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Reliability analysis of beam on elastic nonlinear foundation

K. Frydrýšek [a,*]

[a] *Faculty of Mechanical Engineering, VŠB-Technical University, 17. listopadu 15, 708 33 Ostrava, Czech Republic*

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Abstract

This paper is focused on the solution of simple beam continually supported by elastic (Winkler's) foundation. The foundation contains longitudinal nonlinearity. For the calculation of displacements and bending stresses are used analytical procedures (approximate solution in the form of polynomial function) and probabilistic approaches (SBRA method, Monte Carlo Simulation Method, AntHill software). Probabilistic approach includes influences of variability of load, shape and material of the beam, and variability of modulus of the foundation. Probabilistic approach is used for the reliability expertise of the beam and calculation of safety.

Keywords: beams, elastic foundation, longitudinal nonlinearity, probability, SBRA method, reliability

1. Introduction

The analysis of bending of beams on an elastic foundation is developed on the assumption that the strains are small and the reaction forces $q_R = q_R(x)$ /Nm^{-1}/ in the foundation are proportional at every point to the deflection $v = v(x)$ /m/ of the beam at that point, etc. (first proposed by E. Winkler, Prague 1867), see fig.1.

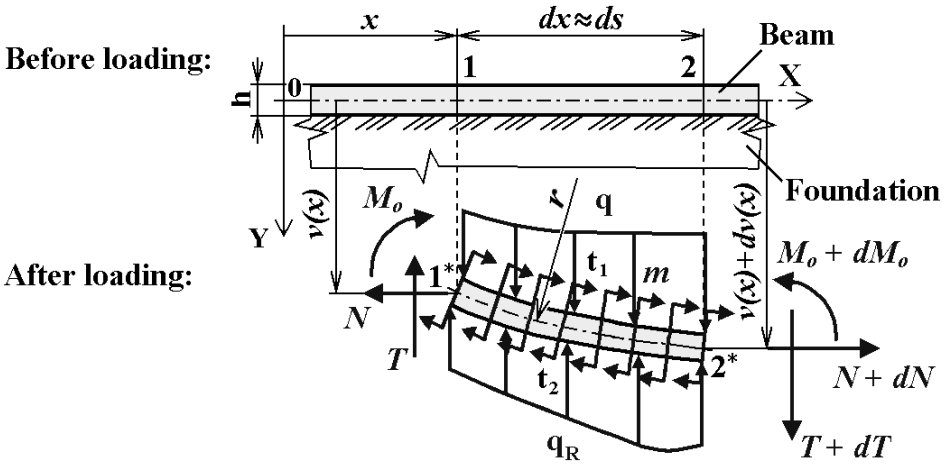

Fig. 1. Element of a Beam on Elastic Foundation.

External loads on the beam also evoke bending moment M_o /Nm/, axial (normal) force N /N/ and shearing force T /N/, see fig.1.

* Corresponding author. Tel.: +420 597324552, e-mail: karel.frydrysek@vsb.cz.