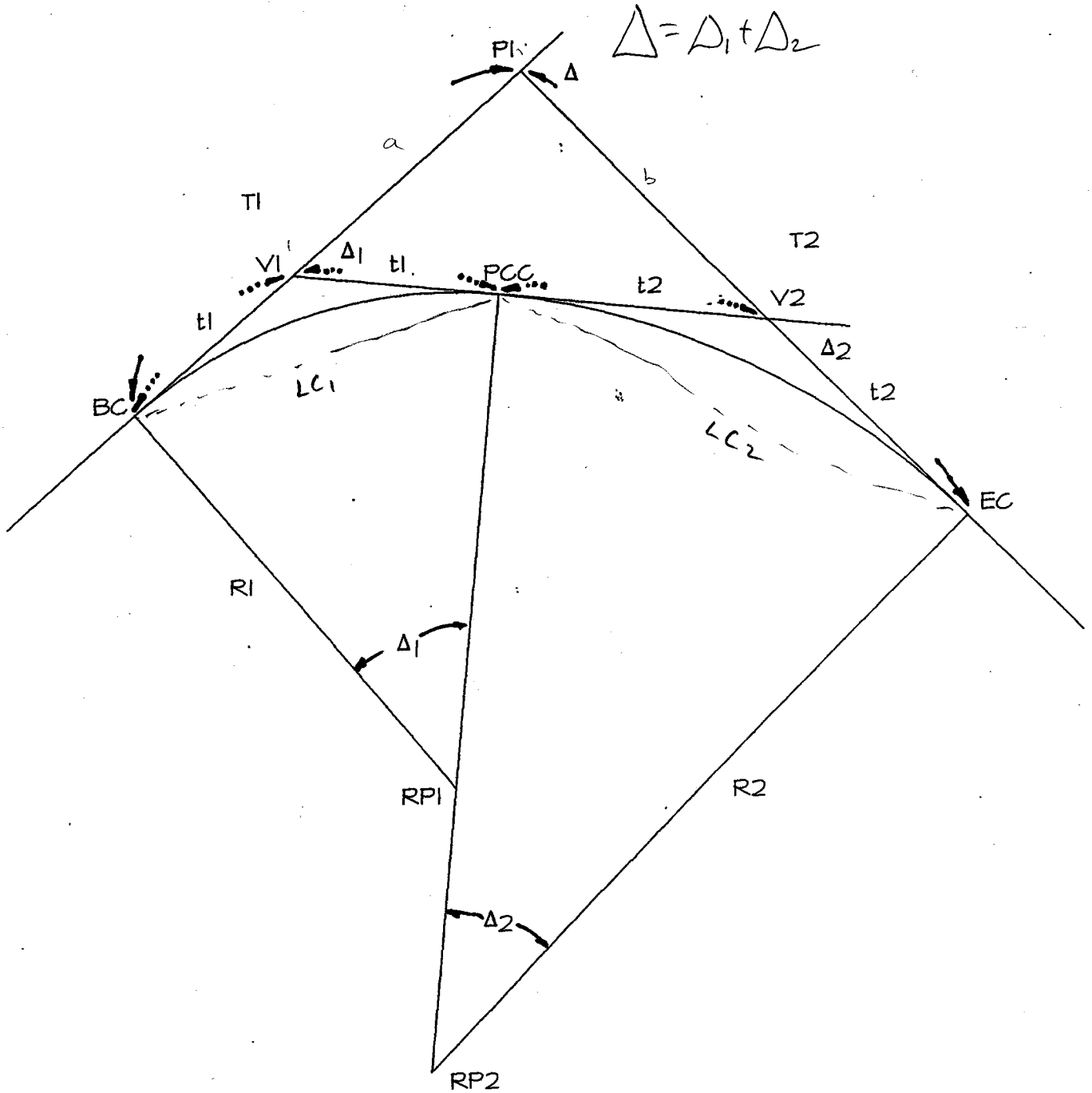
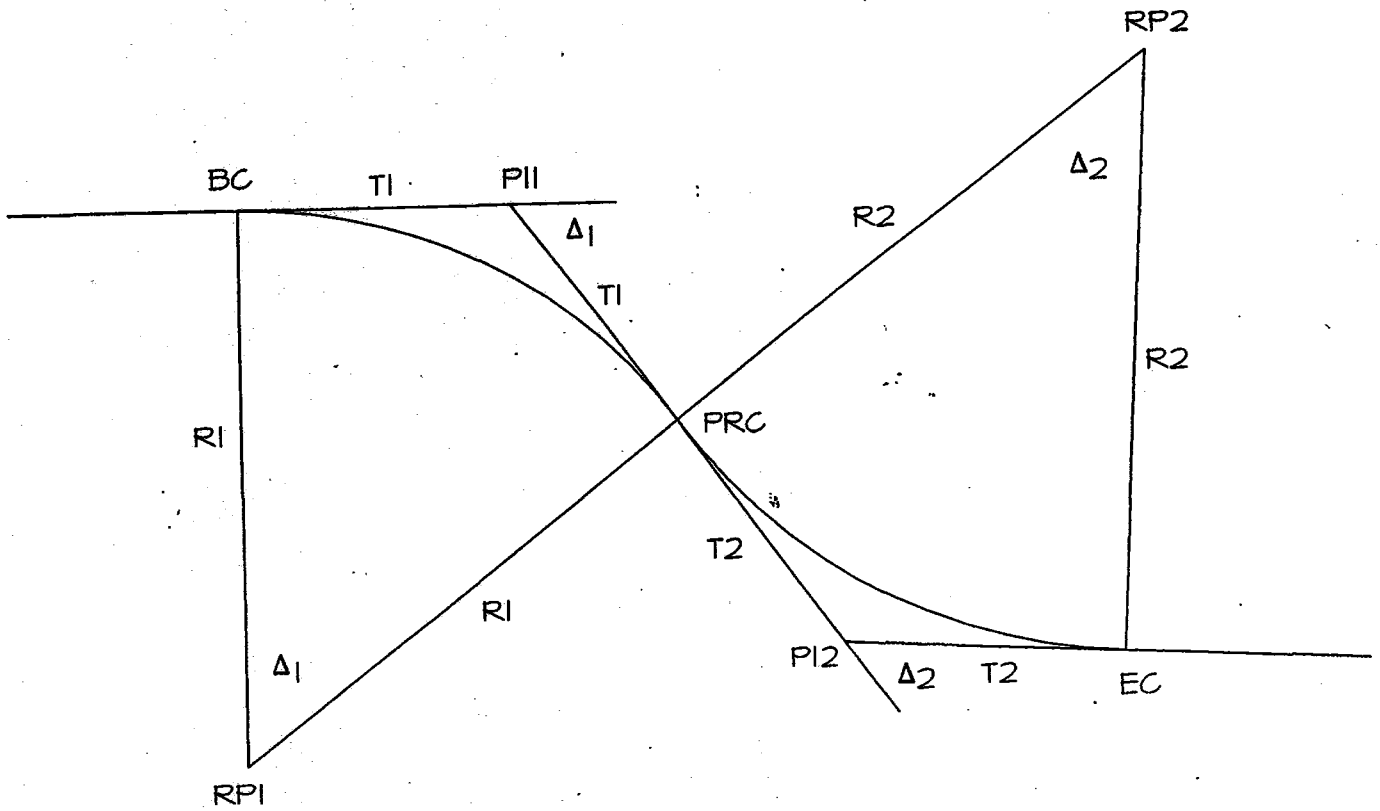


HORIZONTAL CURVE

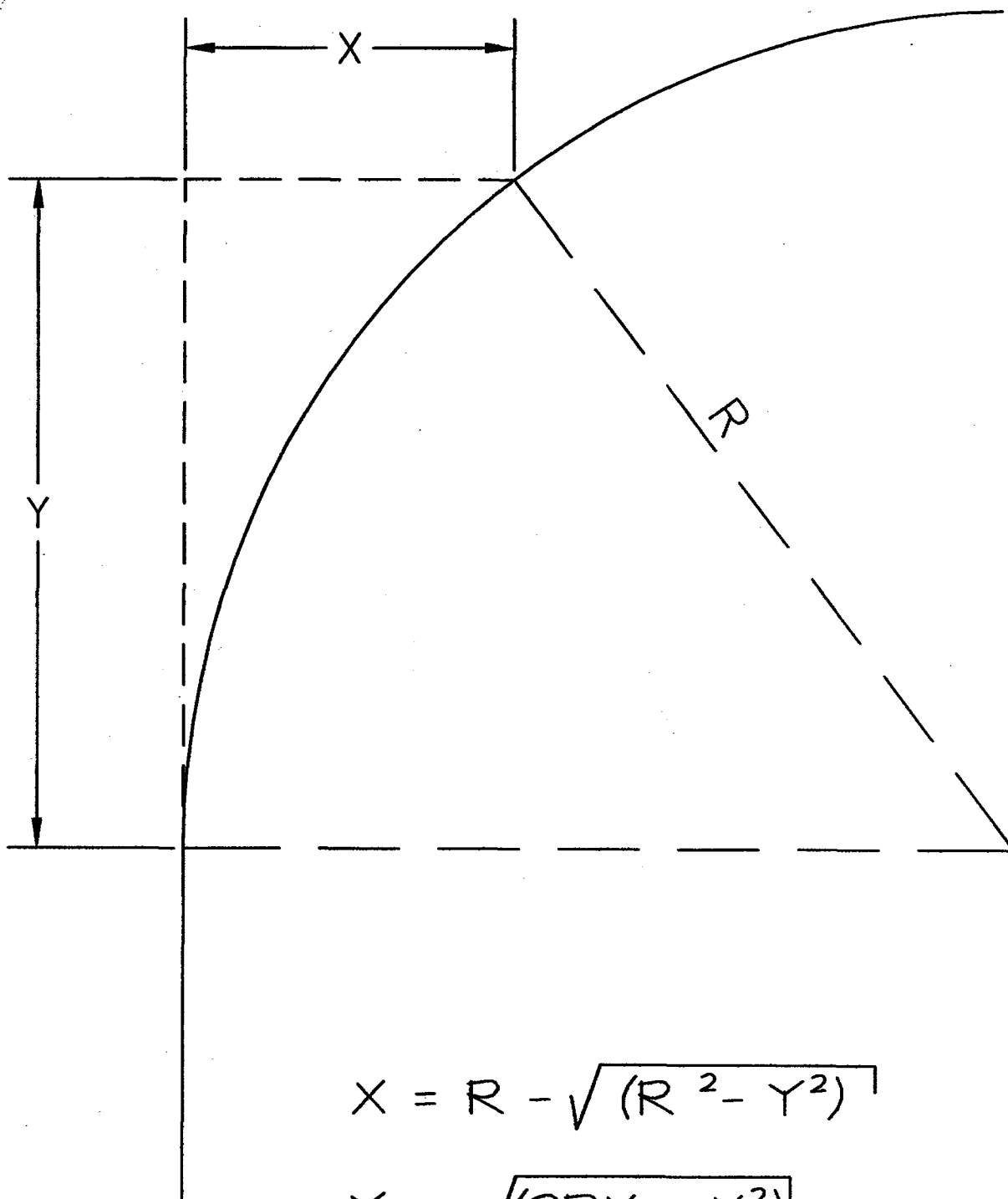
CEST 50B Plane Surveying
Horizontal Curves
Elements of the Compound Curve and Layout



CEST 50B Plane Surveying
Horizontal Curves
Elements of the Reverse Curve and Layout

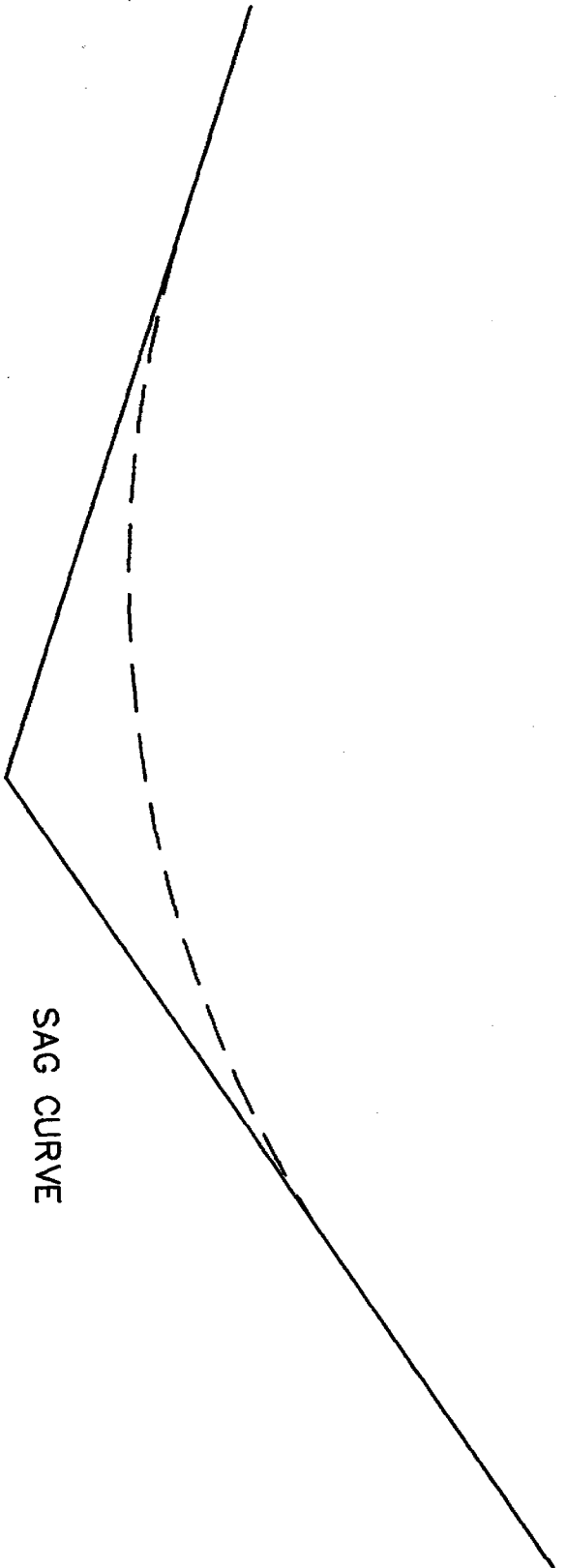


Elements of Tangent Offset



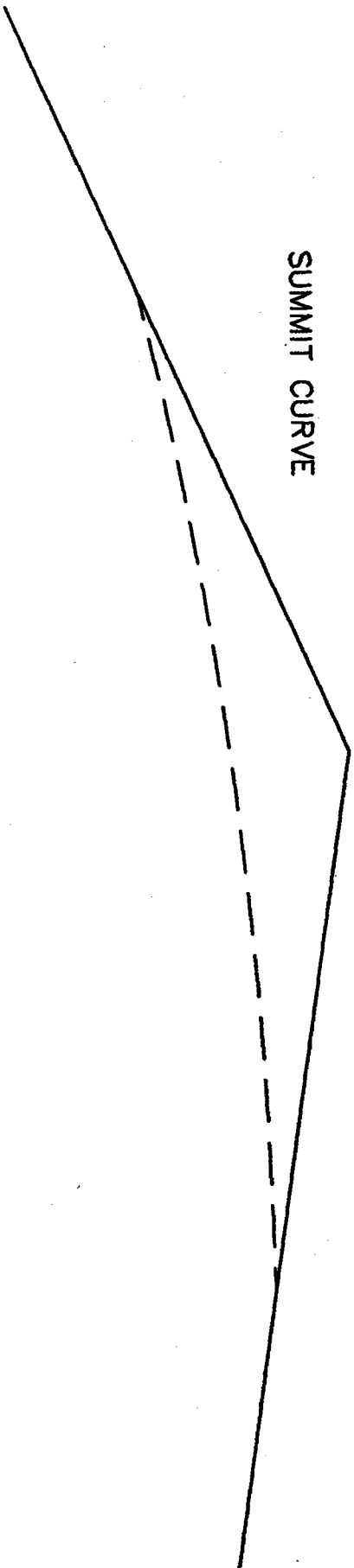
$$X = R - \sqrt{(R^2 - Y^2)}$$

$$Y = \sqrt{(2RX - X^2)}$$

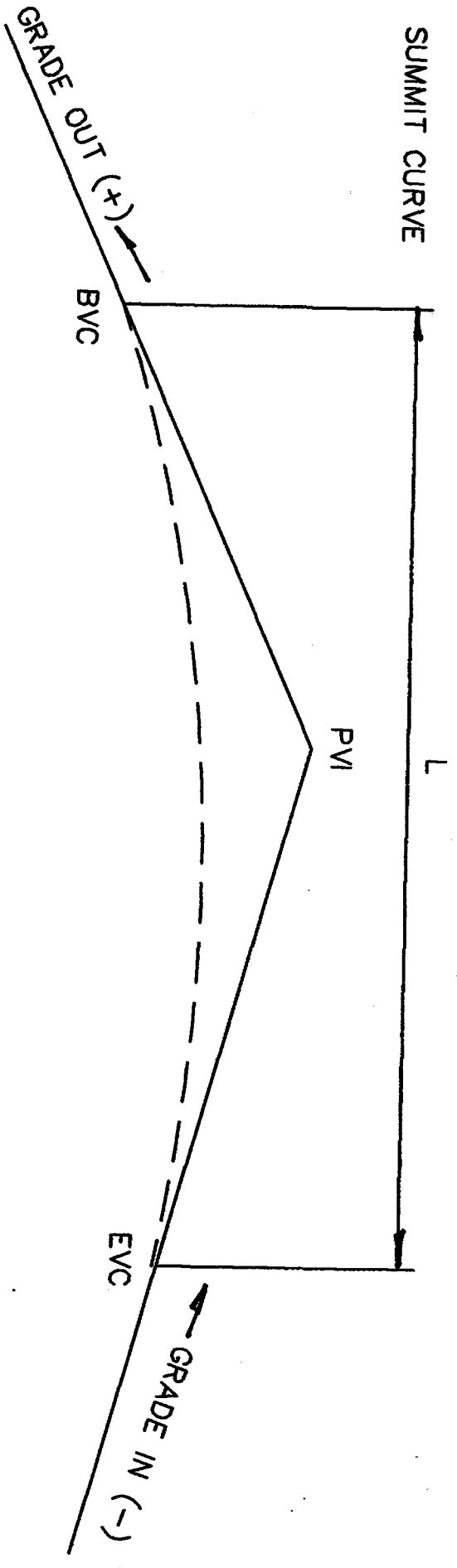
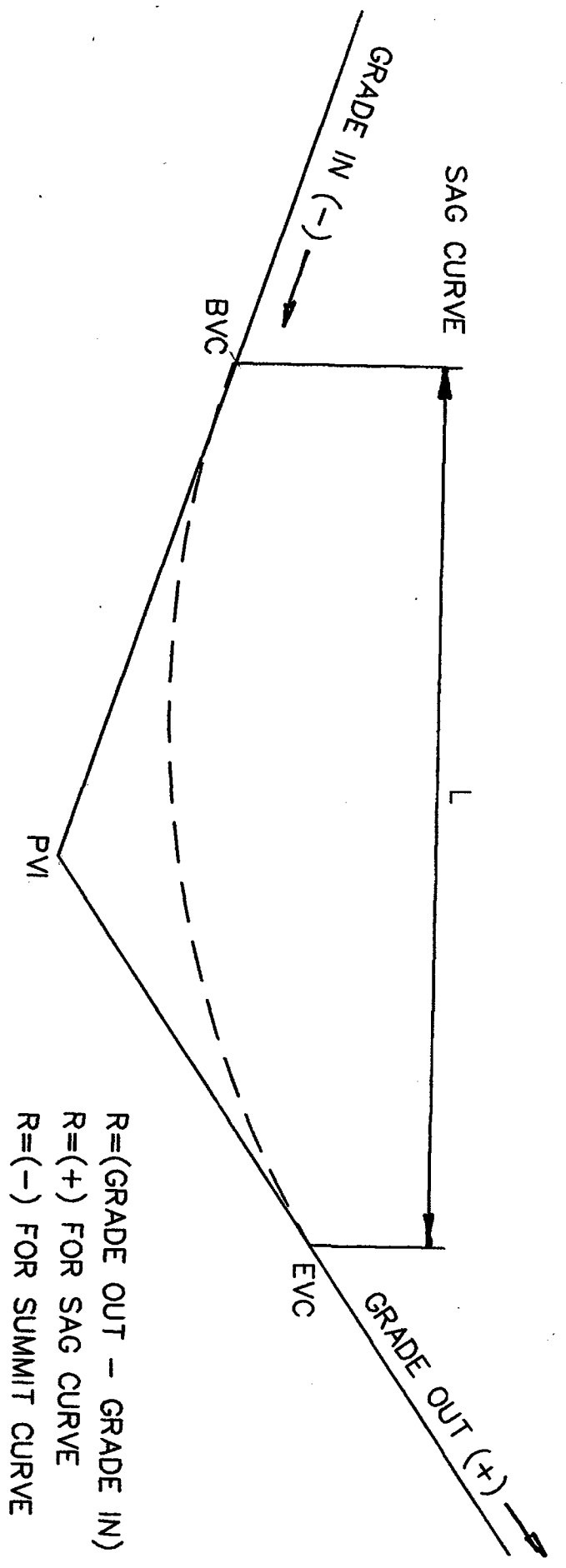


SAG CURVE

SUMMIT CURVE

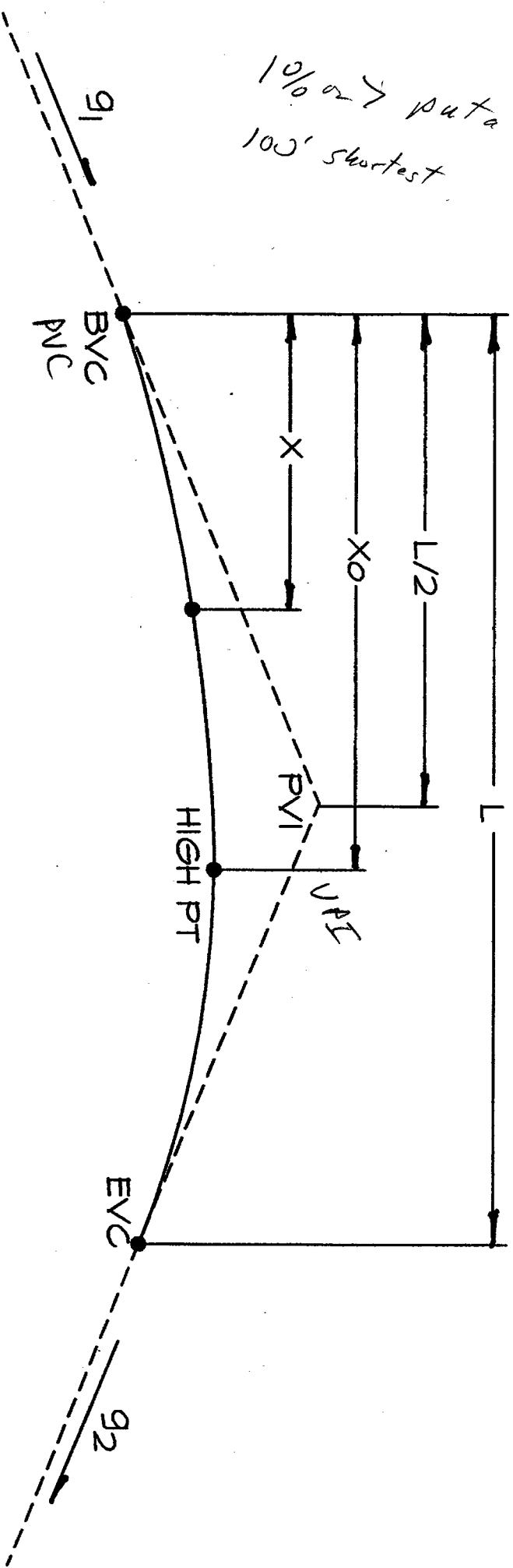


TYPES OF A VERTICAL CURVE



ELEMENTS OF A VERTICAL CURVE

10/6 or 7 put a curve
100' shortest



ELEMENTS OF A VERTICAL CURVE

CEST 50B PLANE SURVEYING

Horizontal Curves:

Angular

$$D_a = \frac{18,000}{\pi R}$$

(Degree of Curvature-Arc Definition)

$$D_c = 2 [\sin^{-1} (50/R)]$$

(Degree of Curvature-Chord Definition)

$$L = \frac{\pi R \Delta}{180}$$

$$LC = 2R(\sin (\Delta/2))$$

$$T = R \tan (\Delta/2)$$

$$E = T \tan (\Delta/4) \quad \text{or} \quad E = R \left[\left(\frac{1}{\cos (\Delta/2)} \right) - 1 \right]$$

$$M = R [1 - \cos (\Delta/2)] \quad \text{or} \quad M = E \cos (\Delta/2)$$

$$\delta = \frac{\text{arc} (\Delta/2)}{L} \quad (\text{Deflection Angles})$$

$$c = 2R \sin \delta \quad (\text{Subchords})$$

Tangent/Offset Equations: (Horizontal Curves)

$$X = R - \sqrt{(R^2 - Y^2)}$$

$$Y = \sqrt{2RX - X^2}$$

Vertical Curves:

$$EL_x = EL_{BVC} + g_1 X + (R/2) X^2$$

$$R = \frac{(g_2 - g_1)}{L} \quad (\text{Rate of Change})$$

$$X_o = \frac{g_1 L}{(g_1 - g_2)} \quad (\text{Distance to Low/High Point})$$

Angular 100 ft arc
for a same R

$$R = \frac{18000}{\pi D_a}$$

highway

$$R = \frac{50}{\sin(\Delta/2)}$$

railroad

$\Delta = I$ in book

VERTICAL CURVE EQUATIONS

$$\text{Slope} = \frac{\Delta EL}{\text{Dist}}$$
$$\Delta EL = \text{Slope} \cdot \text{dist}$$

1. To compute the Elevation of a point on the vertical curve.

$$EL_x = EL_{BVC} + g_1(X) + [(g_2 - g_1) / 2L] X^2$$

Where:

EL_x = Elevation of a point "X" feet from BVC

EL_{BVC} = Elevation of the BVC

X = distance from the BVC to the point on the curve (PT Sta - BVC Sta)

g_1 = Grade in (decimal form)

g_2 = Grade out (decimal form)

L = Length of the Vertical Curve

2. To compute the distance from the BVC to the High or Low Point (X_o) of a vertical curve.

$$(X_o) = \frac{(g_1) L}{(g_1 - g_2)}$$

Where:

X_o = distance from the BVC to the High or Low point on the curve

g_1 = Grade in (decimal form)

g_2 = Grade out (decimal form)

L = Length of the Vertical Curve

3. To compute the Sta of the High or Low Point of a vertical curve

$$\text{High or Low Point Sta} = \text{BVC Sta} + (X_o)$$

4. To compute the Elevation of the High or Low Point (EL_{X_o}) of a vertical curve.

$$EL_{X_o} = EL_{BVC} + g_1(X_o) + [(g_2 - g_1) / 2L] (X_o)^2$$

Where:

EL_{X_o} = Elevation of the High or Low point on the curve

EL_{BVC} = Elevation of the BVC

X = distance from the BVC to the point on the curve (PT Sta - BVC Sta)

g_1 = Grade in (decimal form)

g_2 = Grade out (decimal form)

L = Length of the Vertical Curve