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Non-Destructive Test of Bar for Determination of Critical Compression Force Directed towards the Pole

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Abstract : The phenomenon of buckling of structural elements under compression is revealed in many cases of loading and found consideration in many structures and mechanisms. In the present work the method and results of dynamic test for buckling of bar loaded by a compression force directed towards the pole are considered. Experimental determination of critical force for such system has not been made previously. The tested object is a bar with semi-rigid connection to the base at one of its ends, and with a hinge moving along a circle at the other. The test includes measuring the natural frequency of the bar at different values of compression load. The lateral stiffness is calculated based on natural frequency and reduced mass on the bar's movable end. The critical load is determined by extrapolation the values of lateral stiffness up to zero value. For the experimental investigation the special test-bed was created that allows the stability testing at positive and negative curvature of the movable end's trajectory, as well as varying the rotational stiffness of the other end connection. Decreasing a friction at the movable end allows extend the diapason of applied compression force. The testing method includes: - Methodology of the experiment planning, that allows determine the required number of tests under various loads values in the defined range and the type of extrapolating function; - Methodology of experimental determination of reduced mass at the bar's movable end including its own mass; - Methodology of experimental determination of lateral stiffness of uncompressed bar rotational semi-rigid connection at the base. For planning the experiment and for comparison of the experimental results with the theoretical values of critical load, the analytical dependencies of lateral stiffness of the bar with defined end conditions on compression load. In the particular case of perfectly rigid connection of the bar to the base, the critical load value corresponds to solution by S.P. Timoshenko. Correspondence of the calculated and experimental values was obtained.

Keywords : non-destructive test, buckling, dynamic method, semi-rigid connections
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