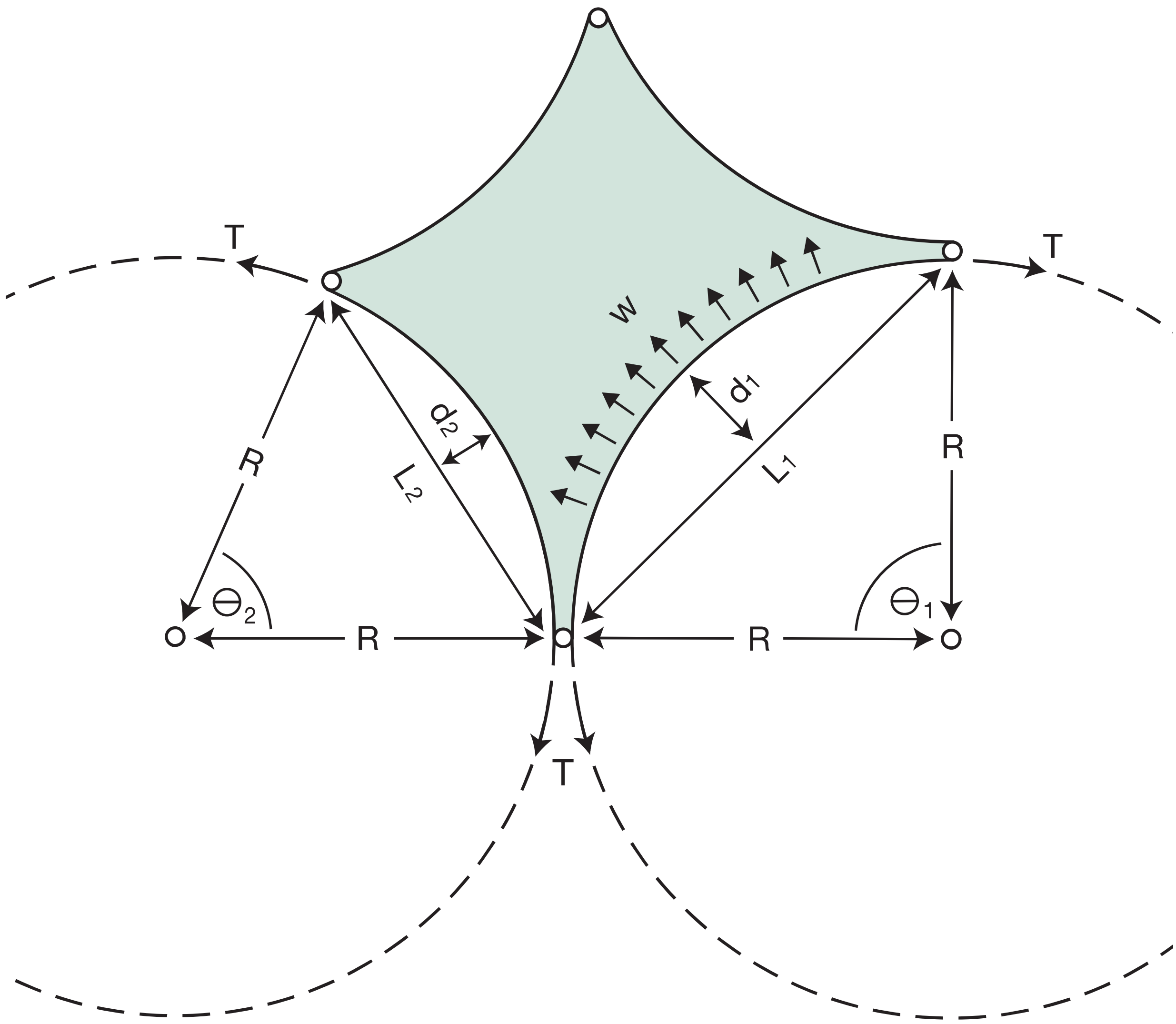
Relationship Between Cable Tension and Curvature

For design conditions of uniform reactive stress, and constant cable tension, the radius of curvature is the same for each span.



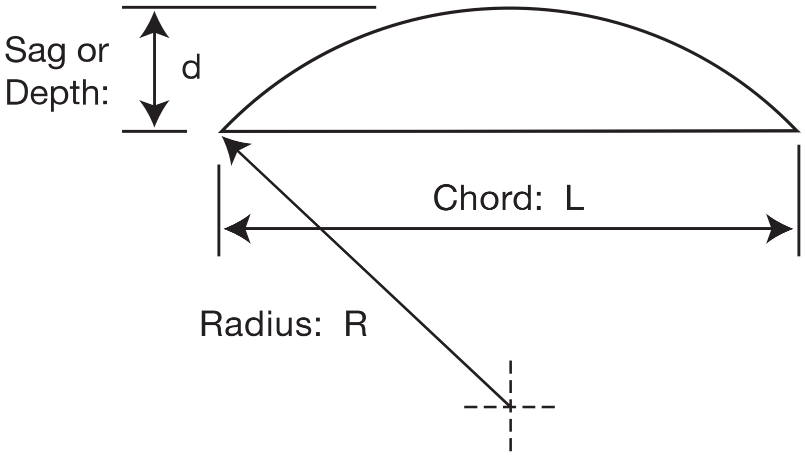
Hoop Stress $T = R \times w$

Where T = Cable Tension (kN)

R = Circle Radius (m)

w = Applied Stress (kN/m)

Therefore Radius: $R = \frac{T}{w}$ **Equation No. (1)**



Equation No. (2)

Sag: $d = R - \dfrac{\sqrt{4R^2 - L^2}}{2}$

Substitute **(1)** into **(2)** Then:

$$d = \frac{T}{w} - \frac{\sqrt{4\left(\frac{T}{w}\right)^2 - L^2}}{2}$$

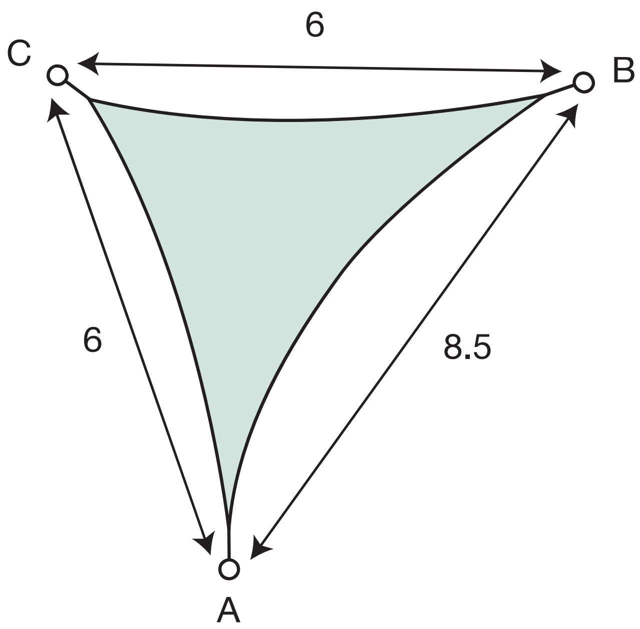
Example:
How to use theory to determine a depth of cut that results in a uniformly stressed sail.

- Allowable stress: $= 0.25kN/m$
- Cable Tension: $= 4.6kN$

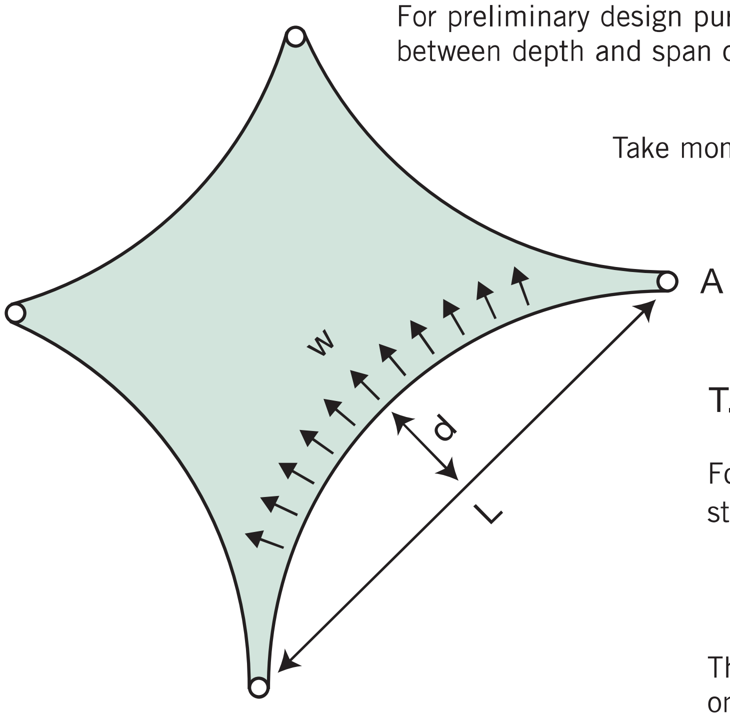
Therefore Depth:

$$d_{AB} = \left(\frac{4.6}{0.25}\right) - \frac{\sqrt{4\left(\frac{4.6}{0.25}\right)^2 - 8.5^2}}{2} = 0.50$$

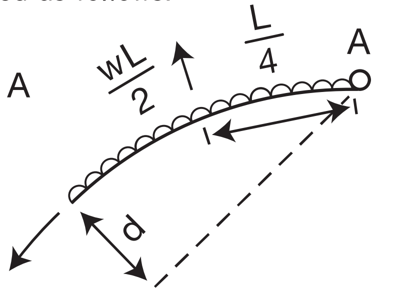
$$d_{AC} = d_{CB} = 0.25$$



For preliminary design purposes, a simpler relationship between depth and span can be derived as follows:–



Take moments about A



$$T.d = \frac{wL}{2} \cdot \frac{L}{4} \quad \therefore \; d = \frac{wL^2}{8T}$$

For constant cable tension and reactive stress, $d = kL^2$ where k is constant.

$$\therefore \; \frac{d_n}{d_1} = \left(\frac{L_n}{L_1}\right)^2$$

This equation is approximate and should only be used for initial design.