# Answers to "Test Yourself" No. 12

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**Vertical Curve**

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For this problem, we must determine the elevation on the vertical curve at Station 41+14.41, then determine if that elevation is more or less than 19'4" from the overhead obstruction elevation of 1234.95 feet. The second part of the problem is to determine the station and elevation of the vertical curve's high point.

<u>Is Vertical Clearance Requirement Met</u>?

The general equation for the elevation at any point on a vertical curve is:

$$Elevation\ (in\ feet) = \frac{g_2 - g_1}{2L} X^2 + g_1 X + BVC\ Elevation$$

where:

- $g_1$ and $g_2$ are the "entry" and "exit" grades of the vertical curve (in percent and properly signed).

- L is the vertical curve length (in stations).

- X is the distance from the BVC to the point in question (in stations).

- BVC elevation is the elevation at the beginning of the vertical curve (in feet).

For this problem:

$g_1$ = +2.46%

$g_2$ = -3.69%

L = 11

X = 41+14.41 − ((44+33.22) − (11+00.00/2))

X   =   2.3119

BVC Elevation = 1234.56 – (0.0246)(550)

BVC Elevation = 1221.03

Therefore Elevation at Obstruction Location is:

$$Elevation\ at\ 41+14.41 = \frac{-3.69 \ - \ 2.46}{(2)(11)}(2.3119)^2 + 2.46\,(2.3119) + 1221.03$$

Elevation on curve at 41+14.41 = 1225.22

Difference between curve elevation and bottom of obstruction is 18.73 feet. Therefore required obstruction clearance of 19'4" is not met.

## Vertical Curve High Point and Station

The general equation for the location of the curve high or low point is given below.  At this point the slope of the curve is zero, so to derive this equation merely take the first derivative of the equation for elevation and set it equal to zero and solve for X.  (And you thought as a surveyor you'd never use calculus!)

$$X = \frac{g_1\,L}{g_1 - g_2}$$

where:

- X is the distance (in stations) from the curve BVC to the high or low point.

- The other terms are as-defined above.

For this curve:

$$X = \frac{(2.46)(11)}{2.46 - (-3.69)} = 4.40000$$

X, 4.40000, is the distance in stations from the BVC to the high point.  So, the stationing of that point's location is 440.00 feet plus 38+83.22 (BVC Station), or 43+23.22.

Now for that point's elevation, substitute its "X" into the general equation for elevation. Doing so yields the curve's high point elevation as 1226.44.

For you who are looking forward to taking the NCEES exams to become licensed, keep in mind that vertical curves are within the exams' syllabi.