Module 3 : Cables  
Lecture 4 : Examples  

Objectives  
In this course you will learn the following  

- Some examples of cable systems.  

Example 3.1 A 35 m cable is supported at ends A and B which are at the same horizontal level and are 25 m apart. A vertical load of 25 kN is acting at point C which is at a distance of 9 m from A. Find the horizontal reaction at A and the dip at C.

![Figure E3.1](image)

Solution:

Free body diagram of the cable:

If the dip at point C is \( \gamma_C \), then applying the general cable theorem, we get:

\[
H \gamma_C = \left( \frac{9}{25} \right) \sum M_B - \sum M_C
\]

Where \( \sum M_B = 25 \times 16 = 400 \text{ kNm} \) and \( \sum M_C = 0 \)

Therefore

\[
H \gamma_C = \frac{9}{25} \times 400 = 144
\]

\[ \Rightarrow H = \frac{144}{\gamma_C} \]

The other equation based on total length of the cable is

\[
\sqrt{9^2 + \gamma_C^2} + \sqrt{16^2 + \gamma_C^2} = 35
\]

\[ \Rightarrow 9^2 + \gamma_C^2 + 16^2 + \gamma_C^2 + 2\sqrt{(9^2 + \gamma_C^2)(16^2 + \gamma_C^2)} = 35^2 \]

\[ \Rightarrow 4(9^2 + \gamma_C^2)(16^2 + \gamma_C^2) = (35^2 - 9^2 - 16^2 - 2\gamma_C^2)^2 \]
Note: Using the static equilibrium conditions we can find that:

\[ A_p = 16 \text{kN} \]
\[ B_p = 9 \text{kN} \]

\[ T_{AC} = 12 \times \frac{15}{9} = 20 \text{kN} \text{ (tension in AC)} \]
\[ T_{BC} = 12 \times \frac{20}{16} = 15 \text{kN} \text{ (tension in BC)} \]

**Example 3.2** A light cable (that is, self weight of cable is negligible compared to external loads) is carrying uniformly distributed load of 30 kN/m. The span of the cable is 75 m and its length is 77 m, where the supports are at same horizontal level. What will be the percentage change in minimum tension if there is a rise of temperature by 35 °C? Coefficient of thermal expansion of the cable material is \((12 \times 10^{-6} / \degree \text{C})\).

**Solution:** if \( y_m \) is the dip at mid point, then using equation 3.13

\[ 77 = 75 + \frac{8 y_m^2}{3 \times 75} \]

\[ \Rightarrow y_m = 7.5 \text{m} \]

Change in length due to temperature rise

\[ \delta S = 77 \times (12 \times 10^{-6}) \times 35 \]

\[ = 0.03234 \text{m} \]

Differentiating equation 3.13, we get:

\[ \delta S = \frac{16 y_m \delta y_m}{3L} \]

\[ \Rightarrow \delta y_m = \frac{3 \times 75 \times 0.03234}{16 \times 7.5} \]

\[ = 0.0606375 \text{m} \]

Differentiating equation 3.8

\[ \delta H = -\frac{wL^2}{8y_m^2} \times \delta y_m \]

\[ \frac{\delta H}{H} = -\frac{\delta y_m}{y_m} = -0.008085 \]

\[ = 0.8085 \% \text{ decrease} \]

This is the change in horizontal reaction, that is, in minimum tension in the cable.

**Recap**

In this course you have learnt the following
• Some examples of cable systems.