Solution to two-dimensional elastic problems involving functionally graded material in radial co-ordinates. (English)


Summary: A general solution is derived for two-dimensional elastic problems involving functionally graded material in radial co-ordinates, similar to Michell’s solution for homogeneous isotropic materials. Young’s modulus is graded along the radial direction \( r \) as a power-law function, while Poisson’s ratio is constant. The stresses are expanded as Fourier series in the tangential direction \( \theta \) with the coefficients as functions of \( r \). Equilibrium and strain compatibility equations are reduced to ordinary differential equations in terms of these coefficients, which are solved to get the general forms of stresses and corresponding displacements. While analytical solutions exist for some of the standard problems with specific geometry and loading conditions, this paper presents a general solution for problems with arbitrary geometry and boundary/loading conditions. Solutions to the standard problems available in the literature are only special cases of the general solution derived here, as shown by validation in this paper.

MSC:
74Exx Material properties given special treatment
74Gxx Equilibrium (steady-state) problems in solid mechanics
74Kxx Thin bodies, structures

Full Text: DOI

References:


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