

Homework 3
(Due: November 1, 2021)

Question 1: 10 points

Figure 1 shows an elevation view of a pre-fabricated steel building frame that is subject to a variety of snow and wind loadings.

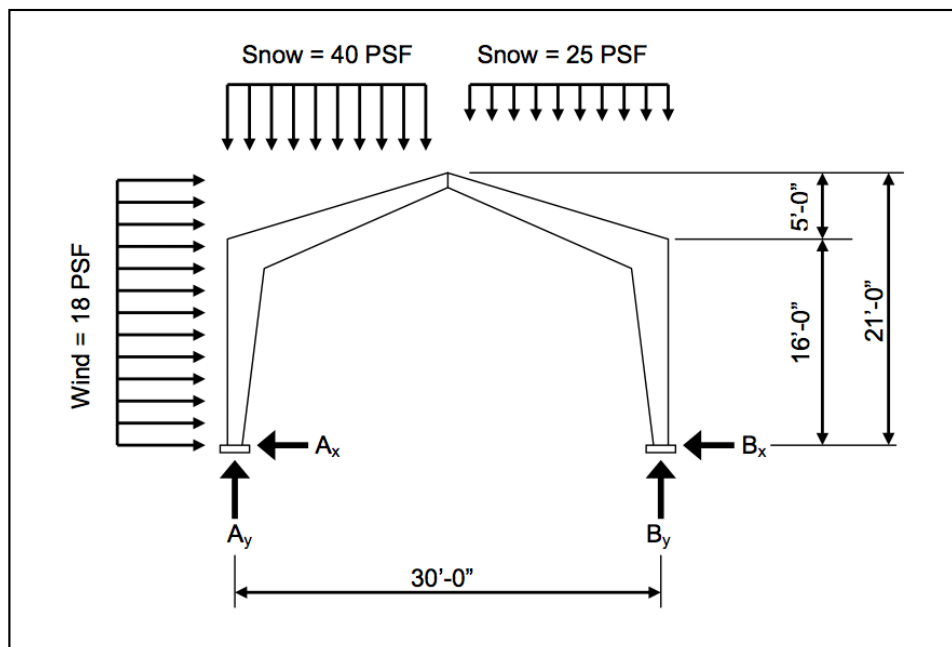


Figure 1: Elevation view of pre-fabricated steel building frame subject to snow and wind loadings.

Assuming that the frames are spaced at 20 ft centers, and that the foundation-level supports and roof apex are pinned (i.e., the frame can be modeled as a three-pinned arch), compute the vertical and horizontal reactions at the base supports.

Question 2: 10 points

The cable structure shown in Figure 2 carries a uniform load w_o N/m along its entire length.

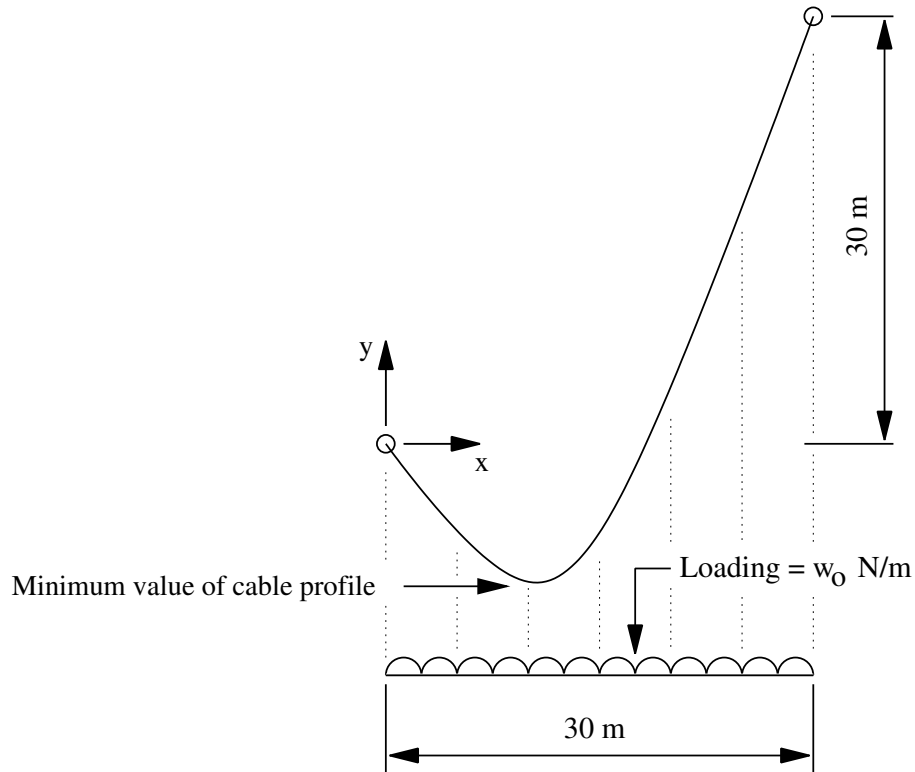


Figure 2: Elevation view of a pedestrian swing bridge.

[2a] Starting from first principles (i.e., the differential equation), show that cable profile is given by the equation

$$y(x) = \frac{w_o x^2}{2H} + \left(1 - \frac{15w_o}{H}\right) x. \quad (1)$$

Now let us assume that the minimum value of the cable profile occurs at $x = 10$.

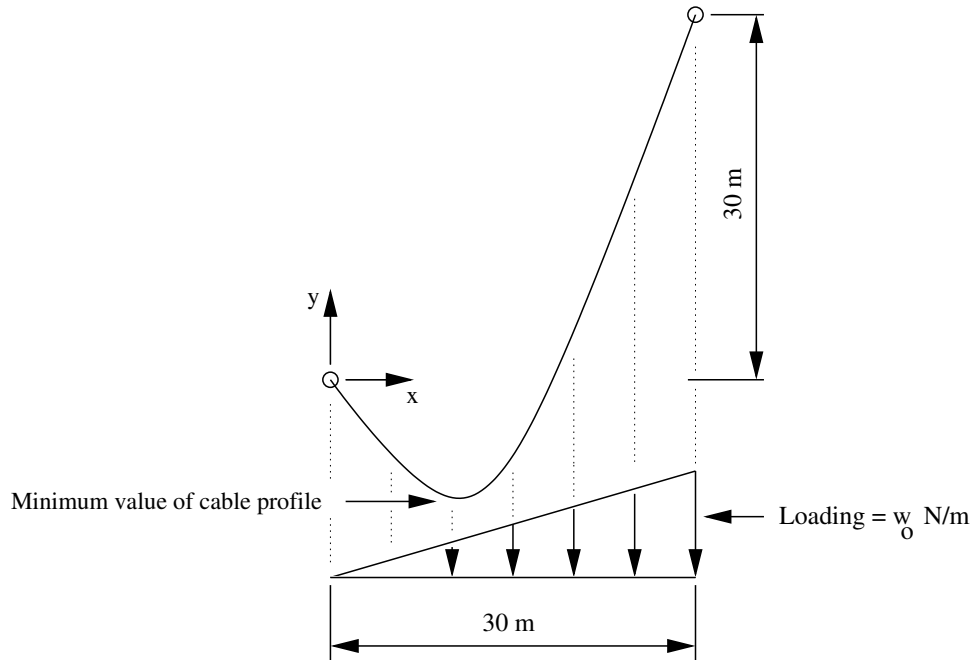
[2b] Show that the horizontal cable force is:

$$H = 5w_o. \quad (2)$$

[2c] Derive a simple expression for the maximum tensile force in the cable.

Question 3: 10 points

The cable structure shown in Figure carries a triangular load that is zero at the left-hand support and increases to w_o N/m at the right-hand support.



[3a] Starting from first principles (i.e., the differential equation), show that cable profile is given by the equation

$$y(x) = \frac{w_o x^3}{180H} + \left(1 - \frac{5w_o}{H}\right) x. \quad (3)$$

Now let us assume that the minimum value of the cable profile occurs at $x = 10$.

[3b] Show that the horizontal cable force is:

$$H = \frac{20w_o}{6}. \quad (4)$$

[3c] Draw and label a diagram showing the horizontal and vertical components of reaction force at the left- and right-hand cable supports.

Question 4: 10 points

An inclined pedestrian walkway is supported by two identical cables and a system of closely spaced hangers. The cable towers are 40 m apart with one 4 m higher than the other. One end of the walkway is 5 m below the cables at the high tower and 3 m below the cables at the low tower.

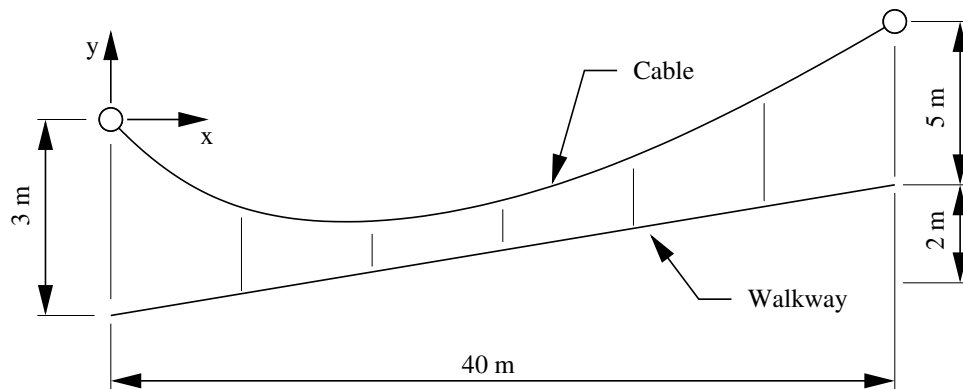


Figure 3: Schematic of walkway dimension (not to scale).

If the smallest possible hanger is 1 m long, and the walkway weighs 5 kN/m, determine:

[4a] H , the horizontal component of force in the cable?

[4b] The maximum force in the cable?

[4c] The length of the cable?