INFLUENCE OF THE LONGITUDINAL INERTIA OF THE MASS ELEMENT TENSILE THE BEAM AND OF THE INTERNAL DAMPING ON THE TRANSVERSAL VIBRATIONS OF THE BEAM

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This paper examines the free vibrations of a beam in tension. The beam's tension is induced by a suspended mass element. Additionally, the influence of the mass element's longitudinal inertia and the beam's internal damping are considered. The boundary value problem for the system under consideration is formulated based on Hamilton's principle, with the small parameter method used due to nonlinearity. The beam under consideration is shown in Fig. 1.

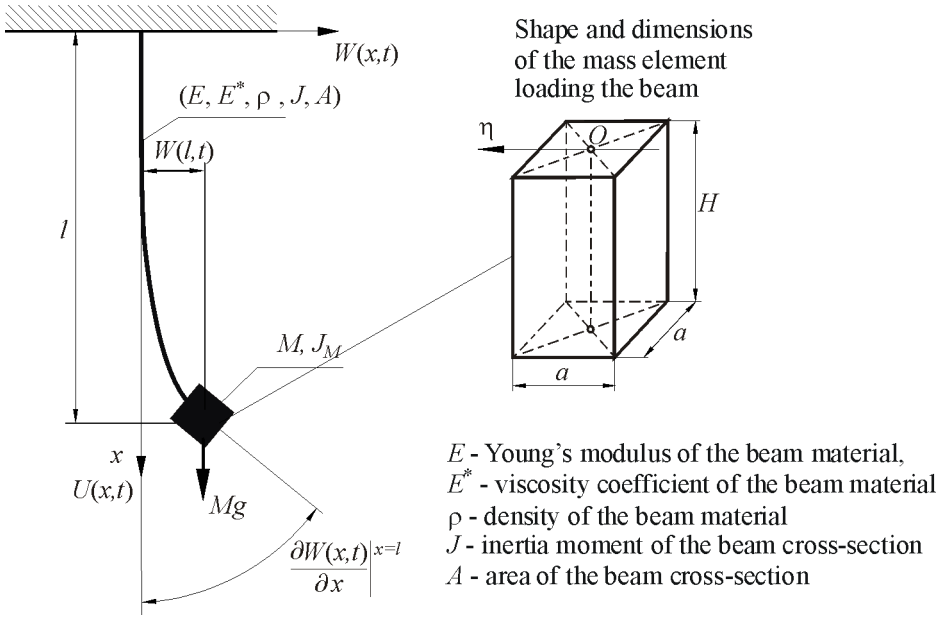

Fig. 1. Considered tensioned beam

This paper examines the natural vibrations of a beam in tension. The beam's tension is caused by a mass element suspended from it. Additionally, the influence

of the mass element's longitudinal inertia and the beam's internal damping are taken into account. The boundary value problem for the system under consideration was formulated based on Hamilton's principle, taking into account the small parameter method due to the nonlinearity. The beam under consideration is shown in Fig. 1. As a basic structural element, the beam is a common subject of research (see [1,2]). Nowadays, designers strive to optimize mechanical systems, most often for economic reasons. Economic criteria require thorough verification of the structure's strength, including fatigue strength. This is particularly important when the mechanical system is exposed to periodic forces that generate mechanical vibrations. Knowledge of the system's dynamic parameters, including the natural vibration frequencies, is therefore necessary to develop a correct design that is optimal in terms of strength and economics. A slender beam subjected to internal tensile forces is called a tie rod ([2]), while a beam loaded with compressive forces is called a column ([3]). Columns are support elements whose failure is determined not by material strain but by loss of stability. This work is a continuation of the research begun in [2]. In this work, a tensile beam was investigated, taking into account the longitudinal inertia of the mass element loading the system without considering damping.

References

[1] Kłoda Ł., Lenci S., Warmiński J., Szmit Z. Flexural-flexural internal resonances 3: 1 in initially straight, extensible Timoshenko beams with an axial spring, Journal of Sound and Vibration, 527, 2022, 116809

[2] Uzny S.: Nonlinear free vibrations of the beam taking into account the longitudinal inertia of the mass element causing the tensile load, Journal of Applied Mathematics and Computational Mechanics, 24, 1, 2025, 100-118

[3] Uzny S., Kutrowski Ł., Skrzypczak T.: Non-linear free vibrations of the column loaded with a mass element and a local heat source, Journal Sound and Vibration, 507, 2021, 116130