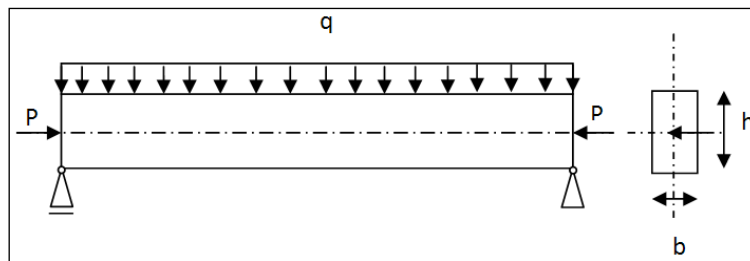


Tutorials : Prestressed Concrete (Chapter I)

Exercise 1

A simply supported beam with a rectangular cross-section (0.55 m wide by 1.20 m high) and a span of 8 meters is subjected to the combined action of a uniformly distributed load of magnitude $q = 20 \text{ kN/m}$ and a total prestressing load P applied at the centroid of the section (Figure below). The objective of this study is to determine the value of the prestressing load required to balance the effects of the load (total prestressing load).

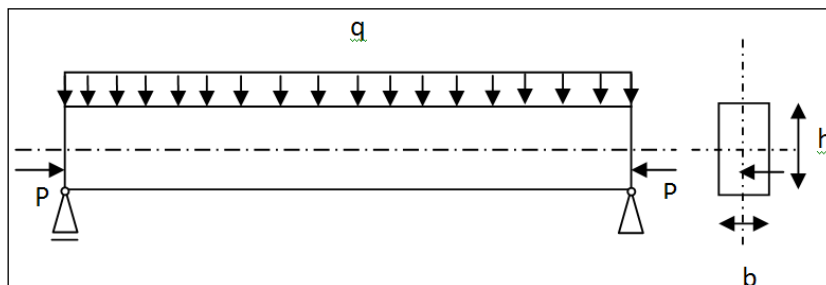
1. Calculate the maximum bending moment induced by the load q .
2. Illustrate by a diagram the distribution (diagram) of the resulting normal stresses in the most stressed section, superimposing the effects of the load q and the prestress P .
3. Determine the value of the prestressing load P that satisfies the stress equilibrium conditions.



Exercise 2

A simply supported beam with a rectangular cross-section (0.55 m wide by 1.20 m high) and a span of 8 meters is subjected to the combined action of a uniformly distributed load of magnitude $q = 20 \text{ kN/m}$ and a total prestressing load P applied below the centroid of the section with an eccentricity $e = 0.35 \text{ m}$ (Figure below). The objective of this study is to determine the value of the prestressing load required to balance the effects of the load (total prestressing).

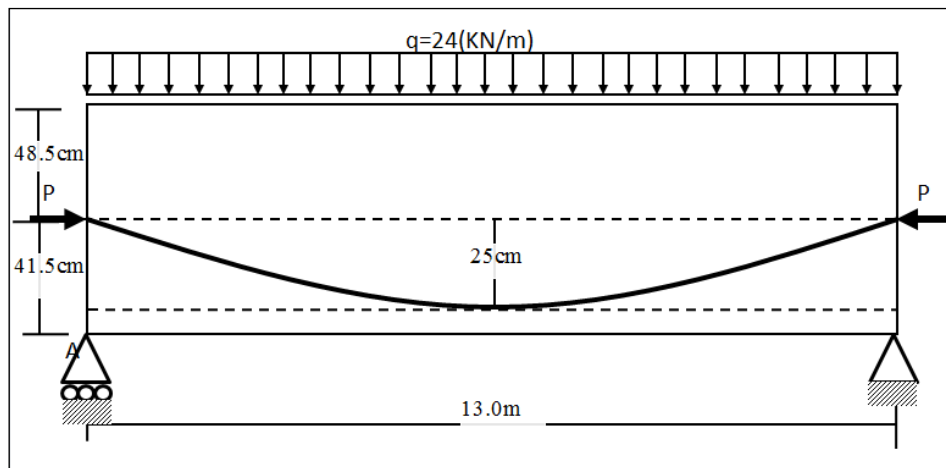
1. Calculate the maximum bending moment induced by the load q .
2. Illustrate by a diagram the distribution (diagram) of the resulting normal stresses in the most stressed section, superimposing the effects of the load q and the prestress P .
3. Determine the value of the prestressing load P that satisfies the stress equilibrium conditions.



Exercise 3

We consider an I-beam, characterized by an area $A = 0.22 \text{ m}^2$ and a moment of inertia $I = 0.02 \text{ m}^4$. This beam is subjected to a prestressing load $P = 1810 \text{ kN}$ applied at its two ends, as well as to a uniformly distributed live load $q = 24 \text{ kN/m}$ (see diagram).

1. Calculate the tensile and compressive stresses induced by the uniformly distributed load q .
2. Determine the average stress generated by the prestress P .
3. Evaluate the additional stress resulting from the eccentricity of the prestress P .
4. Represent the overall stress diagram in the most stressed section.



Exercise 4

Consider a simply supported prestressed concrete beam with a rectangular cross-section of $0.40 \text{ m} \times 1.20 \text{ m}$ and a span of 10 m (see the figure below).

The beam is prestressed by 20 tendons (5 mm diameter) located 0.20 m above the bottom fiber and 5 tendons (5 mm diameter) located 0.10 m below the top fiber. Each tendon is stressed to 1000 N/mm^2 .

The beam is subjected to a uniformly distributed live load of $q = 45 \text{ kN/m}$ and its self-weight (concrete unit weight = 25 kN/m^3).

Calculate the stresses at the critical cross-section and draw the resulting normal stress distribution, taking into account the effects of the prestressing force, its eccentricity, and the external loads.

