ELASTIC-PLASTIC PLATES ON A NONLOCAL SUBGRADE

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A thin elastic-plastic Kirchhoff plate resting on a nonlocal foundation subjected to an axisymmetric load distribution is investigated in the present work. The plate is assumed to obey to the Johansen yield criterion with associative flow rule, whereas the subgrade is modeled like an elastic nonlocal two-parameter foundation. The analysis of an elastic-plastic plate resting on a Winkler soil has been developed in [1]. Later, a generalization has been proposed in [2] by introducing a two parameter foundation, but only for a specific ratio between the soil parameters. The present study extends the previous analysis by considering an arbitrary Pasternak soil.
A method based on a contour integral is adopted here to solve in closed form the fourth-order linear ODE governing the elastic-plastic region of the plate. The boundary conditions are set by imposing proper continuity conditions for displacement, rotation, bending moment and shear force across the boundaries between the annular regions of the plate. Two different mechanisms at the onset of collapse are found, depending mainly on the amplitude of the loaded region as well as on the stiffness of the plate. The study allows to investigate the effect induced by the Pasternak soil parameters on the ultimate bearing capacity of the plate and the corresponding collapse mechanism. In particular, it is found that a circular elastic-plastic region with positive yield lines in both radial and circumferential directions occurs under the loaded area of the plate, whereas such a region degenerates into a point size plastic hinge [1] for a Winkler foundation. Moreover, the amplitude of the loaded region is found to significantly affect the response of the system, particularly in terms of the reactive pressure distribution arising in the underlying foundation.
The study covers a wide array of practical applications in structural and civil engineering, ranging from the assessment of the ultimate bearing capacity of fiber reinforced industrial floors to the behavior of rigid road pavements near its limit state and the ultimate conditions of a building foundation [3].

References

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