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.

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

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

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

3.Calculate S_1 (See Fig. 2)

$$S_1 = S - S_2$$
$$S_1 = 1800 - 1697.82 = 102.18\ Ft$$

4.Calculate D_1 sag using catenary equation.

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

5.D_2 - D_1 should equal the value of H (460 Ft).

463 - 1.64 = 461.38 Ft

This means that span S_2 is too long.

6.Reduce span length to 1695.5 Ft and recalculate D_2 sag.

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

7.Recalculate S_1 span length.

$$S_1 = 1800 - 1695.5 = 104.5\ Ft$$

8.Recalculate D_1 sag.

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

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

$$H = 461.71 - 1.71 = 460\ Ft$$

10.Calculate S_3 span length.

$$S_3 = S / 2 - S_1$$

$$S_3 = 1800 / 2 - 104.5 = 795.5\ Ft$$

11.Calculate D_3 sag using catenary equation.

$$D_3 = \frac{8000}{2.510} x \left(Cosh\left(\frac{795.5x2.510}{8000} \right) \right) - \frac{8000}{2.510} = 99.79\ Ft$$

12.Calculate D sag.

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

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

13.Calculate T_1 and T_2 tensions.

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

$$T_1 = 8000 + 1.71\ x\ 2.510 = 8004\ Lbs$$

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

$$T_2 = 8000 + 461.71\ x\ 2.510 = 9159\ Lbs$$

14.Calculate tension Pav. (This is the tension to be used in sag-tension calculations).

$$Pav = (T_1 + T_2) / 2 - (D\ x\ W) / 2$$

$$Pav = (8004 + 9159) / 2 - (131.92\ x\ 2.510) / 2 = 8416\ Lbs$$

15.Calculate inclined span length.

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

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

16.Calculate sags-tensions using inclined span, SL, and heavy loading tension, Pav.

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

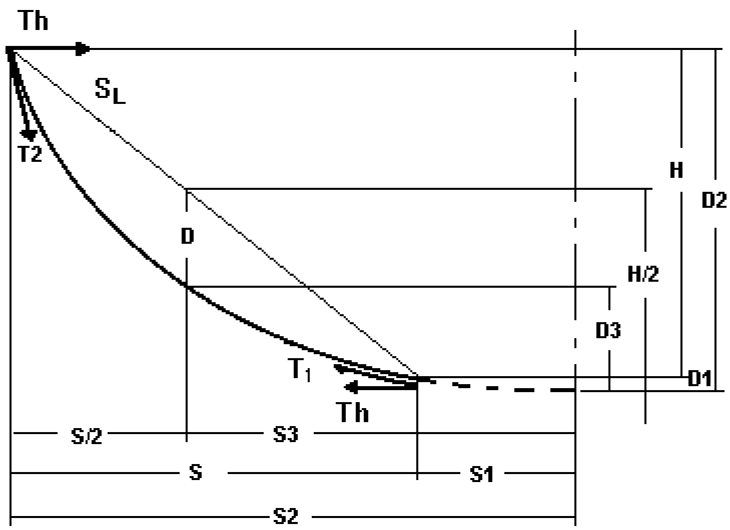

Fig. S1 Low Point of Sag Beyond Lower Support

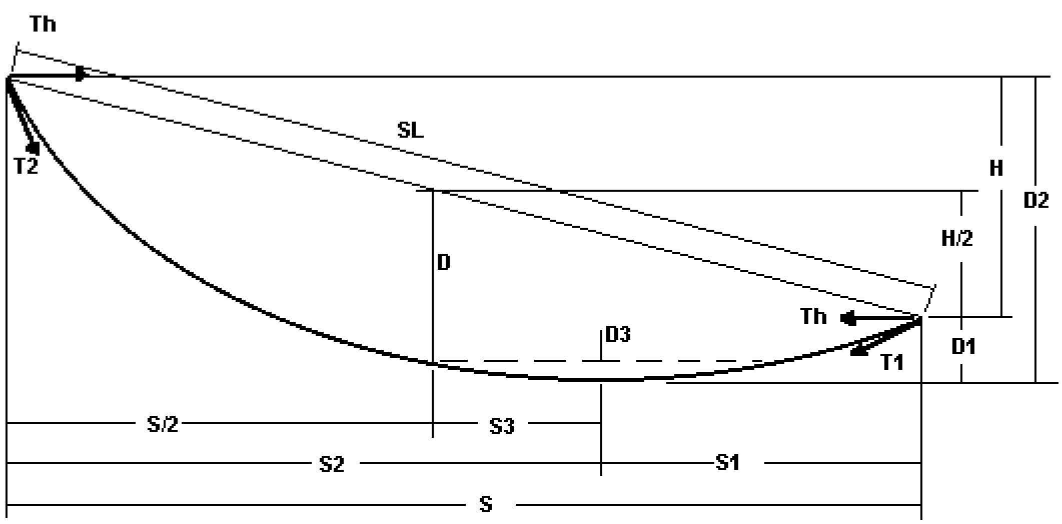

Fig. S2 Span Supported at Different Levels