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Explicit solutions for the buckling of an imperfect strut on a nonlinear foundation ROMAIN LAGRANGE, MIT, DANIEL AVERBUCH, IFPEN, IFPEN TEAM — We perform a theoretical and numerical study of the buckling of an imperfect finite strut on a nonlinear elastic Winkler type foundation. The imperfection is introduced by considering an initially deformed shape which is a sine function with an half wavelength. The length of the strut is chosen such that the first buckling mode is excited and the restoring force is either a bi-linear or an exponential profile. Considering these two profiles, we show (exact piecewise solution theory, explicit Galerkin method, numerical resolution) that the system is subcritical, imperfection sensitive and the deflection is an amplification of the default. For small imperfection sizes, the equilibrium paths hit a limit point which is asymptotic to the Euler load for a critical imperfection amplitude. This critical amplitude is determined analytically and does not depend on the choice of the restoring force. The decrease of the maximum value of the axial force supported by the beam as a function of the imperfection magnitude is determined. We show that the leading term of the development has a different exponent than in subcritical buckling of elastic systems, and that the exponent values depend on the regularization.

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