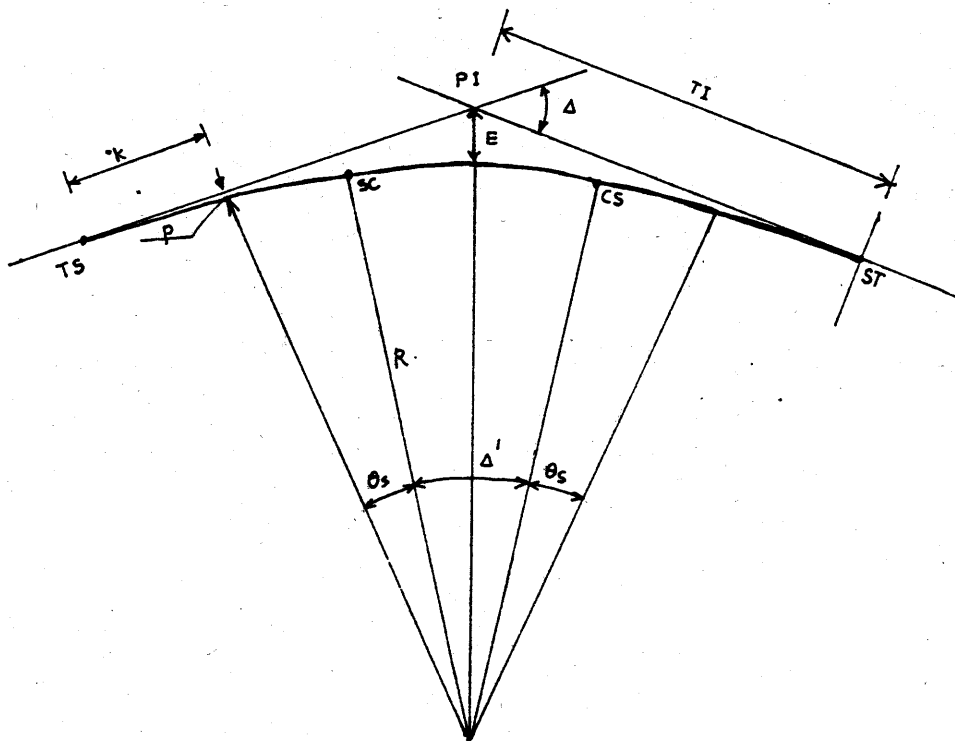
Lebar jalur jalan = 7.00 m

Klasifikasi medan = datar

Radius yang diambil = 400 m

Ditanyakan: - Perhitungan kurva data
- Diagram superelevasi

Perhitungan kurva data :



Panjang spiral = L_S = panjang lengkung TS-SC =
panjang lengkung CS-ST

Panjang bagian lingkaran = L_C = panjang lengkung SC-CS

Panjang bagian tikungan $L = 2 L_S + L_C$

$$R = 400 \text{ m}$$

$$D = \left(\frac{1432,4^\circ}{R} \right) = \left(\frac{1432,4^\circ}{400} \right) = 3,581^\circ = 3^\circ 35'$$

$$V = 80 \text{ km/jam} = 50 \text{ mph}$$

Lihat tabel AASHO untuk $e_{\text{max.}} = 0,10$

Didapatkan : $e = 0,068$

$$L_S = 163 \text{ ft} = 54,3 \text{ m} \longrightarrow 60 \text{ m (dibulatkan)}$$

Periksa harga L_S terhadap modified short formula :

$$\begin{aligned} L_{S\text{min}} &= 0,022 \frac{v^3}{R.C.} - 2,727 \frac{v.k.}{c} \\ &= 0,022 \cdot \frac{(80)^3}{400 \cdot 0,4} - 2,727 \cdot \frac{80 \times 0,068}{0,4} \\ &= 70,4 - 37,09 = 33,31 \text{ m} \end{aligned}$$

$\longrightarrow$ Jadi L_S yang ada $> L_{S\text{min}}$ $\longrightarrow$ O.K.

$$\theta_S = \frac{28,648 L_S}{R} = \frac{28,648 \times 60}{400} = 4,297^\circ$$

$$\Delta'_C = \Delta - 2 \theta_S = 15,5^\circ - 2 \times 4,297^\circ = 6,906$$

Tabel J. Barnett untuk $\theta_S = 4,297^\circ$) $\longrightarrow$ $p^* = 0,00625$
 $L_S = 60 \text{ m}$) $k^* = 0,49991$

$$p = 60 \times 0,00625 = 0,375 \text{ m}$$

$$k = 60 \times 0,49991 = 29,995 \text{ m}$$

$$L_C = \frac{\Delta'}{360} \times 2 \pi R = \frac{6,906}{360} \times 2 \pi (400) = 48,188 \text{ m}$$

$$L = 2 L_S + L_C = 2 \times 60 + 48,188 = 168,188 \text{ m}$$

$$\begin{aligned} T_t &= (R + p) \operatorname{tg} \frac{1}{2} \Delta + k \\ &= (400 + 0,375) \cdot \operatorname{tg} (7,75^\circ) + 29,995 = 84,484 \text{ m} \end{aligned}$$

$$E = \frac{(R + p)}{\cos 1/2 \Delta} - R = \frac{400 + 0,375}{\cos (7,75^\circ)} - 400 = 4,066 \text{ m}$$

w = pelebaran tikungan :

Tabel III - 12 untuk $v = 80 \text{ km/jam} = 50 \text{ mph}$)

Lebar jalur = 7,00 m ∞ 22 ft) $\longrightarrow$

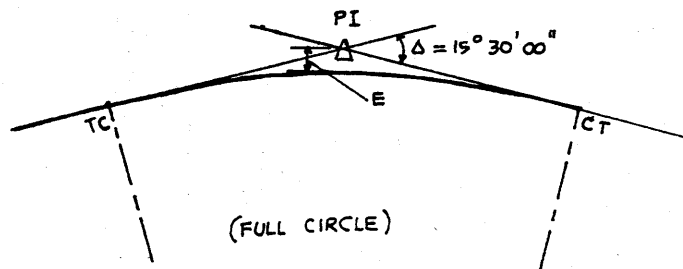
D = $3,581^\circ$)

w = 1,5 ft = 45 cm

Lihat Gambar pada halaman berikutnya.

Contoh II :

Soal pada contoh I, Radiusnya diubah menjadi $R = 1200$ m.
Perhitungan-perhitungan akan menjadi sbb. :



$$L_c = \frac{\Delta}{360} \times 2 \pi R = \frac{15,5}{360} \times 2 \pi \times 1200 = 324,467 \text{ m}$$

$$T_t = R \operatorname{tg} \frac{1}{2} \Delta = 1200 \operatorname{tg} (7,75^\circ) = 163,313 \text{ m}$$

$$E = \frac{R}{\cos \frac{1}{2} \Delta} - R = \frac{1200}{\cos (7,75^\circ)} - 1200 = 11,062 \text{ m}$$

—————> Superelevasi !

$$D = \frac{1432,4}{R} = \left(\frac{1432,4}{1200} \right)^\circ = 1,194^\circ = 1^\circ 12'$$

Table III - 9 ———> $e = 0,027$

—————> Pelebaran tikungan (tabel III - 12) : $w = 0.597 \text{ ft}$
= 18 cm (abaikan)

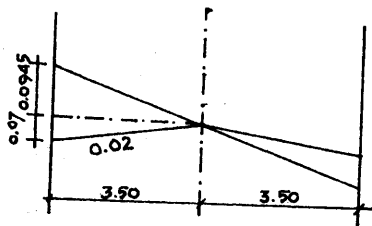
Diagram superelevasi :

Untuk dapat menggambarkan pencapaian kemiringan dari lereng normal ke kemiringan penuh, berhubung kita tidak mempunyai lengkung transisi maka harus kita hitung dulu lengkung transisi fiktif, yang kita beri notasi L'_S . Sesuai dengan namanya yang "fiktif", lengkung transisi tersebut sebetulnya tidak ada.

Tapi karena adanya keperluan untuk pencapaian kemiringan dari normal crown ke full superelevation, maka bagian lurus sepanjang $3/4 L'_S$ plus bagian lingkaran sepanjang $1/4 L'_S$ kita pergunakan sebagai lengkung peralihan fiktif.

Adapun L'_S dihitung berdasarkan landai relatif maximum antara tepi perkerasan. - Untuk $v = 80 \text{ km/jam}$ angka landai relatif tersebut = $\frac{1}{200}$

-(daftar II, standard perencanaan geometrik).



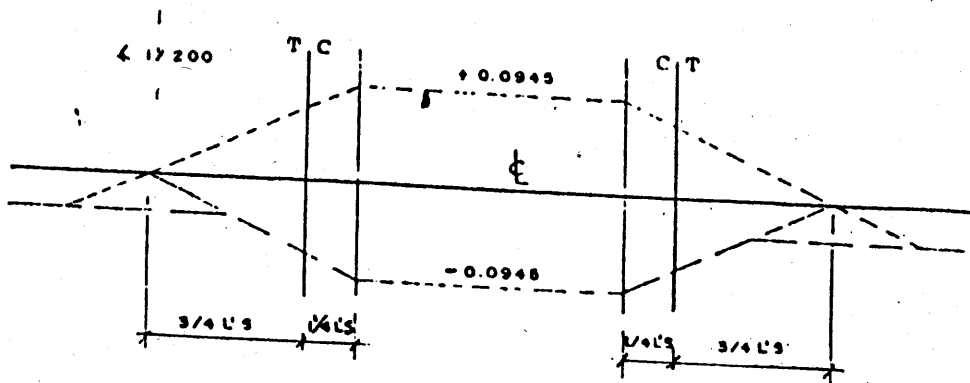
$$h = 0,07 + 0,0945 = 0,1645 \text{ m}$$

$$\frac{h}{L_S} < \frac{1}{200}$$

$$L_S' \geq 200 \times h = 200 \times 0,1645 = 32,9 \text{ m}$$

$$\text{ambil } L_S' = 40,00 \text{ m}$$

Diagram superelevasi menjadi sbb. :

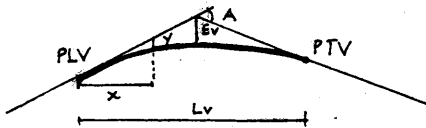


4. Stationing

Stationing dimulai dari titik awal proyek dengan nomor station 0+000. Angka sebelah kiri tanda (+) menunjukkan KM sedang sebelah kanan tanda (+) menunjukkan M. Angka station bergerak keatas dan tiap 50 m dituliskan pada gambar rencana (plan). Kemudian nomor station pada titik-titik utama tikungan (TS, SC, CS, ST atau TC, CT serta PI) harus dicantumkan. Pemberian nomor station diakhiri pada titik akhir proyek.

LENGKUNG VERTIKAL :

* CEMBUNG



$$E_v = \frac{A \cdot L_v}{800}$$

$$y = \frac{A}{200 L_v} \cdot x^2$$

$$L_v = \frac{AS^2}{200(\sqrt{h_1} + \sqrt{h_2})^2} ; S < L_v$$

$$L_v = 2 S - \frac{200(\sqrt{h_1} + \sqrt{h_2})^2}{A} ; S > L_v$$

h_1 = tinggi mata pengemudi.

h_2 = tinggi halangan.

S = jarak pandangan

Untuk jarak pandangan henti :

$$h_1 = 1,25 \text{ m}$$

$$h_2 = 0,10 \text{ m}$$

Untuk jarak pandangan menyiap :

$$h_1 = 1,25 \text{ m}$$

$$h_2 = 1,25 \text{ m}$$

Untuk lengkung vertikal cembung :

1. Syarat keamanan ; berdasarkan :

- jarak pandangan henti ($S < L$ atau $S > L$)

→ pakai grafik III halaman 20 PPGJR.

- jarak pandangan menyiap

→ pakai grafik IV halaman 21 PPGJR.

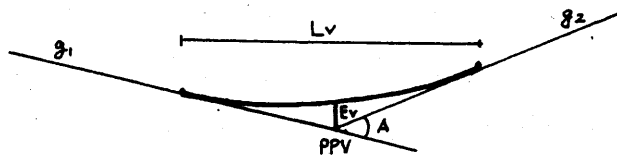
2. Keluwesan bentuk : $L_v = 0,6 v \text{ (m)}$.

dimana v = kecepatan rencana (km/jam).

3. Syarat drainage : $L_v = 40 A$

paling ideal diambil L_v yang terpanjang.

* CEKUNG :



$$S < L_v$$

$$L_v = \frac{A S^2}{150 + 3,5 S}$$

$$S > L_v$$

$$L_v = 2 S - \frac{150 + 3,5 S}{A}$$

Untuk lengkung vertikal cekung :

1. Syarat keamanan Grafik V halaman 22 PPGJR.
2. Syarat kenyamanan :

$$L_v = \frac{A \cdot v^2}{1300 a}$$

a = percepatan sentripetal
 $a \leq 0,3 \text{ m/det}^2$.
 (umumnya diambil $a = 0,1 \text{ m/det}$).

3. Syarat keluwesan bentuk :

$$L_v = 0,6 V$$

V = kecepatan rencana (km/jam).

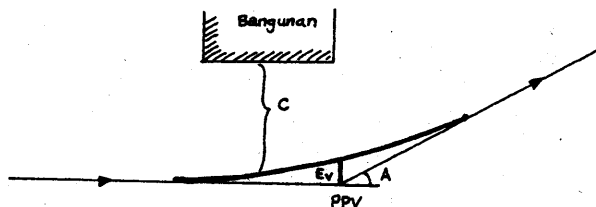
4. Syarat drainage :

$$L_v = 40 A$$

A = perbedaan aljabar dari landai (%)

* paling ideal ambil L_v yang terpanjang.

LENGKUNG VERTIKAL CEKUNG PADA LINTASAN DI BAWAH :



C = kebebasan vertikal.

$$S > L_v$$

$$L_v = 2 S - \frac{2700}{A}$$

$$S < L_v$$

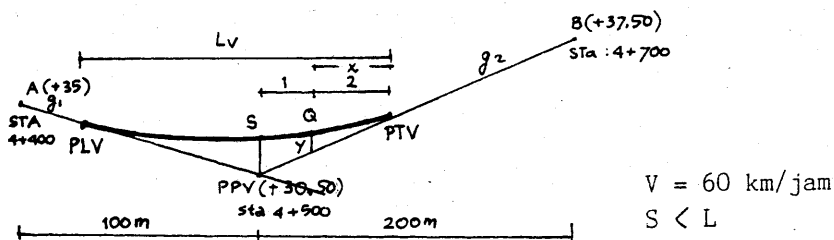
$$L_v = \frac{A \cdot S^2}{2700}$$

Untuk ini L_v dapat dicari dengan memakai grafik VI halaman 23 PPGJR. (masih-memenuhi syarat keamanan berdasarkan jarak pandangan henti).

Perumusan di atas diasumsikan bahwa PPV tepat berada di bawah bangunan : kebebasan vertikal $C = 4,5$ meter.

* LENGKUNG VERTIKAL :

Contoh soal



Hitung : Elevasi & station PLV ; PTV , S dan Q jika diketahui perbandingan an $SQ : Q - PTV = 1 : 2$

Penyelesaian :

grade A - PPV $g_1 = \frac{35 - 30.50}{100 \text{ m}} \times 100 \% = 4,5 \% \quad \ominus \text{ turun.}$

grade PPV - B $g_2 = \frac{37.5 - 30.5}{200} \times 100 \% = + 3,5 \%$

$A = |g_1 - g_2| = |-4,5 - 3,5| = 8 \%$

1. Syarat keamanan : grafik V halaman 22 PPGJR
didapat $L_v = \underline{\underline{120 \text{ m}}}$ $S < L$

$$2. \text{ Syarat kenyamanan : } L_v = \frac{A \cdot v^2}{1300 a} \quad a = 0,1 \text{ m/det}^2$$

$$= \frac{8 \cdot 60^2}{1300 (0,1)} = 221,5 \text{ m (tidak memenuhi juga karena overlap).}$$

Lihat gambar samping.

$$3. \text{ Keluwesan bentuk } L_v = 0,6 V = 0,6(60) = 36 \text{ m.}$$

$$4. \text{ Drainage : } L_v = 40 A = 40(8) = 320 \text{ m (tidak memenuhi karena jarak A - B hanya 300 m).}$$

Kita ambil $L_v = 221,5 \text{ m} \sim 225 \text{ m}$ karena untuk $L_v = 320 \text{ m} > 300 \text{ m}$ (jarak A $\rightarrow$ B).

Pengambilan $L_v = 225 \text{ m}$. perlu diperhatikan adanya lengkung berikutnya agar tidak overlap ; jika overlap dengan lengkung berikutnya akan dipakai $L_v = 120 \text{ m}$ saja (hanya memenuhi syarat keamanan).

dipakai $L_v = 120 \text{ m}$. jika $L_v = 225 \text{ m}$ $\frac{1}{2} L_v = 112,5 \text{ m}$ melampaui-jarak A $\rightarrow$ PPV = 100 m.

$$E_v = \frac{A \cdot L_v}{800} = \frac{8(120)}{800} = 1,20 \text{ m.}$$

Elevasi & Stationing

$$* \text{ Elev. PLV} = \text{elev.PPV} + g_1 \left(\frac{1}{2} L_v \right)$$

$$= 30,50 + 4,5\% \left(\frac{120}{2} \right) = 30,5 + 2,7 = 33,2 \text{ m}$$

$$\text{Sta PLV} = (4 + 500) - \frac{1}{2} L_v = 4 + 440.$$

$$* \text{ Elev.S} = \text{elev.PPV} + E_v = 30,5 + 1,2 = 31,70 \text{ m}$$

$$\text{STA S} = 4 + 500$$

$$* \text{ Elev.PTV} = \text{elev.PPV} + g_2 \left(\frac{1}{2} L_v \right) = 30,5 + 3,5\% (60)$$

$$= 30,5 + 2,1 = 32,6 \text{ m}$$

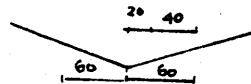
$$\text{STA PTV} = (4 + 500) + \frac{1}{2} L_v = 4 + 560.$$

$$* \text{ SQ : Q - PTV} = 1 : 2 \quad S \rightarrow \text{PTV} = 60 \text{ m.}$$

$$\text{SQ} = \frac{1}{3} \times 60 = 20 \text{ m.}$$

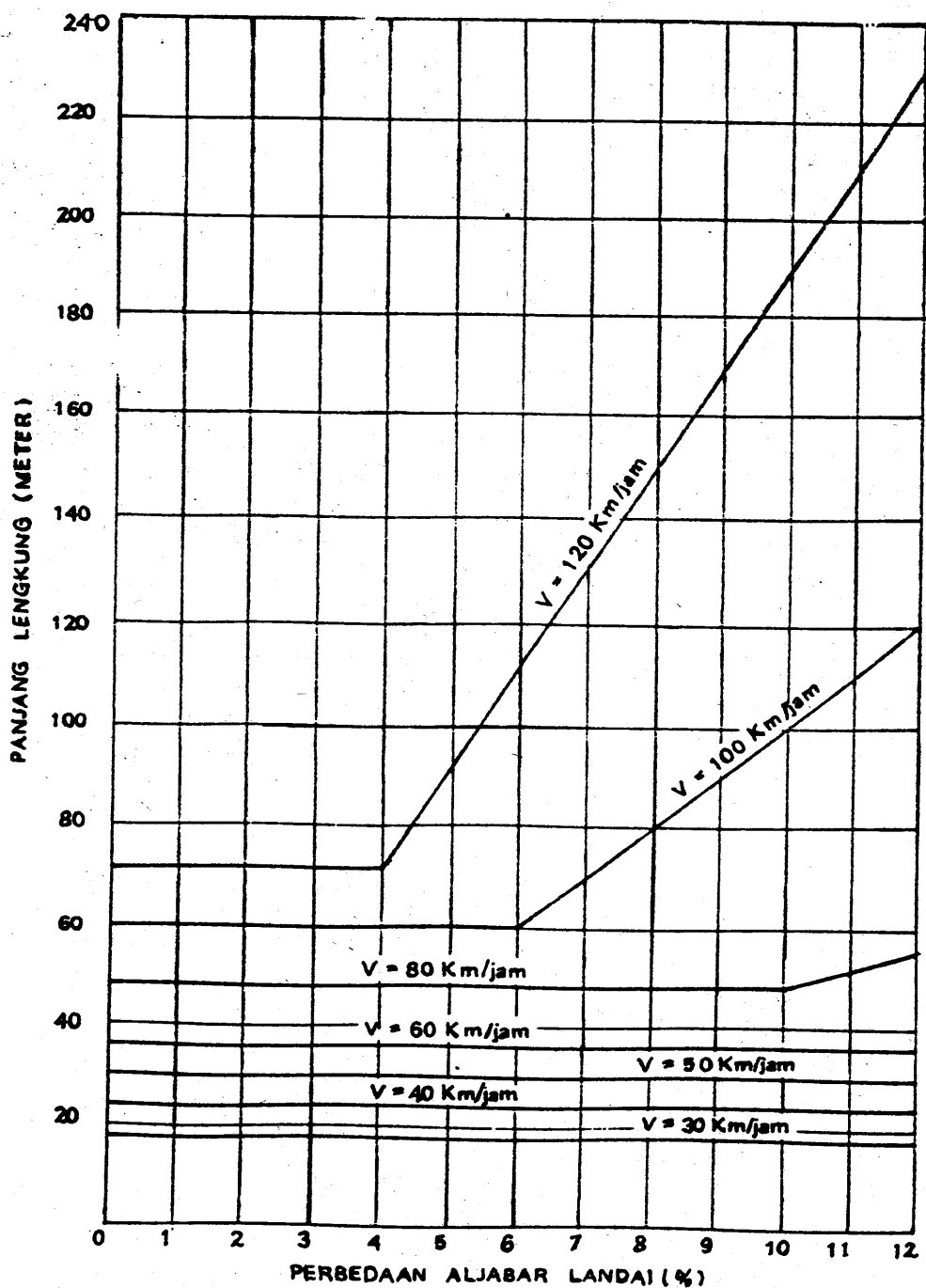
atau 40 m dari PTV

$$Y = \frac{A}{200 L_v} \cdot x^2 = \frac{8}{200(120)} \cdot 40^2 = 0,53 \text{ m}$$

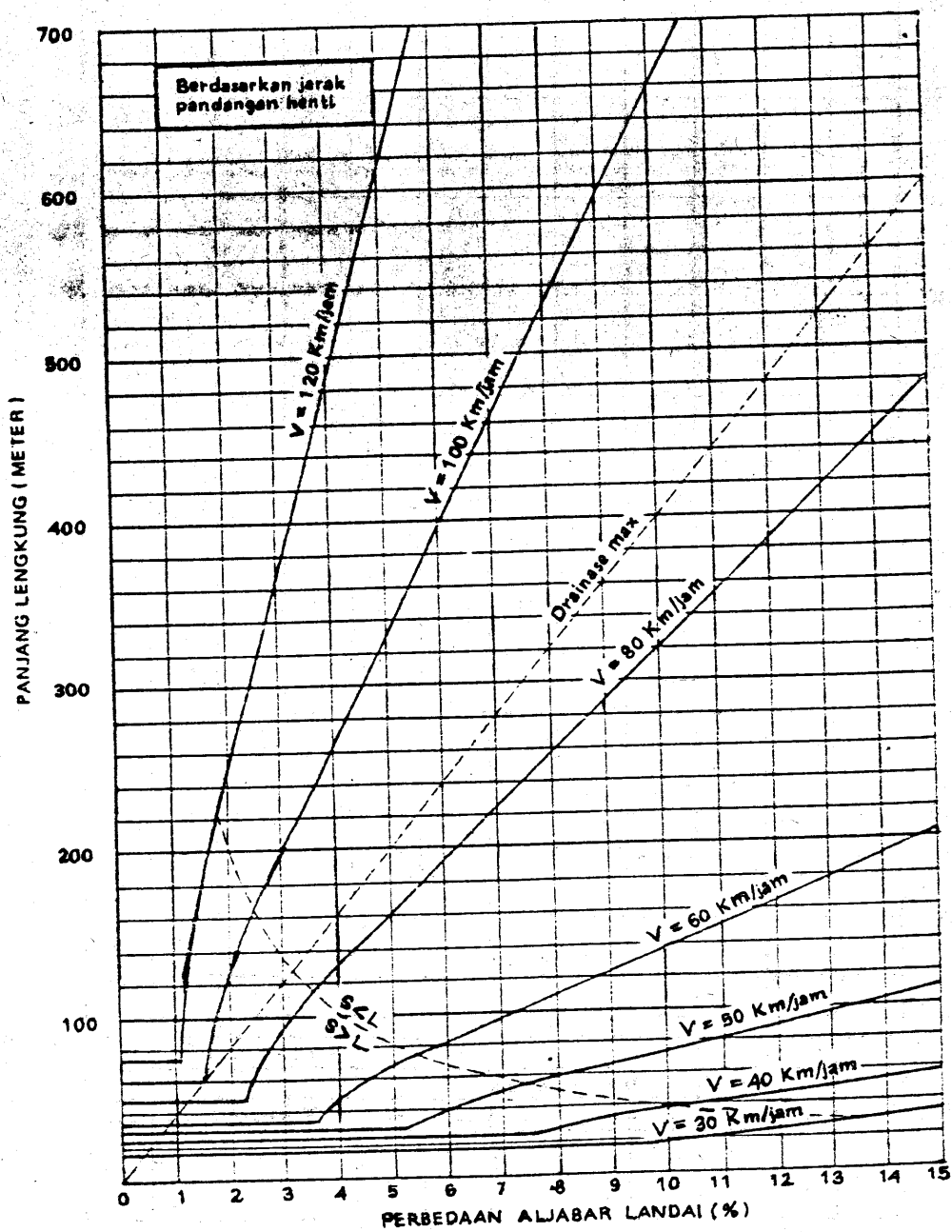


$$\begin{aligned}\therefore \text{Elev. Q} &= (\text{elev. PTV} - g_2 \cdot 40) + Y \\ &= (32,6 - 3,5\% \cdot 40) + 0,53 = 31,2 + 0,53 = 31,73 \text{ m} \\ \text{Sta Q} &= \text{Sta PTV} - 40 \text{ m} = (4 + 560) - 40 = 4 + 520\end{aligned}$$

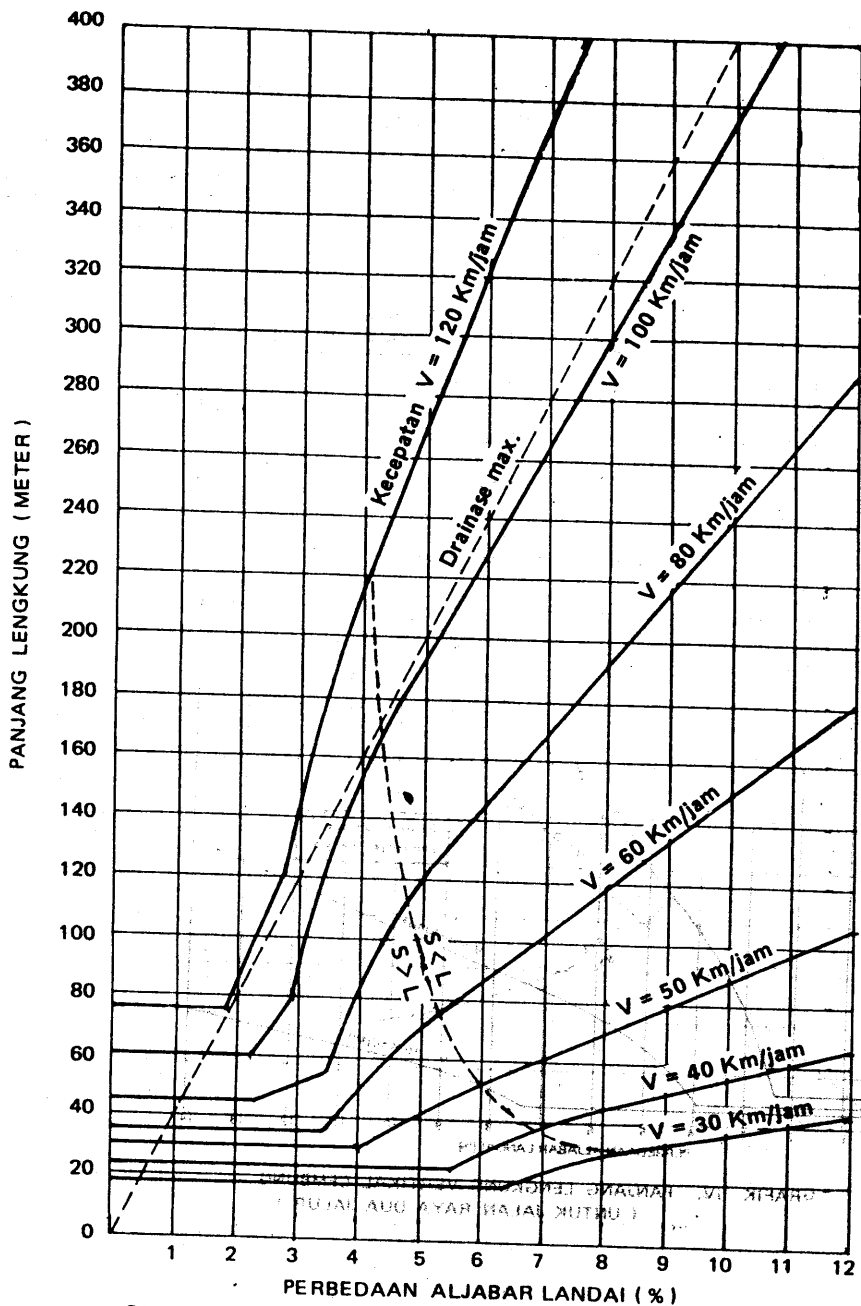
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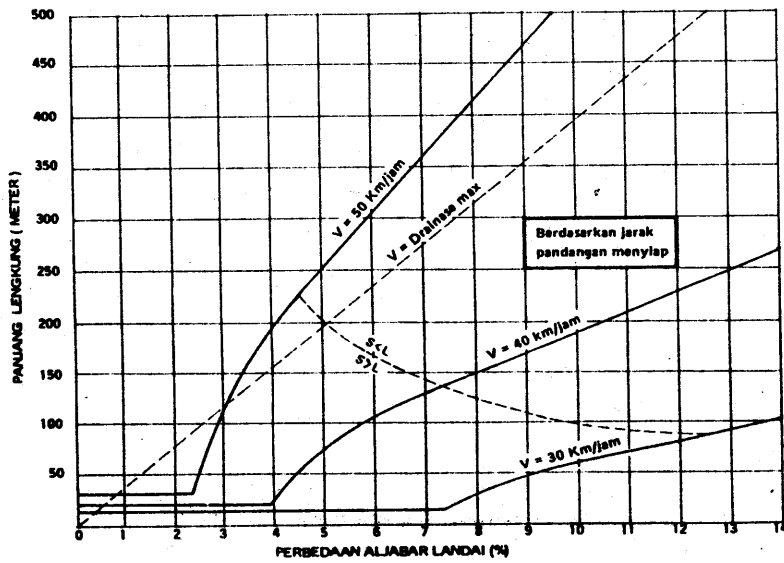
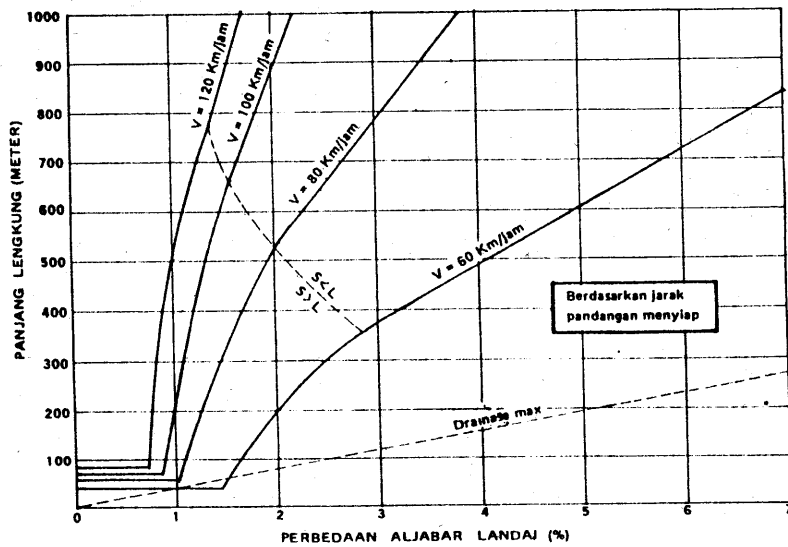
GRAFIK VI. PANJANG LENGKUNG VERTIKAL CEKUNG
PADA LINTASAN DIBAWAH



GRAFIK III. PANJANG LENGKUNG VERTIKAL CEMBUNG



GRAFIK V. PANJANG LENGKUNG VERTIKAL CEKUNG



GRAFIK IV. PANJANG LENGKUNG VERTIKAL CEMBUNG
(UNTUK JALAN RAYA DUA JALUR).