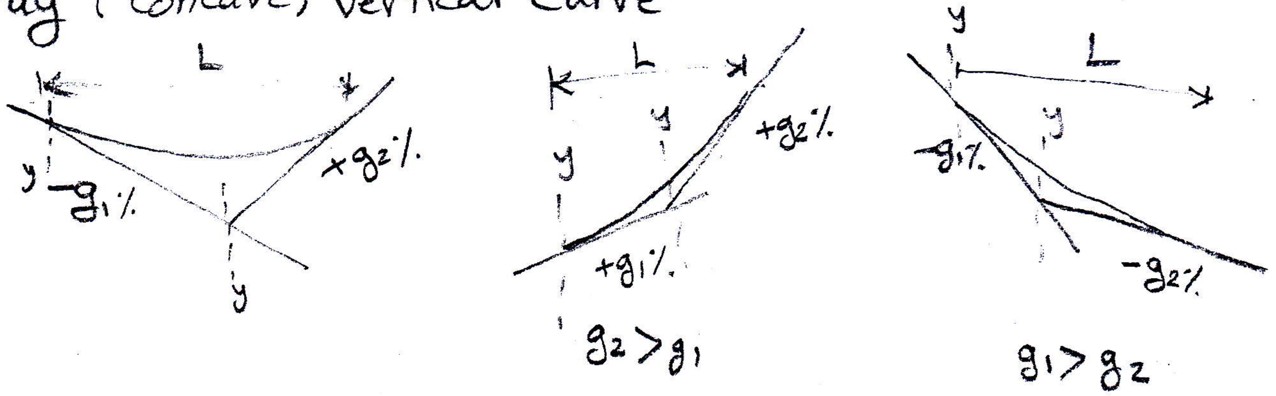
Vertical curves

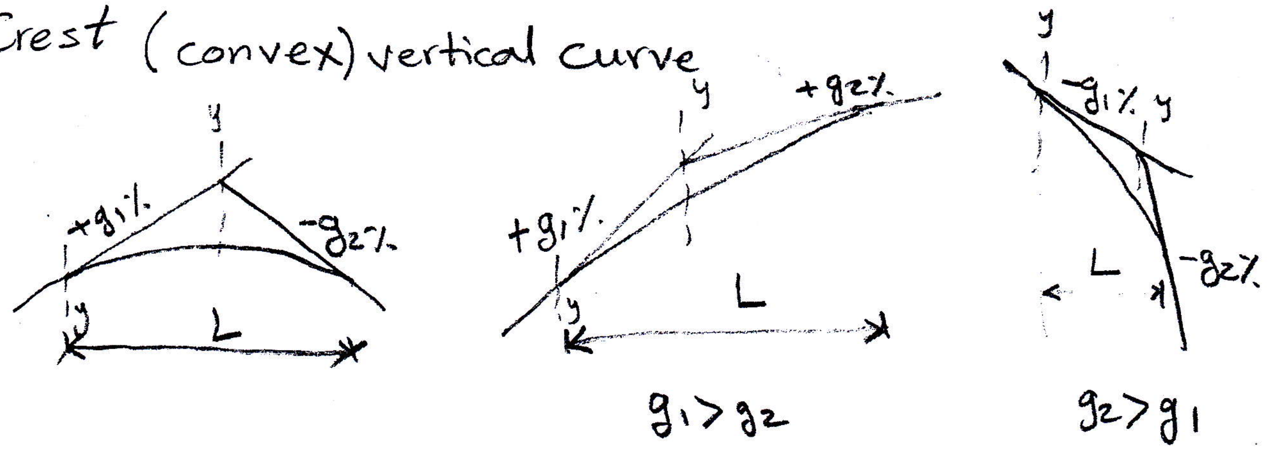
are the second of the two important transition elements ingeometric design for highways. A vertical curve provides a transition between two sloped roadways allowing a vehicle to negotiate the elevation rate change at a gradual rate rather than a sharp cut. This curve is parabolic and are assigned stationing based on a horizontal axis.

kinds of vertical curve

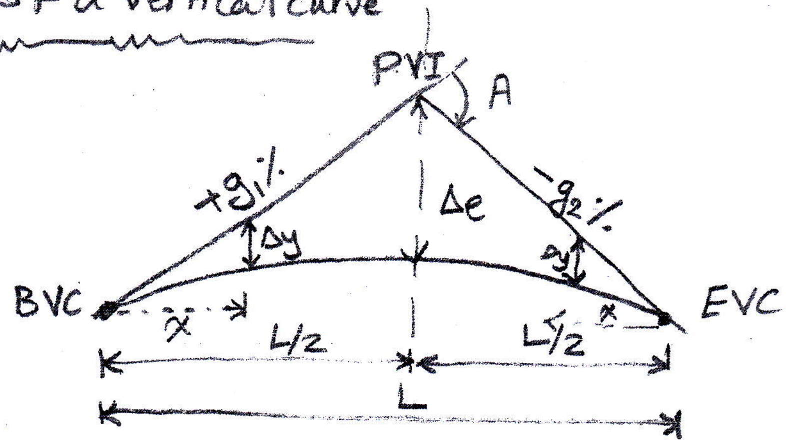
1. Sag (concave) vertical curve



2. Crest (convex) vertical curve



Elements of a vertical curve



(g_1 and g_2) grade of road in percentage.
(L) is the horizontal length of a vertical curve.
(A) is the total change ingrade (difference between grades ($A = g_2 - g_1$).

(r) is the rate of change ingrade ($r = \frac{A}{L}$). L in station.

(BVC) is the begining vertical curve.
(PVI) is the point of vertical curve intersection.
(EVC) is the ending vertical curve.

(X) is the horizontal distance from BVC or EVC in <u>station</u> to the required point.

(Δe) is the difference between elevation of PVI and elevation of curve at middle length of a vertical curve.

(y) is the elevation of point on the curve or (curve elevation).

(Δy) is the difference elevation between tangent and curve @ specified distance (X) in the length of vertical curve.

General equations of computing elevation of point on curve

Since the vertical curve is parabolice, there fore, the general equation is :

$$y = ax^2 + bx + c \qquad \text{------ (A)}$$

@ $x=0$, $y = BVC \longrightarrow \therefore \boxed{BVC = c}$

When taken the first derivative of equation(A), we obtain the slope of curve :

$$y' = 2ax + b$$

@ $x=0$, $y' = g_1 \Rightarrow \boxed{b = g_1}$

The rate of change of slope is given by the the second derivative of equation (A):

$$y'' = 2a$$

$\because y'' = r \Rightarrow r = 2a \Rightarrow \boxed{a = \frac{r}{2}}$

$\because a = \frac{r}{2}$, $b = g_1$, and $c = BVC$, the general equation to find elevation of any point on curve, the equation (A) become :

$$\boxed{y = \frac{r}{2}x^2 + g_1 x + \text{Elev. of } BVC} \qquad \text{----- (B)}$$

Where $r = \frac{A}{L} = \frac{g_2 - g_1}{L}$

station