SUMMARY

This dissertation is devoted to the analysis of the influence of pre-stressing and Winkler on stability and vibrations of a geometrically non-linear column subjected to a follower force directed towards the positive pole.

The literature studies included in the first part of the dissertation summarize and systematize the state of a scientific knowledge related to stability and vibrations of slender linear and geometrically nonlinear systems and the influence of selected parameters on their dynamic properties.

The research part of the paper presents the issue of stability and vibrations of a geometrically non-linear system, taking into account local support on the Winkler and pre-stressing. The column was built of three rods, and its flexural stiffness distribution was described by the asymmetry coefficient of the flexural stiffness distribution, assuming a constant value of the sum of flexural stiffness of the system members. Particular rods of the column were connected by means of a concentrated mass to ensure equal deflections and deflection angles at its free ends.

The boundary problem was formulated on the basis of Bernoulli-Euler's beam theory, determining kinetic and potential energy of the system. Using the Hamilton's principle, differential equations of motion and boundary conditions were determined. The problem was solved using the small parameter method (perturbative method).

Within the scope of numerical calculations, the values of a bifurcation load of the geometrically nonlinear columns and a critical load of the geometrically linear column (comparative system) were determined for variable geometrical and physical parameters of the system. Areas of local and global loss of rectilinear form of static equilibrium were determined. It has been proved that taking into account in the physical model pre-stressing and local support on the elastic foundation may cause an increase in the bifurcation load of a geometrically non-linear column which leads to a reduction in the extent of the local local and global loss of rectilinear form of static equilibrium. The characteristic curves on the plane: natural frequency - external load were also determined. Based on the character of the changes in the eigenvalues, it was found that the considered column is divergent or divergent – pseudoflutter type of system. The paper also presents the deflection shapes corresponding to changes in the natural frequencies at different load values at selected geometrical and physical parameters.

This doctoral thesis is a continuation of research regarding the issue of stability and natural vibrations of slender systems subjected to the specific load, carried out by employees of the Departament of Mechanics and Machine Design Fundamentals at Częstochowa University of Technology.