

Solution to Sag Problem with Conductor Supports at Different Elevations (with Example)

Conductor	795 Kcmil ACSR 26/7
Maximum Horizontal Tension (Th)	8,000 Lbs
Heavy Loading Resultant Weight + K (W)	2.510 Lbs/Ft
Span Length (S)	1800 Ft
Difference in Elevation (H)	460 Ft

1. Estimate span length, S₂, or D₂ sag. (See Fig. 1 & 2)

For this example, D₂ is estimated to be 463 feet.

2. Calculate span, S₂, corresponding to D₂ of 463 feet using catenary equation.

$$D_2 = \frac{T_h}{W} x \left(\text{Cosh} \left(\frac{S_2 x W}{T_h} \right) \right) - \frac{T_h}{W}$$

$$S_2 = \frac{T_h}{W} x \text{Cosh}^{-1} \left(\left(D_2 + \frac{T_h}{W} \right) x \frac{W}{T_h} \right)$$

$$S_2 = \frac{8000}{2.510} x \text{Cosh}^{-1} \left(\left(463 + \frac{8000}{2.510} \right) x \frac{2.510}{8000} \right) = 1697.82 \text{ Ft}$$

3. Calculate S₁ (See Fig. 2)

$$S_1 = S - S_2$$

$$S_1 = 1800 - 1697.82 = 102.18 \text{ Ft}$$

4. Calculate D₁ sag using catenary equation.

$$D_1 = \frac{8000}{2.510} x \left(\text{Cosh} \left(\frac{102.18 x 2.510}{8000} \right) \right) - \frac{8000}{2.510} = 1.64 \text{ Ft}$$

5. D₂ - D₁ should equal the value of H (460 Ft).

$$463 - 1.64 = 461.38 \text{ Ft}$$

This means that span S₂ is too long.

6. Reduce span length to 1695.5 Ft and recalculate D₂ sag.

$$D_2 = \frac{8000}{2.510} x \left(\text{Cosh} \left(\frac{1695.5 x 2.510}{8000} \right) \right) - \frac{8000}{2.510} = 461.70 \text{ Ft}$$

7. Recalculate S₁ span length.

$$S_1 = 1800 - 1695.5 = 104.5 \text{ Ft}$$

8. Recalculate D₁ sag.

$$D_1 = \frac{8000}{2.510} x \left(\text{Cosh} \left(\frac{104.5 x 2.510}{8000} \right) \right) - \frac{8000}{2.510} = 1.71 \text{ Ft}$$

9. Recalculate difference between D_2 and D_1 sags as H .

$$H = 461.71 - 1.71 = 460 \text{ Ft}$$

10. Calculate S_3 span length.

$$S_3 = S / 2 - S_1$$

$$S_3 = 1800 / 2 - 104.5 = 795.5 \text{ Ft}$$

11. Calculate D_3 sag using catenary equation.

$$D_3 = \frac{8000}{2.510} \times \left(\text{Cosh} \left(\frac{795.5 \times 2.510}{8000} \right) \right) - \frac{8000}{2.510} = 99.79 \text{ Ft}$$

12. Calculate D sag.

$$D = H / 2 + D_1 - D_3$$

$$D = 460 / 2 + 1.71 - 99.79 = 131.92 \text{ Ft}$$

13. Calculate T_1 and T_2 tensions.

$$T_1 = T_h + D_1 \times W$$

$$T_1 = 8000 + 1.71 \times 2.510 = 8004 \text{ Lbs}$$

$$T_2 = T_h + D_2 \times W$$

$$T_2 = 8000 + 461.71 \times 2.510 = 9159 \text{ Lbs}$$

14. Calculate tension P_{av} . (This is the tension to be used in sag-tension calculations).

$$P_{av} = (T_1 + T_2) / 2 - (D \times W) / 2$$

$$P_{av} = (8004 + 9159) / 2 - (131.92 \times 2.510) / 2 = 8416 \text{ Lbs}$$

15. Calculate inclined span length.

$$SL = \sqrt{S^2 + H^2}$$

$$SL = \sqrt{1800^2 + 460^2} = 1857.85 \text{ Ft}$$

16. Calculate sags-tensions using inclined span, SL , and heavy loading tension, P_{av} .

Note: A starting condition other than the loaded condition may be used.

