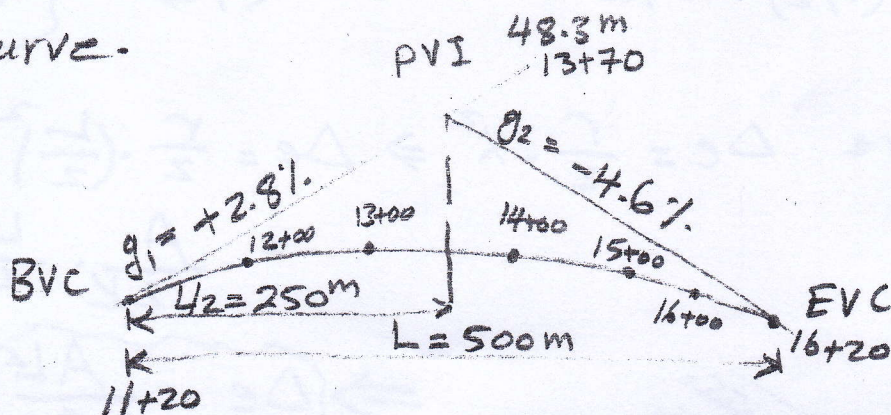


Example 1/ The vertical curve contains two grades, the first grade was upward 2.8% while the second one downward 4.6%. These grades meet at intersection point (PVI), which the Reduce level and station of (PVI) were (48.30m) and (13+70), respectively. The length of vertical curve was 500m. Find

- 1) The Reduce levels and stations of the tangent points.
- 2) The Reduce levels of the curve at 100 m interval.
- 3) The station and Reduce level of highest point on the curve.



Sol.

$$1) \text{ Elevation of BVC} = \text{Elevation of PVI} - g_1 * \frac{L}{2}$$

$$= 48.30 - \frac{2.8}{100} * 250 = 41.30\text{ m}$$

$$\text{Elevation of EVC} = \text{Elevation of PVI} - g_2 * \frac{L}{2}$$

$$= 48.3 - \frac{4.6}{100} * 250 = 36.80\text{ m}$$

$$\text{station of BVC} = \text{station of PVI} - \frac{L}{2}$$

$$= (13 + 70) - (2 + 50) = 11 + 20$$

$$\text{station of EVC} = \text{station of PVI} + \frac{L}{2}$$

$$= (13 + 70) + (2 + 50) = 16 + 20$$

2)

$$y = g_1x + \text{Elev. BVC}$$

BVC station	X	g_1x	Tangent Elev(m)	$\Delta y(m)$	Curve Elev.(m)
11+20	0	0	41.30	0	41.30
12+00	0.8	2.24*	43.54**	-0.47	43.07
13+00	1.8	5.04	46.34	-2.40	43.94
PVI 13+70	2.5	7.00	48.3	-4.62	43.68
14+00	2.8	7.84	49.14	-5.79	43.34
15+00	3.8	10.64	51.94	-10.67	41.26
16+00	4.8	13.44	54.74	-17.03	37.70
EVC 16+20	5	14.00	55.3	-18.50	36.80

* $g_1x = 2.8 * 0.8 = 2.24$

** $y = g_1x + \text{Elevation of BVC}$
 $= 2.24 + 41.30 = 43.54$

$$A = g_2 - g_1 = -4.6 - (2.8) = -7.4$$

$$\Delta e = \frac{A \cdot L^{\text{stat.}}}{8} = \frac{-7.4 * 5}{8} = -4.62$$

$$\Delta y = 4 \cdot \Delta e \cdot \left(\frac{x}{L}\right)^2$$

Some calc. of Δy

$$= 4 * -4.62 * \left(\frac{0}{5}\right)^2 = 0$$

$$= 4 * -4.62 * \left(\frac{0.8}{5}\right)^2 = -0.47$$

$$= 4 * -4.62 * \left(\frac{1.8}{5}\right)^2 = -2.40$$

etc.

(11)

Curve Elevation = Tangent Elevation + Δy

Some calc. of curve Elevation

$$= 41.30 + 0 = 41.30 \text{ m}$$

$$= 43.54 - 0.47 = 43.07 \text{ m}$$

$$= 46.34 - 2.40 = 43.94 \text{ m}$$

We can solve the branch 2, as follows =

$$y = \frac{r}{2}x^2 + g_1x + \text{Elev. of BVC}$$

station	x	x ²	$\frac{r}{2}x^2$	g_1x	* Curve Elevation (m)
11+20	0	0	0	0	41.30
12+00	0.8	0.64	-0.47	2.24	43.07
13+00	1.8	3.24	-2.40	5.04	43.94
13+70	2.5	6.25	-4.62	7.00	43.68
14+00	2.8	7.84	-5.80	7.84	43.34
15+00	3.8	14.44	-10.69	10.64	41.25
16+00	4.8	23.04	-17.05	13.44	37.69
16+20	5	25	-18.50	14.00	36.80

$$r = \frac{A}{L} = \frac{g_2 - g_1}{L} = \frac{-4.6 - (2.8)}{5} = -1.48$$

* Curve elevation = $\frac{r}{2}x^2 + g_1x + \text{Elev. of BVC}$

$$= 0 + 0 + 41.30 = 41.30 \text{ m}$$

$$= -0.47 + 2.24 + 41.30 = 43.07 \text{ m}$$

----- etc

(12)

c) The station of highest point is

$$r = \frac{A}{L} = \frac{g_2 - g_1}{L} = \frac{-4.6 - (2.8)}{5} = -1.48$$

$$x_0 = \frac{-g_1}{r} = \frac{-(2.8)}{-1.48} = 1.89 \text{ in station} \Rightarrow 1+89$$

To find the elevation of highest point, we substitute the value of x_0 instead of x in general equation of vertical curve, as follows:

$$y_0 = \frac{r}{2} x_0^2 + g_1 x_0 + \text{Elevation BVC}$$

$$= -0.74(1.89)^2 + (2.8)(1.89) + 41.30 = 43.95 \text{ m}$$

