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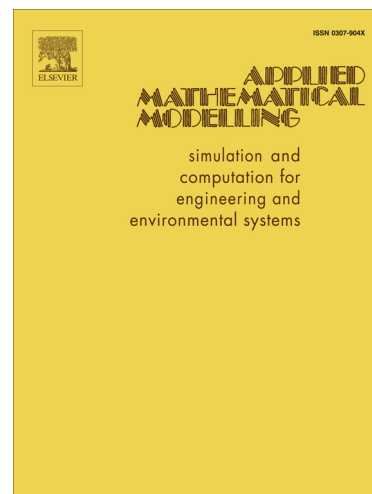
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# Static Analysis of Timoshenko Beam on Elastic Multilayered Soils by Combination of Finite Element and Analytical Layer Element

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**Abstract:** This paper puts forward a theory for static analysis of a Timoshenko beam on elastic multilayered isotropic soils. In the soil-beam system presented below, the analytical solution for a single soil layer loaded by axisymmetric load is deduced by an order reduction method, and then promoted to solve problems involving multilayered soils based on the analytical layer element method; the Timoshenko beam is modeled by the finite element method with locking-free elements. According to the coordination of force and displacements in the contact area, the theory of interaction between beam and soil is established. The comparison between the results from ABAQUS software and those from the presented theory proves that the latter is of good accuracy and high efficiency. Furthermore, some numerical examples show that the behavior of soil-beam system is significantly influenced by the slenderness of the beam, the Young's modulus ratio between beam and soil and the layered characteristics of soils.

**Keywords:** Timoshenko beam; Elastic multilayered soils; Order reduction method; Finite element; Analytical layer element.

## 1. Introduction

In practical projects, such things as strip foundations, railway sleepers and building berths, are usually simplified as foundation beams for calculation. However,

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