Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Lecture "Methods of Finite Elements I"
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Name :.....

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Date :.....

Assignment 1

1. Cantilever Beam

Using the variational approach calculate the vertical displacement w at point A and the bending moment distribution $M(x)$ for a cantilever beam (Figure 1) subjected to

a) a uniform distributed load with q

b) a concentrated load Q at point A.

Here, EI is assumed to be a constant. Approximate the displacement $w(x)$ by a third-order polynomial.

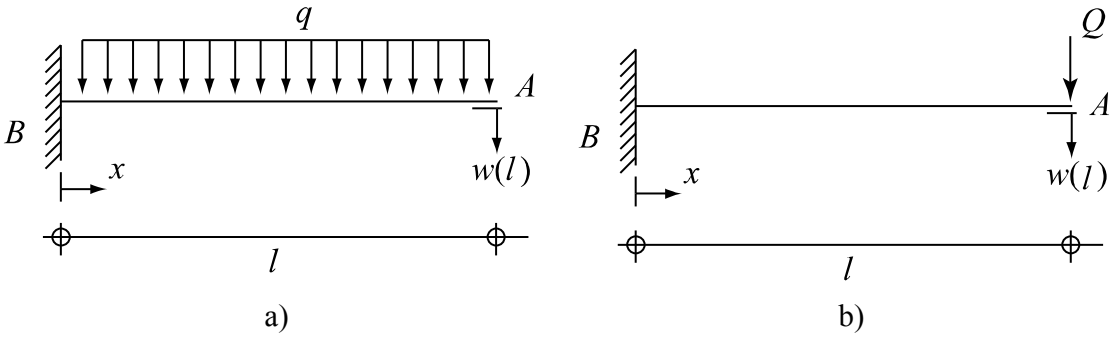

Figure 1. Cantilever beam

Hint: The potential energy of the system is given as:

$$\Pi = \int_0^l \frac{EI}{2}\left(\frac{d^2w}{dx^2}\right)^2 dx - \int_0^l q(x)\, w(x)\, dx - Q\, w(l)$$

And the relationship between the vertical displacement and internal forces of the beam is:

$$\frac{dw}{dx} = -\Psi(x)$$

$$EI\frac{d^2w}{dx^2} = -M(x)$$

$$EI\frac{d^3w}{dx^3} = -Q(x)$$

$$EI\frac{d^4w}{dx^4} = q(x)$$