

BAB IV ANALISIS DAN PEMBAHASAN

4.1 Perolehan Data Hasil Survei

4.1.1 Lalu Lintas Harian Rata-rata

Berdasarkan survei arus lalu lintas yang telah dilakukan pada ruas jalan raya Mindahan-Pecangaan, diperoleh data sebagai berikut:

Tabel 4.1 Lalu Lintas Harian Rata-rata

JENIS KENDARAAN	TOTAL KENDARAAN	TOTAL SMP/HARI
Sepeda Motor	6757	1689,25
Mobil	569	569
MPU	24	24
Angkot	34	34
Pick Up	432	432
Bus Sedang	0	0
Bus Besar	0	0
Truk Sedang	380	456
Truk Besar	9	10,8
Trailer	0	0
Becak/Sepeda	10	8
TOTAL	8215	3223,05

Sumber : Survei LHR, 2019

Guna mendapatkan data diatas maka dilakukan survei diruas jalan terhadap dua sisi yaitu sisi kanan dan kiri, dengan sesuai standar yang berlaku. Berdasarkan tabel 2.9 klasifikasi menurut kelas jalan dan tabel 2.10 lebar jalur ideal yang didapatkan adalah fungsi jalan kolektor dan kelas jalan III B.

4.1.2 Elevasi Setiap STA

Sesudah dilakukannya survei elevasi menggunakan alat *theodolite* dengan mengambil jarak 50 meter per STAny, didapatkan data sebagai berikut:

Tabel 4.2 Nilai Elevasi per STA

TITIK	STA	ELEVASI (m)
A	0,000	101,20
PV1	0,050	102,58
PV2	0,100	102,02
PV3	0,150	102,30
PV4	0,200	99,98
PV5	0,250	103,37
PV6	0,300	101,59
PV7	0,350	100,18
PV8	0,400	100,58
PV9	0,450	101,58
PV10	0,500	101,19
PV11	0,550	99,80
PV12	0,600	101,19
PV13	0,650	97,15
PV14	0,700	101,19
PV15	0,750	98,73
PV16	0,800	101,19
PV17	0,850	101,19
PV18	0,900	103,45
PV19	0,950	102,53
PV20	1,000	97,62
PV21	1,050	93,55

TITIK	STA	ELEVASI (m)
PV22	1,100	100,30
PV23	1,150	100,58
PV24	1,200	106,16
PV25	1,250	102,05
PV26	1,300	105,89
PV27	1,350	108,19
PV28	1,400	108,19
PV29	1,450	97,66
PV30	1,500	104,33
PV31	1,550	107,09
PV32	1,600	108,06
PV33	1,650	102,02
PV34	1,700	100,86
PV35	1,750	91,42
PV36	1,800	99,90
PV37	1,850	99,56
PV38	1,900	99,14
PV39	1,950	94,47
PV40	2,000	96,77

Sumber: Survei menggunakan alat *theodolite* 2019

4.2 Perhitungan Alinyemen Horisontal

Setelah melakukan survei ukur tanah dengan menggunakan alat *theodolite*, dengan berdasarkan Tata Cara Perencanaan Geometrik Jalan Antar, Dirjen Bina Marga 1997. Jalan Mindahan – Pecangaan dikategorikan sebagai kelas jalan III B dan fungsi jalan tersebut adalah kolektor. Sehingga didapatkan data sebagai berikut:

Kecepatan Rencana (V_r) = 50 km/jam (dari tabel 2.11)

Kemiringan Melintang Maksimum (emak)	=10% (TCPGJA, 1997)
Kemiringan Melintang normal (en)	=2% (TCPGJA, 1997)
Lebar Perkerasan	=2,5 m x 2

4.2.1 Perhitungan Tikungan A1

Diketahui :

$$\beta = 61^\circ$$

$$R_d = 63,85 \text{ m}$$

$$\begin{aligned} f_{\max} &= 0,192 - (0,00065 \times V_r) \\ &= 0,192 - (0,00065 \times 50) \\ &= 0,1595 \end{aligned}$$

$$\begin{aligned} R_{\min} &= \frac{V_r^2}{127 \times (e_{\max} + f_{\max})} \\ &= \frac{50^2}{127 \times (0,1 + 0,1595)} \\ &= 75,86 \text{ m} \end{aligned}$$

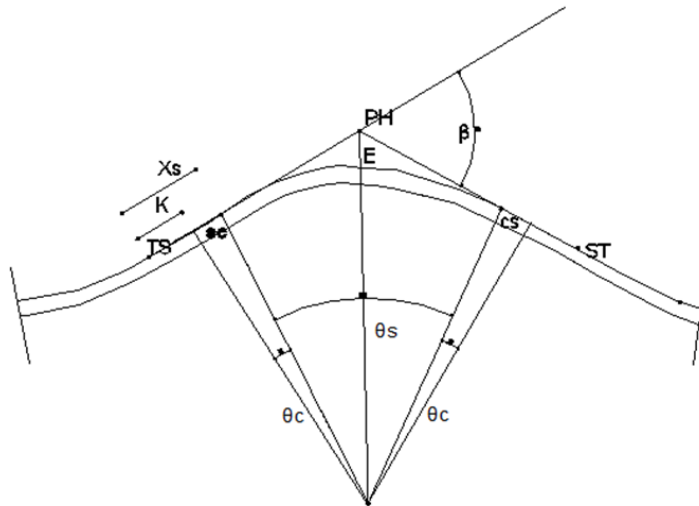
$$\begin{aligned} D_{\max} &= \frac{181.913,53(e_{\max} + f_{\max})}{V_r^2} \\ &= \frac{181.913,53(0,1 + 0,1595)}{50^2} \\ &= 18,88^\circ \end{aligned}$$

Check Untuk Jenis Tikungan Full Circle

Direncanakan sesuai desain $R_d = 63,85 \text{ m}$ dengan $V_r = 50 \text{ km/jam}$. Berdasarkan tabel 2.3 jari-jari minimum (R_{\min}) untuk tikungan Full Circle adalah $350 \text{ m} >$ jari-jari rencana R_d yaitu $63,85 \text{ m}$. Jadi jenis tikungan Full Circle tidak bisa digunakan.

Check Untuk Jenis Tikungan Spiral – Circle – Spiral

Pada tikungan A1 diketahui jari-jari rencana (R_d) adalah $63,85 \text{ m}$ dan tidak memenuhi untuk tikungan *Full Circle*, maka dilanjutkan untuk check dengan tikungan jenis *Spiral – Circle – Spiral*.



Gambar 4.1 Tikungan A1 Spiral-Circle Spiral

a. Menentukan Superelevasi Design

$$D_d = \frac{1432,4}{R_d} = \frac{1432,4}{63,85} = 22,43^0$$

$$\begin{aligned} ed &= \frac{-e_{max} x D_d^2}{D_{max}^2} + \frac{2x e_{max} x D_d}{D_{max}} \\ &= \frac{-0,10 x 22,43^2}{18,88^2} + \frac{2x 0,10 x 22,34}{18,88} = 0,0964 = 9,65\% \end{aligned}$$

b. Menentukan Panjang Lengkung Peralihan (Ls)

- Berdasarkan waktu tempuh maksimum (3 detik) untuk melintasi lengkung peralihan.

$$\begin{aligned} L_s &= \frac{Vr}{3,6} x T \\ &= \frac{50}{3,6} x 3 \\ &= 41,67 \text{ m} \end{aligned}$$

- Berdasarkan rumus modifikasi shorrt.

$$\begin{aligned} L_s &= 0,022 \frac{Vr^3}{RcC} - 2,727 \frac{Vr \times ed}{C} \\ &= 0,022 x \frac{50^3}{63,85 x 0,4} - 2,727 x \frac{50 x 9,65}{0,4} \\ &= 74,79 \text{ m} \end{aligned}$$

- Berdasarkan tingkat pencapaian kelandaian.

$$L_s = \frac{(e_m - e_n) V r}{3.6 \times r e}$$

Dimana re yaitu tingkat pencapaian perubahan kelandaian melintang jalan untuk $v_r \leq 60$ km/jam, $r e$ maks = 0,035 m/m/det.

$$L_s = \frac{(0,10 - 0,02)}{3.6 \times 0,035} \times 50 = 31,75 \text{ m}$$

Maka digunakan lengkung peralihan (L_s) yang memenuhi dan efisien, $L_s = 41,67 \text{ m}$

- c. Menentukan Sudut Spiral (θ_s), Sudut Lengkung (θ_c) dan Lengkung Circle (L_c)

$$\begin{aligned} \theta_s &= \frac{90 L_s}{\pi \times R_c} \\ &= \frac{90 \times 41,67}{3,14 \times 63,85} \\ &= \frac{3750,3}{200,48} \\ &= 18,70^\circ \end{aligned}$$

$$\begin{aligned} \theta_c &= \beta - (2 \times \theta_s) \\ &= 61 - (2 \times 18,70) \\ &= 23,59^\circ \end{aligned}$$

$$\begin{aligned} L_c &= \frac{\theta_c}{180} \times \pi \times R_c \\ &= \frac{23,59}{180} \times 3,14 \times 63,85 \\ &= 26,277 \text{ m} \end{aligned}$$

Syarat Tikungan Jenis S-C-S

$$\theta_c > 0^\circ \quad = 23,59^\circ > 0^\circ$$

$$L_c > 20 \text{ m} \quad = 26,277 \text{ m} > 20 \text{ m}$$

$$\begin{aligned} X_s &= L_s \left(1 - \left(\frac{L_s^2}{40 \times R_c} \right) \right) \\ &= 41,67 \left(1 - \left(\frac{41,67^2}{40 \times 63,85} \right) \right) \end{aligned}$$

$$= 13,34^0$$

$$Y_s = \left(\frac{Ls^2}{6xRd} \right) = \left(\frac{41,67^2}{6x63,85} \right)$$

$$= 4,53^0$$

$$P = \left(\frac{Ls^2}{6xRd} \right) - Rd (1 - \cos \theta_s)$$

$$= \left(\frac{41,67^2}{6x63,85} \right) - 20 (1 - \cos 18,70^0)$$

$$= 1,160 \text{ m}$$

$$K = Ls - \left(\frac{Ls^3}{40xRd^2} \right) - Rd \times \sin \theta_s$$

$$= 41,67 - \left(\frac{41,67^3}{40x63,85^2} \right) - 20 \times \sin 1,160$$

$$= 20,747 \text{ m}$$

$$T_s = (Rd + p) \times \tan \frac{1}{2} \beta + k$$

$$= (63,85 + 1,160) \times \tan 61 + 20,747$$

$$= 59,041 \text{ m}$$

$$E_s = \left(\frac{Rd+p}{\cos \frac{1}{2} \beta} \right) - Rd$$

$$= \left(\frac{63,85+1,16}{\cos 30} \right) - 63,85$$

$$= 11,6 \text{ m}$$

$$L_t = L_c + (2 \times L_s)$$

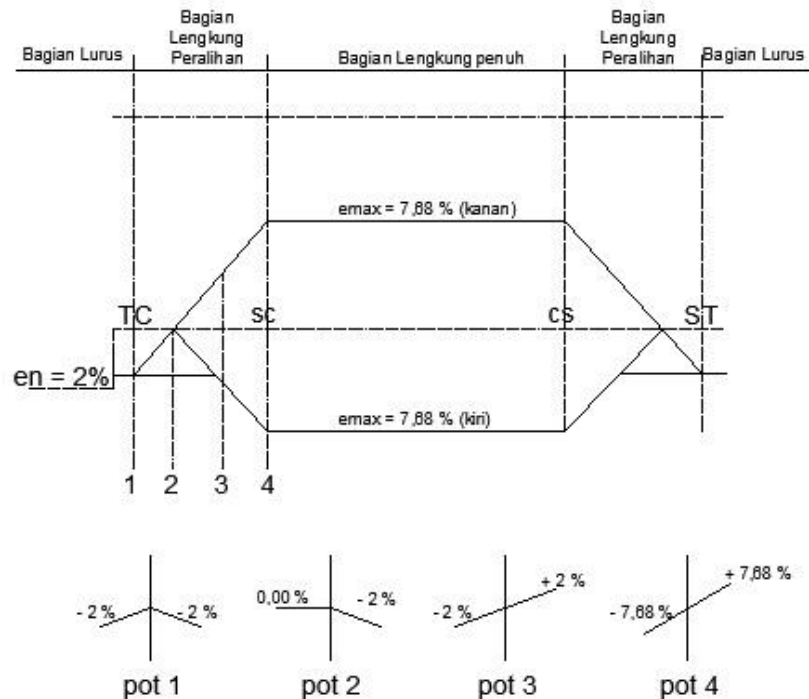
$$= 26,277 + (2 \times 41,67)$$

$$= 109,61 \text{ m}$$

Kontrol Perhitungan S-C-S

$$2 \times T_s > L_{\text{total}}$$

$$118,09 \text{ m} > 109,61 \text{ m} \quad (\text{MEMENUHI})$$



Gambar 4.2 Superelevasi Design Tikungan A1 Spiral-Circle-Spiral

d. Perhitungan Pelebaran Perkerasan di Tikungan

Jalan kelas III C (Kolektor) muatan sumbu terberat (MST) adalah 8 ton, direncanakan kendaraan terberat yang melintas adalah kendaraan sedang. Sehingga :

$$V_r = 50 \text{ km/jam}$$

$$R_d = 63,85 \text{ m}$$

$$n = 2 \text{ (jumlah lajur lintasan)}$$

$$c = 0,8 \text{ m (kebebasan samping)}$$

$$b = 2,6 \text{ m (lebar lintasan kendaraan sedang pada jalan lurus)}$$

$$p = 2,6 \text{ m (jarak antara as roda depan dan belakang kendaraan sedang)}$$

$$A = 0,8 \text{ m (tonjolan depan sampai bumper kendaraan sedang)}$$

Perhitungan :

- Lebar lintasan pada tikungan

$$\begin{aligned}b'' &= Rd - \sqrt{Rd^2 - p^2} \\ &= 63,85 - \sqrt{63,85^2 - 2,6^2} \\ &= 0,053 \text{ m}\end{aligned}$$

- Lebar lintasan total pada tikungan

$$\begin{aligned}b' &= b + b'' \\ &= 2,6 + 0,053 \\ &= 2,653 \text{ m}\end{aligned}$$

- Lebar melintang akibat tonjolan

$$\begin{aligned}T_d &= \sqrt{Rd^2 + A(2p + A)} - Rd \\ &= \sqrt{63,85^2 + 0,8(2 \times 2,6 + 0,8)} - 63,85 \\ &= 0,038 \text{ m}\end{aligned}$$

- Lebar tambahan akibat kelainan dalam mengemudi

$$\begin{aligned}Z &= 0,105 \times \frac{V_r}{\sqrt{Rd}} \\ &= 0,105 \times \frac{50}{\sqrt{63,85}} \\ &= 0,657 \text{ m}\end{aligned}$$

- Lebar Perkerasan pada tikungan

$$\begin{aligned}B &= n(b' + c) + (n - 1) T_d + Z \\ &= 2(2,653 + 0,8) + (2 - 1) 0,038 + 0,657 \\ &= 7,601 \text{ m}\end{aligned}$$

Lebar perkerasan pada jalan lurus 1 lajur = 2,5 m (sesuai survei)

$$B > 6 \text{ m} = 7,601 \text{ m} > 5 \text{ m}$$

$$e = B - W = 7,601 - 5 = 2,60 \text{ m}$$

karena $B > W$, maka diperlukan pelebaran perkerasan pada tikungan sebesar 2,60 m.

e. Perhitungan Kebebasan Samping di Tikungan

Data yang diperoleh :

$$V_r = 50 \text{ km/jam}$$

$$R_d = 63,85 \text{ m}$$

$$W = 5 \text{ m}$$

$$\text{Jarak pandang henti (Jh)} = 55 \text{ m}$$

$$\text{Jarak pandang menyiap (Jd)} = 250 \text{ m}$$

$$\text{Lebar pengawasan minimal} = 30 \text{ m}$$

Perhitungan :

$$(R') = R_d - \frac{1}{2} W$$

$$= 20 - \frac{1}{2} \cdot 5$$

$$= 75,86 \text{ m}$$

$$L_t = 2 \times L_s$$

$$= 2 \times 41,67$$

$$= 83,33 \text{ m}$$

Kebebasan samping yang tersedia

$$(m_o) = \frac{1}{2} \text{ lebar pengawasan} - W$$

$$= \frac{1}{2} \cdot 30 - 5$$

$$= 12,5 \text{ m}$$

Secara analitis

- Berdasarkan Jarak Pandang Henti (Jh)

$$J_h = 55 \text{ m}$$

$$L_t = 83,33 \text{ m}$$

$$E = R' \left(1 - \cos \frac{28,65 \times J_h}{R'} \right)$$

$$= 75,86 \left(1 - \cos \frac{28,65 \times 55}{75,86} \right)$$

$$= 4,9 \text{ m}$$

- Berdasarkan Jarak Pandang Mendahului

$$Jd = 250 \text{ m}$$

$$Lt = 83,33 \text{ m}$$

$$\begin{aligned} E &= R' \left(1 - \cos \frac{28,65 \times Jd}{R'} \right) + \frac{Jd - Lt}{2} \times \sin \left(\frac{28,65 \times Jd}{R} \right) \\ &= 75,68 \left(1 - \cos \frac{28,65 \times 250}{75,68} \right) + \frac{250 - 83,33}{2} \times \sin \left(\frac{28,65 \times 250}{75,68} \right) \\ &= 88,01 \text{ m} \end{aligned}$$

Jadi :

- Kebebasan samping henti = 4,93 m
- Kebebasan samping menyiap = 88,01 m
- Kebebasan samping tersedia = 12,5 m
- Kebebasan samping berdasarkan jarak henti 2,5 m < 12 m (aman)
- Kebebasan samping berdasarkan jarak pandang menyiap 63,92 m > 12 m (aman)

4.3 Perhitungan Alinyemen Vertikal

4.3.1 Perhitungan Kelandaian Memanjang

Perhitungan kelandaian memanjang g (A-PV1)

$$\text{Elevasi A} = 101,20 \text{ m} \quad \text{STA} = 0+000$$

$$\text{Elevasi PV1} = 102,58 \text{ m} \quad \text{STA} = 0+050$$

$$g = \frac{\text{elevasi}(A) - \text{elevasi}(PV1)}{\text{STA}(A) - \text{STA}(PV1)} \times 100\%$$

$$= \frac{101,20 - 102,58}{(0+50) - (0+100)} \times 100$$

$$= -2,76 \%$$

$$A = g_2 - g_1$$

$$= -1,12 - (-2,75) = -387 \% \text{ (Lv Cekung)}$$

Untuk perhitungan selanjutnya disajikan dalam tabel berikut :

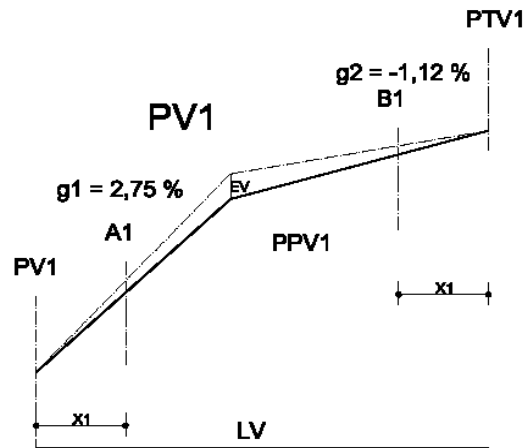
Tabel 4.3 Kelandaian Memanjang

TITIK	STA	ELEVASI (m)	Jarak (m)	Kelandaian Memanjang (%)
A	0,000	101,20	50	
PV1	0,050	102,58	50	g1 2,75
PV2	0,100	102,02	50	g2 -1,12
PV3	0,150	102,30	50	g3 0,56
PV4	0,200	99,98	50	g4 -4,63
PV5	0,250	103,37	50	g5 6,77
PV6	0,300	101,59	50	g6 -3,56
PV7	0,350	100,18	50	g7 -2,83
PV8	0,400	100,58	50	g8 0,83
PV9	0,450	101,58	50	g9 2,00
PV10	0,500	101,19	50	g10 -0,87
PV11	0,550	99,80	50	g11 -2,78
PV12	0,600	101,19	50	g12 2,78
PV13	0,650	97,15	50	g13 -8,09
PV14	0,700	101,19	50	g14 8,09
PV15	0,750	98,73	50	g15 -4,93
PV16	0,800	101,19	50	g16 4,93
PV17	0,850	101,19	50	g17 0,00
PV18	0,900	103,45	50	g18 4,51
PV19	0,950	102,53	50	g19 -184
PV20	1,000	97,62	50	g20 -9,81
PV21	1,050	93,55	50	g21 -8,14
PV22	1,100	100,30	50	g22 13,50
PV23	1,150	100,58	50	g23 0,57

TITIK	STA	ELEVASI (m)	Jarak (m)	Kelandaian Memanjang (%)
PV24	1,200	106,16	50	g24 11,14
PV25	1,250	102,05	50	g25 -8,21
PV26	1,300	105,89	50	g26 7,68
PV27	1,350	108,19	50	g27 4,61
PV28	1,400	108,19	50	g28 0,75
PV29	1,450	97,66	50	g29 6,25
PV30	1,500	104,33	50	g30 5,53
PV31	1,550	107,09	50	g31 1,93
PV32	1,600	108,06	50	g32 -15,14
PV33	1,650	102,02	50	g33 0,74
PV34	1,700	100,86	50	g34 0,00
PV35	1,750	91,42	50	g35 -9,44
PV36	1,800	99,90	50	g36 16,95
PV37	1,850	99,56	50	g37 -0,66
PV38	1,900	99,14	50	g38 -0,85
PV39	1,950	94,47	50	g39 -5,33
PV40	2,000	96,77	50	g40 -3,42

4.3.2 Perhitungan Lengkung Vertikal

1. PV1



Gambar 4.3 Lengkung Vertikal PV1

Data-data :

Stationing PV1 = 0+050

Elevasi PV1 = 102,58 m

Vr = 50 km/jam

A = -3,9% (Lv Cembung)

$$\begin{aligned} Jh &= 0,278 \times Vr \times T + \left(\frac{Vr^2}{254x(fp \pm g)} \right) \\ &= 0,278 \times 50 \times 2,5 + \left(\frac{50^2}{254x(0,35 \pm 0,01)} \right) \\ &= 62,09 \text{ m} \end{aligned}$$

1. Mencari panjang lengkung vertikal :

- Berdasarkan syarat keluwesan bentuk

$$\begin{aligned} Lv &= 0,6 \times Vr \\ &= 0,6 \times 50 \\ &= 30 \text{ m} \end{aligned}$$

- Berdasarkan syarat drainase

$$Lv = 40 \times A$$

$$= 40 \times -3,9$$

$$= -156 \text{ m}$$

- Berdasarkan syarat kenyamanan pengemudi

$$L_v = \frac{Vr}{3,6} \times T$$

$$= \frac{50}{3,6} \times 3$$

$$= 41,7 \text{ m}$$

- Berdasarkan syarat pengurangan guncangan

$$L_v = \frac{Vr^2 \times A}{360}$$

$$= \frac{50^2 \times -3,9}{360}$$

$$= -26,89 \text{ m}$$

Diambil L_v sebesar 41,7 m

Check syarat $J_h > L_v = 62,09 > 41,7$ maka digunakan rumus :

$$E_{v1} = \frac{AxL_v}{800}$$

$$= \frac{0,4 \times 41,7}{800}$$

$$= 0,02 \text{ m}$$

$$X_1 = \frac{1}{4} L_v$$

$$= \frac{1}{4} \times 41,64$$

$$= 10,41 \text{ m}$$

$$\gamma_1 = \frac{A}{200 \times L_v} X^2$$

$$= \frac{0,4}{200 \times 41,67} 10,41^2$$

$$= 0,005 \text{ m}$$

2) Stationing Lengkung Vertikal PV1

$$\text{STA PLV1} = \text{STA PV1} - \frac{1}{2} L_v$$

$$= 50 - \frac{1}{2} \cdot 41,7$$

$$= 29,17 \text{ m}$$

$$\text{STA A1} = \text{STA PV1} - \frac{1}{4} L_v$$

$$= 50 - \frac{1}{4} \cdot 41,67$$

$$= 39,58 \text{ m}$$

$$\text{STA PPV1} = \text{STA PV1}$$

$$= 50 \text{ m}$$

$$\text{STA B1} = \text{STA PV1} + \frac{1}{4} \text{ LV}$$

$$= 50 + \frac{1}{4} \cdot 41,7$$

$$= 60,42 \text{ m}$$

$$\text{STA PTV1} = \text{STA PV1} + \frac{1}{2} \text{ Lv}$$

$$= 50 + \frac{1}{2} \cdot 41,67$$

$$= 70,83 \text{ m}$$

3) Elevasi lengkung vertikal

$$\text{Elevasi PLV}_1 = \text{Elevasi PV}_1 - \frac{1}{2} \text{ Lv} \times g1$$

$$= 102,58 - \frac{1}{2} 41,7 \times 2,75$$

$$= 112,5 \text{ m}$$

$$\text{Elevasi A}_1 = \text{Elevasi PV}_1 - \frac{1}{4} \text{ Lv} \times g1 + \gamma1$$

$$= 102,58 - \frac{1}{4} 41,7 \times 2,75 + 0,005$$

$$= 112,95 \text{ m}$$

$$\text{Elevasi PPV}_1 = \text{Elevasi PV}_1 + \text{Ev}_1$$

$$= 102,58 + 0,02$$

$$= 102,37 \text{ m}$$

$$\text{Elevasi B}_1 = \text{Elevasi PV}_1 + \frac{1}{4} \text{ Lv} \times g1 + \gamma1$$

$$= 102,58 + \frac{1}{4} 41,7 \times 2,75 + 0,005$$

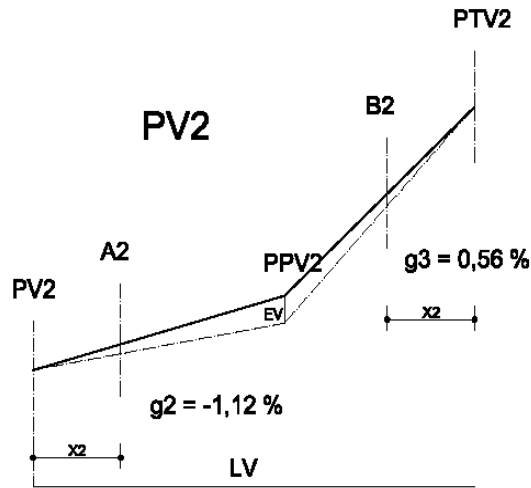
$$= 113,28 \text{ m}$$

$$\text{Elevasi PTV}_1 = \text{Elevasi PV}_1 + \frac{1}{2} \text{ Lv} \times g2$$

$$= 102,58 + \frac{1}{2} 41,7 \times 2,75$$

$$= 112,6 \text{ m}$$

2. PV₂



Gambar 4.4 Lengkung Vertikal PV₂

Data-data :

Stationing PV₂ = 0+100

Elevasi PV₂ = 102,02 m

V_r = 50 km/jam

A = 2% (Lv Cekung)

$$\begin{aligned}
 J_h &= 0,278 \times V_r \times T + \left(\frac{V_r^2}{254x(fp \pm g)} \right) \\
 &= 0,278 \times 50 \times 2,5 + \left(\frac{50^2}{254x(0,35 \pm 0,01)} \right) \\
 &= 62,09 \text{ m}
 \end{aligned}$$

1. Mencari panjang lengkung vertikal :

- Berdasarkan syarat keluwesan bentuk

$$\begin{aligned}
 L_v &= 0,6 \times V_r \\
 &= 0,6 \times 50 \\
 &= 30 \text{ m}
 \end{aligned}$$

- Berdasarkan syarat drainase

$$\begin{aligned}
 L_v &= 40 \times A \\
 &= 40 \times 2
 \end{aligned}$$

$$= 80 \text{ m}$$

- Berdasarkan syarat kenyamanan pengemudi

$$\begin{aligned} L_v &= \frac{Vr}{3,6} \times T \\ &= \frac{50}{3,6} \times 3 \\ &= 41,7 \text{ m} \end{aligned}$$

- Berdasarkan syarat pengurangan guncangan

$$\begin{aligned} L_v &= \frac{Vr^2 \times A}{360} \\ &= \frac{50^2 \times 2}{360} \\ &= 13,88 \text{ m} \end{aligned}$$

Diambil L_v sebesar 41,7 m

Check syarat $J_h > L_v = 62,09 > 41,7$ maka digunakan rumus:

$$\begin{aligned} E_{v2} &= \frac{A \times L_v}{800} \\ &= \frac{2 \times 41,7}{800} \\ &= 0,0033 \end{aligned}$$

$$\begin{aligned} X_2 &= \frac{1}{4} \times L_v \\ &= \frac{1}{4} \times 41,7 \\ &= 4,008 \end{aligned}$$

$$\begin{aligned} \gamma_2 &= \frac{A}{200 \times L_v} X^2 \\ &= \frac{2}{200 \times 41,7} 4,08^2 \\ &= 0,008 \end{aligned}$$

2) Stationing Lengkung Vertikal PV2

$$\begin{aligned} \text{STA PLV2} &= \text{STA PV2} - \frac{1}{2} L_v \\ &= 100 - \frac{1}{2} \cdot 41,7 \\ &= 91,98 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{STA A2} &= \text{STA PV2} - \frac{1}{4} L_v \\ &= 100 - \frac{1}{4} \cdot 41,67 \\ &= 95,99 \text{ m} \end{aligned}$$

$$\text{STA PPV2} = \text{STA PV2}$$

$$= 100 \text{ m}$$

$$\begin{aligned}\text{STA B}_2 &= \text{STA PV}_2 + \frac{1}{4} L_V \\ &= 100 + \frac{1}{4} \cdot 41,7 \\ &= 104,01 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{STA PTV}_2 &= \text{STA PV}_2 + \frac{1}{2} L_V \\ &= 100 + \frac{1}{2} \cdot 41,67 \\ &= 108,02 \text{ m}\end{aligned}$$

3) Elevasi lengkung vertikal

$$\begin{aligned}\text{Elevasi PLV}_2 &= \text{Elevasi PV}_2 - \frac{1}{2} L_V \times g^2 \\ &= 102,02 - \frac{1}{2} 41,7 \times -1,12 \\ &= 102,01 \text{ m}\end{aligned}$$

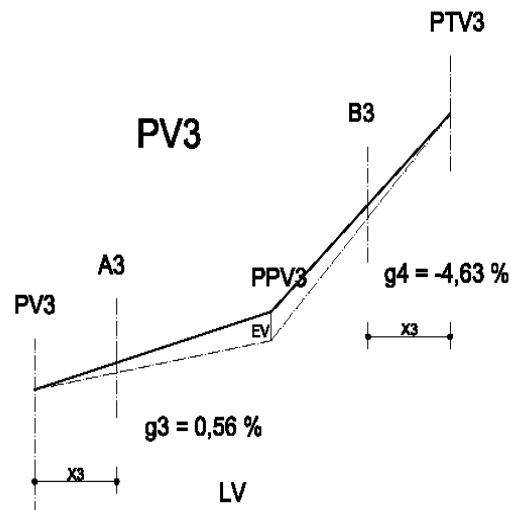
$$\begin{aligned}\text{Elevasi A}_2 &= \text{Elevasi PV}_2 - \frac{1}{4} L_V \times g^2 + \gamma^2 \\ &= 102,02 - \frac{1}{4} 41,7 \times -1,12 + 0,008 \\ &= 102,13 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi PPV}_2 &= \text{Elevasi PV}_2 + E_{v_2} \\ &= 102,02 + (0,0033) \\ &= 102,02 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi B}_2 &= \text{Elevasi PV}_2 + \frac{1}{4} L_V \times g^2 + \gamma^2 \\ &= 102,02 + \frac{1}{4} 41,7 \times -1,12 + 0,008 \\ &= 102,24 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi PTV}_2 &= \text{Elevasi PV}_2 + \frac{1}{2} L_V \times g^2 \\ &= 102,02 + \frac{1}{2} 41,7 \times 0,008 \\ &= 102,01 \text{ m}\end{aligned}$$

3. PV₃



Gambar 4.5 Lengkung Vertikal PV₃

Data-data :

Stationing PV₃ = 0+150

Elevasi PV₃ = 102,30 m

V_r = 50 km/jam

A = 5,19% (Lv Cekung)

$$\begin{aligned}
 J_h &= 0,278 \times V_r \times T + \left(\frac{V_r^2}{254 \times (f_p \pm g)} \right) \\
 &= 0,278 \times 50 \times 2,5 + \left(\frac{50^2}{254 \times (0,35 \pm 0,01)} \right) \\
 &= 62,09 \text{ m}
 \end{aligned}$$

1. Mencari panjang lengkung vertikal :

- Berdasarkan syarat keluwesan bentuk

$$\begin{aligned}
 L_v &= 0,6 \times V_r \\
 &= 0,6 \times 50 \\
 &= 30 \text{ m}
 \end{aligned}$$

- Berdasarkan syarat drainase

$$\begin{aligned}
 L_v &= 40 \times A \\
 &= 40 \times 5,19 \\
 &= 207,6 \text{ m}
 \end{aligned}$$

- Berdasarkan syarat kenyamanan pengemudi

$$\begin{aligned} L_v &= \frac{Vr}{3,6} \times T \\ &= \frac{50}{3,6} \times 3 \\ &= 41,7 \text{ m} \end{aligned}$$

- Berdasarkan syarat pengurangan guncangan

$$\begin{aligned} L_v &= \frac{Vr^2 \times A}{360} \\ &= \frac{50^2 \times 1,59}{360} \\ &= 36,06 \text{ m} \end{aligned}$$

Diambil L_v sebesar 41,7 m

Check syarat $J_h > L_v = 62,09 > 41,7$ maka digunakan rumus:

$$\begin{aligned} E_{v3} &= \frac{A \times L_v}{800} \\ &= \frac{1,59 \times 41,7}{800} \\ &= 0,0027 \end{aligned}$$

$$\begin{aligned} X_3 &= \frac{1}{4} \times L_v \\ &= \frac{1}{4} \times 41,7 \\ &= 10,41 \text{ m} \end{aligned}$$

$$\begin{aligned} \gamma_3 &= \frac{A}{200 \times L_v} X^2 \\ &= \frac{1,59}{200 \times 41,7} 4,08^2 \\ &= 0,006 \text{ m} \end{aligned}$$

2) Stationing Lengkung Vertikal PV3

$$\begin{aligned} \text{STA PLV3} &= \text{STA PV3} - \frac{1}{2} L_v \\ &= 150 - \frac{1}{2} \cdot 41,7 \\ &= 129,16 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{STA A3} &= \text{STA PV3} - \frac{1}{4} L_v \\ &= 150 - \frac{1}{4} \cdot 41,67 \\ &= 139,58 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{STA PPV3} &= \text{STA PV3} \\ &= 150 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{STA B}_3 &= \text{STA PV}_3 + \frac{1}{4} L_V \\ &= 150 + \frac{1}{4} \cdot 41,7 \\ &= 160,41 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{STA PTV}_3 &= \text{STA PV}_3 + \frac{1}{2} L_V \\ &= 150 + \frac{1}{2} \cdot 41,67 \\ &= 170,83 \text{ m} \end{aligned}$$

3) Elevasi lengkung vertikal

$$\begin{aligned} \text{Elevasi PLV}_3 &= \text{Elevasi PV}_3 - \frac{1}{2} L_V \times g_3 \\ &= 102,30 - \frac{1}{2} 41,7 \times 0,56 \\ &= 102,29 \text{ m} \end{aligned}$$

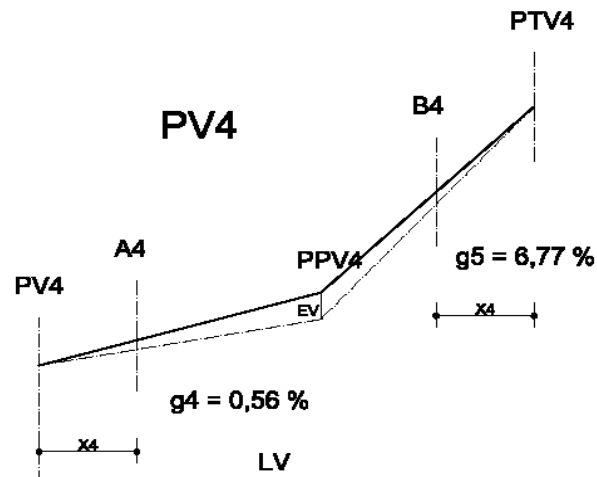
$$\begin{aligned} \text{Elevasi A}_3 &= \text{Elevasi PV}_3 - \frac{1}{4} L_V \times g_3 + \gamma_3 \\ &= 102,30 - \frac{1}{4} 41,7 \times 0,56 + 0,006 \\ &= 102 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Elevasi PPV}_3 &= \text{Elevasi PV}_3 + E_{V_3} \\ &= 102,30 + (0,0027) \\ &= 102,03 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Elevasi B}_3 &= \text{Elevasi PV}_3 + \frac{1}{4} L_V \times g_3 + \gamma_3 \\ &= 102,30 + \frac{1}{4} 41,7 \times 0,56 + 0,006 \\ &= 102,23 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Elevasi PTV}_3 &= \text{Elevasi PV}_2 + \frac{1}{2} L_V \times g_2 \\ &= 102,30 + \frac{1}{2} 41,7 \times 0,006 \\ &= 102,29 \text{ m} \end{aligned}$$

4. PV4



Gambar 4.5 Lengkung Vertikal PV4

Data-data :

Stationing PV4 = 0+200

Elevasi PV4 = 99,98 m

Vr = 50 km/jam

A = 11,40% (Lv Cekung)

$$\begin{aligned}
 Jh &= 0,278 \times Vr \times T + \left(\frac{Vr^2}{254x(fp \pm g)} \right) \\
 &= 0,278 \times 50 \times 2,5 + \left(\frac{50^2}{254x(0,35 \pm 0,01)} \right) \\
 &= 62,09 \text{ m}
 \end{aligned}$$

1. Mencari panjang lengkung vertikal :

- Berdasarkan syarat keluwesan bentuk

$$\begin{aligned}
 Lv &= 0,6 \times Vr \\
 &= 0,6 \times 50 \\
 &= 30 \text{ m}
 \end{aligned}$$

- Berdasarkan syarat drainase

$$\begin{aligned}
 Lv &= 40 \times A \\
 &= 40 \times 11,40 \\
 &= 456,1 \text{ m}
 \end{aligned}$$

- Berdasarkan syarat kenyamanan penumpang

$$\begin{aligned} L_v &= \frac{Vr}{3,6} \times T \\ &= \frac{50}{3,6} \times 3 \\ &= 41,7 \text{ m} \end{aligned}$$

- Berdasarkan syarat pengurangan guncangan

$$\begin{aligned} L_v &= \frac{Vr^2 \times A}{360} \\ &= \frac{50^2 \times 11,40}{360} \\ &= 79,19 \text{ m} \end{aligned}$$

Diambil L_v sebesar 41,7 m

Check syarat $J_h > L_v = 62,09 > 41,7$ maka digunakan rumus:

$$\begin{aligned} E_{v4} &= \frac{A \times L_v}{800} \\ &= \frac{11,40 \times 41,7}{800} \\ &= 0,0059 \end{aligned}$$

$$\begin{aligned} X_4 &= \frac{1}{4} \times L_v \\ &= \frac{1}{4} \times 41,7 \\ &= 10,41 \text{ m} \end{aligned}$$

$$\begin{aligned} \gamma_4 &= \frac{A}{200 \times L_v} X^2 \\ &= \frac{11,40}{200 \times 41,7} 4,08^2 \\ &= 0,0001 \end{aligned}$$

2) Stationing Lengkung Vertikal PV4

$$\begin{aligned} \text{STA PLV4} &= \text{STA PV4} - \frac{1}{2} L_v \\ &= 200 - \frac{1}{2} \cdot 41,7 \\ &= 179,16 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{STA A4} &= \text{STA PV4} - \frac{1}{4} L_v \\ &= 200 - \frac{1}{4} \cdot 41,67 \\ &= 189,58 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{STA PPV4} &= \text{STA PV3} \\ &= 200 \text{ m} \end{aligned}$$

$$\begin{aligned}\text{STA B}_4 &= \text{STA PV}_4 + \frac{1}{4} \text{LV} \\ &= 200 + \frac{1}{4} \cdot 41,7 \\ &= 210,41 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{STA PTV}_4 &= \text{STA PV}_4 + \frac{1}{2} \text{Lv} \\ &= 200 + \frac{1}{2} \cdot 41,67 \\ &= 220,83 \text{ m}\end{aligned}$$

3) Elevasi Lengkung Vertikal

$$\begin{aligned}\text{Elevasi PLV}_4 &= \text{Elevasi PV}_4 - \frac{1}{2} \text{Lv} \times g_4 \\ &= 99,89 - \frac{1}{2} \cdot 41,7 \times 0,56 \\ &= 99,99 \text{ m}\end{aligned}$$

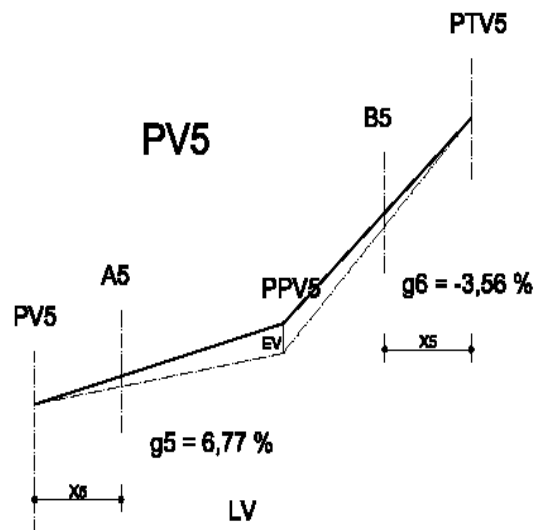
$$\begin{aligned}\text{Elevasi A}_4 &= \text{Elevasi PV}_4 - \frac{1}{4} \text{Lv} \times g_4 + \gamma_4 \\ &= 99,89 - \frac{1}{4} \cdot 41,7 \times 0,56 + 0,006 \\ &= 100 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi PPV}_4 &= \text{Elevasi PV}_4 + \text{Ev}_4 \\ &= 99,89 + (0,0059) \\ &= 100,58 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi B}_4 &= \text{Elevasi PV}_4 + \frac{1}{4} \text{Lv} \times g_4 + \gamma_4 \\ &= 99,89 + \frac{1}{4} \cdot 41,7 \times 0,56 + 0,001 \\ &= 100,13\end{aligned}$$

$$\begin{aligned}\text{Elevasi PTV}_4 &= \text{Elevasi PV}_4 + \frac{1}{2} \text{Lv} \times g_4 \\ &= 99,89 + \frac{1}{2} \cdot 41,7 \times 0,006 \\ &= 99,99 \text{ m}\end{aligned}$$

5. PV5



Gambar 4.6 Lengkung Vertikal PV5

Data-data :

Stationing PV5 = 0+250

Elevasi PV5 = 103,37 m

Vr = 50 km/jam

A = -10,34% (Lv Cekung)

$$\begin{aligned}
 Jh &= 0,278 \times Vr \times T + \left(\frac{Vr^2}{254 \times (fp \pm g)} \right) \\
 &= 0,278 \times 50 \times 2,5 + \left(\frac{50^2}{254 \times (0,35 \pm 0,01)} \right) \\
 &= 62,09 \text{ m}
 \end{aligned}$$

1. Mencari panjang lengkung vertikal :

- Berdasarkan syarat keluwesan bentuk

$$\begin{aligned}
 Lv &= 0,6 \times Vr \\
 &= 0,6 \times 50 \\
 &= 30 \text{ m}
 \end{aligned}$$

- Berdasarkan syarat drainase

$$\begin{aligned}
 Lv &= 40 \times A \\
 &= 40 \times -10,34
 \end{aligned}$$

$$=-413,4 \text{ m}$$

- Berdasarkan syarat kenyamanan pengemudi

$$\begin{aligned} L_v &= \frac{Vr}{3,6} \times T \\ &= \frac{50}{3,6} \times 3 \\ &= 41,7 \text{ m} \end{aligned}$$

- Berdasarkan syarat pengurangan guncangan

$$\begin{aligned} L_v &= \frac{Vr^2 \times A}{360} \\ &= \frac{50^2 \times -10,34}{360} \\ &=-71,77 \text{ m} \end{aligned}$$

Diambil L_v sebesar 41,7 m

Check syarat $J_h > L_v = 62,09 > 41,7$ maka digunakan rumus:

$$\begin{aligned} E_{v5} &= \frac{A \times L_v}{800} \\ &= \frac{-10,34 \times 41,7}{800} \\ &= 0,0534 \end{aligned}$$

$$\begin{aligned} X_5 &= \frac{1}{4} \times L_v \\ &= \frac{1}{4} \times 41,7 \\ &= 10,41 \text{ m} \end{aligned}$$

$$\begin{aligned} \gamma_5 &= \frac{A}{200 \times L_v} X^2 \\ &= \frac{-10,34}{200 \times 41,7} 4,08^2 \\ &= 0,001 \text{ m} \end{aligned}$$

2) Stationing Lengkung Vertikal PV4

$$\begin{aligned} \text{STA PLV5} &= \text{STA PV5} - \frac{1}{2} L_v \\ &= 250 - \frac{1}{2} \cdot 41,7 \\ &= 456,70 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{STA A5} &= \text{STA PV5} - \frac{1}{4} L_v \\ &= 250 - \frac{1}{4} \cdot 41,67 \\ &= 353,35 \text{ m} \end{aligned}$$

$$\text{STA PPV5} = \text{STA PV5}$$

$$= 250 \text{ m}$$

$$\begin{aligned}\text{STA B}_5 &= \text{STA PV}_5 + \frac{1}{4} L_V \\ &= 250 + \frac{1}{4} \cdot 41,7 \\ &= 146,64 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{STA PTV}_5 &= \text{STA PV}_5 + \frac{1}{2} L_V \\ &= 250 + \frac{1}{2} \cdot 41,67 \\ &= 43,29 \text{ m}\end{aligned}$$

3) Elevasi Lengkung Vertikal

$$\begin{aligned}\text{Elevasi PLV}_5 &= \text{Elevasi PV}_5 - \frac{1}{2} L_V \times g_5 \\ &= 103,37 - \frac{1}{2} 41,7 \times 6,77 \\ &= 103,37 \text{ m}\end{aligned}$$

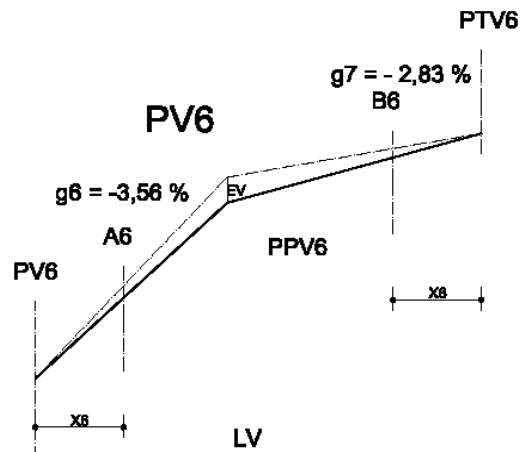
$$\begin{aligned}\text{Elevasi A}_5 &= \text{Elevasi PV}_5 - \frac{1}{4} L_V \times g_5 + \gamma_5 \\ &= 103,37 - \frac{1}{4} 41,7 \times 6,77 + 0,001 \\ &= 102,4 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi PPV}_5 &= \text{Elevasi PV}_5 + E_{v_5} \\ &= 103,37 + (0,0534) \\ &= 108,71 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi B}_5 &= \text{Elevasi PV}_5 + \frac{1}{4} L_V \times g_5 + \gamma_5 \\ &= 103,37 + \frac{1}{4} 41,7 \times 6,77 + 0,001 \\ &= 104,70 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi PTV}_5 &= \text{Elevasi PV}_5 + \frac{1}{2} L_V \times g_5 \\ &= 10,37 + \frac{1}{2} 41,7 \times 0,001 \\ &= 103,37 \text{ m}\end{aligned}$$

6. PV6



Gambar 4.7 Lengkung Vertikal PV6

Data-data :

Stationing PV6 = 0+300

Elevasi PV6 = 101,59

Vr = 50 km/jam

A = 0,73% (Lv Cembung)

$$\begin{aligned}
 Jh &= 0,278 \times Vr \times T + \left(\frac{Vr^2}{254 \times (fp \pm g)} \right) \\
 &= 0,278 \times 50 \times 2,5 + \left(\frac{50^2}{254 \times (0,35 \pm 0,01)} \right) \\
 &= 62,09 \text{ m}
 \end{aligned}$$

1. Mencari panjang lengkung vertikal :

• Berdasarkan syarat keluwesan bentuk

$$\begin{aligned}
 Lv &= 0,6 \times Vr \\
 &= 0,6 \times 50 \\
 &= 30 \text{ m}
 \end{aligned}$$

• Berdasarkan syarat drainase

$$\begin{aligned}
 Lv &= 40 \times A \\
 &= 40 \times 0,73 \\
 &= 29,28 \text{ m}
 \end{aligned}$$

- Berdasarkan syarat kenyamanan pengemudi

$$\begin{aligned}
 L_v &= \frac{Vr}{3,6} \times T \\
 &= \frac{50}{3,6} \times 3 \\
 &= 41,7 \text{ m}
 \end{aligned}$$

- Berdasarkan syarat pengurangan guncangan

$$\begin{aligned}
 L_v &= \frac{Vr^2 \times A}{360} \\
 &= \frac{50^2 \times 0,73}{360} \\
 &= 5,083 \text{ m}
 \end{aligned}$$

Diambil L_v sebesar 41,7 m

Check syarat $J_h > L_v = 62,09 > 41,7$ maka digunakan rumus:

$$\begin{aligned}
 E_{v6} &= \frac{A \times L_v}{800} \\
 &= \frac{0,73 \times 41,7}{800} \\
 &= 0,0381
 \end{aligned}$$

$$\begin{aligned}
 X_6 &= \frac{1}{4} \times L_v \\
 &= \frac{1}{4} \times 41,7 \\
 &= 10,41 \text{ m}
 \end{aligned}$$

$$\begin{aligned}
 \gamma_6 &= \frac{A}{200 \times L_v} X^2 \\
 &= \frac{0,73}{200 \times 41,7} 4,08^2 \\
 &= 0,009 \text{ m}
 \end{aligned}$$

2) Stationing Lengkung Vertikal PV4

$$\begin{aligned}
 \text{STA PLV6} &= \text{STA PV6} - \frac{1}{2} L_v \\
 &= 300 - \frac{1}{2} \cdot 41,7 \\
 &= 279,16 \text{ m}
 \end{aligned}$$

$$\begin{aligned}
 \text{STA A6} &= \text{STA PV6} - \frac{1}{4} L_v \\
 &= 300 - \frac{1}{4} \cdot 41,67 \\
 &= 289,58 \text{ m}
 \end{aligned}$$

$$\begin{aligned}
 \text{STA PPV6} &= \text{STA PV6} \\
 &= 300 \text{ m}
 \end{aligned}$$

$$\begin{aligned}\text{STA B}_6 &= \text{STA PV}_6 + \frac{1}{4} L_v \\ &= 300 + \frac{1}{4} \cdot 41,7 \\ &= 310,41 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{STA PTV}_6 &= \text{STA PV}_6 + \frac{1}{2} L_v \\ &= 300 + \frac{1}{2} \cdot 41,67 \\ &= 320,83 \text{ m}\end{aligned}$$

3) Elevasi Lengkung Vertikal

$$\begin{aligned}\text{Elevasi PLV}_6 &= \text{Elevasi PV}_6 - \frac{1}{2} L_v \times g_6 \\ &= 101,59 - \frac{1}{2} 41,7 \times -3,56 \\ &= 101,58 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi A}_6 &= \text{Elevasi PV}_6 - \frac{1}{4} L_v \times g_6 + \gamma_6 \\ &= 101,59 - \frac{1}{4} 41,7 \times -3,56 + 0,009 \\ &= 101,6 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi PPV}_6 &= \text{Elevasi PV}_6 + E_{v_6} \\ &= 101,59 + (0,0381) \\ &= 101,63 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi B}_6 &= \text{Elevasi PV}_6 + \frac{1}{4} L_v \times g_6 + \gamma_6 \\ &= 103,37 + \frac{1}{4} 41,7 \times -3,56 + 0,009 \\ &= 101,59 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Elevasi PTV}_6 &= \text{Elevasi PV}_6 + \frac{1}{2} L_v \times g_6 \\ &= 101,59 + \frac{1}{2} 41,7 \times 0,009 \\ &= 101,58 \text{ m}\end{aligned}$$

Selanjutnya perhitungan alinyemen vertikal akan dilanjutkan dan disajikan pada tabel berikut:

Tabel 4.4 Hasil Perhitungan Lengkung Vertikal

NO	TITIK	KODE	STA (m)	ELEVASI (m)	KELANDAIAAN (%)
1	A			101,20	
2	PV1	Elv. PLV	29,16	112,50	2,75
		Elv. A	39,58	112,92	
		Elv. PPV	50	102,37	
		Elv. B	60,41	113,28	
		Elv. PTV	70,83	112,60	
3	PV2	Elv. PLV	91,98	102,01	-1,12
		Elv. A	95,99	102,00	
		Elv. PPV	100	102,05	
		Elv. B	104,00	102,02	
		Elv. PTV	108,01	102,01	
4	PV3	Elv. PLV	129,16	102,29	0,56
		Elv. A	139,58	102,00	
		Elv. PPV	150	102,03	
		Elv. B	160,41	102,23	
		Elv. PTV	170,83	102,29	
5	PV4	Elv. PLV	179,16	99,98	-4,63
		Elv. A	189,58	100,00	
		Elv. PPV	200	100,58	
		Elv. B	210,41	100,13	
		Elv. PTV	220,83	99,98	
6	PV5	Elv. PLV	456,70	103,37	6,77
		Elv. A	353,35	102,04	
		Elv. PPV	250	108,71	
		Elv. B	146,64	104,70	
		Elv. PTV	160,50	103,37	
7	PV6	Elv. PLV	279,16	101,58	-3,56
		Elv. A	289,58	101,60	
		Elv. PPV	300	101,63	
		Elv. B	310,41	101,59	
		Elv. PTV	320,83	101,58	
8	PV7	Elv. PLV	329,16	100,17	-2,83
		Elv. A	339,58	100,10	
		Elv. PPV	350	100,37	
		Elv. B	360,41	100,22	
		Elv. PTV	370,83	100,17	
9	PV8	Elv. PLV	379,16	100,59	0,83

		Elv. A	389,58	100,57	
		Elv. PPV	400	100,65	
		Elv. B	410,41	100,61	
		Elv. PTV	420,83	100,59	
10	PV9	Elv. PLV	429,16	101,59	2,00
		Elv. A	439,58	101,63	
		Elv. PPV	450	101,45	
		Elv. B	460,41	101,55	
		Elv. PTV	470,83	101,59	
11	PV10	Elv. PLV	479,16	101,20	-0,78
		Elv. A	489,58	101,19	
		Elv. PPV	500	101,24	
		Elv. B	510,41	101,21	
		Elv. PTV	520,83	101,20	
12	PV11	Elv. PLV	529,16	101,20	0,00
		Elv. A	539,58	101,24	
		Elv. PPV	550	101,04	
		Elv. B	560,41	101,16	
		Elv. PTV	570,83	101,20	
13	PV12	Elv. PLV	579,16	130,28	-2,98
		Elv. A	589,58	135,31	
		Elv. PPV	600	99,60	
		Elv. B	610,41	221,00	
		Elv. PTV	620,83	342,36	
14	PV13	Elv. PLV	587,13	635,00	-5,11
		Elv. A	618,56	97,00	
		Elv. PPV	650	99,23	
		Elv. B	681,43	129,10	
		Elv. PTV	712,86	160,01	
15	PV14	Elv. PLV	960,46	101,19	8,09
		Elv. A	830,24	99,00	
		Elv. PPV	700	109,68	
		Elv. B	569,75	103,32	
		Elv. PTV	439,50	101,19	
16	PV15	Elv. PLV	729,16	98,73	-4,93
		Elv. A	739,58	99,00	
		Elv. PPV	750	99,25	
		Elv. B	760,41	98,86	
		Elv. PTV	770,83	98,73	
17	PV16	Elv. PLV	898,19	101,19	4,93
		Elv. A	849,09	101,00	
		Elv. PPV	800	102,41	
		Elv. B	750,90	101,50	
		Elv. PTV	701,80	101,199	

18	PV17	Elv. PLV	829,16	90,79	0,02
		Elv. A	839,58	96,00	
		Elv. PPV	850	100,96	
		Elv. B	860,41	97,81	
		Elv. PTV	870,83	94,54	
19	PV18	Elv. PLV	879,16	103,45	4,48
		Elv. A	889,58	103,62	
		Elv. PPV	900	102,77	
		Elv. B	910,41	103,28	
		Elv. PTV	920,83	103,45	
20	PV19	Elv. PLV	929,16	99,18	-8,54
		Elv. A	939,58	99,11	
		Elv. PPV	950	99,46	
		Elv. B	960,41	99,25	
		Elv. PTV	970,83	99,18	
21	PV20	Elv. PLV	79,16	99,18	-3,11
		Elv. A	89,58	99,11	
		Elv. PPV	1000	99,18	
		Elv. B	110,41	99,25	
		Elv. PTV	120,83	99,18	
22	PV21	Elv. PLV	84,16	93,55	-8,14
		Elv. A	94,58	93,27	
		Elv. PPV	1050	94,68	
		Elv. B	115,41	93,84	
		Elv. PTV	125,83	93,55	
23	PV22	Elv. PLV	1079,16	100,30	13,05
		Elv. A	1089,58	100,47	
		Elv. PPV	1100	99,63	
		Elv. B	1110,41	100,14	
		Elv. PTV	1120,83	100,30	
24	PV23	Elv. PLV	1129,16	100,59	0,57
		Elv. A	1139,58	100,45	
		Elv. PPV	1150	101,14	
		Elv. B	1160,41	100,73	
		Elv. PTV	1170,83	101,29	
25	PV24	Elv. PLV	1179,16	106,16	11,14
		Elv. A	1189,58	106,41	
		Elv. PPV	1200	105,15	
		Elv. B	1210,41	105,91	
		Elv. PTV	1220,83	107,51	
26	PV25	Elv. PLV	1229,16	102,06	-8,21
		Elv. A	1239,58	101,85	
		Elv. PPV	1250	102,88	
		Elv. B	1260,41	102,26	

		Elv. PTV	1270,83	101,73	
27	PV26	Elv. PLV	1279,16	105,90	7,68
		Elv. A	1289,58	105,94	
		Elv. PPV	1300	105,74	
		Elv. B	1310,41	105,86	
		Elv. PTV	1320,83	105,90	
		Elv. PLV	1329,16	108,20	
28	PV27	Elv. A	1339,58	108,25	
		Elv. PPV	1350	108,00	
		Elv. B	1360,41	109,35	
		Elv. PTV	1370,83	110,60	
		Elv. PLV	1379,16	97,66	0,75
29	PV28	Elv. A	1389,58	97,67	
		Elv. PPV	1400	97,62	
		Elv. B	1410,41	97,65	
		Elv. PTV	1420,83	97,66	
		Elv. PLV	1429,16	529,25	6,25
30	PV29	Elv. A	1439,58	131,00	
		Elv. PPV	1450	104,29	
		Elv. B	1460,41	92,44	
		Elv. PTV	1470,83	80,57	
		Elv. PLV	1517,16	87,52	5,53
31	PV30	Elv. A	1508,58	107,00	
		Elv. PPV	1500	107,25	
		Elv. B	1491,41	100,95	
		Elv. PTV	1482,83	94,73	
		Elv. PLV	1891,27	108,05	1,93
32	PV31	Elv. A	1720,63	104,00	
		Elv. PPV	1550	122,61	
		Elv. B	1379,36	111,69	
		Elv. PTV	1208,72	108,05	
		Elv. PLV	1579,16	100,48	-15,14
33	PV32	Elv. A	1589,58	100,00	
		Elv. PPV	1600	101,31	
		Elv. B	1610,41	100,69	
		Elv. PTV	1620,83	100,49	
		Elv. PLV	1664,76	100,85	0,74
34	PV33	Elv. A	1657,38	101,00	
		Elv. PPV	1650	100,88	
		Elv. B	1642,61	100,86	
		Elv. PTV	1635,23	100,85	
		Elv. PLV	1679,16	90,44	0,00
35	PV34	Elv. A	1689,58	96,00	
		Elv. PPV	1700	100,37	

		Elv. B	1710,41	97,40	
		Elv. PTV	1720,83	94,19	
36	PV35	Elv. PLV	1729,16	91,42	-9,44
		Elv. A	1739,58	91,08	
		Elv. PPV	1750	92,80	
		Elv. B	1760,41	91,76	
		Elv. PTV	1770,83	91,42	
37	PV36	Elv. PLV	1779,16	99,90	16,95
		Elv. A	1789,58	100,13	
		Elv. PPV	1800	98,98	
		Elv. B	1810,41	99,67	
		Elv. PTV	1820,83	99,90	
38	PV37	Elv. PLV	1829,16	99,57	-0,66
		Elv. A	1839,58	99,57	
		Elv. PPV	1850	99,57	
		Elv. B	1860,41	99,57	
		Elv. PTV	1870,83	99,57	
39	PV38	Elv. PLV	1879,16	98,28	-0,85
		Elv. A	1889,58	98,27	
		Elv. PPV	1900	98,33	
		Elv. B	1910,41	98,29	
		Elv. PTV	1920,83	98,28	
40	PV39	Elv. PLV	1929,16	98,85	-5,33
		Elv. A	1939,58	98,85	
		Elv. PPV	1950	98,86	
		Elv. B	1960,41	98,85	
		Elv. PTV	1970,83	98,85	
41	PV40	Elv. PLV	1979,16	99,50	-3,42
		Elv. A	1989,58	99,50	
		Elv. PPV	2000	99,51	
		Elv. B	2010,41	99,50	
		Elv. PTV	2020,83	100,20	