

# Vertical Curve

## Problem 1:

An **equal tangent** crest vertical curve has a PVC station of chainage 2000 m at +10.0 m elevation. The initial grade is +2.0% and the final grade is -4.5%. Determine the elevation and stationing of PVI, PVT, the high point of the curve and all peg stations. Design Speed = 70 km/h.

## Solution:

$$V = 70 \text{ km/h}$$

$$\therefore \text{SSD} = 105 \text{ m (from Table)}$$

$$\text{and } k = 17 \text{ (from Table, for summit curve)}$$

$$\text{rate of vertical curve, } k = L/A$$

$$\begin{aligned} A &= |(G_2 - G_1)| \\ &= |(-4.5 - 2)| = 6.5 \end{aligned}$$

$$\begin{aligned} \therefore L &= KA \quad (K = L/A) \\ &= 17 \times 6.5 \text{ m} \\ &= 110.5 \text{ m} \\ &= 110 \text{ m} \end{aligned}$$

$$y = ax^2 + bx + c$$

$$\frac{dy}{dx} = 2ax + b$$

$$\frac{d^2y}{dx^2} = 2a$$

$$a = -0.000295$$

$$\text{at, } x = 0, y = 0; \therefore c = 0$$

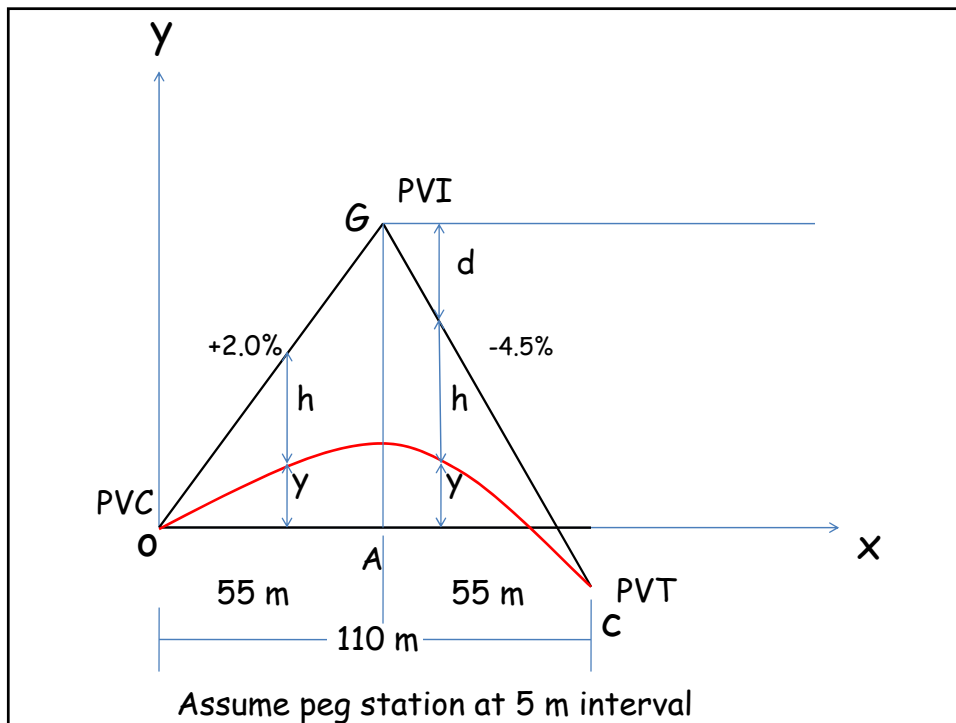
$$\text{at, } x = 0, y = 0; \frac{dy}{dx} = 2.0\% = 0.02$$

$$\therefore 0.02 = 2a \times 0 + b$$

$$\therefore b = 0.02$$

$$2a = \frac{G_2 - G_1}{L}$$

$$2a = \frac{-4.5 - 2.0}{100 \times 110}$$



Peg station no. 6

$$l = x = 6 \times 5 = 30 \text{ m}$$

$$Y = ax^2 + bx + c$$

$$= a(30)^2 + b(30) + c$$

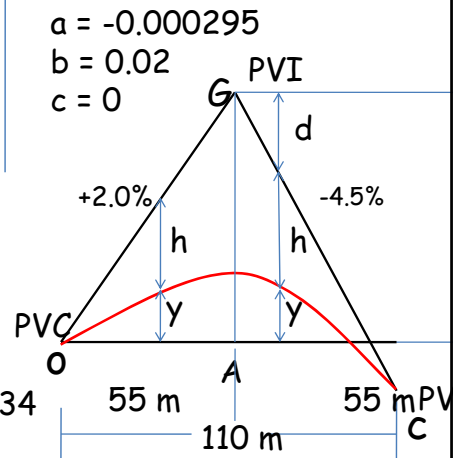
$$= 0.334 \text{ m}$$

$$h + y = \frac{2}{100} \times 30 = 0.600 \text{ m}$$

$$h = 0.600 - 0.334$$

$$= 0.266 \text{ m}$$

$$\begin{aligned} \text{Elevation or RL} &= 10.000 + 0.334 \\ &= 10.334 \text{ m} \end{aligned}$$



Similarly, all other peg stations

Peg station No. 18

$$l = x = 18 \times 5 = 90 \text{ m}$$

$$Y = a(90)^2 + b(90)$$

$$= -0.593 \text{ m}$$

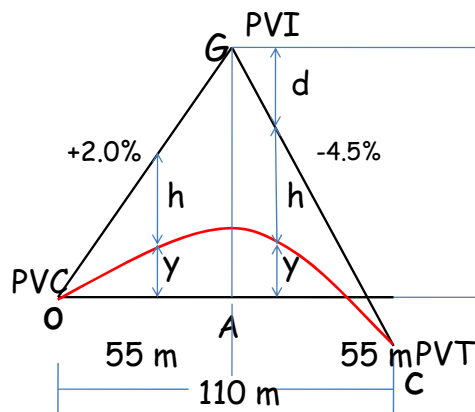
$$\text{RL} = 10.000 - 0.593$$

$$= 9.407 \text{ m}$$

$$h = ?$$

$$d + h + y = \frac{2}{100} \times 55$$

$$= 1.100 \text{ m}$$



$$d = \frac{4.5}{100} \times (90 - 55) = 1.575 \text{ m}$$

$$h = 1.100 - 1.575 - (-0.593) = 0.118 \text{ m}$$

$$\text{RL of PVI} = 10.000 + 1.100 = 11.100 \text{ m}$$

last peg station (PVT)

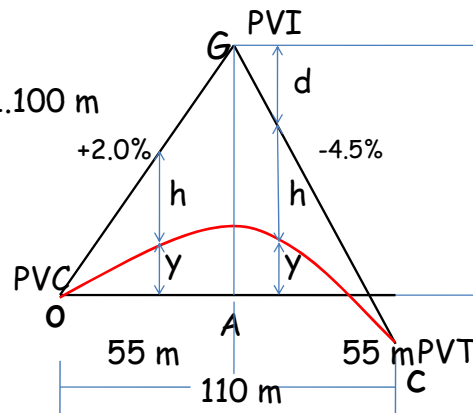
$$l = x = 110 \text{ m}$$

$$y = -1.375 \text{ m}$$

$$d = \frac{4.5}{100} \times (110 - 55) = 2.475 \text{ m}$$

$$\text{RL of PVT} = 10.000 - 1.375 = 8.625 \text{ m}$$

$$\text{or} = 11.100 - 2.475 = 8.625 \text{ m}$$

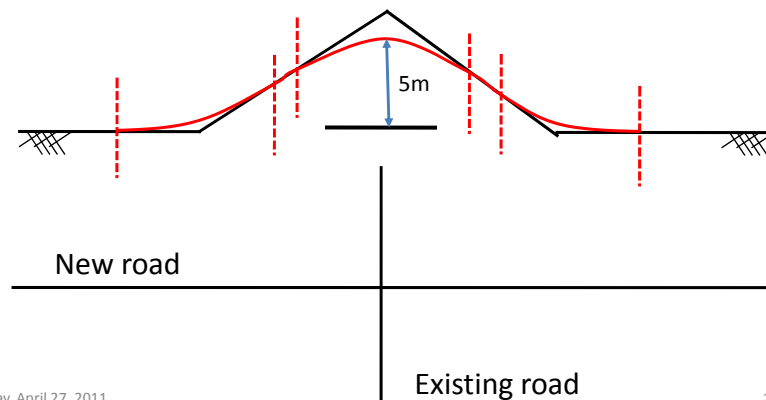


peg st.	$l=x$ (m)	ch. (m)	$y$ (m)	$y+h$ (m)	$h$ (m)	RL (m)
0	0	2000	0.000	0.000	0.000	10.000
1	5	2005	0.093	0.100	0.007	10.093
2	10	2010	0.170	0.200	0.030	10.170
3	15	2015	0.234	0.300	0.066	10.234
4	20	2020	0.282	0.400	0.118	10.282
5	25	2025	0.315	0.500	0.185	10.315
6	30	2030	0.334	0.600	0.266	10.334
7	35	2035	0.338	0.700	0.362	10.338
8	40	2040	0.327	0.800	0.473	10.327
9	45	2045	0.302	0.900	0.598	10.302
10	50	2050	0.261	1.000	0.739	10.261
11	55	2055	0.206	1.100	0.894	10.206

peg st.	$l=x$ (m)	ch. (m)	$y$ (m)	$y+h$ (m)	$h$ (m)	RL (m)
12	60	2060	0.136	0.875	0.739	10.136
13	65	2065	0.052	0.650	0.598	10.052
14	70	2070	-0.048	0.425	0.473	9.952
15	75	2075	-0.162	0.200	0.362	9.838
16	80	2080	-0.291	-0.025	0.266	9.709
17	85	2085	-0.435	-0.250	0.185	9.565
18	90	2090	-0.593	-0.475	0.118	9.407
19	95	2095	-0.766	-0.700	0.066	9.234
20	100	2100	-0.955	-0.925	0.030	9.045
21	105	2105	-1.157	-1.150	0.007	8.843
22	110	2110	-1.375	-1.375	0.000	8.625

## Grade separation problem

Use 5% Grade



Wednesday, April 27, 2011

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Any Question ?