Problem M2

A cable (i.e. a rope, string or chain) is a structural member that can only carry axial tensile loads (i.e. the tension in the cable at a particular point acts in the direction of the cable at that point). Nevertheless, it can deflect in the transverse direction. The deflection is related to the load that it is carrying and the tension in the cable.

a) A flexible cable weighing 10 N/m is stretched between two points at the same level 100 m apart. In addition to its weight, it supports a vertical load of 500 N at a horizontal distance of 30 m from one end. The dip (distance below the horizontal) at that point being 1.9 m. Find (approximately) the horizontal component of the cable tension and the dip at midspan.

b) If the cable has an effective cross-sectional area of 1000 mm$^2$ and an effective Young’s modulus of 2 GPa, estimate the extension of the cable due to the loading in part (a). Would this extension affect the assumptions you made to evaluate the tension in the cable in part (a)?