Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Student number\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Assignment 1**

Determine the buckling force of the beam shown by using one element. Second moment of area *I* and Young’s modulus *E* are constants.

*L*

1

*F*

*X,x*

*Z,z*

2

**Solution template**

Linear and non-linear parts of virtual work expression of internal forces of a beam element (displacements in *xz*-plane) are given by

,



in which  is the second moment of area, *E* is the Young’s modulus, and *N* is the axial force in the beam. The axial stress resultant *N* of the beam in terms of the loading parameter *F* (use the figure to deduce the relationship)

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Linear and non-linear parts of virtual work expression of internal forces of the beam (substitute also the expression for the axial stress resultant *N*) are

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Principle of virtual work   implies (assuming that )

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