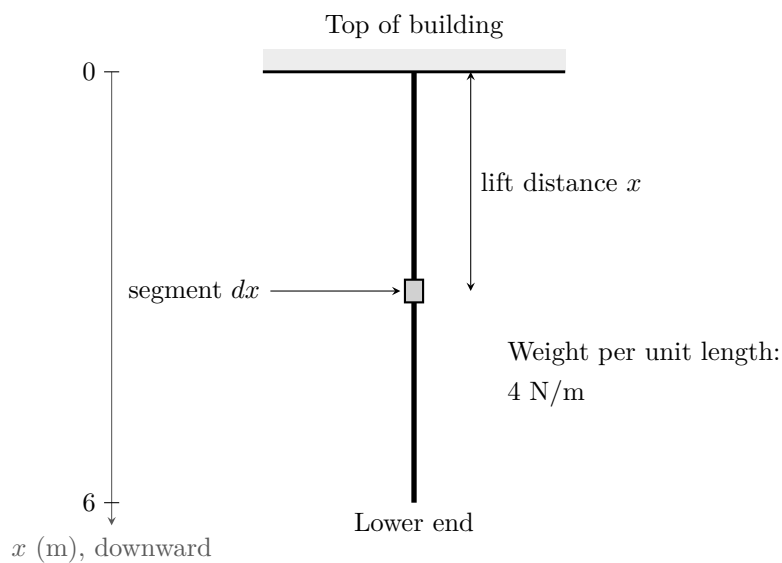


Question 4

A 6-meter cable hangs vertically from the top of a building. The cable has constant linear weight density 4 N/m .

Find the work required to lift the entire cable to the top of the building.



Initial configuration; x is measured down from the top.

Question 4 – Solution

1. Choose a coordinate for each cable segment.

Let x measure the initial distance downward from the top of the building. The cable occupies $0 \leq x \leq 6$ meters.

2. Find the weight of a small segment.

The given quantity is weight per unit length. A segment of length dx weighs

$$dF = (4 \text{ N/m}) dx.$$

No additional factor of gravity is needed.

3. Find its lifting distance and work.

The segment initially at depth x must rise x meters. Thus

$$dW = (\text{weight})(\text{distance}) = 4x dx.$$

4. Add the work for all segments.

$$W = \int_0^6 4x dx = [2x^2]_0^6 = 2(36) - 0 = 72.$$

5. State and check the result.

$$\boxed{W = 72 \text{ J}}.$$

The cable weighs $4(6) = 24$ N, and its center of mass rises 3 m. This gives the same work: $24(3) = 72$ J.