P = Theoretical Point at PVI
M = Offset from the PVI to the curve, in meters
Z = Any tangent offset, in meters
L = Horizontal length of vertical curve, in meters
L_1 = Horizontal distance from PVC to PVI, in meters
L_2 = Horizontal distance from PVT to PVI, in meters
X = Horizontal distance from PVC or PVT to any ordinate "Z," in meters
G_1 & G_2 = Rates of grade, expressed algebraically, in percent

ALL EXPRESSIONS TO BE CALCULATED ALGEBRAICALLY

$$ELEV\ \ OF\ \ PVI\ = ELEV\ \ PVC\ + \frac{G_1 L_1}{100}$$

$$ELEV\ \ OF\ \ PVT\ = ELEV\ \ PVC\ + \frac{G_1 L_1}{100} + \frac{G_2 L_2}{100}$$

$$ELEV\ \ \ OF\ \ \ P\ = ELEV\ \ \ PVC\ \ + \frac{L_1}{L}\left(\frac{G_1 L_1 + G_2 L_2}{100} \right)$$

$$MID\text{ - }ORDINATE\ \ DISTANCE\ \ "M" = \frac{L_1 L_2}{200\ L}(G_2 - G_1) = \frac{ELEV.\ OF\ \ P\ -\ ELEV.\ OF\ \ PVI}{2}$$

For offset "Z" at distance "X" from PVC:

For offset "Z" at a distance "X" from PVT:

$$Z = M\left(\frac{X}{L_2} \right)^2$$

CALCULATING HIGH OR LOW POINT ON CURVE

If high or low point occurs on left portion of curve:

$$X_T = \frac{L_1}{L_2}\left(\frac{G_1\ L}{(G_2 - G_1)} \right)$$

$$Z = M\left(\frac{X}{L_1} \right)^2$$

Where "X_T" equals the horizontal distance from the PVC to the high or low point on the curve in meters.

$$ELEV\ OF\ THIS\ POINT = ELEV\ PVC\ - \frac{L_1}{L_2}\left(\frac{L\ G_1^2}{(G_2 - G_1)\ 200} \right)$$

If high or low point occurs on the right portion of curve:

$$X_T = \frac{L_2}{L_1}\left(\frac{G_2\ L}{(G_2 - G_1)}\right)$$

Where "X_T" equals the horizontal distance from the PVT to the high or low point on the curve in meters.

$$ELEV\ OF\ THIS\ POINT = ELEV\ PVT - \frac{L_2}{L_1}\left(\frac{L\,G_2^2}{(G_2 - G_1)\,200}\right)$$

UNSYMMETRICAL VERTICAL CURVE EQUATIONS
Figure 44-3H